Annex 32

Other forecasting assumptions

Introduction

A32.1 This annex explains the rest of the assumptions we have made to forecast costs and revenues for the purpose of modelling the charge controls. In particular in this annex we set out our analysis for our assumptions relating to:

- volume forecasts;
- asset and cost volume elasticities (AVEs and CVEs); and
- asset and input price changes.

A32.2 The Efficiency and WACC assumptions are discussed separately in Annexes 29 and 30 respectively.

Summary

We forecast significant Ethernet volume growth until 2018/19 but expect some cannibalisation by the dark fibre access remedy

A32.3 We have generated volume forecasts for Ethernet services that predict significant growth during the forecasting period. This growth is driven by a sustained demand for higher bandwidth Ethernet services over the next few years. This is likely to be related to factors that include increasing demand for bandwidth-intensive activities and applications, the deployment of NGA broadband and 4G mobile networks and a downward trend in the unit cost of Ethernet by bandwidth.

A32.4 However, we have forecast a decline in active Ethernet services and an increase in passive Ethernet services in years two and three of the charge control. As dark fibre becomes available, we would expect CPs to purchase dark fibre for some circuits instead of the active equivalent. Therefore, the availability of dark fibre will reduce the active volumes forecast in the Ethernet basket. This reduction in active volumes is sufficiently large to have an impact on the charge control ‘X’. The reduction in the Ethernet basket volumes results in the overall Ethernet basket ‘X’ reducing by 1.0% (i.e. results in a shallower decline in prices).

We forecast significant TI volume decline until 2018/19

A32.5 We have generated volume forecasts for TI services and forecast all low bandwidth volumes to decline during the charge control period. This is likely to be driven by BT ending support for its Plesiochronous Digital Hierarchy (PDH) platform, which supports sub-2Mbit/s services, the availability of NGA broadband and EFM services, and increasing demand for higher bandwidths where Ethernet is a cheaper technology.

We have based the 2016 LLCC cost forecasts on our estimates of the relevant CVEs and AVEs for this control

A32.6 We have used AVEs and CVEs to forecast the costs to the end of the control period which are based on calculated LRIC to FAC ratios, derived from the outputs of BT's 2014/15 LRIC model, except where otherwise specified as set out in this Annex.

We have adopted pay inflation at 3%, specific rates where rates can be identified (e.g. for accommodation costs) and CPI for all other non-pay costs

A32.7 We have adopted pay inflation at 3.0% based on November 2015 OBR Earning Index forecasts, November 2015 ONS change in average gross weekly earnings forecasts and forecast BT management accounting data.

A32.8 We have also adopted non pay inflation at 3.2% and 2.1% per annum for TI and Ethernet services respectively. Where a specific rate for a non-pay cost item was identified, we have set the modelled rate at that value. We have identified specific rates for energy (for which we will use the latest DECC services sector forecasts as at November 2015), accommodation (BT has a long-term arrangement with Telereal that its property rental prices rise at 3% per year) and cumulo costs (2.3% in 2015/16, 0.8% in 2016/17 and RPI after that in line with legislation). Other non-pay we have set at forecast CPI (February 2016 HM Treasury consensus forecast). We have then weighted these assumptions to produce our final non-pay inflation assumptions.

We have adopted asset price change assumptions such that duct and copper are valued through the RAV-based approach and all other asset prices are assumed to stay constant

A32.9 We have adopted our June 2015 LLCC Consultation proposals with updated data analysis where appropriate such that:

- duct and copper are valued through the RAV-based approach (RPI inflation); and
- all other asset prices (for example for fibre, electronics and software) are assumed to stay constant (flat in nominal terms).

Volume forecasts

Methodology and approach

A32.10 Service volume forecasts are a key determinant of the values of X for the Ethernet and TI baskets; they drive both our cost and revenue forecasts.

A32.11 As we are forecasting the costs and revenues of BT's Ethernet and TI leased lines, our volume forecasts are based on BT's volumes (and not, for example, market-wide volumes). Furthermore, BT's leased lines consist of a significant number of different products (e.g. PPCs, RBS, EAD, WES, etc.), bandwidths and charging elements (for example connections, local ends and main links). Our cost model requires forecasts for each product and charging element, as the unit costs are likely to vary across these dimensions.[1] For example, the network components used to provide a local end can be different to those used to provide a main link.

A32.12 Our model also requires forecasts for leased line services outside the scope of the charge control (for example Ethernet and WDM services above 1Gbit/s and TI services above 8Mbit/s).This is because charge controlled services share certain network components with other non-charge controlled services. The costs for controlled services may therefore depend on the demand for non-controlled services due to the presence of economies of scale and scope across these shared network components. Furthermore, in the case of the Ethernet basket, non-controlled services are relevant in terms of modelling the impact of the dark fibre remedy (as described in Annex 33).

A32.13 There are two ways in which volume forecasts can be generated for a charge control model; a 'top-down' or a 'bottom-up' approach. The latter involves identifying a set of volume drivers for different types of leased lines and modelling forecasts based on the future trends of the relevant drivers.[2] A 'top-down' approach involves taking current volumes and generating forecasts based on relevant evidence, such as historical trends and forecasts from network operators and industry analysts. It does not seek to identify specific volume drivers and quantify their impact on leased line volumes.

A32.14 Consistent with the 2013 LLCC, we have adopted a top-down approach to forecasting leased line volumes. Identifying the relevant volume drivers for leased lines is very difficult as they are likely to include a range of factors such as number of specific business types,[3] economic growth, number of households and population. Furthermore, as our model requires volume forecasts for a large number of different products and charging elements, we would have to quantify the impact of each driver on each product/element. Given the scale of such a task, we do not consider it proportionate or practical to derive volume forecasts using a bottom-up approach. In this regard, we note that none of the CPs or industry analysts from whom we have obtained information on forecast volumes use a bottom-up approach when forecasting leased line volumes.

A32.15 We have therefore derived our volume forecasts by reviewing a number of relevant leased line forecasts provided by BT, other CPs and forecasts developed by two independent industry analysts. While we consider all evidence in the round, we consider that BT's forecasts are of particular importance, for two reasons:

- first, BT forecasts services at the level of granularity required for our model (i.e. for each product and charging element, split by internal and external customers), whereas the forecasts we have obtained from other CPs and industry analysts are at a much more aggregate level (e.g. 100Mbit/s Ethernet rentals); and

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[1] Although, as discussed in Annex 26, we estimate costs and revenues based on the service codes that BT uses in its regulatory accounting system. Some of these service codes aggregate multiple services (for example the service code for internal EAD 1Gbit/s rental outside the WECLA includes the standard EAD 1Gbit/s product as well as the Extended Reach variant and the resilience options).

[2] Depending on the product, volume drivers for a communications service may include the number of households, number of businesses, GDP, disposable income etc. A bottom-up model would quantify the impact of each of these on service volumes and it would then use forecasts of each driver to generate the volume forecasts.

[3] For example, the number of small/medium/large businesses in each sector or industry.

- second, as discussed above, the charge control requires us to forecast BT's volumes. We consider BT to be better positioned to understand the demand for its own services relative to other stakeholders. This is because BT provides services for a wide range of customers and uses (e.g. access and backhaul) whereas other operators often have narrower requirements, which means their sales/purchases can be focused on a particular service or bandwidth.

A32.16 A potential concern in using volume forecasts obtained from BT is that it may have an incentive to 'game' the charge control by submitting biased forecasts.[4] For example, in the case of growing Ethernet services BT may have an incentive to under-forecast volume growth such that Ofcom's forecast reductions in unit costs are not as large as BT actually expects them to be. However, as we explain in more detail below, we consider that this risk of gaming is mitigated by:

- using the volume forecasts that BT uses for its internal business planning (rather than using forecasts that are specifically prepared for the LLCC);

- assessing BT's historical forecasting accuracy (where possible and feasible) and drawing any relevant insights from this assessment for the current forecasting period; and

- considering BT forecasts in the round alongside a range of relevant forecasts from a range of non-BT sources.

A32.17 For this statement, we obtained detailed forecasts from both Openreach and BT Wholesale for CISBO (i.e. Ethernet and WDM) and TI services respectively. BT produces a BT Group forecast that is used for business planning purposes. The Group forecast is dependent on forecasts submitted and agreed with each line of business (LOB). The forecast is updated twice per year and it underpins the budget and targets for each LOB. It therefore represents the formal commitment of the LOB in terms of the contribution it will make to BT Group. The forecasts are also aligned such that volumes submitted by upstream LOBs are aligned to the volumes submitted by downstream LOBs.[5] Given that the forecasts we use feed into BT's internal targets that represent formal commitments for each LOB (including all services, both regulated and unregulated), we do not consider it likely that they have been 'gamed' for the purposes of the leased lines charge control.

A32.18 Furthermore, BT explained that its forecasts draw on a number of sources, including [✂].[6] We have therefore analysed BT's forecasts by checking the accuracy of BT's previous forecasts (presented during the 2013 LLCC) by comparing them to outturn volumes for the relevant years (we have also done the same exercise with Ofcom's forecasts in the 2013 LLCC) and considering long-term historical trends. This has allowed us to check whether BT has systematically under- or over-forecast volumes.

[4] We note that other stakeholders may also have similar (albeit opposing) incentives when submitting alternative forecasts.
[5] BT response dated 5 September 2014 to questions A7–A9 of the 1st s135 notice dated 7 August 2014; BT response dated 18 January 2016 to the 32nd s135 notice dated 4 January 2016.
[6] BT response dated 5 September 2014 to questions A7-A9 of the 1st s135 notice dated 7 August 2014; BT response dated 18 January 2016 to the 32nd s135 notice dated 4 January 2016.

A32.19 We have also compared the trends predicted by BT's forecast to those predicted by OCPs and industry analysts.[7]

A32.20 Below, we set out our analysis of the volume forecasts for Ethernet and TI services. For both types of service, we structure the analysis as follows:

- we start by discussing the current trends and key market developments that we expect to materialise during the charge control period;
- we then compare the forecasts that were prepared during the 2013 LLCC by both Ofcom and BT with actual outturns in order to assess whether there was any systematic bias in the forecasts;
- we analyse BT's current forecast and review it in the context of longer-term historical trends;
- we then compare BT's forecasts with those of other CPs and industry analysts to check for consistency; and
- last, we conclude by presenting our volume forecasts.

A32.21 For Ethernet services, we also explain how we have forecast demand for the proposed dark fibre remedy and how we forecast this to impact active Ethernet volumes during the charge control period.

Volume forecasts for Ethernet and WDM services

A32.22 We have followed two steps to establish our volume forecasts for Ethernet and WDM services. The first step is to forecast active-only circuit volumes. The second step is to estimate how demand for Ethernet and WDM leased lines may be affected by the availability of the proposed dark fibre remedy. As a result, we derive two forecasts: one based only on active volumes and another that includes dark fibre volumes (plus the cannibalisation effect on the active volumes).

Key developments and trends in the market for Ethernet and WDM services

A32.23 As discussed in Section 3, Volume I, Ethernet services now account for the majority of installed leased line circuits in the UK, with further growth forecast during the next charge control period. We consider that the overall trend in demand for higher bandwidth Ethernet services over the next few years is likely to be driven by the following factors:

- increasing demand for bandwidth-intensive activities and applications;
- the need to transmit increasingly large amounts of data quickly;
- the deployment of NGA and new services delivered over 4G mobile networks (which will further increase the requirement for backhaul capacity); and

[7] As OCPs and analysts do not forecast to the degree of granularity that BT does, our comparisons are carried out at the more aggregate level (for example 'Ethernet 100Mbit/s rentals' rather than specific 100Mbit/s products such as EAD, EAD LA, WES etc.)

- the lower unit cost of Ethernet by bandwidth, which is likely to drive further significant growth in the demand for Ethernet services.

A32.24 Within the broad category of Ethernet services, we expect there will be strong growth in services at 100Mbit/s and above but not for services up to 10Mbit/s. The latter is driven by two main factors:

- since the start of the current charge control period BT has charged similar prices for EAD 10Mbit/s and 100Mbit/s circuits, meaning that a significant number of customers have migrated to the higher bandwidth service; and

- the emergence of NGA and EFM services as an alternative to users that do not necessarily need very fast upload and download speeds or other features of leased lines.

Accuracy of previous LLCC forecasts

A32.25 We have assessed the accuracy of Ofcom's forecasts and the forecasts BT submitted as part of the 2013 LLCC for 2012/13, 2013/14 and 2014/15 in relation to Ethernet and WDM services. We also include a comparison of the 2015/16 volumes in BT's and Ofcom's 2013 LLCC forecasts.

A32.26 We start by comparing BT's and Ofcom's 2013 LLCC forecast volumes with the outturn for services of all bandwidths up to and including 1Gbit/s, as presented in Figure A32.1. We then carry out a similar assessment at a more granular level by comparing forecasts with outturns for circuits at 10Mbit/s, 100Mbit/s, 1Gbit/s and above 1Gbit/s. This is shown in Figure A32.2.

Figure A32.1: Openreach's 2012 forecast, Ofcom's March 2013 BCMR Statement and outturn Ethernet service volumes, up to and including 1Gbit/s

Source: 2013 LLCC and BT[8]

A32.27 For services up to 1Gbit/s, Openreach's 2012 forecast volumes were close to the outturn in 2014/15 (under-forecasting by approximately [✂] or [✂] [0-5%]). Similarly, Ofcom's forecast was close to the outturn in 2014/15, although it predicted a slower growth than Openreach's forecast and the outturn (under-forecasting by approximately [✂] or [✂] [5-10%]).

A32.28 As regards the mix of bandwidths within the total number of circuits up to and including 1Gbit/s, the outturn for 10Mbit/s services was below Openreach's 2012 forecast (over-forecasting by approximately [✂] or [✂] [25-30%] in 2014/15) and below Ofcom's forecast (over-forecasting by approximately [✂] or [✂] [10-15%] in 2014/15). As discussed above, this is likely to be driven by two factors. The first is a result of end-users substituting from 10Mbit/s fibre-based leased lines to EFM and NGA. The second factor is caused by BT setting EAD 10Mbit/s prices at a similar level to 100Mbit/s prices, which resulted in a significant proportion of end-users migrating from 10Mbit/s to 100Mbit/s services. For 100Mbit/s services, the outturn was above Openreach's 2012 forecast (under-forecasting by approximately [✂] or [✂] [10-15%] and, similarly, above Ofcom's forecast in 2014/15.

A32.29 For 1Gbit/s services, Openreach's 2012 forecast was above the outturn in 2012/13, close to the outturn in 2013/14 and below the outturn in 2014/15 (under-forecast by approximately [✂], or [✂] [5-10%] Ofcom's forecast assumed slower growth to 2013/14 but higher growth in 2014/15 and 2015/16, resulting in forecast volumes being close to Openreach's 2012 forecast and below the outturn in 2014/15 (under-forecast by approximately [✂], or [✂] [10-15%]).

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[8] BT response dated 29 January 2015 to question B2 of the 8th s135 notice dated 12 January 2015.

Figure A32.2: Openreach's 2012 forecasts, Ofcom's March 2013 BCMR Statement and outturn Ethernet and WDM service volumes, above 1Gbit/s

Source: 2013 LLCC and BT[9]

A32.30 For services above 1Gbit/s Openreach's 2012 forecast was close to the outturn in 2012/13 and 2013/14, and below the outturn in 2014/15 (under-forecast by approximately 1,800 circuits, or [✂] [20-25%]) Ofcom's forecast predicted a slower growth rate, thus forecast volumes were below the outturn in 2014/15 (under-forecast by approximately 2,300 circuits or [✂] [25-30%]).

A32.31 Given the above analysis, it does not appear that the forecasts BT submitted in the 2013 LLCC were biased in a particular direction. Although Ofcom's forecasts were below actual outturns in all years from 2012/13 to 2014/15, the overall difference was not large (less than 1% in 2012/13 and 2013/14 and less than 6% in 2014/15). This is consistent with the analysis presented in Section 7, Volume II, which shows that differences between forecast volumes and outturns are not the key driver in explaining BT's relatively high rates of return for Ethernet services in 2013/14.

Analysis of Openreach's forecasts for the 2016 LLCC

A32.32 Openreach provided a forecast in November 2015 that it has used for its own internal business planning purposes. BT subsequently provided us with a revised view of the Openreach forecast, the January 2016 forecast, which is not part of BT's

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[9] BT response dated 29 January 2015 to question B2 of the 8th s135 notice dated 12 January 2015.

internal business plan.[10] BT has explained that the January 2016 forecast contains [✂][11]

A32.33 We have thus analysed Openreach's November 2015[12] and January 2015[13] forecasts.

A32.34 Openreach's forecasts are driven by a number of factors, that include:

- an expected overall growth of Ethernet services;
- a shift of volumes towards higher bandwidths; and
- a gradual phasing-out of legacy Ethernet services (WES, BES).

A32.35 In terms of the number of rental circuits, growth is forecast to be driven mainly by [✂]. The trend for these services is shown in Figure A32.3 and Figure A32.4. These charts illustrate that there are some significant differences in trends by product, for example [✂].

Figure A32.3: Openreach's forecast trend for connections and rentals (EAD and EAD LA, 100Mbit/s)

[✂]

Source: Openreach, Ofcom analysis

Figure A32.4: Openreach's forecast trend for connections and rentals (EAD and EAD LA, 1Gbit/s)

[✂]

Source: Openreach, Ofcom analysis

A32.36 We have also analysed the trend for the main link element of Ethernet and WDM services for all bandwidths. As presented in Figure A32.5, main links are predicted to grow at a relatively slower rate compared to circuits ([✂]).

Figure A32.5: Openreach's forecast trend for rentals and main links of Ethernet and WDM services

[✂]

Source: Openreach, Ofcom analysis

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[10] BT has told us that the revised view of Openreach's volumes forecast is likely to be reflected in BT's next business plan.

[11] BT response dated 18 January 2016 to question A1 of the 32nd s135 notice dated 4 January 2016; BT response dated 19 February 2016 to question D2 of the 33rd s135 notice dated 17 February 2016.

[12] "Openreach's November 2015" forecast is Openreach's September 2015 forecast which was supplied to Ofcom in November 2015.

[13] "Openreach's January 2016" forecast is Openreach's December 2015 forecast which was supplied to Ofcom in January 2016.

A32.37 We have also reviewed Openreach's forecasts for Ethernet and WDM services in the context of a longer-term historical trend. This is presented in Figure A32.6 through Figure A32.9 for 10Mbit/s, 100Mbit/s, 1Gbit/s and above 1Gbit/s circuits.

Figure A32.6: Openreach's forecasts and historical trend (10Mbit/s)

[✄]

Source: Openreach, Ofcom analysis. Note that Openreach does not operate in Northern Ireland, so the Openreach forecasts only reflect Great Britain. Actuals are reported for the whole of the United Kingdom. Also note that the actuals are reported on a basis consistent with the RFS, whereas the Openreach forecasts are prepared on a basis that may sometimes differ from the RFS.

A32.38 Figure A32.6 shows that Openreach's November 2015 forecast for 10Mbit/s predicts a sharp decline from 2014/15 onwards. The decline in volumes between 2013/14 and 2014/15 departs from the historical trend of continuous growth between 2007/08 and 2013/14 (albeit with a decreasing rate of growth over time). As discussed above, this is primarily driven by [✄].

Figure A32.7: Openreach's forecasts and historical trend (100Mbit/s)

[✄]

Source: Openreach, Ofcom analysis. Note that Openreach does not operate in Northern Ireland, so the Openreach forecasts only reflect Great Britain. Actuals are reported for the whole of the United Kingdom. Also note that the actuals are reported on a basis consistent with the RFS, whereas the Openreach forecasts are prepared on a basis that may sometimes differ from the RFS.

A32.39 Figure A32.7 shows that Openreach's November 2015 forecast for 100Mbit/s predicts a consistent trend of significant growth through to 2018/19. [✄]. We note that Openreach's November 2015 forecast predicts stronger growth in 100Mbit/s circuits than its January 2016 forecast.

Figure A32.8: Openreach's forecasts and historical trend (1Gbit/s)

[✄]

Source: Openreach, Ofcom analysis. Note that Openreach does not operate in Northern Ireland, so the Openreach forecasts only reflect Great Britain. Actuals are reported for the whole of the United Kingdom. Also note that the actuals are reported on a basis consistent with the RFS, whereas the Openreach forecasts are prepared on a basis that may sometimes differ from the RFS.

A32.40 Figure A32.8 shows that Openreach's November 2015 forecast for 1Gbit/s circuits broadly predicts [✄], albeit with a temporary slowing of growth between 2013/14 and 2014/15. We note that in contrast to the 100Mbit/s forecasts, Openreach's November 2015 forecast predicts slower growth in 1Gbit/s than its January 2016 forecast.

Figure A32.9: Openreach's forecasts and historical trend (above 1Gbit/s)

[✄]

Source: Openreach, Ofcom analysis. Note that Openreach does not operate in Northern Ireland, so the Openreach forecasts only reflect Great Britain. Actuals are reported for the whole of the United Kingdom. Also note that the actuals are reported on a basis consistent with the RFS, whereas the Openreach forecasts are prepared on a basis that may sometimes differ from the RFS.

A32.41 Similar to the forecasts of 1Gbit/s services, Figure A32.9 shows that Openreach's forecasts for above 1Gbit/s services predict continuous growth. Given the relatively low volumes of services above 1Gbit/s, it is difficult to infer a forecast trend based on historical data. However, the path of fairly steady growth is broadly consistent with the historical trends observed for 100Mbit/s and 1Gbit/s services (when those services went from being relatively low-volume niche products to mass-market products).

Analysis of forecasts of Openreach, OCPs and industry analysts

A32.42 We have received Ethernet and WDM volume forecasts from two industry analysts and seven operators.[14] These forecasts show a consistent pattern of market trends, though the rates of growth vary. Figure A32.10 through Figure A32.13 below compare the forecasts of these providers and analysts for circuits of specific bandwidths.

Figure A32.10: Comparison of Ethernet circuits forecasts, up to and including 1Gbit/s

[✂]

Source: BT, IDC, Ovum and other operators[15]

A32.43 Figure A32.10 shows that for all services up to and including 1Gbit/s, Openreach's forecasts predict growth rates close to [✂]. They are somewhat above (although comparable to) [✂]. Openreach's forecasts are also above [✂], which predicts growth until 2016/17 and decline from 2017/18. Openreach's forecasts are below (although comparable to) [✂], which predicts similar growth until 2017/18 but higher growth in 2018/19, and [✂], which predicts higher growth until 2016/17 and decline from 2017/18. Openreach's forecasts are lower than [✂] and [✂], which predict steeper growth.

A32.44 For 10Mbit/s services, Openreach forecasts a substantial decline in rental volumes over the analysed period by more than [✂]%. Given that Openreach continues to price EAD and EAD LA 10Mbit/s circuits at a similar level to 100Mbit/s circuits, we consider it reasonable to assume that its sales of these services will rapidly decline. The vast majority of new customers are likely to purchase 100Mbit/s services rather than 10Mbit/s (as they can get ten times the capacity for a similar price) while we expect existing 10Mbit/s customers to continue to upgrade their bandwidth or migrate to EFM and NGA.

A32.45 For the purposes of comparison, we have analysed the 10Mbit/s services together with the 100Mbit/s services and compared the trend forecast by Openreach with those forecast by industry analysts and OCPs. This is shown in Figure A32.11.

[14] [✂].
[15] [✂].

Figure A32.11: Comparison of Ethernet circuits forecasts, up to and including 100Mbit/s

[✂]

Source: BT, IDC, Ovum and other operators[16]

A32.46 For services up to and including 100Mbit/s services, Openreach's forecasts are similar to [✂] and [✂], above [✂] and below [✂]. [✂] and [✂] expect a sharp decrease by [✂] between 2014/15 and 2018/19, while [✂] also expects a decrease, although at a moderate rate by [✂] over the same period. The decreasing trend forecast by [✂]].

Figure A32.12: Comparison of Ethernet circuits forecasts, 1Gbit/s

[✂]

Source: BT, IDC, Ovum and other operators[17]

A32.47 For 1Gbit/s services, analysts and [✂] forecast a broadly consistent pattern of growth over the analysed period, though in this case Openreach's growth trend is slightly slower than most other forecasts. However, this difference may be partly explained by the fact that Openreach's forecasts for services above 1Gbit/s, as shown below, is above those of most CPs and analysts. [✂][18] [19]

Figure A32.13: Comparison of Ethernet and WDM circuits forecasts, above 1Gbit/s

[✂]

Source: BT, IDC, Ovum and other operators[20]

Ofcom's forecast of Ethernet and WDM service volumes

A32.48 Given the evidence and analysis presented above, we forecast significant growth in demand for Ethernet services, with the exception of 10Mbit/s services. We note that both the November 2015 forecast and the January 2016 forecast show a significant growth in the volumes of Ethernet services, consistent with the historical trend over the recent years, except for the 10Mbit/s services where they predict significant decline. Both Openreach's forecasts are broadly in line with the expectations of OCPs and the industry analysts. Although the November 2015 forecast is currently used for BT's own internal business planning purposes, we have placed weight on the January 2016 forecast, which represents the latest available view of BT's forecast and predicts a growth pattern of 1Gbit/s services more consistent with the OCP and analyst expectations than predicted in the later years of the November 2015 forecast.

A32.49 Our forecast of total Ethernet circuit volumes is summarised in Figure A32.14 below.[21] By the end of this charge control, we expect the total number of Ethernet

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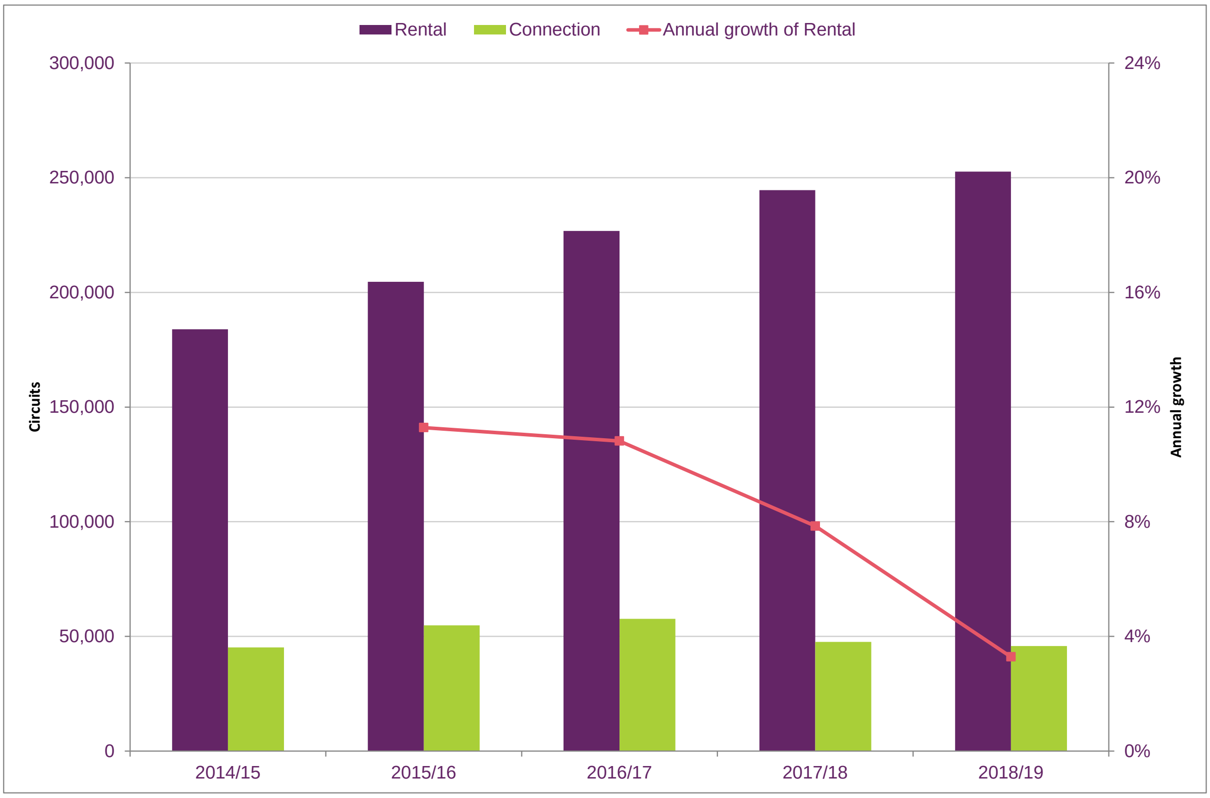
16 [✂].
17 [✂].
18 [✂].
19 [✂].
20 [✂].

circuits to increase by around 37% compared to 2014/15 (or about 8% growth per annum).

Figure A32.14: Ofcom forecast volumes for Ethernet and WDM services (number of circuits, new connections and annual growth, pre dark fibre cannibalisation)



Source: Ofcom forecast

A32.50 We expect the declining trend of 10Mbit/s services to continue in the coming years. The majority of the forecast growth is driven by 100Mbit/s and 1Gbit/s circuits, which are forecast to grow by about 64% and 70%, respectively, by the end of the control (compared to 2014/15), which represents approximately 13% and 14% growth per annum, respectively. We also forecast circuits above 1Gbit/s to account for a growing proportion of total volumes, with these circuits growing almost three times by 2018/19. This is illustrated in Figure A32.15 below.

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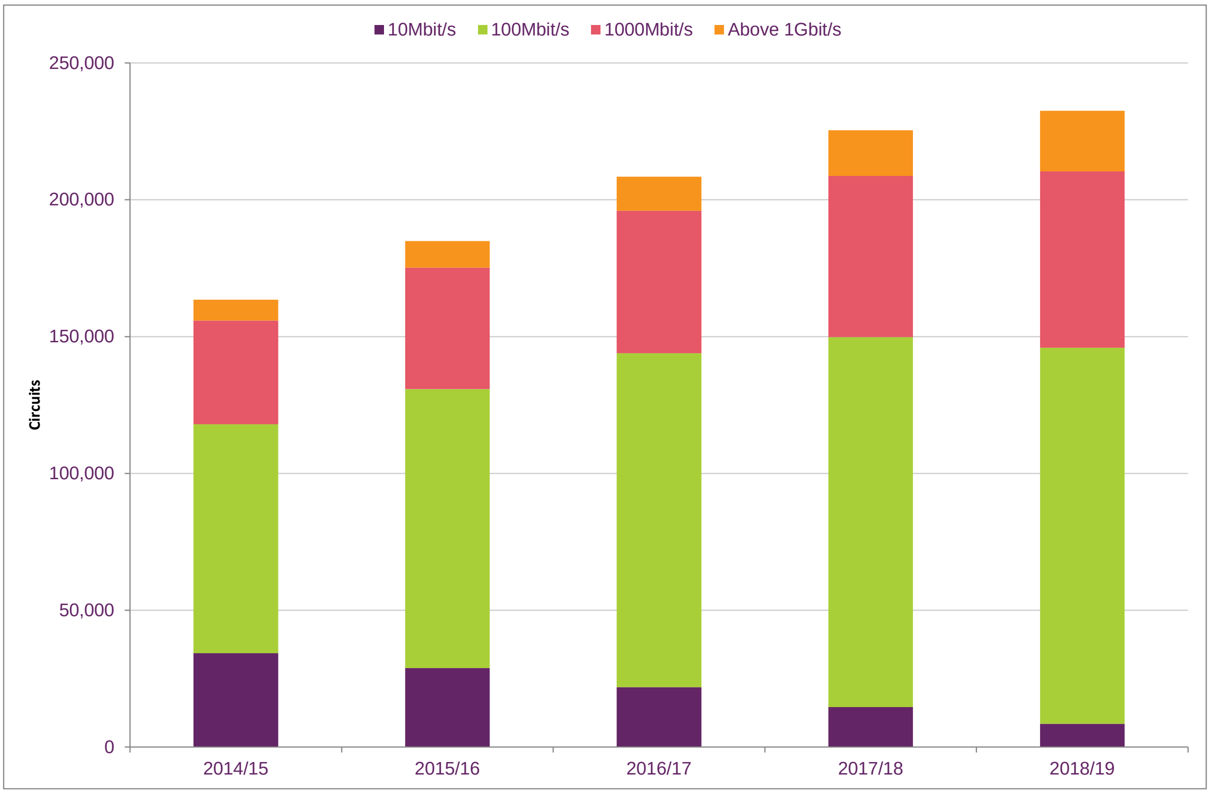
[21] In the chart, we have not included circuits with no identifiable bandwidth, for example OSA/OSEA bearer circuits and certain resilience circuits, and we have also not included bandwidths with significantly low volumes (for example 2Mbit/s, 155Mbit/s and 622Mbit/s).

Figure A32.15: Ofcom forecast volumes for Ethernet and WDM services (number of circuits by bandwidth, pre dark fibre cannibalisation)



Source: Ofcom forecast. Major bandwidths in terms of total volumes are presented. Other circuits, not presented on the chart, include mostly Cablelink (about two-thirds of those other circuits in 2014/15 and nearly all in 2018/19) as well as various other products and bandwidths.

Volume forecasts for dark fibre

Introduction

A32.51 We use the term cannibalisation to refer to the reduction of BT's active circuit volumes as a result of customers switching to dark fibre access product (either in relation to new connections or from existing active circuits).

A32.52 As set out in Annex 33, we need to make an assumption about cannibalisation rates for two key reasons. First, we need it to calculate the appropriate volume of active circuits in the Ethernet basket. Second, it allows us to forecast the appropriate level of efficiently incurred costs that BT should be allowed to recover as a result of customers switching away from active circuits to dark fibre.[22]

Our final cannibalisation assumptions

A32.53 We set out our analysis on cannibalisation from dark fibre in Annex 33, where we conclude on the final cannibalisation assumptions set out in Table A32.1 below. These assumptions indicate the proportion of active circuits (for a given product type and bandwidth) that will be cannibalised by dark fibre. By existing circuits, we refer to circuits that were not installed for the first time in the given financial year

[22] We have taken these costs into account because otherwise there is a risk that the dark fibre remedy will undermine BT's ability to recover its efficiently incurred costs.

(i.e. ongoing rentals). By new circuits, we refer to circuits that were connected in that financial year.

Table A32.1: Ofcom's final cannibalisation assumptions for all circuits[23]

<table>
<tr><th colspan="2">Product</th><th>Existing circuits (17/18)</th><th>Existing circuits (18/19)</th><th>New circuits (17/18)</th><th>New circuits (18/19)</th></tr>
<tr><td rowspan="3">EAD LA</td><td>10/100M</td><td rowspan="11">0%</td><td>0%</td><td colspan="2">0%</td></tr>
<tr><td>1G</td><td>5%</td><td>25%</td><td>95%</td></tr>
<tr><td>10G</td><td>17%</td><td>25%</td><td>95%</td></tr>
<tr><td rowspan="3">EAD & WES/BES</td><td>10/100M</td><td>0%</td><td colspan="2">0%</td></tr>
<tr><td>1G</td><td>6%</td><td>25%</td><td>95%</td></tr>
<tr><td>10G</td><td>24%</td><td>25%</td><td>95%</td></tr>
<tr><td>OSA</td><td>>1G</td><td>0%</td><td>25%</td><td>95%</td></tr>
<tr><td rowspan="2">EBD</td><td>1G</td><td>0%</td><td>1%</td><td>6%</td></tr>
<tr><td>10G</td><td>12%</td><td>14%</td><td>57%</td></tr>
</table>

Source: Ofcom analysis

A32.54 On the basis of the above, we have forecast the 2017/18 and 2018/19 dark fibre volumes as well as accounted for reduced active volumes by making adjustments in the LLCC volumes model. Overall, we expect the greatest impact of the introduction of dark fibre to be on the volumes of services above 1Gbit/s which, we note, are not in the charge control basket.

A32.55 By applying a cannibalisation rate to active connections in a given year, we have calculated the absolute number of new connections that year that are expected to be dark fibre rather than active products. We have also taken into account the corresponding reduction in active rental volumes.[24] Where we have reduced active volumes by our cannibalisation rates, we have increased dark fibre volumes by the equivalent amount (for rentals and connections) so that we continue to capture BT's economies of scale. We carry forward the full year reduction in active volumes (and subsequent increase in dark fibre volumes) into later years.[25]

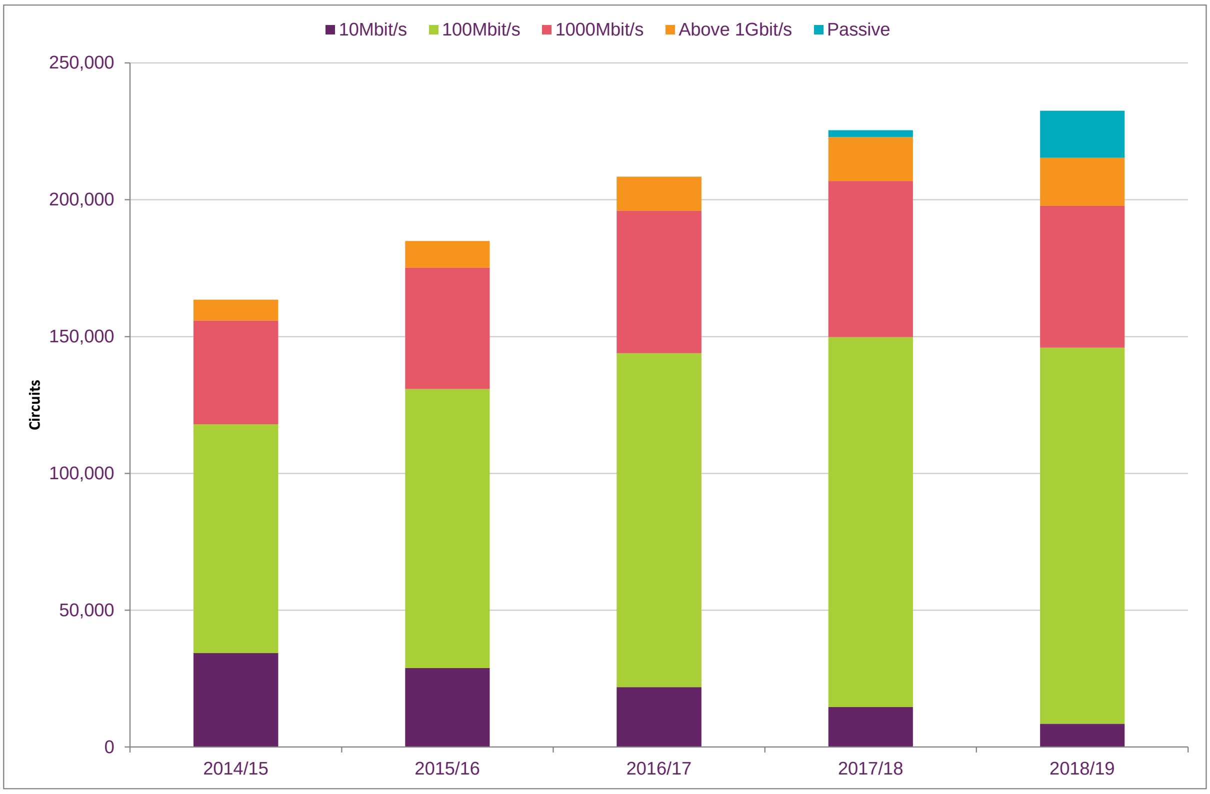
A32.56 By applying the cannibalisation rate to existing circuits in a specific year (i.e. 2018/19), we have calculated the number of ongoing rental volumes (i.e. removing rentals due to new connections) that are expected to be dark fibre rather than active

[23] For new EAD and OSA connections, we have rounded our estimates to the nearest 5% recognising the uncertainty around forecasting dark fibre volumes.
[24] Whereas we have reduced connections by the absolute number of new connections in a year, for existing rentals, we assume that the switch to dark fibre occurs half-way during the year (2018/19) on average.
[25] We note that this does not take into account any ceases of dark fibre services after their initial year of use. This is likely to overstate the impact of our cannibalisation assumptions with regards to the volumes forecasted. However, since we assume connection cannibalisation only in the last two years of the control, the potential issue with ceases would only be relevant in the last year of the control. We consider it likely that this impact is not significant.

products.[26] This adjustment is made having already taken into account the new connection cannibalisation in the prior year.

A32.57 Our forecast of Ethernet and WDM circuit volumes in the presence of dark fibre is summarised in Figure A32.16 below.

Figure A32.16: Ethernet, WDM and Passive Circuit Volume Forecasts (number of circuits by bandwidth)[27]



Source: Ofcom forecast. Major bandwidths in terms of total volumes are presented. Other circuits, not presented on the chart, include mostly Cablelink (about two-thirds of those other circuits in 2014/15 and nearly all in 2018/19) as well as various other products and bandwidths.

Volume forecasts for TI services

Key developments and market trends

A32.58 As discussed in Section 5, Volume I, there are three main drivers for the declining volumes in the TI market:

- BT has signalled to end-users that it is ending support for the PDH platform that supports sub-2Mbit/s services due to obsolescence of the equipment;

[26] We have not included volumes for migration services to dark fibre given that the specifics of a dark fibre migration service will be decided by industry and so we currently do not hold information on the cost for this service.

[27] This includes all Ethernet rentals, split between active and passive circuits, and converting WES/BES local ends into circuits.

- a large number of TI users are increasing their bandwidths above 10Mbit/s or higher (where Ethernet is the cheaper technology); and
- the widespread availability of NGA broadband and Ethernet First Mile services to support higher upload and download speeds using Wholesale Local Access remedies (i.e. LLU and VULA).

A32.59 As a consequence, many (though not all) customers are expected to migrate from TI to higher bandwidth services delivered using Ethernet (including EFM) and other technologies; the Ethernet forecasts are consistent with this view of growth in high bandwidth services.

A32.60 However, it is likely a significant proportion of customers will remain on TI services over the charge control period, particularly those with specialised requirements. Furthermore, as set out in Section 5, Volume I, TI remains a cheaper technology for users with low bandwidth needs (i.e. below 10Mbit/s).

Accuracy of previous LLCC forecasts

A32.61 As with Ethernet, we have assessed the accuracy of Ofcom's forecasts and the forecasts BT submitted as part of the 2013 LLCC for 2012/13, 2013/14 and 2014/15. We have also included a comparison of the 2015/16 volumes in BT's and Ofcom's 2013 LLCC forecasts.[28]

A32.62 In the case of TI volumes, this historical comparison cannot be made on a like-for-like basis due to BT recently identifying some errors in the 2013/14 volumes reported in its RFS.[29] However, although some caution is required in drawing conclusions from the analysis, it is still a consideration in our overall analysis.

A32.63 Our analysis of BT Wholesale's 2012 forecast and Ofcom's 2013 LLCC forecast by different bandwidths is shown in Figure A32.17 and Figure A32.18.

[28] BT Wholesale has also provided us with indicative 2015/16 mid-year actual volumes of rentals for its PPC, RBS and Siteconnect products up to and including 2Mbit/s. We discuss these in the following sub-section.

[29] The 2013/14 volumes were overstated by more than [✂] for PPC 64Kbit/s and understated by close to [✂] for PPC 2Mbit/s. See BT's 2013/14 and 2014/15 RFS.

Figure A32.17: BT Wholesale's 2012 forecast, Ofcom's March 2013 BCMR Statement and outturn TI service volumes, sub-2Mbit/s

Source: 2013 LLCC and BT[30]

A32.64 For the sub-2Mbit/s services, BT Wholesale's 2012 forecast predicted a slower decline compared to the outturn in 2014/15 (over-forecasting by approximately [[✂] or around [✂] [25-30%]), although its forecasts in 2012/13 were close to actual outturns.

A32.65 Ofcom's forecast predicted a rate of decline faster than BT Wholesale's 2012 forecast, but still lower than the outturn rate of decline. Thus forecast volumes were above outturn in 2014/15 (over-forecasting by approximately [✂] or [✂] [25-30%]).

[30] Updated BT response dated 25 March 2015 to question B1 of the 13th s135 notice dated 26 February 2015.

Figure A32.18: BT Wholesale's 2012 forecast, Ofcom's March 2013 BCMR Statement and outturn TI service volumes, 2Mbit/s

Source: 2013 LLCC and BT[31]

A32.66 For 2Mbit/s services, BT Wholesale's 2012 forecast predicted a more rapid decline compared to the outturn in 2012/13 through to 2014/15 (under-forecasting by [✂] or [✂] [25-30%] in 2014/15).

A32.67 In Ofcom's forecast volumes were close to BT Wholesale's 2012 forecast, predicting a slightly steeper decline by 2013/14 (but a lower rate of decline by 2014/15) thus forecast volumes were below outturn in 2014/15 (under-forecasting by [✂] thousand local ends or [✂] [20-25%]).

A32.68 As with Ethernet, it does not appear that the forecasts BT submitted in the 2013 LLCC were biased in a particular direction, nor did Ofcom systematically over- or under-forecast volumes for all services. However, as we noted in the June 2015 LLCC Consultation, the differences in the mix of volumes (i.e. the relatively fast decline of sub-2Mbit/s services and the relatively slower decline of 2Mbit/s services) was one of the reasons why BT's return on capital in 2013/14 was higher than we forecast in the 2013 LLCC.[32] We have therefore considered whether BT's latest forecasts are likely to result in similar differences going forward.

Analysis of BT Wholesale's forecasts for the 2016 LLCC

A32.69 In the lead up to the 2016 BCMR Statement, BT Wholesale submitted two forecasts of TI service volumes:

[31] Updated BT response dated 25 March 2015 to question B1 of the 13th s.135 notice dated 26 February 2015.
[32] See Annex 5 of the June 2015 LLCC Consultation for further details.

- the August 2015 forecast, which has not been subject to a formal internal approval, and is based on the actual 2014/15 volumes and the growth rates in BT's previous internally approved forecast; and

- the November 2015 forecast, which reflects BT's latest internally approved forecast.

A32.70 In addition, BT Wholesale provided us with indicative 2015/16 mid-year actual volumes of rentals (local ends) for the PPC, RBS and Siteconnect products up to and including 2Mbit/s. BT Wholesale suggested that the indicative 2015/16 outturn is closer to the August 2015 forecast than the November 2015 forecast.

A32.71 In the following paragraphs, we analyse BT Wholesale's forecasts of TI service volumes. The differences between each forecast and the mid-year 2015/16 indicative actual volumes are shown in Figure A32.19.

Figure A32.19: Differences between BT Wholesale's forecasts and indicative mid-year 2015/16 actual volumes

[✂]

Source: BT Wholesale, Ofcom analysis

A32.72 For most products and bandwidths, the August 2015 forecast is closer to the indicative mid-year actual volumes compared to the November 2015 forecast. The most pronounced differences arise for PPC 2Mbit/s, where both forecasts are below the indicative mid-year actuals, although we note that the August 2015 forecast is significantly closer than the November 2015 forecast. In terms of RBS 2Mbit/s, we note that both forecasts are above the mid-year actuals and fairly close to each other. If both products are taken together, we note that the August 2015 forecast departs from the actuals significantly less than the November 2015 forecast. For PPC 64Kbit/s the November 2015 forecast is closer to the indicative mid-year actuals, but the differences are relatively small compared to the other products. However, taking together the RBS Sub 2Mbit/s and PPC 64Kbit/s, we find that the August 2015 forecast is closer to the indicative mid-year actuals.

A32.73 Both BT Wholesale's November 2015 forecast and its August 2015 forecast are based on a continuing decline of TI service volumes, although at different rates. In terms of local ends, the decline is [✂] for the RBS 2Mbit/s services in both forecasts ([✂] decrease by 2018/19, respectively, or [✂]% annual decrease over the forecast period) and for the PPC 64Kbit/s services ([✂]% decrease by 2018/19, respectively, or annual decrease of [✂]% over the forecast period). RBS sub-2Mbit/s services are predicted to decline at a [✂] ([✂], respectively, by 2018/19, or an annual decrease of [✂] over the forecast period). PPC 2Mbit/s are predicted to decline at a [✂] in the November 2015 forecast and a [✂] in the August 2015 forecast ([✂], respectively, by 2018/19, or an annual decrease of [✂]% over the forecast period).[33] The forecast trends for the most important service types and bandwidths are presented in Figure A32.20 and Figure A32.21.[34]

Figure A32.20: BT Wholesale's forecast trend for local ends (PPC 64Kbit/s and 2Mbit/s, RBS sub-2Mbit/s and 2Mbit/s) – November 2015 forecast

[✂]

Source: BT Wholesale, Ofcom analysis

Figure A32.21: BT Wholesale's forecast trend for local ends (PPC 64Kbit/s and 2Mbit/s, RBS sub-2Mbit/s and 2Mbit/s) – August 2015 forecast

[✂]

Source: BT Wholesale, Ofcom analysis

A32.74 We have also analysed BT Wholesale's forecast for TI services by charging element (local ends, links, distribution, trunk and new connections). We note that the trend for links, distribution and trunk is very similar to that for local ends presented above. New connections for RBS sub-2Mbit/s and 2Mbit/s services are forecast to decline to [✂] by 2015/16 and 2016/17, respectively. PPC 64Kbit/s new connections are predicted to decline to [✂] by 2018/19 in the current forecast, while the August 2015 forecast predicts a decline by ([✂]%). PPC 2Mbit/s new connections are forecast to decline by ([✂]%) by 2018/19 in the current forecast and the August 2015 forecast, respectively.

A32.75 We have also reviewed BT Wholesale's forecasts in the context of a longer-term historical trend. This is presented in Figure A32.22 and Figure A32.23 for sub-2Mbit/s and 2Mbit/s local ends, respectively.

Figure A32.22: BT Wholesale's forecasts and historical trend (sub-2Mbit/s)

[✂]

Source: BT Wholesale, Ofcom analysis

Figure A32.23: BT Wholesale's forecasts and historical trend (2Mbit/s)

[✂]

Source: BT Wholesale, Ofcom analysis

A32.76 BT Wholesale's November 2015 forecasts for the sub-2Mbit/s and 2Mbit/s services are generally consistent with the historic trend.

[33] [✂]. The chart presents an indexed trend rather than actual volumes due to significant variations by product.

[34] The forecasts in this chart use indices, with 2014/15 as the base year. This means that if the value of the index in 2015/16 is 90, volumes for that particular service are forecast to decline by 10% from 2015/16.

Analysis of forecasts of BT Wholesale, OCPs and industry analysts

A32.77 We have received TI volume forecasts from an industry analyst and six operators. The six operators comprise three mobile operators and three fixed operators. Their forecast trends are shown in Figure A32.24, Figure A32.25 and Figure A32.26.[35] The trends demonstrate a broadly consistent view of declining TI demand.

Figure A32.24: Comparison of TI volume forecasts (sub-2Mbit/s)

[✂]

Source: BT, IDC and other operators[36]

A32.78 Figure A32.24 above shows that all the forecasts predict declining demand for services sub 2Mbit/s,[37] though the rates of decline vary between the forecasts.

Figure 32.25: Comparison of TI volume forecasts (2Mbit/s)

[✂]

Source: BT, IDC and other operators[38]

A32.79 Figure A32.25 shows that most of these forecasts (including the independent analyst) predict a strong decline in the volume of 2Mbit/s circuits between 2014/15 and 2018/19. This is particularly pronounced for the forecasts we have received from [✂], which is consistent with BT's forecast reduction of [✂] illustrated in Figure A32.26.[39]

A32.80 However, we note that [✂], and similarly [✂], are forecasting a slower decline, which is consistent with BT's slower reduction of [✂] in the August 2015 forecast (Figure A32.21). Furthermore, a significant proportion of BT Wholesale's TI sales remain internal (around [✂]% in 2014/15).[40]

Figure A32.26: Comparison of TI volume forecasts (RBS 2Mbit/s)

[✂]

Source: BT, IDC and other operators[41]

Ofcom's forecast of TI service volumes

A32.81 Given the evidence and analysis presented above, we predict an overall decline in the demand for sub-2Mbit/s and 2Mbit/s TI terminating segments. We consider this

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35 The chart presents an indexed trend rather than actual volumes as the latter are not generally comparable between CPs and independent analysts (for example BT often sells more than other operators, while analysts do not include leased lines used for backhaul).

36 [✂].

37 The 2Mbit/s services are particularly important as these currently make up the majority of TI volumes.

38 [✂].

39 [✂].

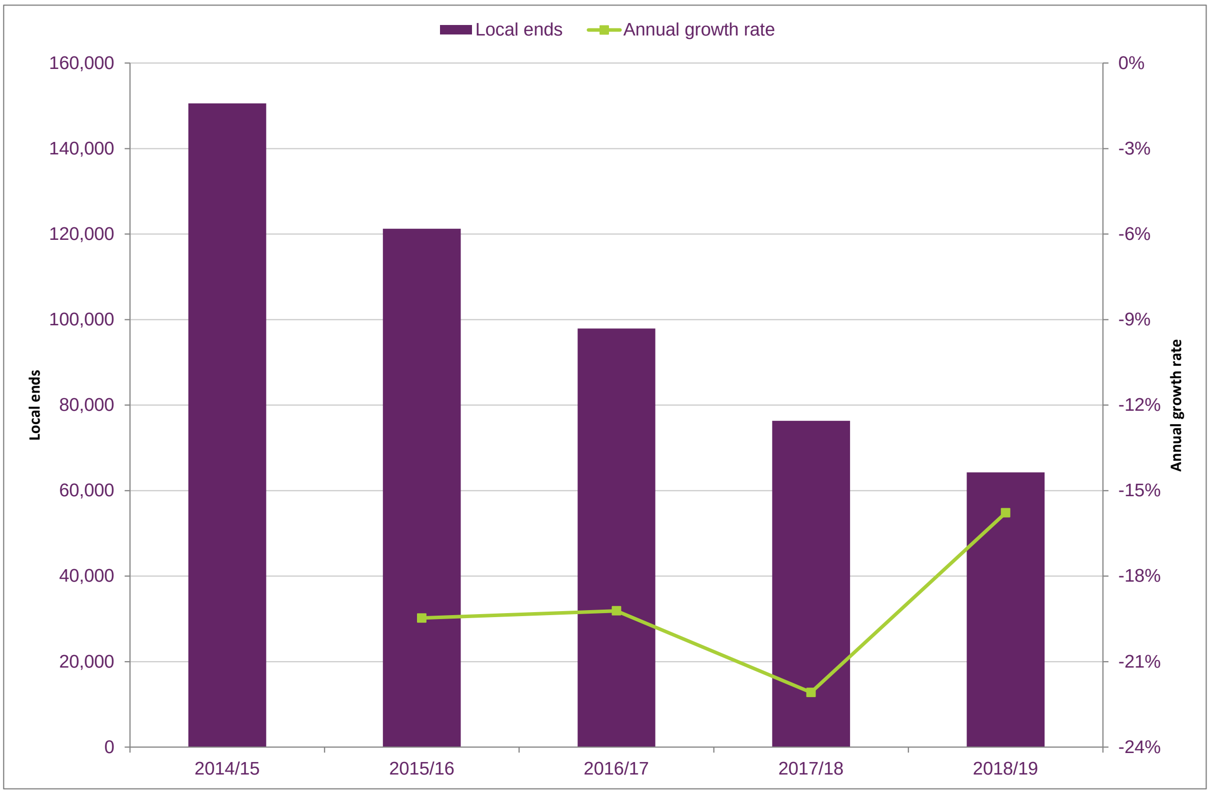
40 Updated BT response dated 25 March 2015 to question B1 of the 13th s135 notice dated 26 February 2015.

41 [✂].

to be reasonable as we expect continuing migration from TI to Ethernet and other services in the short-to-medium term (including by mobile operators), but in the longer term there will be a small but significant number of customers that are less willing and/or able to switch from TI services.

A32.82 In deciding on our forecasts for TI services, we note that both the August 2015 forecast and the November 2015 forecast show a significant decline in the volumes of TI services, consistent with the historical trend over the recent years. Also, both forecasts are broadly in line with the expectations of OCPs and the industry analyst. Although the November 2015 forecast is currently used for BT's own internal business planning purposes, we have placed weight on the August 2015 forecast, which is significantly closer to the indicative mid-year 2015/16 actuals, as set out above, so more consistent with the latest available evidence of BT's actual volumes.

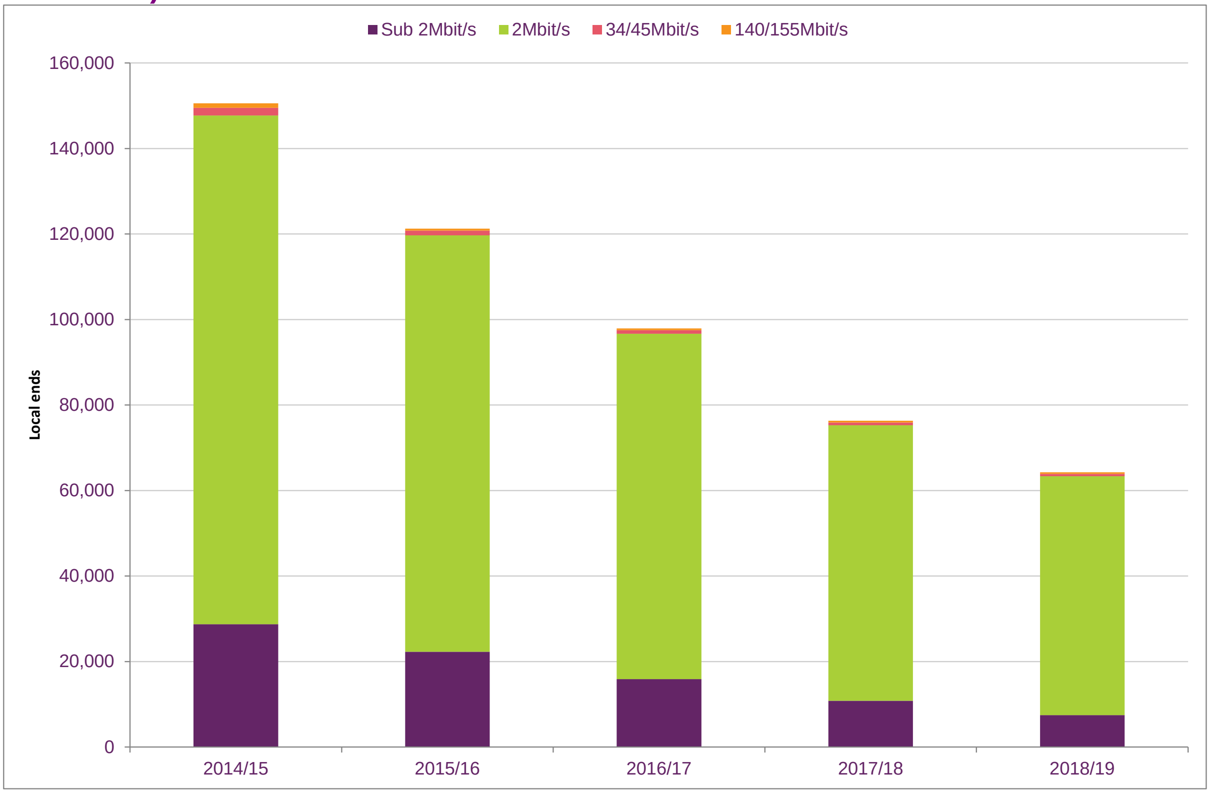
Figure A32.27: Ofcom's forecast of TI services to 2018/19 (number of local ends and annual growth rate)



Source: Ofcom forecast

A32.83 Figure A32.28 shows that sub-2Mbit/s and 2Mbit/s local ends currently make up the vast majority of all TI local ends, and this is forecast to continue as the higher speed TI services (34/45 Mbit/s and 140/155 Mbit/s) migrate to other technologies, such as NGA and Ethernet-based services.

Figure A32.28: Ofcom's forecast of TI services to 2018/19 (number of local ends by bandwidth)



Source: Ofcom forecasts

A32.84 By the end of this charge control, we expect the total number of sub-2Mbit/s and 2Mbit/s TI local ends to decline by approximately 57% compared to 2014/15 (around 19% reduction per annum). We forecast stronger decline for sub-2Mbit/s services (around 29% reduction per annum) compared to 2Mbit/s services (around 17% reduction per annum). This is consistent with the recent trends we have observed as well as information received from BT, other operators and the industry analyst, all of whom forecast faster decline in sub-2Mbit/s services.

Asset and cost volume elasticities (AVEs/CVEs)

Introduction

A32.85 We would normally expect changes in volumes for services to have some impact on the costs and assets associated with providing those services. However, where a firm incurs fixed and common costs, costs may not change by exactly the same proportion as volumes. Therefore, when we forecast costs we need to appropriately reflect the underlying (sometimes complex) relationship between forecast changes in volumes and assets/costs.

A32.86 As set out in Volume II Section 4, the impact that forecast changes in volumes have on forecast costs in the 2016 LLCC Model (before taking into account efficiency improvements) is determined by CVEs and AVEs.

A32.87 In the sub-sections below we set out how we have estimated our base year CVEs and AVEs. We first summarise our June 2015 LLCC Consultation proposals, then the changes proposed the November 2015 LLCC Consultation and then the responses we received. We then set out our analysis of the response and our decision in relation to our base year CVEs and AVEs.

We have based the 2016 LLCC cost forecasts on our estimates of the relevant CVEs and AVEs for this control

June 2015 LLCC Consultation

A32.88 In our June 2015 LLCC Consultation we proposed to:

- reject the CVEs and AVEs submitted by BT as we considered that they could be improved upon in a number of respects,[42] and instead use information on the relationship between LRIC and FAC for the (super-) components[43] relevant to the 2016 LLCC from BT's LRIC model as the basis for our CVEs and AVEs. We considered this information to be the best available for setting this control;

- adopt a consistent approach to estimating CVEs and AVEs using LRIC to FAC ratios for the relevant components directly from the LRIC model outputs. This proposed approach was consistent with that used in previous controls for calculating CVEs, but was a departure with respect to AVEs;

- use data from BT's LRIC model for the same year as our base year financial information as we considered it to be desirable to use consistent sets of information;

- assume that the base year CVE and AVE estimates remain constant over the control period;

- base our pay and non-pay CVE estimates on the LRIC to FAC ratios for pay and non-pay[44] cost categories[45] within the LRIC model outputs for the relevant components. Similarly, to base the AVE estimates on the LRIC to FAC ratios for the fixed asset cost categories for the relevant components. As assets are valued in the LRIC model outputs on an NRC basis, this approach involved using NRC weighted average LRIC to FAC ratios for the fixed asset categories;

- in two specific cases, to replace LRIC to FAC ratios for the component[46] with those for a proxy component as the LRIC to FAC ratios implied by the LRIC model were outside the range of plausible values; and

- reject BT Wholesale's representations that we should adopt different elasticities for certain TI costs due to the decline in TI volumes.[47]

[42] See paragraph A8.116 of the June 2015 LLCC Consultation.
[43] The 2015 LLCC Model forecast costs for components, as explained in paragraph A6.79 of the June 2015 LLCC Consultation. However, BT's LRIC model outputs are presented at the more aggregated super-component level. We were unable to directly estimate component CVEs and AVEs where they were not mapped one-to-one to a super-component. Rather, in such cases, we proposed to assume that all components within the super-component had the same CVEs and AVEs as the super-component as a whole (paragraph A8.123 of the June 2015 LLCC Consultation).
[44] Excluding depreciation.
[45] We proposed to base our CVE and AVE estimates on both the dependent and independent cost categories included in BT's LRIC model (paragraph A8.116 of the June 2015 LLCC Consultation).
[46] i.e. The fixed asset LRIC to FAC ratio for 'CO438 PC rental 2Mbit/s local end copper' and the non-pay LRIC to FAC ratio for 'CO484 Ethernet main links'.
[47] See paragraph A8.128 onwards of the June 2015 LLCC Consultation.

November 2015 LLCC Consultation

A32.89 In the November 2015 LLCC Consultation we proposed three changes in relation to our CVEs and AVEs. We proposed to:

- alter our approach to estimating AVEs such that rather than weighting fixed asset cost categories using NRC weights, we use GRC weights.[48]
- model our CVEs and AVEs such that they no longer were assumed to remain constant over the control period. Rather we proposed that they should adapt to reflect changes in the implied mix of incremental and fixed and common costs over the control period.[49]
- model TI capital costs at a more disaggregated level (i.e. by splitting component costs into the various asset types that make up the component). This involves calculating base year AVEs that are disaggregated by the various asset types within each of the TI components.[50]

A32.90 We have set out stakeholder responses and our conclusions in relation to each of these three areas in Volume II, Sections 5 and 6. In short, we have decided to adopt each of the changes proposed in the November 2015 LLCC Consultation. In the remainder of this subsection we set out the methodology and analysis for deriving the base year (i.e. 2014/15) CVEs and AVEs.[51] We set out how we model changes in the elasticities over the control period in Annex 26.

Stakeholders' comments

A32.91 Those stakeholders that commented on our proposals were broadly supportive of our proposed approach.

A32.92 [✂] set out that it "*trusts that Ofcom's maths on Asset and Cost Volume Elasticities is correct*" and that "the previous Fully Allocated Cost to Long Run Incremental Cost model is a fair reference point".[52]

A32.93 BT agreed "*in principle on the use of AVEs and CVEs*"[53] in its response to the June 2015 LLCC Consultation. But it raised two specific concerns in relation to our proposed AVEs and CVEs:

- as set out in detail in Section 6, Volume II, BT raised concerns about the use of AVEs and CVEs derived from the LRIC model given the volume decline forecast for TI services over the control period. BT set out that it "*is concerned that the AVEs and CVEs have been derived from BT's Long*

[48] Paragraph 5.23 to 5.33 of the November 2015 LLCC Consultation.
[49] Paragraph 5.34 to 5.50 of the November 2015 LLCC Consultation.
[50] Paragraph 5.51 to 5.63 of the November 2015 LLCC Consultation.
[51] In the June 2015 LLCC Consultation we explained why we had not adopted CVE and AVE estimates provided to Ofcom by BT in advance of the publication of the consultation (paragraph A8.116 to A8.121). Neither BT nor any other stakeholder commented in response to either the June 2015 LLCC Consultation or the November 2015 LLCC Consultation on our reasoning nor did they argue that we should revert to BT's estimates or methodology. We therefore do not repeat our reasoning from the June 2015 LLCC Consultation in this document.
[52] [✂] response to the June 2015 LLCC Consultation.
[53] BT response to the June 2015 LLCC Consultation, paragraph 86.

Run Incremental Cost (LRIC) model, which takes a long term view of costs and assumes that the network can be rearranged so as to optimise the costs incurred. In practice, the time horizon of the charge control is relatively short and not all costs can be avoided as volumes are reduced."[54] In its response to the November 2015 LLCC Consultation BT raised similar arguments, but BT focused on its accommodation and transmission equipment costs.

- as set out in detail in Section 5, Volume II, it argued that our assessment of access fibre AVE based on BT's LRIC model outputs would lead to an understatement of access fibre costs for Ethernet services given the forecast volume growth for these services.

Our conclusions

The use of LRIC to FAC ratios as a proxy for CVEs and AVEs

A32.94 As we set out in Annex 26, in general we base our cost forecast modelling on component costs extracted from BT's regulatory financial reporting systems.[55] Therefore, the relevant costs and volumes that the CVEs and AVEs[56] are applied to are the component costs and volumes. For example, to forecast pay operating costs for a particular component we use the following formula:

Pay(t) = Pay(t-1) * [1 – eff] * [1 + IPC(t)] * [1 + %volume change(t) * CVE]

where Pay (t) is the pay operating costs in the year t, 'eff' is efficiency, IPC(t) is the input price change in year t and CVE is the assumed pay operating cost CVE.

A32.95 The pay CVE for a component should be estimated to capture the extent to which pay operating costs for that component are expected to increase over the control period given the forecast change in component volumes, but holding all else (such as efficiency savings) constant. The equivalent is also true for non-pay operating costs[57] and (fixed) assets.[58] CVEs and AVEs should therefore capture the marginal costs associated with the component volume change over the control period.

A32.96 In the short-run, marginal costs can be lumpy, perhaps as a result of costs which are incurred when a particular level of output is reached, but then are fixed for a particular output range. For example, consider a product that requires one engineer for every one thousand lines to maintain those lines. For each line that exceeds a multiple of a thousand, a new engineer is required. Therefore, the short-run

[54] BT response to the June 2015 LLCC Consultation, paragraph 89.
[55] With the exception of TI capital costs which, as we explain in Section 6, Volume II, we forecast by splitting component costs into the various asset types that make up the component costs.
[56] We do not use AVEs to estimate changes in net current assets; unit net current assets are assumed to remain constant (in real terms) over the control period, as shown in Annex 26.
[57] Note that non-pay operating costs exclude depreciation as it is separately modelled within the 2016 LLCC Model.
[58] For assets the AVE measures the extent to which asset costs change with movements in component volumes. AVEs are therefore usually used to derive estimates of capital expenditure driven by changes in volumes.

marginal cost for the (N*1000)+1 line will also include the cost of an additional engineer.[59]

A32.97 However, in the long-run, marginal costs are less lumpy as a result of inputs that, in the short-run, may have been fixed for certain output ranges being treated as fully variable and scalable. For the purposes of charge controls we focus on the long-run marginal costs, which therefore abstract from a degree of the lumpiness that may be observed in the short-run.[60]

A32.98 On this basis, the CVEs (and AVEs) are intended to measure the long-run elasticity of total component costs with respect to changes in component output. Algebraically this can be expressed as:[61]

$$\mathrm{CVE} = \frac{\%\Delta\mathrm{LRTC}}{\%\Delta\mathrm{Q}}$$

where: $\%\Delta\mathrm{LRTC}$ is the % long-run change in total component cost, and $\%\Delta\mathrm{Q}$ is the change in total component volumes.

Alternatively this can be expressed as:

$$\mathrm{CVE} = \frac{\Delta\mathrm{LRTC}/\mathrm{TC}}{\Delta\mathrm{Q}/\mathrm{Q}}$$

Or:

$$\mathrm{CVE} = \frac{\Delta\mathrm{LRTC}/\Delta\mathrm{Q}}{\mathrm{TC}/\mathrm{Q}}$$

As $\Delta\mathrm{LRTC}/\Delta\mathrm{Q}$ is the long-run marginal cost (‘LRMC’) and TC/Q is average total cost (ATC), the CVE is equivalent to the ratio of the LRMC to the ATC:

$$\mathrm{CVE} = \frac{\mathrm{LRMC}}{\mathrm{ATC}}$$

A32.99 Granular information identifying BT’s component level long-run marginal cost is not readily available. Ofcom has therefore historically used BT estimated CVEs and AVEs based on information from BT’s LRIC model. Specifically, we have used BT information on the ratio of LRIC to FAC.[62] As the algebra above demonstrates, in

[59] Where N is an integer.

[60] While this long-run approach may imply that for certain points in time and levels of volume the modelled marginal cost exceeds the likely short-run marginal costs relevant to the control period, at other times the converse will be true. Therefore these impacts should mitigate to some extent each other over time.

[61] The algebra relates specifically to CVEs but it can also be applied for AVEs.

[62] Note that in this context we specifically refer to LRIC as opposed to DLRIC. BT’s regulatory accounts historically have reported a ‘LRIC floor’. However, this measure of costs relates to the so-called DLRIC cost concept. The distinction between LRIC and DLRIC is explained in BT’s LRIC Model. In essence, DLRIC involves adding an element of fixed and common cost to the LRIC of a component. For the purposes of estimating CVEs and AVEs, LRIC is therefore a more relevant cost measure than DLRIC as it provides a closer measure of the marginal costs that are of particular interest in the context of CVEs and AVEs.

general, assuming that LRIC is a good proxy for LRMC, and FAC is a good proxy for ATC, then LRIC to FAC ratios can provide a good proxy for CVEs (and AVEs).[63]

A32.100 In BT's LRIC modelling FAC and LRIC information for individual components are built up from values for individual cost categories.[64] The LRIC for a component therefore is the sum of a series of LRICs for individual component and cost category combinations[65]. These component LRICs for each cost category are driven by the cost-volume relationships (CVR) applied to each cost category.

A32.101 In the charge control model we forecast pay and non-pay operating costs separately. We therefore need to have separate CVEs for pay and non-pay operating costs. Historically one pay CVE and one non-pay CVE were applied to all components (or super-components) modelled by Ofcom. This was the case in the 2009 LLCC, for example. However more recently, including in the 2013 LLCC and the 2014 LLU/WLR charge controls, component-specific pay and non-pay CVEs have been adopted, thereby avoiding the need for averaging CVEs across components.[66]

A32.102 AVEs can be calculated in the same manner as CVEs (i.e. separately for each component). However, the approach historically adopted by Ofcom has been to use BT estimated AVEs (based on information from the BT LRIC model) across a group of components for around a dozen asset types (e.g. duct, fibre, etc.).[67] These asset type AVEs have then been converted to component AVEs (within Ofcom's charge control modelling) by calculating component specific weighted averages of the underlying asset type AVEs, using a split of GRC by asset type as the component-specific weights. Given the potential for a loss of accuracy associated with aggregating asset types, and then disaggregating asset type AVEs to component AVEs, in our view adopting a consistent approach to estimating CVEs and AVEs is likely to be preferable.

Our broad approach to calculating base year CVEs and AVEs

A32.103 To calculate the base year elasticities we consider it appropriate to use:

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[63] There may however be occasions where LRIC is not a good proxy for LRMC, for example where there are substantial increment-specific fixed costs. We investigated whether there were any such costs for leased line components but were not able to identify any.

[64] For more information on the operation of the LRIC model see BT, *Long Run Incremental Cost Model: relationships and parameters*, 31 July 2015, http://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2015/LRICModelRelationshipsandParameters201415.pdf (BT's LRIC Model).

[65] There are two types of cost category within the LRIC model:

- Independent categories – where there is a direct relationship between cost and volume; and
- Dependent categories - where there is no direct relationship between cost and volume and LRIC 'depends' on the LRIC value of other cost categories elsewhere in the LRIC model.

The CVEs and AVEs that we are seeking to estimate reflect how total component costs change with component volumes. We therefore consider include both the independent and dependent cost categories in the estimates of CVEs and AVEs.

[66] Or to be more precise super-component specific – BT's LRIC model does not contain information on individual components, but rather for super-components which are an amalgamation of a number of individual components. Therefore, references below to component information in relation to BT's LRIC model should strictly be taken as referring to super-components, rather than components, unless explicitly set out to the contrary.

[67] Asset types comprise of a number of relevant cost categories grouped together.

- information on the relationship between LRIC and FAC from BT's LRIC model[68] as the basis for our CVEs and AVEs. While we recognise that LRIC data may not be a perfect proxy for LRMC, we consider them to be the best available for setting this control;

- a consistent approach to calculating our CVEs and AVEs. In principle, CVEs and AVEs can be estimated using the same methodology, as set out above. Rather than using the LRIC to FAC ratios for components derived from the operating cost categories, as is used for CVEs, the AVEs could be estimated on the basis of the LRIC to FAC ratios for the components derived from the fixed assets cost categories; and

- data from BT's LRIC model for the same year as our base year financial information. BT's CCA FAC information is an important component of our base year financial data and a key input to BT's LRIC model. Therefore, we consider it desirable to use information from BT's LRIC model that is consistent with the base year data (i.e. 2014/15).

Adopting different elasticities for certain TI costs due to the decline in TI volumes

A32.104 As set out above, in response to both the June and November 2015 LLCC Consultations BT made representations that we should depart from the LRIC to FAC ratios derived from BT's LRIC model when modelling certain TI costs. It argued that it is unable to reduce certain costs at the rate implied by the LRIC to FAC ratios given the sharp declines in TI volumes forecast over the control period.

A32.105 We set out in Annex 26 how we have adapted our modelling approach. In broad terms, we accept that it may not be feasible for BT to dispose of its transmission assets at the rate implied by the LRIC to FAC ratios derived from the LRIC model. We have therefore amended our modelling approach so that we forecast the value of the transmission asset base to reduce (in real terms) over the control period, as a result of assets reaching the end of their life, but we do not forecast additional volume-related disposals of the transmission assets. We have implemented this amendment by changing how we model BT's capital costs, not by changing the assumed AVEs.

A32.106 BT's TI accommodation requirement in exchange buildings is related to the TI transmission equipment housed within those exchanges. Reflecting this interaction, we have also considered whether our treatment of BT's TI accommodation costs needs to be amended to ensure it reflects our revised treatment of transmission costs.

A32.107 We understand that BT's TI accommodation costs are split broadly into:

- capital costs associated with certain assets BT owns (which includes, for example, plant within buildings); and

- operating costs which comprise of payments for leased property (which includes the vast majority of the exchange building estate as well as office and other building costs) and electricity payments.

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[68] The detailed super-component LRIC and FAC data, split by cost category, are provided by BT to Ofcom (on a confidential basis) each year (i.e. AFI1 and AFI3) as part of the suite of Additional Financial Information (AFI) that accompanies the RFS.

A32.108 Our analysis of the detailed outputs of BT's 2014/15 LRIC model suggests that both these broad types of cost have relatively high LRIC to FAC ratios. For example:

- Capital costs: the fixed asset cost categories 'Fixed assets, Accommodation Plant (Network)'[69] and 'Fixed assets, Buildings'[70] (i.e. two of the important accommodation fixed asset cost categories for TI) have LRIC to FAC ratios of around [✂]% and [✂]% respectively.

- Non-pay operating costs: the cost category 'Opex, Non pay, Other, Accommodation, General Purpose'[71] (which appears to be the key accommodation operating cost category for TI) has a LRIC to FAC ratio of [✂]%.

A32.109 These relatively high LRIC to FAC ratios, if used as the basis of our elasticities, would imply that BT's TI accommodation costs are highly variable with volumes. This is inconsistent with our revised treatment of transmission asset costs. We have therefore also concluded it is appropriate to revise our treatment of BT's TI accommodation costs.

A32.110 For capital costs we have adopted the same modelling approach as used for transmission assets (see Section 6, Volume II). Under this approach we forecast the existing asset base for the asset type 'land and buildings' to continue to experience disposals as assets reach the end of their life, but we do not forecast additional volume-related disposals of these assets.

A32.111 For non-pay operating costs we have adopted a revised LRIC to FAC ratio[72] for the key accommodation cost category (i.e. 'Opex, Non pay, Other, Accommodation, General Purpose') when calculating the non-pay CVEs for the TI (super-) components. The revised LRIC to FAC ratio we have adopted is 21%.[73] We explain how we have derived this value below.

A32.112 In its response to the November 2015 LLCC Consultation BT provided evidence in support of Ofcom using an accommodation CVE for TI services of 0.13.[74] This CVE estimate is based on its analysis of how "*TI volume reductions would enable the number of SDH network structures to reduce*" in the period up to 2018/19. On this basis BT argues that "*the forecast reduction in TI volumes of around 20% per annum is consistent with an AVE of approximately 0.13 for transmission equipment, and consequently for the accommodation occupied by this equipment*".[75]BT argued

[69] i.e. cost category code 'CEFAZZZZZZDFZZZZ'.
[70] i.e. cost category code 'CEFAZZZZZZDQZZZZ'
[71] i.e. cost category code 'PLOPNPOTZZBCGPZZ'
[72] Specifically when calculating the FAC and LRIC for each TI super-component we retain the FAC for the 'Opex, Non pay, Other, Accommodation, General Purpose' cost category, but recalculated the LRIC value using our revised LRIC to FAC ratio.
[73] This compares to [✂]% implied by BT's LRIC model outputs.
[74] We note that, although BT proposed that we use an accommodation CVE of 13% (see Table 8 of the November 2015 LLCC Consultation for example), BT presented its estimate of 13% as "*an upper limit on the CVE that be used for accommodation*" (paragraph 111). As explained above, the 13% value was estimated on the basis of the transmission equipment that BT considered it could remove from its network over the control period. BT argued that the specialised accommodation costs cannot be reduced as quickly as transmission equipment is reduced as "*it is only when a whole suite of equipment is used that the floor space can be cleared and made available for re-use*" (paragraph 111).
[75] Paragraph 110, BT response to the November 2015 LLCC Consultation.

that a 0.13 CVE should be considered an upper limit for the accommodation CVE as accommodation space can only be cleared and made available for re-use when a whole suite of transmission equipment becomes unused.[76]

A32.113 BT's revised estimate of 13% implies that, while accommodation costs are forecast to reduce as volumes decline, the accommodation costs are relatively inelastic. This is broadly consistent with what we would expect given our treatment of transmission costs. We also note that BT adopted a different methodology for estimating an accommodation CVE for TI services in advance of the June 2015 LLCC Consultation.[77] This methodology was based on looking at how historic SDH equipment and footprint costs have changed as volumes changed. Although we set out some concerns about this methodology in the June 2015 LLCC Consultation[78], we note that it generated a broadly similar estimate (i.e. 11%) to the revised methodology adopted in response to the 2015 November LLCC Consultation.

A32.114 Our understanding is that BT's estimated CVE of 13% relates to "*specialised accommodation costs*" (i.e. exchange accommodation).[79] However, as set out above, our understanding is that BT's accommodation costs comprise of more than just specialised space; they also include office space and electricity costs. It appears reasonable to consider that changes in BT's electricity costs are likely to be highly correlated with changes in the volume of transmission equipment that consume the electricity. However, the arguments for departing from the LRIC to FAC ratio implied by the LRIC model outputs for transmission equipment do not appear to apply to office space. As demand for TI services declines it seems reasonable to assume that fewer staff will be required to support the TI portfolio, and therefore less office space will be required.

A32.115 As the elements that make up BT's TI accommodation costs are unlikely to all respond in the same way to changes in volumes, we have therefore estimated a revised LRIC to FAC ratio for the 'Opex, Non pay, Other, Accommodation, General Purpose' cost category that takes this mix of different accommodation costs into account by taking a weighted average of the various types of accommodation cost.

A32.116 We have assumed the following LRIC to FAC ratios in deriving the weighted average:

- For specialised buildings we assume a LRIC to FAC ratio of 13%, based on BT's estimate as set out above.
- For electricity we assume a LRIC to FAC ratio of 13%. For the reasons set out above we consider it appropriate to assume that costs will respond to volume changes in the same way as the specialised accommodation costs given that both relate to the underlying volume of transmission equipment.
- For office space we assume a LRIC to FAC ratio of [✂]%. As set out above, we do not consider BT's arguments in relation to transmission equipment apply to office space.

[76] Paragraph 110, BT response to the November 2015 LLCC Consultation.
[77] As set out in paragraphs A8.128 to A8.138 of the June 2015 LLCC Consultation.
[78] Which primarily related to how it isolated the impact of TI volume changes on SDH costs (as opposed to other changes).
[79] See paragraph 111 of BT response to the November 2015 LLCC Consultation.

A32.117 Calculating a weighted average of these LRIC to FAC ratios requires weights for each of the types of accommodation cost. For the weights we have used information supplied by BT on the split of accommodation costs within the 'Opex, Non pay, Other, Accommodation, General Purpose' cost category in 2014/15.[80] The information supplied by BT separately identified the split for each of the business connectivity markets. We have therefore been able to calculate the split specifically for TISBO services (up to and including 8Mbit/s), Wholesale Regional Trunk Segments, and Technical areas (Point of Handover) markets. This information shows that:

- Specialised buildings constitute [✂]% of the relevant accommodation costs;
- Electricity constitutes [✂]% of the relevant accommodation costs; and
- Office space constitutes the remaining [✂]% of the relevant accommodation costs.

A32.118 Based on these weights and the assumed LRIC to FAC ratios set out above, we have concluded that the appropriate LRIC to FAC ratio for the 'Opex, Non pay, Other, Accommodation, General Purpose' cost category for TI components in 2014/15 is 21%. This is summarised in the table below.

Table A32.2: Estimating the LRIC to FAC ratio for the 'Opex, Non pay, Other, Accommodation, General Purpose' cost category

	Weight	LRIC to FAC ratio
Specialised space	[✂]	[✂]
Electricity	[✂]	[✂]
Office space	[✂]	[✂]
Total		**21%**

Source: Ofcom analysis of BT data and Ofcom assumptions

Access Fibre AVE

A32.119 Access fibre costs are used by a number of Ethernet components and are an important element of the Ethernet basket cost stack. Access fibre costs are particularly relevant to the EAD Fibre (CW609)[81] and WES Fibre (CO450)[82] components (e.g. access fibre represents in excess of [✂]% of NRC for these components),[83] which are used by EAD and WES services respectively. As set out in Section 5, Volume II we are applying the MEA approach to the Ethernet basket and have defined EAD services as the MEA services in this control. As a result, we

[80] BT response dated 18 December 2015 to question G1 of the 30th s135 notice.
[81] CW609: Ethernet Access Direct Fibre component
[82] CO450: Wholesale LAN extension services fibre etc. component
[83] In BT's regulatory cost system, the EAD Fibre and WES Fibre components are both mapped to a parent Ethernet fibre super-component, ICO450: Wholesale LAN extension services fibre etc super-component.

have principally considered the access fibre AVE for the purposes of forecasting EAD service costs.

A32.120 As explained in Section 5, Volume II, our standard approach is to forecast capital costs using AVEs that are derived from the LRIC to FAC outputs of BT's LRIC model. However, for access fibre costs, we consider that in this charge control it is necessary to depart from our standard approach and to calculate the AVE based on alternative historical cost and volume data.

A32.121 BT has argued that an access fibre AVE of 0.8 should be adopted in line with the figure used in the 2013 LLCC. BT estimated that the use of the BT LRIC model access fibre AVE of 0.13 instead of 0.8 would overstate the X by 3 percentage points.[84]

A32.122 In this regard, we consider that BT may have conflated the elasticity of the access fibre cost category with the elasticity for the EAD Fibre component. As mentioned above, access fibre is a cost category that is used by various Ethernet components, including, for example, EAD Fibre. Like all cost components, EAD Fibre is made up of a number of other cost categories that relate to other asset types (e.g. duct, transmission and land and buildings), each of which have individual AVEs based on the outputs of BT's LRIC model. The AVE for EAD Fibre is the weighted average of the AVEs for all the underlying cost categories.

A32.123 According to the 2013/14 BT LRIC model, the access fibre LRIC to FAC ratio is 0.09 which gives an AVE for the EAD Fibre component as a whole of 0.13. If the access fibre LRIC to FAC ratio is set to 0.8, as in the 2013 LLCC, this gives an AVE for the EAD Fibre component as a whole of 0.59.

A32.124 In terms of the 0.8 figure used for the 2013 LLCC, this AVE estimate was arrived at by rearranging the additional capex formula from the LLCC model and using BT's historical costs and volumes between 2008/09 and 2011/12:

AVE = additional capex(t) / GRC(t-1) x (1 – efficiency) x (1 + Input price changes(t)) x % change in component volume (t)

A32.125 One of the key assumptions of this approach is the way in which additional capex (the capex driven by volume growth) is derived. For the 2013 LLCC, additional capex was calculated on the basis of the year-on-year change in access fibre GRC. This method (hereafter referred to as Method 1) assumes that steady state capex replaces the value of the assets that are disposed in a particular year (i.e. the capex required so that GRC in year 2 equals GRC in year 1). The difference between GRC in year 2 and GRC in year 1 can then be attributed to volume-driven capex (i.e. additional capex).

A32.126 For the purposes of forecasting costs for the 2016 LLCC, we consider it appropriate to use more recent historical cost and volume data to estimate the access fibre AVE. We have gathered information on access fibre costs allocated to Ethernet components and component volumes covering the period 2011/12 to 2014/15. In addition, as detailed below, we have re-examined the methodology used in the 2013 LLCC.

[84] BT response to the June 2015 LLCC Consultation, paragraphs 80-95.

A32.127 We firstly considered the use of the data we gathered to estimate the AVE on the basis of Method 1. Table A32.3 below sets out the access fibre GRCs allocated to EAD Fibre, the implied additional capex, EAD Fibre volumes and the calculated AVEs using Method 1 for 2012/13, 2013/14 and 2014/15.[85]

Table A32.3: Estimate of Access Fibre AVE on the basis of Method 1 (£m)

	2013 RFS		2014 RFS		2015 RFS	
	2011/12	2012/13	2012/13	2013/14	2013/14	2014/15
EAD Fibre access fibre GRC[86]	[✂] [200-250]	[✂] [350-400]	[✂] [400-450]	[✂] [600-650]	[✂] [550-600]	[✂] [750-800]
Method 1 additional capex		[✂] [100-150]		[✂] [200-250]		[✂] [150-200]
EAD Fibre volume change		74%		39%		28%
Calculated AVE		0.88		1.33		1.07

Source: Ofcom analysis

A32.128 As shown in Table A32.3, [✂]. Given that under most circumstances we would not expect costs to increase at a faster rate than volumes, we have re-assessed the suitability of Method 1 for calculating AVEs. We consider that the high AVE values derived under Method 1 are principally driven by the calculation of additional capex. As explained above, under Method 1, additional capex is based on the annual change in GRC. Table A32.3 above shows that in each year considered, there are increases in the access fibre GRC allocated to EAD Fibre of between [✂] to [✂] [£100-250m] in each year.

A32.129 To assess whether this level of additional capex on access fibre is likely to be reasonable, we have considered the actual capex BT invested in leased lines during this period. Table A32.4 below shows BT's total capex on leased lines, which we have estimated based on the capex Openreach invested in leased lines, as recorded in its management accounts plus our apportionment of TSO capex to leased lines.[87] It also shows our estimate of access fibre total capex for EAD fibre under Method 1 (the sum of additional and steady state capex).[88]

Table A32.4: Comparison of BT total capex on leased lines reported in Openreach management accounts (£m)

	2012/13	2013/14	2014/15
(A) BT actual leased lines total capex	[✂]	[✂]	[✂]
(B) Method 1 total EAD Fibre access fibre capex	[✂]	[✂]	[✂]
(B) as % of (A)	[✂]	[✂]	[✂]

85 For the purposes of this calculation, efficiency was assumed to be 5% per annum and Input price changes were assumed to be 0% per annum.
86 BT response dated 16 November 2015 to the 28th s135 notice.
87 Ofcom analysis of data received from BT on 17 December 2015 in response to 30th s135.
88 To allow for a like-for-like comparison of total capex, we have added to the additional access fibre capex for EAD fibre an estimate of steady state capex (which we have based on in-year OCM depreciation).

Source: BT response to 30th s135 received on 17 December 2015

A32.130 Table A32.4 shows that BT's actual total capex on leased lines between 2012/13 and 2014/15 was between £[✂]m and £[✂]m. The implied access fibre capex for the EAD Fibre component under Method 1 was [✂]% of BT's total leased lines capex during this period. We would expect access fibre capex for EAD Fibre to be a considerably lower share of BT's total leased lines capex. Access fibre is only one of a number of the cost categories that underlie cost components. Other large cost categories for leased lines include duct, transmission and electronics. In 2014/15 access fibre made up approximately [✂]% of total Ethernet basket GRC, and [✂]% of Ethernet basket OCM depreciation. Both measures are considerably lower than the proportions in Table A32.4. Similarly, BT's total leased lines capex covers BT's expenditure on all leased lines services, not just its expenditure on EAD services. In 2014/15, BT allocated [✂]% of GRC and [✂]% of OCM depreciation to non-EAD services (i.e. EBD, WES, BES, optical services and TI services).[89]

A32.131 We have considered why the use of the annual increase in GRC (as per Method 1) may overstate the level of additional capex for EAD Fibre. BT has explained that the GRC values are attributed to components in the same way as NRCs (Net Replacement Costs) as set out in BT's 2015 Accounting Methodologies Document (AMD). However attributions methodologies may changes year on year. Hence, the movement in year-on-year EAD Fibre GRC will be driven by changes in the attribution percentage, as well as by capex. BT has provided a breakdown of the drivers of year-on-year changes in GRC between 2011/12 and 2014/15 (see Table A32.5 below).[90]

Table A32.5: BT breakdown of annual changes in EAD Fibre (CW609) GRC (£m)

	2012/13 RFS	2013/14 RFS	2014/15 RFS
Opening Mean GRC	[✂] [200-250]	[✂] [400-450]	[✂] [550-600]
Mean Capex	[✂] [0-50]	[✂] [50-100]	[✂] [50-100]
Movement in PY closing GRC to CY Opening GRC	[✂] [100-150]	[✂] [100-150]	[✂] [50-100]
Other Historical Cost (HCA) Movement	[✂] [0-50]	[✂] [0-50]	[✂] [0-50]
Current Cost (CCA) movements	[✂] [0-50]	[✂] [0-50]	[✂] [0-50]
Closing Mean GRC	[✂] [350-400]	[✂] [600-650]	[✂] [750-800]

Source: BT Response to 35th s.135 received on 15 March 2016

A32.132 Table A32.5 shows that only a small amount in the movement in mean GRC is explained by capex. The majority of the movement is driven by increases in the year-on-year attributions to EAD Fibre, which is shown above in row 3 as the movement in prior year (PY) closing GRC to current year (CY) opening GRC. BT has explained that these year-on-year changes in attributions have been principally driven by the volume movements of the services that use access fibre. In particular, access fibre costs are shared between EAD, WES/BES and TI PPC services. The combination of increases in the volumes of EAD services and decreases in the

[89] We note that BT is likely to invest less capex on declining services (e.g. TI services, WES and BES services) but consider that some capex will be required to maintain operating capability (e.g. where BT replaces assets that reach the end of their economic life).

[90] BT response dated 13 January 2016 to question E2 of the 30th s135 notice.

volumes of WES/BES and TI PPC services has resulted in a shift in attribution towards EAD services.[91]

A32.133 On the basis of this evidence, we consider that Method 1 is not suitable for estimating the access fibre AVE. As year-on-year changes in GRC reflect changes in BT's attributions, we consider that Method 1 will likely overstate additional capex, which in turn would lead to an overstated AVE.

A32.134 In light of this, we have considered an alternative method of estimating the access fibre AVE which is based on BT's actual capex (Method 2). We have used Method 2 to estimate the access fibre AVE by carrying out the following steps:

- First, we obtained the total access fibre capex (measured on a FAC basis) allocated to the Ethernet fibre super-component (ICO450) for the years 2012/13, 2013/14 and 2014/15 from BT's LRIC model outputs.[92]

- Second, we apportioned the total Ethernet fibre super-component capex to the EAD Fibre component. As discussed in Section 5, Volume II, we understand that the main cost driver for access fibre capex is circuit provisions (because access fibre capex is required where BT needs to expand its network to provide a customer with a connection to their premises). We therefore apportioned the total ICO450 capex across the EAD Fibre and WES Fibre components on the basis of the split of EAD and WES connection volumes in each year.[93] Row 1 of Table A32.6 below shows our estimates of the total access fibre capex for the EAD Fibre component.

- Third, we derived the additional access fibre capex for the EAD Fibre component. We convert total capex to additional (i.e. growth-driven) capex as the equation used to estimate the AVE is based on additional capex. We derived additional access fibre capex by subtracting EAD Fibre access fibre in-year depreciation from the total EAD Fibre access fibre capex. The assumption that in-year depreciation equals steady state capex is the approach used in the LLCC model, as set out in Annex 26. Rows 2 and 3 of Table A32.6 below respectively show our estimates of steady state and additional access fibre capex for the EAD Fibre component.

- Fourth, we estimated the AVE on the basis of the equation set out in paragraph 32.124 and using the estimates of additional capex, annual changes in EAD Fibre volumes and other inputs such as annual efficiency and input price changes.

Table A32.6: Estimate of Access Fibre AVE on the basis of Method 2

	2012/13	2013/14	2014/15

[91] BT response dated 15 March 2016 to question E1 of 35th s135 notice.
[92] BT's LRIC model outputs are provided by BT to Ofcom as part of the suite of Additional Financial Information (AFI) that accompanies the RFS.
[93] EAD Fibre and WES Fibre are the only components that are mapped to the ICO450 super-component. While EBD and BES components also contain access fibre costs, they are mapped to separate super-components (ICN616 and ICO447 respectively). Therefore, in order to apportion ICO450 access fibre costs to EAD Fibre, it was necessary to split the costs between the EAD Fibre and WES Fibre components only.

1. Method 2 total capex (£m)	[✂]	[✂]	[✂]
2. Method 2 steady state capex (£m)	[✂]	[✂]	[✂]
3. Method 2 additional capex (1 – 2) (£m)	[✂]	[✂]	[✂]
4. EAD Fibre volume change	74%	30%	28%
5. Calculated AVE	0.45	0.48	0.39

Source: Ofcom analysis

A32.135 Table A32.6 shows that the use of Method 2 results in an access fibre AVE of between 0.4 and 0.5. We consider that Method 2 is likely to provide a more reasonable estimate of the access fibre AVE. This method derives the AVE from the actual capex BT allocates to Ethernet fibre components in its regulatory cost system. In addition, we consider that AVEs in this range are more likely to realistically reflect how costs respond to volume changes than AVEs of greater than one (as implied by Method 1). We also note that despite large variations in component volume growth between years, Method 2 produces estimates which are relatively stable across this period.

A32.136 As a result, in our charge control modelling we have adopted an access fibre AVE of 0.44, which is the average of the annual AVE estimates for 2012/13 to 2014/15 under Method 2.

Our base year AVE and CVE estimates

A32.137 We have used BT's LRIC model outputs[94] to calculate our own CVE and AVE estimates for the 2014/15 base year of the charge control.

A32.138 Consistent with the discussion set out above and in our June 2015 and November 2015 LLCC Consultations, our estimates are derived on the following basis:

- for each super-component relevant to our modelling of leased line services we have estimated a pay CVE, non-pay CVE and an AVE;
- our elasticity estimates are based on the (super-)component LRIC to FAC ratios from BT's LRIC model using the component totals of:
  - non-pay operating cost categories (excluding depreciation cost categories) to estimate non-pay CVEs; [95]
  - pay operating cost categories to estimate pay CVEs; [96]
  - fixed asset cost categories to estimate AVEs.[97]

[94] i.e. we have used the data contained in AFI1 and AFI3 from BT's 2015 AFI submissions to calculated the LRIC to FAC ratios.

[95] [✂].

[96] i.e. those cost categories with codes starting "PLOPPYZZ".

- as set out above, we have amended the LRIC to FAC relationship for BT's TI accommodation non-pay operating costs and Ethernet access fibre fixed asset costs;

- the super-component estimates are applied to each component within the super-component (as the LRIC model does not report at the component level);

- we use the LRIC model outputs to directly estimate AVEs for each (super-) component using the equivalent methodology adopted for CVEs;

- we use GRC weights (rather than NRC weights) for deriving AVEs (as explained in Sections 5 and 6); and

- finally, reflecting our more granular forecasting approach for the capital costs associated with TI services, set out in Section 6, we also estimate AVEs for each asset type and TI super-component combination. This uses the same broad approach as we use to estimate super-component AVEs, but the fixed asset cost categories are mapped to the asset types and the LRIC to FAC ratios are calculated on the basis of only those cost categories relevant to each asset type;[98]

A32.139 Based on this approach we have derived elasticity estimates for all the super-components relevant to leased line services. All of our super-component elasticity estimates are in the range of 0 to 1, as we would usually expect.[99]

A32.140 Our resulting CVE and AVE estimates for the super-components relevant to the 2016 LLCC are presented in Figure A32.7 below.[100]

[97] i.e. those cost categories with codes starting "CEFA".

[98] Asset type LRIC to FAC ratios are derived by mapping each of the fixed asset cost categories to asset sectors (using the cost category coding) and then to asset types using the same mapping of asset sector to asset type used in generating the base year financial information.

[99] As explained above, for the June 2015 LLCC Consultation we replaced two specific LRIC to FAC ratios for two components because they were outside the range of 0 to 1 that we would typically expect for CVEs and AVEs.

[100] In Table A32.7 we focus on the 40 super-components that are relevant to the 2016 LLCC. Our analysis and modelling relates to 65 super-components, but we have excluded from Table A32.7 any super-components that either have no leased lines costs forecast during the control period (i.e. 1 April 2016 to 31 March 2019), or are used by non-charge controlled services (e.g. 34/45Mbit/s TI services).

Table A32.7: Our CVE and AVE estimates for the super-components relevant to the 2016 LLCC

	Super-component	AVE	Pay CVE	Non-Pay CVE
CO417	64kbit/s PC link connection cct provision	0.78	0.99	0.70
CO418	64kbit/s PC link connection cct rearrangements	0.78	0.99	0.70
CO432	PC rental 64kbit/s link local end	0.96	0.89	0.43
CO381	PC rental 64kbit/s link	0.00	0.00	0.00
CO391	PC rental 64kbit/s link per km transmission	0.00	0.00	0.00
CO413	2Mbit/s and above PC link connection cct provision	0.80	0.98	0.78
CO438	PC rental 2Mbit/s local end copper	0.96	0.95	0.50
CO439	PC rental 2Mbit/s local end fibre	0.72	0.60	0.68
CO383	PC rental 2Mbit/s link	0.00	0.00	0.00
CO371	PC rental 2Mbit/s link per km distribution	0.00	0.00	0.00
CG101	PC rental 2Mbit link per km regional trunk	0.51	0.74	0.47
CG201	PC rental 2Mbit link per km national trunk	0.52	0.74	0.43
CL139	Local Loop Unbundling systems development	0.00	0.00	0.00
CL161	MDF Hardware jumpering	0.00	0.00	0.00
CL171	E side copper capital	0.27	0.49	0.44
CL172	E side copper current	0.81	0.43	0.74
CL173	D side copper capital	0.29	0.52	0.68
CL174	D side copper current	0.80	0.52	0.69
CL175	Local exchanges general frames capital	0.23	0.73	0.36
CL176	Local exchanges general frames current	0.00	0.00	0.00
CL177	PSTN line test equipment	0.00	0.00	0.00
CL178	Dropwire capital & PSTN NTE	0.00	0.00	0.00
CL180	Residential PSTN drop maintenance	0.00	0.00	0.00
CO187	Broadband line testing systems	0.00	0.00	0.00
CO379	Point of Handover electronics	0.74	0.89	0.49
CO401	NetStream equipment	0.86	0.85	0.82
CO506	SG & A partial private circuits	0.85	0.89	0.87

CP502	Sales product management	0.84	0.97	0.89
CD999	Notional Debtors	0.00	0.00	0.00
CL501	Service Centres - Provision	0.00	0.00	0.00
CL503	Service Centres - Assurance	0.00	0.00	0.00
CL160	Routeing & records	0.83	0.99	0.78
CE104	AISBO Excess Construction	0.02	0.00	0.02
CN013	21CN Backhaul Link & Length	0.00	0.00	0.00
CO447	Backhaul extension services fibre etc.	0.13	0.21	0.71
CO450	Wholesale & LAN extension services fibre etc.	0.13	0.21	0.73
CW609	Ethernet Access Direct Fibre	0.45	0.22	0.77
CO484	Ethernet main links	0.37	0.86	0.80
CO485	Ethernet Electronics	0.99	0.93	0.90
CT454	Wholesale & LAN extension services BNS	0.00	0.00	0.00

Source: Ofcom analysis of BT's 2014/15 LRIC model outputs

Input and asset price inflation

A32.141 As set out in Volume II, Sections 5 and 6 we take into account an assumed annual inflation rate that we expect BT to face between our base year and the last year of the charge control. In Volume II, Section 3 we explain our choice of CPI as the measure of inflation for indexing the charge control.

A32.142 Separate from how we index the charge control it is also necessary to define how input prices for each cost item vary over time. Our modelling approach considers input price inflation separately from efficiency and the effects of changes in volumes. We forecast input price inflation for pay and non-pay operating costs and assets separately. These inflation assumptions are inputs that are required to forecast costs within the 2016 LLCC model.[101]

A32.143 In the sub-sections below we set out firstly our assessment for input price inflation and then for asset price inflation. We then summarise our June 2015 LLCC Consultation proposals, which were unchanged by the November 2015 LLCC Consultation, and we then set out the responses we received. We then review the sources of evidence we have used to derive our estimates and set out our decision. As in the June 2015 LLCC Consultation, we have analysed a mixture of historical and forecast evidence from a range of sources, including BT and other independent sources.

[101] The historical and forecast rates are also used within our assessment of an appropriate efficiency assumption.

Input price inflation

We have adopted pay inflation at 3%

June 2015 LLCC Consultation

A32.144 We proposed pay inflation within the range of 2% to 3% with 2.5%, the mid-point of the range, being an appropriate point estimate.[102] This was based on BT's management accounting information and forecasts and external economy-wide pay indices.

Stakeholders' comments

A32.145 The only response received was from BT. BT argued that our assumed pay inflation was too low and instead should be within the range of 2.5% to 4%. This view was based on its current pay agreement and the external views on the expected rise in pay costs over the forecast period.[103]

A32.146 BT argued that "*there is not much relevance in looking at the historic pay trends, given new negotiations may not be dependent on the past, but may be more linked to the expected future performance of the company*"[104]. BT referenced an average earnings growth forecast index published by OBR (see Table A32.8 below) and said that "*as the economy recovers, there will be an expectation that wages rise, and this will be taken account of in future pay negotiations*"[105].

Table A32.8: Office of Budget Responsibility (OBR) Forecast of average earnings

Year to March	2014	2015	2016	2017	2018	2019	2020
Wages and salaries	4.2	4.2	4.2	4.5	4.3	4.6	4.9
Average Earnings	2.6	2.6	2.2	3.6	3.9	4.1	4.4

Source: Table 3.6, Economic and fiscal outlook July 2015, Office of Budget Responsibility 2015

Our conclusions

A32.147 We have considered both historical and forecast data in order to forecast BT's future pay inflation. In particular we have considered:

- data from BT's Annual Reports;
- BT's management accounting information (including PVEO & total labour costs (TLC) analyses[106]);
- reports of the pay agreement with the Trade Unions; and
- economy-wide pay indices.

[102] See June 2015 LLCC Consultation, Annex 8, paragraphs A8.251 to A8.270.
[103] BT response to the June 2015 LLCC Consultation, paragraph 110
[104] BT response to the June 2015 LLCC Consultation, paragraph 109
[105] BT response to the June 2015 LLCC Consultation, paragraph 109
[106] A PVEO analysis breaks down movement into costs in Price, Volume, Efficiency and Other effects. TLC stands for Total Labour costs. More detail is provided in our analysis of BT Management accounting pay cost data below.

A32.148 When reviewing management accounting data we have focused on the results for three BT divisions: Technology and Service Operations (TSO), BT Wholesale (BTW) and Openreach as these divisions contribute the vast majority ([✂][107] [80-100%]) of pay costs for TI and Ethernet services. We refer to these three BT divisions as Relevant BT divisions.

BT plc Annual Report pay cost data

A32.149 We have reviewed BT's pay costs as reported in BT's Annual Reports[108]. The changes in BT pay costs per average full-time equivalent employee (FTE) over the last few years are summarised in Table A32.9 below.

Table A32.9: Changes in BT Group plc pay costs per FTE

	2010/11	2011/12	2012/13	2013/14	2014/15	CAGR
Wages and Salaries	-0.5%	4.7%	-0.4%	-2.3%	-5.3%	-0.8%
Social security costs	7.5%	3.8%	-0.7%	1.7%	-1.9%	2.0%
Pension costs	44.2%	6.1%	-4.0%	17.8%	-0.2%	11.5%
Share-based payment expense	0.9%	15.0%	-13.1%	-4.9%	15.5%	2.1%
Total	2.9%	4.9%	-0.9%	-0.3%	-4.2%	0.4%
CPI	3.5%	4.3%	2.7%	2.3%	1.1%	0.3%
RPI	5.0%	4.8%	3.1%	2.9%	2.0%	1.2%

Source: Ofcom calculations from staff cost data published in BT's Annual Report and Accounts

A32.150 Table A32.9 above shows that BT Group plc pay cost inflation has varied significantly year on year with different contributions from the various elements of pay costs. It also shows that on average BT Group plc pay costs per employee have changed by less than CPI and RPI over the last few years.

A32.151 We have, however, given this evidence very low weight in our final decision for two reasons. Firstly, the series show no discernible trends that could reliably underpin a pay cost assumption. Secondly this data covers employees in all BT divisions. We believe our analysis should be more focused on pay cost inflation in the Relevant BT divisions, given these divisions account for the vast majority of Ethernet and TI market pay costs. These divisions may have experienced different changes to grade and skill mix to those in for example BT's Global Services, BT Retail or Consumer divisions.

BT management accounting pay cost data (including PVEO & TLC analyses)

A32.152 In the June 2015 LLCC Consultation we presented the results of our analysis of PVEO analyses for the Relevant BT divisions. These PVEO analyses showed how a division's costs were forecast to change from actual costs in one year to forecast

[107] BT response to 30th s135 dated 17th December 2015, question A1.
[108] For example see page 159 of BT's 2015 Annual Report, https://www.btplc.com/Sharesandperformance/Annualreportandreview/pdf/2015_BT_Annual_Report.pdf

costs in the next as a result of price changes (P), volume effects (V), efficiency (E) and other (O). Pay costs were analysed separately to non-pay costs. These pay costs included wages and salaries, pension costs and social security costs but these different elements were not identified or analysed separately.

A32.153 The price changes on pay costs from these PVEO analyses therefore provide estimates of historical and forecast price inflation. A benefit of this evidence is that it provides estimates that are BT-specific and that reflect management's knowledge of the labour markets and in particular the relevant grade-mix (for example the relevant proportions of managerial and non-managerial staff) within each division.

A32.154 Since the publication of the June 2015 LLCC Consultation the majority of BT divisions no longer prepare PVEO analyses as part of the BT budgeting and planning process. Of the Relevant BT divisions only Openreach continues to prepare PVEO analyses.[109] Openreach has provided us with updated PVEOs analyses out to 2018/19.[110] However, for BT Wholesale and BT TSO the PVEO forecast information we have is out to 2015/16 only and this was prepared in September 2014.

A32.155 Although BT divisions no longer prepare PVEO analyses, they do prepare analyses of Total Labour Costs (TLC) that are similar to the previous PVEO analyses. These TLC analyses show how pay costs are expected to change over the year with the impacts of inflation, volume and efficiency separately identified.[111] We obtained this analysis for the Relevant BT divisions for 2015/16 and 2016/17.

A32.156 Table A32.10 below shows pay inflation estimates derived both from the most recent historical and forecast PVEO and TLC analyses for each Relevant BT division.

Table A32.10: Pay cost inflation – derived from PVEO analysis and divisional total labour cost forecasts

	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Openreach	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
TSO	n/a	n/a	[✂]	[✂]	[✂]	[✂]
BT Wholesale	[✂]	[✂]	[✂]	[✂]	[✂]	n/a

Source: BTs PVEOs as provided in response to S135 requests

A32.157 The PVEO analysis suggests that historically, pay inflation was expected to be in the region of 2.0% to 3.5%, with an average[112] of [✂]%. Looking forward, the PVEO analysis suggests pay inflation is forecast to be in the region of [✂]% with an average of [✂]%. We believe this is relevant evidence and we give it the most weight when constructing our final assumption, particularly for the period up to 2016/17.

[109] BT response to 24th s135 dated 23 October 2015, question D10.
[110] BT response to 24th s135 dated 10 November 2015, question D2.
[111] BT response to 24th s135 dated 23 October 2015, question D12.
[112] A simple unweighted average of the data points.

Reports of the pay agreement with the Trade Unions

A32.158 In 2014 BT reached a 33-month pay agreement (up to 30 May 2017) with the CWU[113] and Prospect[114] Trade Unions. In general the CWU represent non-managerial staff; Prospect represents managers. The 2014 pay agreement was for a 2% increase in base pay in 2014 plus a flat rate increase of £200, which equates to rises of between 2.5% and 3%. The pay agreement for 2015 and 2016 is for an increase of 2.5% with the CWU requiring further discussion if RPI inflation is outside the range of 2% to 3% (measured at February 2015 and 2016). RPI in February 2015 was 1% and BT invoked this clause and a review took place with the CWU which resulted in no change to the original negotiated agreement of a 2.5% increase being agreed.[115]

A32.159 This pay deal only lasts until the end of May 2017, and so covers a period up to the beginning of the second year of the control. This time period is similar to that from the PVEO analysis above. We place somewhat less weight on this evidence than on our analysis of BT's management accounting information as the pay deal is only directly relevant to the wages and salaries element of pay costs and indirectly relevant to social security costs (which tend to increase with base pay). Total pay costs also include pension costs and share based payment expenses. Nonetheless, we note that this agreement gives figures broadly in line with the PVEO analysis.

Economy wide pay indices

A32.160 In the June 2015 LLCC Consultation, we considered a number of non-BT sources of information for input pay inflation. For this statement we have extended our range of sources to include the OBR study referred to by BT in its response to our June 2015 LLCC Consultation.

A32.161 In our June 2015 LLCC Consultation we presented ONS data on average weekly earnings, from the ONS Survey of Hours and Earnings. This annual change can be considered an estimate of average historical pay inflation for the UK, however it only relates to the wages and salaries element of pay costs. Figure A32.29 presents the latest ONS data[116].

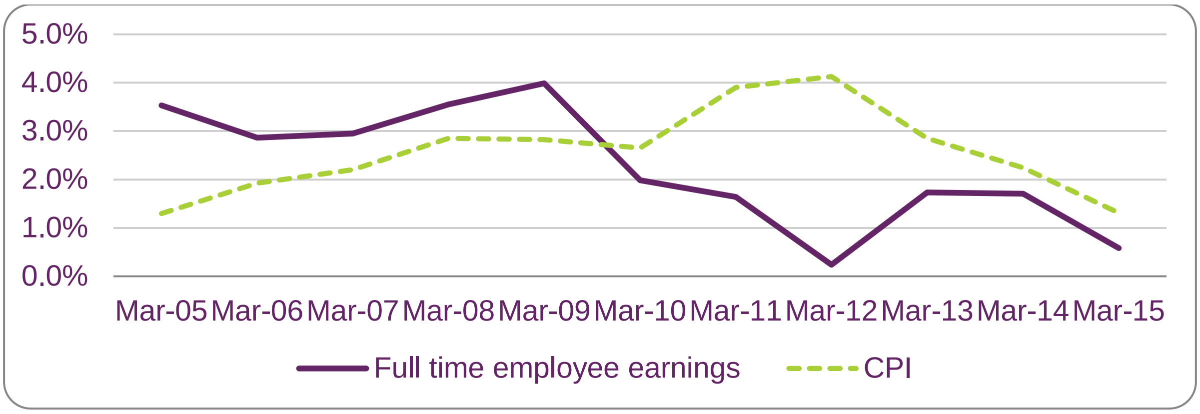
[113] BT, Pay Review 2014, http://www.cwu.org/telecoms-financial-services/department-and-businesses/bt/bt-pay-2014/

[114] BT, Pay Review 2014, http://www.prospect.org.uk/select_an_industry/telecoms/employers/bt/payreview/index?_ts=1

[115] http://www.cwu.org/media/news/2015/april/15/pay-rise-for-bt-members/

[116] ONS, *Annual Survey of Hours and Earnings, 2015 Provisional Results*, *Office of National Statistics*, 18 November 2015, http://www.ons.gov.uk/ons/dcp171778_424052.pdf

Figure A32.29: Annual percentage change in median full-time gross weekly earnings for all employees



Source: Ofcom calculations based on Figure 1, Annual Survey of Hours and Earnings, 2015 Provisional Results, Office of National Statistics. http://www.ons.gov.uk/ons/dcp171778_424052.pdf

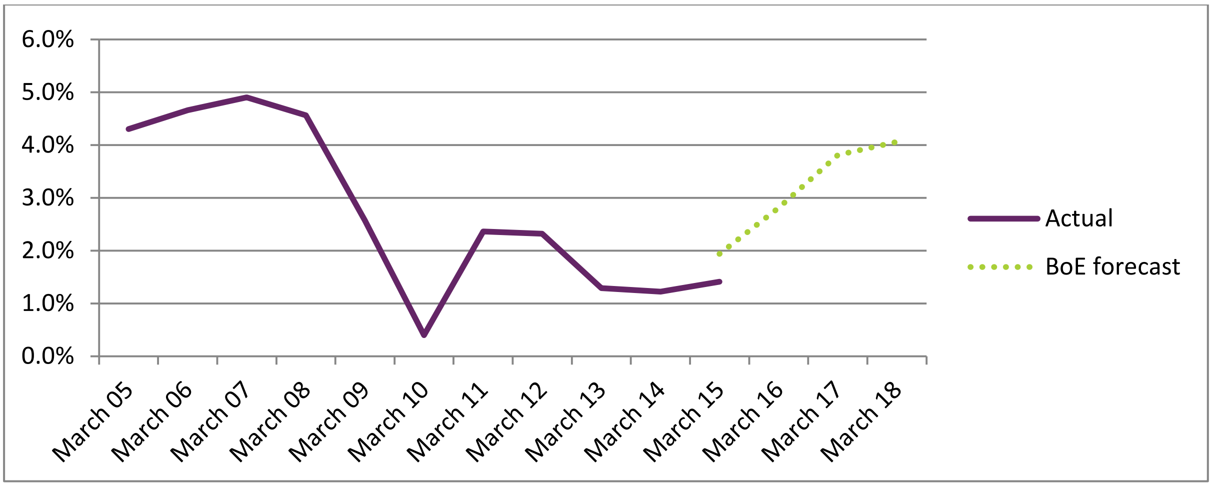
A32.162 Figure A32.29 suggests that since March 2010 UK average weekly earnings growth has been between 0% and 2% (on average 1.2%) and below CPI inflation. In contrast the period before 2009 was characterised by higher growth of greater than 3% and above CPI inflation.

A32.163 As in our June 2015 LLCC Consultation, we interpret this to mean that while pay inflation has been relatively low recently, this has not always been the case and therefore it is important to not just look at the recent past but also forward. For this purpose we have examined other economy-wide pay indices.

A32.164 In our June 2015 LLCC Consultation we also presented data from the ONS on historical annual growth in average weekly earnings (total pay, i.e. including bonuses). The advantage of this data series is that this metric is also forecast by the Bank of England.[117] Figure A32.30 shows the latest historical data and forecasts.

[117] Bank of England, *Inflation report*, November 2015 http://www.bankofengland.co.uk/publications/Documents/inflationreport/2015/nov.pdf

Figure A32.30: Annual percentage change in average weekly earnings (total pay). Actual and Bank of England Forecast



Source: Ofcom calculations based on Office of National Statistics data series KAB9, http://www.ons.gov.uk/ons/datasets-and-tables/data-selector.html?cdid=KAB9&dataset=lms&table-id=15 *Table 5d, Bank of England Inflation Report, November 2015* *http://www.bankofengland.co.uk/publications/Documents/inflationreport/2015/nov.pdf*

A32.165 In the June 2015 LLCC Consultation we noted that the data in Figure A32.30 is more variable than that in Figure A32.29 but that the overall change is very similar. This remains the case in that average total weekly earnings (including bonuses) grew at 1.5% per annum since March 2010 (based on the data from Figure A32.29) compared to 1.2% per annum (based on the data from Figure A32.30).

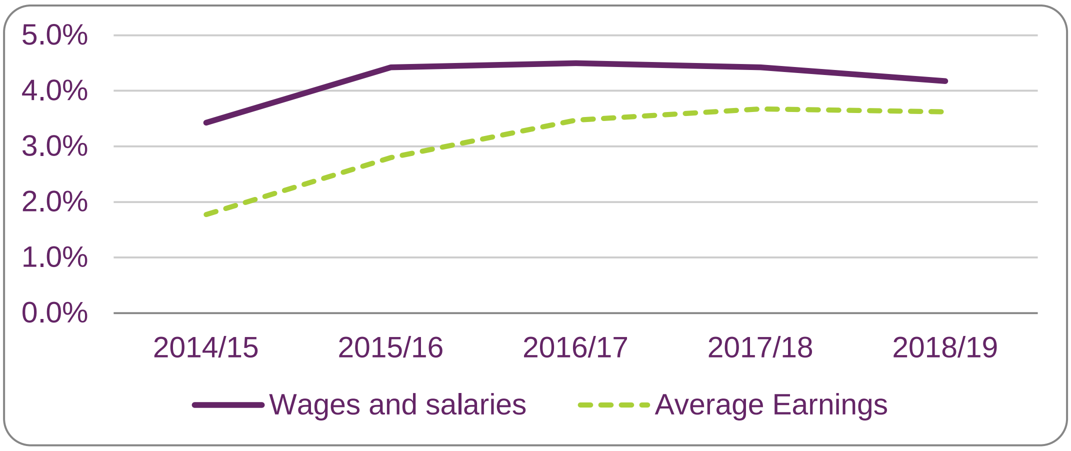
A32.166 However, the Bank of England forecast, which was used in its November 2015 Inflation Report, suggests that the percentage change in average weekly earnings (total pay) will increase from current levels up to 4.0% per annum. This equates to an average rate of 3.2% per annum from our base year up to the end of the forecasts (2018/19).

A32.167 As noted above BT's response to the June 2015 LLCC Consultation referred to an average earnings growth forecast index published by OBR[118] and said that this data shows that "*as the economy recovers, there will be an expectation that wages rise*"[119]. Figure A32.31 below presents the latest OBR forecasts to which BT referred for both wages and salaries and average earnings.

[118] BT response to the June 2015 LLCC Consultation referenced the July 2015 OBR report. Figure A32.31 has been updated to reflect the more recent publication which was released by OBR in November 2015.

[119] BT response to the June 2015 LLCC Consultation, paragraph 109

Figure A32.31: Latest OBR forecasts of average earnings and wages and salaries



Source: Ofcom calculations based on Table 1.1, Economic and fiscal outlook November 2015, Office of Budget Responsibility 2015 http://cdn.budgetresponsibility.independent.gov.uk/EFO_November__2015.pdf

A32.168 Figure A32.31 above shows that the most recent OBR forecast, like the Bank of England, predicts that growth in average earnings[120] will increase over the forecast period. The OBR forecasts that average earnings will grow by 3.4% per annum from our base year through to the end of the charge control. The highest increase is 3.7% in 2017/18, similar to the 4% peak in 2017/18 forecast by the Bank of England.

A32.169 We have used forecast data from OBR in previous charge controls.[121] However, we have also noted that while these indices may be a good indicator of changes to wages and salaries and social security costs, they do not cover all pay costs.[122] In particular they do not cover pension costs inflation. Pension costs are approximately 10% of BT's total pay costs and have shown considerable volatility in recent years, but have generally decreased.[123]

Our estimate of pay inflation

A32.170 Having considered responses to the June 2015 LLCC Consultation and recent pay and earnings data and forecasts, we have decided to adopt a pay cost inflation assumption of 3% per annum to the end of the charge control period.

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[120] The metric "average earnings" is calculated as wages and salaries divided by employees. We therefore consider this to be a more appropriate metric when considering pay inflation.
[121] For example see June 2014 WBA Statement, paragraphs A7.98 to A7.105
[122] See for example June 2014 WBA Statement, paragraphs A7.98 to A7.105.
[123] In our June 2014 WBA Statement we noted that pension costs per FTE appeared to be reducing in

nominal terms in 2012/13. In contrast to the reduction in 2012/13, the Annual Report for 2013/14

shows an increase in pension costs per FTE of 18% and the Annual report for 2014/15 shows no

increase in pension costs per FTE. See also Table A32.9 above.

A32.171 We have determined our final pay inflation assumption by weighting together the different sources of evidence to produce annual inflation estimates in 2015/16 and 2016/17. For these years, we have placed the most weight on our analysis of BT's forward looking management accounting information but have also considered the Trade Union pay agreement and the ONS and Bank of England forecasts. For the remaining years of the charge control, where we only have forecasts from ONS and the Bank of England, we have estimated pay inflation using our weighted 2016/17 estimate but have then reflected the movements in pay inflation provided from these external forecasts. Our final assumption represents the average pay inflation over the period 2014/15 to 2018/19.

For non-pay costs we have adopted specific rates where rates can be identified (e.g. for accommodation costs) and CPI for all other non-pay costs

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A32.172 We proposed non-pay inflation should be set at 2.6%.[124] Non-pay operating costs include costs types which may face very specific and different inflation rates. Therefore, in order to forecast non-pay inflation more accurately, we estimated inflation for energy, accommodation and cumulo costs separately. We considered that CPI would be an appropriate measure of inflation for all other non-pay costs. We then produced an overall rate for non-pay cost inflation of 2.6% by weighting these estimates together using information derived from BT's management accounts.

Stakeholders' comments

A32.173 The only response received on our non-pay inflation proposals was from BT.

A32.174 BT said the CPI forecasts we had used when assessing inflation for other non-pay costs were not consistent with the CPI assumptions we used within the 2015 LLCC model[125].

A32.175 BT also noted[126] that our RPI inflation assumption was lower than that published by OBR in their Economic and Fiscal Outlook July 2015 publication.[127]

A32.176 BT raised no comments regarding any of our other non-pay inflation assumptions.

Our conclusions

A32.177 Non-pay operating costs include a variety of different types of costs that may face very specific and different inflation rates. Therefore, in order to more accurately forecast non-pay inflation, we estimate certain inflation costs separately. This process results in different non-pay assumptions for Ethernet and TI services as the mix of costs for these two sets of services is different.

[124] See Annex 8, paragraphs A8.271 to A8.286 of the June 2015 LLCC Consultation
[125] BT response to the June 2015 LLCC Consultation, paragraph 111
[126] BT response to the June 2015 LLCC Consultation, paragraph 111
[127] Office of Budget Responsibility, *Economic and Fiscal Outlook July 2015*, Table 3.6, http://budgetresponsibility.org.uk/economic-fiscal-outlook-july-2015/

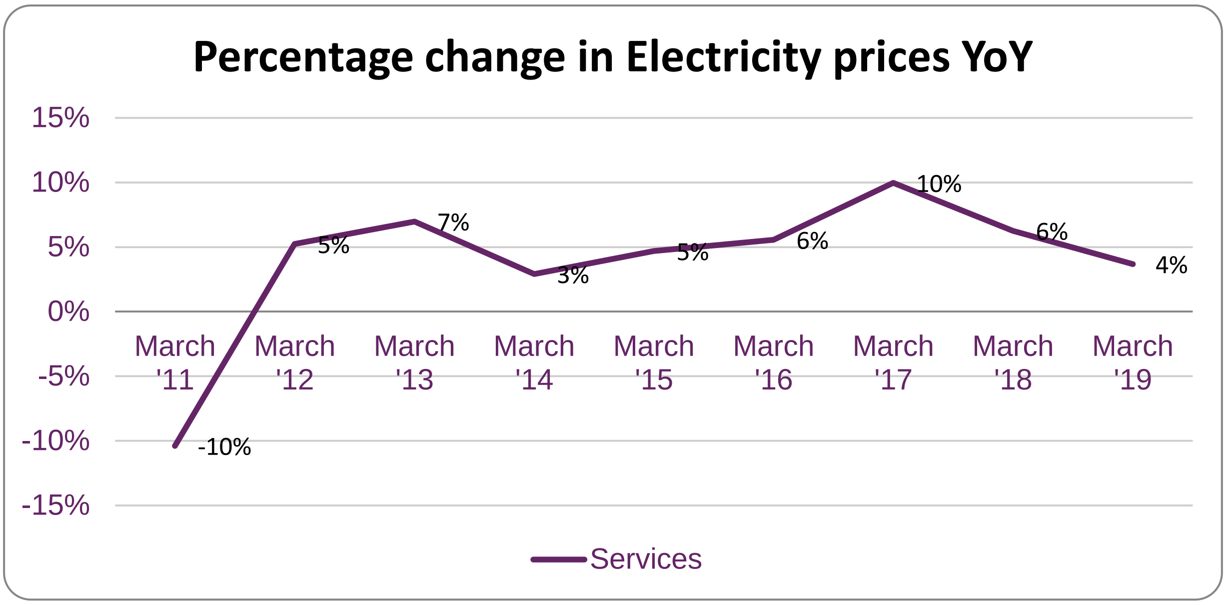
<u>Energy Costs</u>

DECC forecasts

A32.178 In our June 2015 LLCC Consultation we presented forecasts for energy prices that had been published by the Department of Energy and Climate Change (DECC). Every year DECC publishes updated energy projections (UEPs) that analyse and project future energy use and greenhouse gas emissions in the UK. The projections are based on assumptions of future economic growth, fossil fuel prices, electricity generation costs, UK population and other key variables.

A32.179 In previous market review statements we have used DECCs forecasts of retail prices per kilowatt hour for 'services' as an estimate of the electricity price inflation that BT is likely to face.[128] Figure A32.32 below presents our analysis of DECC's most recent forecasts.[129]

Figure A32.32: Annual percentage change in retail electricity price for services p/kWh



Source: Ofcom calculations based on DECC UEPs and ONS GDP deflator

A32.180 Figure A32.32 above shows that DECC expect electricity prices to continue to increase quite rapidly over the forecast period but the rate of increase will start to slow. The average increase over the period from our base year, 2014/15 to the end of the charge control period is 6.4%.

[128] See for example paragraphs A7.108-112 in Annex 7 of Ofcom's 2014 Review of the wholesale broadband access markets http://stakeholders.ofcom.org.uk/binaries/consultations/review-wba-markets/statement/Statement_Annexes.pdf and paragraphs A13.188-191 in Annex 13 of Ofcom's 2014 Fixed Asset market Review consultation http://stakeholders.ofcom.org.uk/telecoms/ga-scheme/specific-conditions-entitlement/market-power/fixed-access-market-reviews-2014/statement/

[129] DECC, *Updated Energy & Emissions Projections*, Annex M, November 2015. https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2015. DECC no longer publish a reference scenario so we have presented the simple average of the high and low forecast scenarios. The DECC forecasts are also based on calendar years and prices are deflated using the ONS' GDP deflator. We have therefore re-inflated the prices using ONS' GDP deflator and converted to a March year end.

A32.181 The DECC forecasts provide an independent and unbiased view of future relevant electricity price inflation over the whole of the charge control period. As no stakeholders (including BT) commented directly on our use of the DECC forecasts we have decided, consistent with our proposal in the June 2015 LLCC Consultation, to adopt the adjusted DECC services forecasts presented above. As a result we are forecasting that energy prices will increase by 6.4% per annum in nominal terms from our base year to the end of the charge control period.

Accommodation Costs (including Business rates)

A32.182 Operating costs within BT's accommodation sector include rents on buildings, non-domestic rates, electricity costs and facilities management costs.[130] We have discussed electricity costs above.

Non domestic rates costs

A32.183 BT pays non-domestic rates not only on its offices but on other rateable assets within its UK network.[131] The UK network rateable assets consist primarily of "passive" infrastructure assets such as duct, fibre, manholes and cabinets, as well as exchange buildings. For BT these network assets are assessed together in what is a called a "cumulo" assessment. These associated costs are usually referred to as BT's cumulo rates costs.

A32.184 Non-domestic rates liabilities are the result of applying a rate in the pound to a rateable value. Different rates in the pound apply in England, Scotland, Wales and Northern Ireland[132] although in recent years the Scottish authorities have set their rates in the pound to be the same as those in England.

A32.185 Rateable values are an estimate of rental values under a set of statutory conditions, and are usually reassessed every 5 years. The next reassessment in England, Scotland and Wales will take effect from 1 April 2017. Between revaluations rateable values generally stay constant though a ratepayer may make appeals on the basis that there have been "material changes in circumstance" (MCCs). MCCs are defined under legislation and generally cover physical changes to the rateable assets in question: economic changes do not constitute valid grounds for claiming there have been MCCs. In recent years BT's cumulo RV has reduced as a result of several successful appeals[133].

A32.186 Between re-valuations rates in the pound in England generally increase under legislation by the change in RPI at the prior September, though increases lower than this were set in 2014/15 and 2015/16.[134]

A32.187 We consider the result of changes in BT's rateable values within our assessment of BT's efficiency in Annex 29. We therefore consider the relevant measure of non-domestic rates inflation to be changes to rates in the pound. BT's cumulo assessments in England and Scotland account for over 90% of BT's cumulo payments. Scotland has set its rates in the pound to be the same as those in England in recent years. We therefore consider the changes in rates in the pound in

[130] See example the description of Sector BC give on page 329 in BT's 2015 AMD.
[131] BT's UK network includes assets in England, Scotland, Wales and Northern Ireland
[132] Different rates in the pound also apply in different council areas of Northern Ireland.
[133] See for example BT's Central List assessments in England and Wales which can be found at http://www.2010.voa.gov.uk/rli/static/HelpPages/English/help/help153-central_rating_list.html
[134] See for example http://www.legislation.gov.uk/cy/uksi/2014/404/made

England provide a reasonable estimate of the inflation in non-domestic rates that BT will face over the forecast period. Table A32.11 shows how these rates have changed in recent years.

Table A32.11: Recent rates in the pound in England and Scotland[135]

	2012/13	2013/14	2014/15	2015/16	2016/17
Uniform Business Rate	45.0	46.2	47.1	48.0	48.4
Large property Supplement[136]	0.8	0.9	1.1	1.3	1.3
Total	45.8	47.1	48.2	49.3	49.7
Change in total		2.8%	2.3%	2.3%	0.8%

Source: VOA and Scottish assessor web-sites

A32.188 In practice, rates in the pound in 2017/18 are likely be different to those in 2016/17 as the result of the 2017 revaluation.[137] However the inflation BT will face in that year will reflect the effect of the revaluations on all its rateable values as well as changes in the rates in the pound. We understand from the Valuation Office Agency (VOA, the rating agency for England and Wales) that Department for Communities and Local Government (DCLG) are likely to publish a draft list in autumn 2016.[138] Changes in rateable values as well as changes in rates in the pound will therefore not be known until after this change control comes into force. For the last two years of the control period, 2017/18 and 2018/19, we therefore assume that rates in the pound will increase in line with annual change in the previous September's RPI. We consider this a neutral assumption.

A32.189 The net effect of the above assumptions is that we forecast non domestic rates costs will increase by 2.4% on average between the base year and the last year of the control period.

Other accommodation costs

A32.190 Consistent with other recent reviews[139] and the June 2015 LLCC Consultation, we have decided to adopt the assumption that other accommodation costs will increase at 3% per annum. This is the rate at which rental prices increase for those buildings

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[135] England rates from http://www.2010.voa.gov.uk/rli/static/HelpPages/English/faqs/faq146-what_are_the_current_multipliers.html, Scotland rates from http://www.saa.gov.uk/ratespayable.html. 2016/17 rates are currently but from e.g. http://www.cheshireeast.gov.uk/business/business_rates/rating_multipliers.aspx

[136] Most ratepayers pay the rate including the large property supplement. The conditions under which a ratepayer might be eligible for a discount under the small business rate relief scheme differ between UK countries. See for example a description of the English scheme at http://www.2010.voa.gov.uk/rli/static/HelpPages/English/faqs/faq092-small_business_rate_relief_england.html.

[137] We understand that rates in the pound in the first year following a revaluation are reset so that total non-domestic rates income will increase in line with the change in the previous September's RPI. If, for example rateable values for all ratepayers increased significantly this could result in reductions to the rate poundage.

[138] Meeting between the VOA and Ofcom, 30 September 2015

[139] See for example paragraphs A7.107 in Annex 7 of Ofcom's 2014 Review of the wholesale broadband access markets http://stakeholders.ofcom.org.uk/binaries/consultations/review-wba-markets/statement/Statement_Annexes.pdf and paragraphs A13.195 in Annex 13 of Ofcom's 2014 Fixed access market review consultation http://stakeholders.ofcom.org.uk/telecoms/ga-scheme/specific-conditions-entitlement/market-power/fixed-access-market-reviews-2014/statement/

subject to BT's agreement with Telereal Trillium.[140] This agreement covers [✂]% of BT's properties and we understand that rental costs account for the bulk of BT's accommodation costs.

<u>All other non-pay costs</u>

A32.191 Non-pay operating costs other than those specifically mentioned above comprise approximately [✂] [60-80%] of non-pay operating costs for Ethernet and approximately [✂] [20-40%] of non-pay operating costs for TI. In the June 2015 LLCC Consultation we proposed that, where a specific rate cannot be reliably identified, CPI would be an appropriate measure to use to forecast inflation in these other non-pay costs.

A32.192 We received no stakeholder comments on this proposal and so therefore we have decided to use CPI forecasts as the measure of inflation for these costs. Average CPI inflation between the base year and the last year of the control period is 1.3% per annum.[141]

Use of CPI and RPI forecasts

A32.193 Consistent with the approach taken in the June 2015 LLCC Consultation, for our CPI and RPI forecasts we use the latest HMT consensus forecasts[142] and convert these from calendar to financial years. These are presented in Table A32.12 below.

Table A32.12: CPI and RPI forecasts used within the model

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
CPI	3.5%	4.3%	2.7%	2.3%	1.1%	0.3%	1.2%	1.9%	2.0%
RPI	5.0%	4.8%	3.1%	2.9%	2.0%	1.2%	2.2%	3.0%	3.3%

Source: HMT February 2016 forecast for UK economy report, average of all independent forecasts.

A32.194 In light of BT's response to the June 2015 LLCC Consultation, we have reviewed our CPI and RPI forecasts and do not believe the rates we used within the 2015 LLCC model or in our previous assessment of other non-pay cost inflation were inconsistent. Additionally, for this statement we have reviewed and checked that the various forecasts we are using for CPI and RPI are calculated using the same HMT forecasts referred to above. However the way we use these forecasts does vary:

- For cost forecasting within the model, we use the geometric mean over the forecasting period.

- When calculating the WACC, we use the HMT RPI forecasts for the 2018/19 financial year. The reasons for this are discussed in Annex 30.

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[140] See for example: BT Group, *Financial Review: profit on sale of property fixed assets*, 2002, http://www.btplc.com/report/financial_fixedassets.shtml.

[141] Ofcom calculations based on medium term forecasts taken from HM Treasury publication, Forecasts for the UK economy, February 2016 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/500929/201602_Forecomp_February_2016_v2.pdf

[142] HMT February 2016 forecast for UK economy report, average of all independent forecasts https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/500929/201602_Forecomp_February_2016_v2.pdf

Conclusion on non-pay inflation assumption

A32.195 As in the June 2015 LLCC Consultation we combine all the above non-pay inflation assumptions to calculate an overall non-pay inflation assumption. We have weighted the different estimates together using cost weights derived from BT's regulatory accounting information[143] as set out in Table A32.13 below.

Table A32.13: Summary of non-pay inflation assumptions

Type of cost	Assumption basis	June 2015 Inflation Proposal	June 2015 Weighting	Final Inflation Decision	Final Weighting	
					Ethernet	TI
Energy	DECC	6.5%	[✂] [0-20%]	6.4%	[✂]	[✂]
Other Accommodation Costs	Telereal Trillium Contractual rate	3.0%	[✂] [20-40%]	3.0%	[✂]	[✂]
Cumulo	RPI	2.3%	[✂] [0-20%]	2.4%	[✂]	[✂]
All other non-pay costs	CPI	1.5%	[✂] [40-60%]	1.3%	[✂]	[✂]
Weighted average	n/a	2.6%	100.0%	Ethernet 2.1% TI 3.2%	100.0%	100.0%

Source: Ofcom analysis, weightings from BT responses to question A1 of the 30th S135.

A32.196 We therefore have decided that the appropriate forecast for non-pay inflation to be used in our cost modelling is 2.1% for Ethernet and 3.2% for TI services. Having different assumptions for Ethernet and TI services is a change from the June 2015 LLCC Consultation proposals where we proposed that a single assumption of 2.6%, should apply to both Ethernet and TI services. This updated approach is however consistent with how we assess BT's efficiency from historic and forecast management accounting information where we take account of the different cost mixes for these two groups of services.

Inflation assumptions for our efficiency analysis

A32.197 As we noted above, we also use our input price inflation assumptions within our assessment of BT's historical and forecast efficiency. We do so in order to adopt a consistent approach to inflation throughout our analysis. The historic and forecast values we have used when considering BT's efficiency are summarised in Table A32.14 and Table A32.15 below. These reflect both pay and non-pay operating costs.

Table A32.14: Inflation assumptions used for our regulatory cost accounting efficiency analysis

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16 to 2018/19

[143] BT response to 30th S135 question A1

Ethernet	1.7%	2.7%	2.9%	2.3%	2.3%	2.5%
TI services	0.7%	2.9%	3.2%	2.4%	2.6%	3.1%

Source: Ofcom analysis

Table A32.15: Inflation assumptions used for our management account efficiency analysis

	2011/12	2012/13	2013/14	2014/15	2015/16 to 2018/19
Pay	1.9%	1.6%	1.8%	2.0%	3.0%
Property	3.0%	3.0%	3.0%	3.0%	3.0%
Energy	5.2%	7.0%	2.9%	4.7%	6.4%
Other External	3.5%	4.3%	2.7%	2.3%	1.3%
Ethernet Transfers	3.6%	4.4%	2.7%	2.6%	2.1%
TI services Transfers	3.7%	4.4%	2.8%	3.1%	3.2%

Source: Ofcom analysis

Asset price inflation

We have adopted asset price change assumptions such that duct and copper are valued through the RAV-based approach and all other asset prices are assumed to stay constant in nominal terms

A32.198 We also require assumptions about forecast changes in asset prices. These assumptions are inputs to our estimates of forecast capital costs, both capital expenditure and holding gains and losses within our 2016 LLCC Model.

June 2015 LLCC Consultation

A32.199 In our June 2015 LLCC Consultation we proposed that:

- The price of duct and copper would increase by RPI. This was consistent with the RAV-based approach that we proposed to adopt in the cost modelling.
- All other asset prices would be assumed to stay constant, i.e. flat in nominal terms, largely on the basis of low holding gains and losses historically.

Stakeholders' comments

A32.200 The only response we received on our asset price inflation proposals was from BT. BT made three points.

A32.201 Firstly, BT agreed with our proposed treatment of duct and copper assets.[144]

A32.202 Secondly, it disagreed with the way that we had calculated holding gains and losses in the model. BT said that there should be "*a real holding loss added to the cost*

[144] BT response to the June 2015 LLCC Consultation, paragraph 97

stack and not the real holding gains removed from the cost stack that Ofcom has calculated"[145].

A32.203 Lastly, BT believed that "*the application of real asset price reduction in Ofcom's model mean that its capex efficiency assumption is overstated … We suggest maintaining the asset price change assumption (though with the change of the holding (gain)/loss calculation), but removing the capex efficiency assumption altogether*"[146].

Our conclusions

A32.204 BT's argument about the calculation of holding gains and losses makes a more general modelling point that we address in Annex 29. Its argument on the interaction between our asset price assumptions and capex efficiency is more a criticism of the level of our capex efficiency assumption than our asset price assumptions. Indeed BT's proposal is, as noted above, to retain our asset price assumptions. We therefore address this point within our discussion of capex efficiency.[147]

A32.205 Within BT's RFS, duct and copper assets are valued using the indexed historic methodology and the Retail Price Index[148]. Our June proposal is consistent with the treatment of these assets within BT's RFS.

A32.206 We have updated the analysis of historic asset price changes, holding gains and losses and capex movements within BT's PVEO analyses completed for the June 2015 LLCC Consultation, with particular focus on the other assets rather than the duct and copper assets.

A32.207 In our updated analysis of the historical asset price changes that BT has made within its RFS we first looked at the extent to which BT re-values assets used to support Ethernet and TI services.[149] This showed that, although BT re-values assets within relatively few sectors the assets within the sectors that are re-valued account for a large proportion ([✂] [80-100%]) of the mean capital employed for both Ethernet and TI services.[150] That is, because BT re-values its duct, fibre and 21 CN assets. However the proportion is also [✂] [60-80%] for non-duct and copper assets, though there are some notable sectors for which assets are not re-valued, most noticeably sector DK, which covers Private Circuits and SMDS equipment.[151]

A32.208 We then weighted these annual price movements by base year GRCs within the charge control model to estimate the average annual asset price change over the last 5 years. The results are shown in Table A32.16 below. This confirms that for

[145] BT response to the June 2015 LLCC Consultation, paragraph 102
[146] BT response to the June 2015 LLCC Consultation, paragraph 106
[147] See paragraphs A29.251 to A29.264 in Annex 29
[148] See page 14, BT's 2014/15 AMD
[149] We did this using information on historic asset price changes by class of work, BT response to 22nd s135 Notice, Question E1 &E2 and GRC data contained within the base year of the Charge Control model.
[150] This is less true for the GRC of TI services where the proportion drops [✂]%.
[151] See page 336 of BT's AMD for a description of the assets contained within this sector. These include equipment used to provide Ethernet and TI services. SMDS stands for Switched Multimegabit Data Services. Page 323 of BT's 2015 AMD describes these as legacy data services for bandwidth users.

assets other than duct and copper, asset price changes have generally been low although with some variation year on year.

Table A32.16: Average asset price change over the last 5 years

	Ethernet	TI
All non-copper and duct assets	[✂]%	[✂]%
Only those non-copper and duct assets subject to revaluation	[✂]%	[✂]%

Source: Ofcom analysis

A32.209 We have also updated our analysis of holding gains and losses that BT reports within its RFS. Holding gains and losses cover a variety of adjustments but largely occur when the value of an asset held by BT increases (or decreases) in value. If these were significant, it might suggest large changes to BT's asset prices and therefore cast doubt on our previous asset price assumption of no nominal change to asset prices for assets other than duct and copper. Our analysis shows that on average holding gains/losses were -0.7% and -0.9%[152] of mean capital employed for non-current assets for Ethernet and TI services respectively over the last 5 years.

A32.210 BT's RFS do not distinguish between holding gains or losses on duct and copper assets and those on other assets. The revaluation of duct and copper assets in line with RPI will have driven the majority of these holding gains. Further the above comparisons are with respect to net replacement costs (i.e. after the deduction of accumulated depreciation).[153] A more appropriate comparison would be against GRCs and would result in lower values. This analysis therefore provides some evidence to support the previous assumption of low asset price inflation assumptions for TI and Ethernet assets other than Duct and Copper.

A32.211 Lastly we have reviewed capex inflation estimates from the Openreach capex PVEO analyses[154]. These include spend on duct and copper. Openreach forecast capex inflation at [✂] per annum over the five years up to 2016/17. This is [✂] than RPI which averaged 2.3% per annum over the same period. This again provides some evidence to support a weighted average rate of asset price inflation for duct and copper of RPI and low asset price inflation for all other assets.

A32.212 We have decided to adopt the asset price proposals that we made in the June consultation for this statement. We received no substantive comments on our asset price inflation assumptions. We have updated our previous analysis which has again supported our previous proposals. We therefore have decided that:

- Duct and Copper prices will increase by RPI.
- All other asset prices will stay constant, i.e. flat in nominal terms.

[152] Negative costs indicate holding gains and therefore price increases. BT publishes information on holding gains and losses in different markets in its RFS. See for example pages 27 and 28 of BT's revised 2015 RFS, https://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2015/RevisedCurrentCostFinancialStatements2015.pdf
[153] Net replacement cost is approximately 40% for Ethernet and 20% for TI of gross replacement cost.
[154] BT response to the 6th S135 and 24th S135

Annex 33

Impact of dark fibre on Leased Lines Charge Control

Introduction

A33.1 This Annex sets out our analysis on the impact that introducing regulated dark fibre access (DFA) has on the Leased Lines Charge Control (LLCC). We consider there are two main ways that dark fibre could impact the LLCC.

A33.2 Firstly, as dark fibre becomes available, we would expect CPs to purchase dark fibre for some circuits instead of the active equivalent. Therefore, the availability of dark fibre will reduce the active volumes forecast in the Ethernet basket.

A33.3 Secondly, dark fibre will affect BT's cost recovery; both directly through the implementation costs incurred to introduce the remedy, and more indirectly as the substitution of active circuits for dark fibre affects BT's ability to recover its efficiently-incurred costs.[155] Therefore the introduction of dark fibre will affect the costs that need to be recovered from the Ethernet basket, which we have quantified below.

A33.4 We consider it appropriate to uplift the 2018/19 forecast costs for the Ethernet basket by including:

- **Common cost uplift** – approximately £1.3m in total, or about 0.3% of the Ethernet basket costs.
- **Stranded assets** – approximately £0.7m in total, or about 0.2% of the Ethernet basket costs.
- **Implementation costs** – approximately £[✂] in total, or about [✂]% of the Ethernet basket costs.

A33.5 The combined impact of these two effects (volume impact and cost uplift) is to make the X for the Ethernet basket less negative by [✂]%. The majority of this impact is due to the reduction in active volumes (which standalone makes the X less negative by 1%), with the remainder attributable to the cost uplifts.

A33.6 We have structured this Annex into five sub-sections:

- **cannibalisation assumptions** – by cannibalisation, we refer to the decision made by Communication Providers to use dark fibre instead of an active leased line. This sub-section sets out the assumed cannibalisation rates that Ofcom considers appropriate. These assumed cannibalisation rates determine the 1Gbit/s and below volumes within the Ethernet basket, but also affect the unavoidable costs that we need to ensure BT recovers and the level of stranded assets;

[155] This includes where dark fibre will make a lower contribution to BT's common costs than the active circuit it replaces, and also the potential for stranded assets (where existing active circuits migrate to dark fibre such that BT is unable to fully recover its efficiently incurred equipment costs).

- **common cost recovery at risk** – this sets out the common cost recovery[156] that would potentially be at risk from the cannibalisation of active circuits by dark fibre. In particular, reflecting those costs that are non-avoidable (i.e. they are still incurred regardless of whether dark fibre is being supplied instead of an active circuit);

- **stranded assets** – this sets out, in light of the assumed cannibalisation rates for existing circuits, the potential cost faced by BT due to stranded assets as active circuits migrate to dark fibre;

- **implementation costs** – this sets out the estimated total implementation costs associated with the introduction of dark fibre products; and

- **recovery of cost uplift, stranded assets, and implementation cost** – this sets out the appropriate method and calculation for recovery of the costs listed in the bullets above. In particular, we consider whether these costs should be recovered as part of the LLCC, and if so, what proportion of costs should be included in the control.

Cannibalisation assumptions

Introduction

A33.7 We use the term cannibalisation to refer to the reduction of BT's active circuit volumes as a result of customers switching to dark fibre access product (either in relation to new connections or from existing active circuits).

A33.8 We need to make an assumption about cannibalisation rates for two key reasons. First, we need it to calculate the appropriate volume of active circuits in the Ethernet basket. Second, it allows us to forecast the appropriate level of efficiently incurred costs that BT should be allowed to recover as a result of customers switching away from active circuits to dark fibre (which we discuss further in paragraph A1.280 below).[157]

A33.9 Since the June 2015 LLCC Consultation and in light of stakeholder responses, we have reviewed our cannibalisation assumptions for both existing circuits and new connections. In Section 9 we discuss our decision to require BT to provide a dark fibre product by 1 October 2017. In light of this decision relating to the implementation of dark fibre, we have assessed the impact on volumes in each year of the charge control based on dark fibre being available for new connections from 1 October 2017, in the UK excluding Hull and CLA.

A33.10 There is always a degree of uncertainty when making assumptions about future volumes. We note that estimating future dark fibre use is subject to particular uncertainty at this stage given the regulated product is not currently available from BT and there are still elements of the product design to be negotiated. We also recognise that there are likely to be a range of factors which may affect the likely

[156] This is the recovery of costs that are common across all leased lines and is calculated by multiplying the dark fibre forecasts by the difference between the Fully Allocated Costs (FAC) of a circuit and the Long Run Incremental Costs (LRIC) of the active-specific elements of that circuit.
[157] We have taken these costs into account because otherwise there is a risk that the dark fibre remedy will undermine BT's ability to recover its efficiently incurred costs.

take-up of dark fibre by different CPs.[158] To estimate the cannibalisation of active circuits by the dark fibre remedy, we have considered the potential use of dark fibre informed by:

- qualitative and quantitative information from CPs (via consultation responses as well as responses to our formal and informal information requests)[159];
- our own analysis of commercial viability based on the characteristics of the dark fibre remedy; and
- our own quantitative analysis using data on existing circuits (e.g. prices and circuit lengths).

A33.11 Using this information, we have assessed the potential cannibalisation of:

- **new connections (on a one-for-one basis)** – we consider it appropriate to adjust our proposed cannibalisation assumptions for new connections given the later introduction of DFA in 2017/18. We have also re-assessed our proposed cannibalisation assumptions for EBD[160];
- **existing circuits (on a one-for-one basis)** – we still consider there to be significant barriers to switching which limit the willingness and ability for CPs to switch existing circuits in the short term (as set out in paragraph A1.97 to A1.109 below). However, we have undertaken further analysis on the rate at which CPs may fully utilise the potential for replacing existing circuits with dark fibre; and
- **duplicate circuits (i.e. the potential for aggregation)** – we expect the impact of dark fibre with regards to incremental aggregation to be limited in this review period.

A33.12 Having considered each of these, we have determined our final cannibalisation assumptions, which are summarised below in Table A33.1. These assumptions indicate the proportion of active circuits (for a given product type and bandwidth) that we expect will be cannibalised by dark fibre. By existing circuits, we refer to circuits that were not connected in the given financial year (i.e. ongoing rentals). By new circuits, we refer to circuits that were connected in that financial year.

[158] BT submitted an economic model developed by Analysys Mason which assessed the scope for take-up of passives based on BT circuit data and a number of assumptions (including passive and active pricing levels based on current wholesale Ethernet pricing). The report referred to a number of factors which it considered could drive the take-up of passives and extent of arbitrage, including: circuit length, bandwidth, scope and density, and location and their own network topology. See Annex to BT's response to the November 2015 LLCC Consultation, *Report for BT Plc: The potential take-up of passive products by CPs*, page 2.

[159] In the absence of finalised specifications for dark fibre access (including pricing, availability, migration terms etc.), CPs' ability to forecast their expected use of dark fibre was (understandably) limited, and so many provided more qualitative information.

[160] In particular, for EBD circuits we have used current price differentials and circuit lengths to estimate the likely long term scope of cannibalisation.

Table A33.1 – Ofcom's final cannibalisation assumptions for all circuits

Product		Existing circuits (17/18)	Existing circuits (18/19)	New circuits (17/18)	New circuits (18/19)
EAD LA	10 / 100Mbit/s	0%	0%	0%	0%
	1Gbit/s		4%	25%	95%
	10Gbit/s		17%	25%	95%
EAD & WES/BES	10 / 100Mbit/s		0%	0%	0%
	1Gbit/s		6%	25%	95%
	10Gbit/s		29%	25%	95%
OSA	>1Gbit/s		0%	25%	95%
EBD	1Gbit/s		0%	1%	6%
	10Gbit/s		12%	14%	57%

Source: Ofcom analysis

A33.13 We now explain how we have determined these assumptions. This sub-section on cannibalisation rates is structured as follows:

- impact on volumes of new active connections (in the absence of aggregation considerations);
- impact on volumes of existing active rentals (in the absence of aggregation considerations);
- assessment of scope for aggregation of active circuits using dark fibre; and
- final volume assumptions.

A33.14 For each of these, we set out the consultation position, a summary of stakeholder responses, and our analysis and final view (reflecting the data and views received).

Impact of dark fibre on new active connections (in the absence of aggregation)

June 2015 LLCC Consultation

A33.15 In the June 2015 LLCC consultation we proposed to adjust the Ethernet volume forecasts to take into account the proposed dark fibre remedy in this review period. To estimate the cannibalisation of active circuits by the proposed dark fibre remedy, we made some principle-based assumptions about the potential use of dark fibre, informed where possible by qualitative information from BT, OCPs and our proposed dark fibre remedy design. This included the following assumptions:

- only circuits with bandwidth of 1Gbit/s or above would be cannibalised by dark fibre;
- both internal and external BT sales will be affected; and

- CPs are likely to need to initially test/trial the product which means demand for dark fibre is likely to start slow and rapidly increase, focusing initially on new connections (rather than the migration of existing active circuits to dark fibre).

A33.16 On the basis of these assumptions and stakeholder views, we proposed the following cannibalisation rates:

- 50% cannibalisation of new connections (and associated rentals) for EAD, EAD LA and OSA circuits at 1Gbit/s and above in the second year of the control (the first year that we proposed the dark fibre remedy would be commercially available);
- 100% cannibalisation of new connections (and associated rentals) for EAD, EAD LA, and OSA circuits at 1Gbit/s and above in the final year of the control (in other words, we assumed no new connections for these active circuits); and
- zero cannibalisation of existing rentals in this review period.

A33.17 We noted that any potential overestimate of cannibalisation by assuming 100% of new connections in 2018/19 (for 1Gbit/s and above EAD and OSA circuits) could be balanced with potential underestimation as a result of assuming no cannibalisation of existing circuits.

A33.18 In our consultation, we noted that Ethernet Backhaul Direct (EBD) products are provided in a different manner to EAD products, i.e. they use a different network architecture (21st Century Network[161]) and equipment[162]. In light of this, we considered it unlikely that a single EBD circuit would be replicated using dark fibre (and so assumed no cannibalisation of EBD), for the following reasons:

- **EBD is an inherently different product** – EAD (and so dark fibre) and OSA type circuits are dedicated connections whilst EBD circuits use shared infrastructure and equipment. We assumed that a CP expecting to buy a single EBD today rather than an EAD or OSA, would do so for the specific characteristics of EBD, and so would likely continue to do so in a dark fibre world. In relation to EBD internal volumes, we noted that the costs to provide EBD had already been incurred by BT thus it may be less willing to cannibalise its own (i.e. internal) EBD circuits; and
- **EBD requires significant aggregation** – we considered it likely that a CP would need significant traffic to aggregate over the same connection in order to make it worthwhile to use dark fibre to replace its EBD circuits. This was partly due to the shared infrastructure nature of EBD, as reflected in the fact that equipment (rather than duct or fibre) costs associated with EBD were a significant cost (around 60% of BT's EBD cost stack appeared to relate to equipment costs).

[161] This is a separate national network that uses rings and daisy chains to securely deliver large volumes of uncontended data from an Access Serving Node (ASN) to an Openreach Handover Point (OHP).

[162] EBD uses wave division multiplexing (WDM) equipment which has high upfront costs where it is only economically viable to use with high bandwidth and/or multiple circuit usage.

A33.19 We also proposed no cannibalisation of Main Link[163] as this would still be required with a dark fibre circuit. We noted that [✂] but we considered it was unclear whether this would occur in this review period.

Stakeholders' comments

<u>Scope for cannibalisation of new connections</u>

A33.20 Some stakeholders (e.g. Sky[164], GTC[165], and Vodafone[166]) argued that our cannibalisation assumptions for new connections were an overestimate, whilst BT[167] considered that they were an underestimate.

A33.21 Sky, GTC, and PAG[168] argued that dark fibre may not be economically viable for some circuits (e.g. in areas with limited economies of scale or with low bandwidth circuits). Sky also argued that some business customers may not have the technical expertise or desire to self-supply active products using BT's dark fibre. PAG, Sky and Vodafone argued that Ofcom's dark fibre pricing proposals limit the ability of CPs to use dark fibre access to provide 1Gbit/s services.

A33.22 In response to the June 2015 LLCC Consultation, BT[169] provided its own cannibalisation rates for new connections (as set out in Table A33.2 below) which suggest a greater scope for cannibalisation than we proposed. These are based on [✂].

Table A33.2 – [✂]

[✂]	[✂]	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]
	[✂]	[✂]	[✂]
	[✂]	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]
	[✂]	[✂]	[✂]
	[✂]	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]
	[✂]	[✂]	[✂]

[163] Except where both local ends are terminated at the same BT local exchange, circuits are connected through the BT network by a "Main Link", which is priced according to the distance between the BT local exchanges used at each end of the circuit.
[164] See Sky's non-confidential response to the June 2015 LLCC Consultation, paragraphs 8.26-8.27 and 10.16.
[165] See GTC's non-confidential response to the June 2015 LLCC Consultation, pages 3 to 5.
[166] See Vodafone's non-confidential response to the June 2015 LLCC Consultation, paragraph 4.42.
[167] See BT's non-confidential response to the June 2015 LLCC Consultation, pages 42 and 43.
[168] See PAG's non-confidential response to the June 2015 LLCC Consultation, paragraphs 1.8, 2.17, and 5.1.
[169] See [✂].

[✂]	[✂]	[✂]	[✂]

Source: BT's confidential response to LLCC consultation (2015)

A33.23 BT highlighted that [✂], although BT still assumed [✂].[170] We have also received evidence from BT[171] that suggests the continued use of EBD for backhaul circuits at or greater than 35km long following the introduction of dark fibre, at least in the short term.

Rate of dark fibre take-up for new connections

A33.24 We have received mixed responses from stakeholders regarding the speed of dark fibre take-up. Both BT and Sky argued that there would be a rapid adoption of dark fibre for new connections, with BT arguing for a more rapid adoption assumption than we proposed in the LLCC consultation. When responding to the June 2015 LLCC Consultation, some stakeholders (GTC, Vodafone, and Frontier Economics commissioned by PAG[172]) argued that our proposed rate of dark fibre take-up was too rapid.

A33.25 Vodafone argued that demand for dark fibre may be lower initially while the product proves itself with early adopters. Vodafone also argued that there is uncertainty around whether BT will be in a position to deliver a workable product by Year 2 of the control. However, Vodafone stated in response to our informal questions that it would expect all new installations to be provided using dark fibre relatively quickly after it was made available and had been trialled (except where there are volume commitments under existing contracts.[173] GTC argued that uncertainty around the dark fibre product will lead to less adoption than proposed in the June 2015 LLCC Consultation.[174] Frontier Economics argued that a 100% adoption rate of dark fibre (for new connections) in the final year of the forthcoming charge control period is unlikely.

A33.26 BT argued that there would be more rapid adoption highlighting that its "[✂] shows that [✂]". Sky stated that it would expect to be able to take advantage of passive inputs very quickly for new circuits. Its reasons for this were because its ordering business processes have the flexibility to allow it to order passive inputs quickly, and it would expect it to be straightforward to substitute leased lines for dark fibre with little technical change.[175]

Other comments

A33.27 CityFibre[176] argued that our proposed adoption figures are inconsistent with our proposed pricing for dark fibre. It argued that our proposed pricing approach would

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170 We note that there are [✂], which likely explains why BT has still assumed [✂] despite this.
171 See confidential [✂].
172 Frontier Economics, *Ofcom's proposals on regulated dark fibre pricing,* July 2015, page 14 http://stakeholders.ofcom.org.uk/binaries/consultations/llcc-dark-fibre/responses/Passive_Access_Group_Annex_Frontier_Economics_report_on_regulated_dark_fibre_pricing.pdf
173 Vodafone confidential response to LLCC informal questions, February 2015.
174 Vodafone has also argued that poor Openreach quality of service (QoS) experience is now widely known and anticipated by many customers which will further deter take-up of a yet unproven product.
175 Sky's confidential response to LLCC informal questions, February 2015
176 CityFibre non-confidential response to the June 2015 LLCC Consultation, paragraphs 7.2.6 to 7.2.8.

result in only very high bandwidth circuits benefiting from dark fibre, which CityFibre argued is inconsistent with our cannibalisation assumptions.

A33.28 Virgin noted that it is appropriate to assume that Openreach loses all internal and external sales of the relevant circuits. It argued that BT's retail arm should be treated as having the same incentives as any independent third party CP when choosing whether to purchase an active or passive remedy.[177]

A33.29 Some stakeholders also commented on how dark fibre is likely to be used. [✂][178] stated that [✂]. Colt[179] and [✂][180] argued that dark fibre would not be used to simply substitute active products (such as EAD) but instead be used to expand existing network. GTC argued that dark fibre can expand the Ethernet market as providers compete on quality and innovation, targeting all segments of the market.

Our conclusions

A33.30 In light of stakeholder responses and further analysis, we have re-assessed our proposed cannibalisation assumptions for new connections. When assessing the cannibalisation of new connections we have broken down our analysis as follows:

- underlying assumptions;
- analysis of price incentives – we start by analysing which circuit types have a price incentive to switch to dark fibre in order to identify the maximum scope for cannibalisation;
- analysis of incentives by CP type – we recognise that CP incentives and ability to use dark fibre may vary, and so we then take into account these differences in preferences, strategies and ability between CPs;
- impact of the timing of DFA introduction in 2017/18 – we note that dark fibre will only be available for six months in 2017/18, and CPs have expressed a desire to trial dark fibre when it is initially available, which will affect the extent of cannibalisation in this review period; and
- final view of cannibalisation of new connections in the absence of aggregation in 2017/18 and 2018/19.

Underlying assumptions

A33.31 We initially assume a one-for-one substitution of relevant active circuits to dark fibre circuits. However, we then go on to assess the potential for aggregation. We consider cannibalisation of Main Link to be similar to aggregation of circuits, given that this involves aggregating backhaul traffic for multiple circuit routes. We assess the incremental impact of dark fibre on aggregation in paragraphs A33.173 to A33.217 below before concluding on our final cannibalisation assumptions.

A33.32 The basis for our analysis is that dark fibre access is introduced from 1 October 2017 as set out in Section 9 and that it is priced on a 1Gbit/s active minus basis. We also

[177] Virgin non-confidential response to the November 2014 BCMR Passives Consultation, page 18.
[178] See [✂] response to 13th s135 notice dated 9th October 2015, which indicates that [✂].
[179] Colt non-confidential response to the June 2015 LLCC Consultation, page 10 and 11.
[180] See [✂].

assume that our design of the dark fibre remedy (as set out in Annex 22) will also allow the technical replicability of existing Ethernet services, as it will allow CPs to provide a point to point dedicated fibre connection. Therefore we consider the scope for cannibalisation of EAD, EAD LA, OSA, EBD, WES and BES services.

A33.33 We also assume that when CPs consider purchasing dark fibre:

- they respond to the relative cost of providing a business circuit using dark fibre compared to the active equivalent. We start from a presumption that active circuits would be replaced by dark fibre only where dark fibre is no more expensive;
- they recognise that dark fibre access will be a new product in this review period and thus will want to first test and trial the product; and
- BT downstream will generally respond to similar market demands and incentives as other CPs in order to compete in the leased lines market.[181]

A33.34 We note that dark fibre will only be available for six months in 2017/18 and stakeholders have indicated that they would want to trial it first. Therefore we have focused on incentives under 'business as usual'[182] to determine the full scope of use and then consider what degree of scaling is required for 2017/18 figures taking into account this will be a period during which industry will be trialling the product.

A33.35 We have also assumed that the dark fibre remedy will have no impact on total market size (i.e. the total number of circuits will be unchanged) in this review period. We note that dark fibre may offer the potential to change network design in the longer term. However, contrary to Colt and [✂], we consider that such major changes are likely to take some time. Therefore we consider it is not appropriate (and would be too speculative) at this stage to attempt to reflect any market expansion effect from dark fibre, particularly within this review period.

Analysis of price incentives for new connections

A33.36 In arriving at our volume assumptions, we consider that the primary factors determining CPs' choice of available Openreach services will be the total cost of ownership (TCO) of a leased line circuit, alongside the additional benefits from the use of dark fibre. Therefore we assume that a CP will choose dark fibre instead of an equivalent active circuit if:

- the TCO of the active circuit is higher than the dark fibre alternative (i.e. the dark fibre price plus the equipment costs)[183]; and
- the TCO of the active circuit is similar to the dark fibre alternative but there are additional benefits from the use of dark fibre over and above the equivalent active circuit.[184]

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181 [✂].

182 We consider 'business as usual' to refer to when CPs are familiar with BT's dark fibre access product such that the use of dark fibre falls under the normal execution of operations within an organisation.

183 [✂].

A33.37 Therefore where dark fibre is the lower cost option of obtaining a wholesale circuit type (of a given type and bandwidth), we would expect, all else being equal, that the CP would prefer to use dark fibre. As a result, prices are a key input to understanding the incentives to use dark fibre in a 'business as usual' scenario (e.g. in 2018/19). Therefore, we have made price comparisons between active circuits and dark fibre.

A33.38 In cases where dark fibre offers a similar TCO, we start from the assumption that the additional benefits of dark fibre mean it will be preferred instead of an active circuit. For the purposes of our analysis, we have assumed that for new connections, the decision to use dark fibre is a simple trade-off between two substitute wholesale inputs. Therefore, if using dark fibre is not higher cost it will always be preferred, given the additional benefits of dark fibre. For example, dark fibre would allow a CP to determine whether, when and how to develop its own active services (rather than being reliant on BT).[185] We further set out these additional benefits from the use of dark fibre in Annex 18.

A33.39 Our TCO analysis takes into account rental and connection charges, where appropriate a Main Link charge, and the cost of relevant equipment to use with dark fibre. A high level summary of the elements in our TCO analysis for new connections is set out in Table A33.3 below, with our full reasoning set out below.

Table A33.3 – high level breakdown of cost elements involved in TCO analysis of new connections

	EAD	Additional factors with OSA	Additional factors with EBD
Active TCO	• Three years of the annual rental charge for the relevant active circuit • One connection charge for the relevant active circuit • Assumed Main Link charge[186]		• No Main Link charge
Dark fibre TCO	• Three years of the dark fibre annual rental charge • One dark fibre connection charge • Assumed Main Link charge • Cost of active equipment[187]	• Sensitivity test assuming use of dual fibre option	• Calculated Main Link charges (using BT circuit data on EBD) • Cost of upgrading existing equipment[188]

Source: Ofcom's TCO analysis to inform analysis of cannibalisation of active circuits due to dark fibre

A33.40 In our analysis, we have assumed that CPs using dark fibre will face business rates similar to BT's cumulo costs.[189] Although the setting of non-domestic rates is a

[184] Where there are additional benefits from dark fibre, a CP will have an incentive to use dark fibre on non-price grounds. We have not quantified this benefit, given that it would be highly speculative to do so in this review period.
[185] We note that CPs might value the flexibility and option to innovate and product differentiate that comes from the use of dark fibre.
[186] For EAD and OSA circuits, the percentage saving from dark fibre over actives (on a TCO analysis) is lower when Main Link is included in the TCO. We have initially assumed no Main Link charge but have also assessed the TCO cost saving when assuming a Main Link of 45km (radial distance). The absolute saving per circuit does not change so this assumption does not affect whether a cost advantage exists or not.
[187] This includes the appropriate chassis, power supply unit, transponders, and transceivers.
[188] For EBD we assume that CPs will replicate the backhaul service using cheaper optical equipment (such as that used for EAD) rather than replicate BT's EBD network.
[189] 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. The assessment of BT's rateable network assets is called a 'cumulo' assessment.

matter for Government, and not for Ofcom, we intend nevertheless to monitor the effects of non-domestic rates on take–up of dark fibre and bring any competition concerns to the attention of relevant Government departments.[191] We note that this assumption has a limited impact on our conclusions for above 1Gbit/s circuits and has no impact on our cost uplift for 1Gbit/s circuits.

A33.41 We consider it reasonable to assume a three year contract period for our TCO analysis, which is in line with the average contract cycle for end customers (see paragraph A33.144 below).

A33.42 In the absence of dark fibre volume actuals, we have assessed the likely incentives for use of dark fibre based on the information that we have available (including current prices). In terms of the specific prices used in the TCO, we would ideally use information of the relative prices at the point that the purchase decision is being made. However, as dark fibre will not even be available until October 2017, this would require us to predict future prices.

A33.43 Therefore, we use current (2016) price differentials as a proxy for future incentives to switch to dark fibre for the purposes of this analysis. While we recognise that the scale of price incentives may change over time, we consider this to be a reasonable and appropriate approach since:

- it seems unlikely that a circuit type which is significantly[192] more expensive than the (hypothetical) dark fibre alternative today would be priced below the dark fibre alternative in the future[193]; and

- similarly, we would not expect an active circuit which is cheaper than dark fibre today to be priced above the dark fibre alternative (and therefore be liable to switch to dark fibre) in the future.

A33.44 Prices (both levels and structure) may continue to change over time and potentially in direct response to the introduction of dark fibre (a view reiterated by BT[194]). However, predicting future prices across the duration of the market review period is subject to a high degree of uncertainty, as supported by BT.[195] It is unclear whether attempting to estimate future dark fibre prices will lead to more robust estimates for the take-up of dark fibre.

A33.45 The 2015/16 dark fibre price is calculated based upon the current prices for EAD 1Gbit/s rental and connection minus the 2015/16 LRIC. For OSA circuits we have

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[190] As discussed in Annex 23, we consider 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.

[191] 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 under Ofcom's regulations, in which case we would no longer expect cumulo to be relevant for determining the dark fibre price.

[192] For the purposes of our pricing analysis in this section, we consider a TCO differential of 10% or greater to be significant.

[193] We have not quantified the benefits from dark fibre in our analysis. We note that, if dark fibre should have a lower price incentive than we have estimated, the actual value that CPs place on the benefits of dark fibre could mitigate the effect of having lower price incentives.

[194] BT has noted that it [✂]. See *Annex B – Price rebalancing* of BT's response to the LLCC consultation.

[195] BT has argued that [✂].

assumed the use of a single dark fibre as well as the use of the dual fibre option.[196] We note that there will be a dark fibre variant that uses BT's RO2, and that this will be priced on a similar active minus basis (as set out in Annex 23). However, we consider it appropriate to assume the same price incentives will apply to the dark fibre resilience option.[197]

A33.46 We have calculated the cost of equipment given that this is a significant proportion of costs at the active layer. As a simplification, we have not accounted for any additional maintenance and management costs associated with using dark fibre over the active.[198] Furthermore, we have not accounted for one-off costs for procuring or setting up systems to obtain dark fibre since our pricing analysis assumes a business as usual scenario.

A33.47 We have calculated the equipment cost that a CP would require when using dark fibre based upon current prices of [✂][199] equipment. Our base case assumption for existing circuits is that CPs already have suitable terminal equipment at both ends of the circuit. However, we note that a CP will still face the cost of replacing the short distance transceiver at the backhaul end of its equipment with a longer distance transceiver.[200]

A33.48 We have conducted this analysis for all Ethernet circuit types at all bandwidths available for new connections.[201] As a simplifying modelling assumption we assess prices with reference to the base product only. We do not distinguish between the prices of different variants of those broad categories of circuits in our analysis. For example, when considering the EAD 1Gbit/s category, we consider the price of the standard EAD 1Gbit/s service, rather than the price of the RO1 or Enable variants. This is because all variants of the Ethernet service categories considered are priced above the standard variants, against which we have assessed the dark fibre price. Therefore, we would expect (broadly speaking) that if the standard variant switches to dark fibre then all individual variants would be expected to switch as well.

A33.49 In light of this simplifying assumption, our pricing analysis uses Openreach's price list (as of February 2016) rather than average revenue per circuit. The only exception to this is for OSA, where we have used average revenue as this implicitly allows us to assume the average wavelengths and bearers per circuit.

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[196] As set out in Annex 23, the dual fibre price option will allow a CP to order two unlit fibres on the same route and it will be priced at up to double the single fibre rental and connection charge, but will continue to face a single Main Link charge.
[197] We note that EAD circuits using BT's RO1 are cheaper than those using BT's RO2. However, EAD 1Gbit/s circuits currently primarily use RO2 (c.95% of 2014 circuits). Furthermore, any active circuits above 1Gbit/s that use RO1 will likely prefer a dark fibre RO2 variant that is priced at 1Gbit/s minus.
[198] We consider this is reasonable since CPs may already be incurring these costs where they are using their own electronics for existing circuits. Furthermore BT's cost accounting data indicates that these administrative costs represent [✂] of the total cost stack for the active layer.
[199] We note that [✂], which we found to be of slightly higher cost but the difference in equipment cost was not significant.
[200] This is because a CP currently using an EBD circuit would require short distance transceivers to connect its equipment located in BT exchanges to the EBD circuit. However, a replacement circuit using dark fibre would require longer distance transceivers suitable for the full circuit length.
[201] We note that no new connections will be available for WES and BES circuits when dark fibre is introduced in 2017/18.

A33.50 We now set out the outputs of our pricing analysis for Ethernet circuits. We consider non-EBD and EBD circuits separately due to the different characteristics of EBD relative to other Ethernet circuits.

EAD and OSA circuits

A33.51 The results of our TCO price comparisons are shown in Table A33.4 below, broken down by product and bandwidth. This suggests that, there is a price incentive to use dark fibre for above 1Gbit/s, while for circuits below 1Gbit/s, in the absence of aggregation, dark fibre is unlikely to offer a pricing advantage compared to active circuits.

Table A33.4 – three year TCO analysis of active circuits vs. dark fibre for new connections, in the absence of aggregation

Product	Bandwidth	Average % cost saving from using dark fibre rather than active equivalent (3 year TCO)
EAD	10 / 100Mbit/s	No cost saving
	1Gbit/s	Indifferent on TCO basis for majority of CPs and circuits
	10Gbit/s	Approximately 55% (when excluding Main Link[202])
OSA	>1Gbit/s (single fibre)	Approximately 40% (when excluding Main Link)
	>1Gbit/s (dual fibre)	Indifferent on TCO basis for majority of CPs and circuits

Source: Ofcom analysis of Openreach price list (2015); BT's 2014/15 Regulatory Financial Statement

A33.52 In light of this analysis, we consider it likely that there will be no cannibalisation (on a one-for-one basis) of new connections below 1Gbit/s circuits.

A33.53 BT has highlighted that some variants of these low bandwidth circuits, particularly Extended Reach may be subject to cannibalisation. However, we note that fewer than [✂]% of low bandwidth (i.e. 10/100Mbit/s) circuits are Extended Reach, with the majority of Extended Reach products being for 1Gbit/s products. Furthermore, using dark fibre to replicate a low bandwidth circuit with a resilience option would likely lead to a higher price than the low bandwidth active alternative. Therefore, as a modelling simplification at this stage, we consider it is reasonable to assume that these variants of 10Mbit/s and 100Mbit/s do not switch to dark fibre in the absence of aggregation.[203]

A33.54 Our TCO analysis suggests that new connections for EAD and OSA (single fibre) at 1Gbit/s and above are likely to be commercially viable with dark fibre.[204] We consider it appropriate to assume at least as much cannibalisation for above 1Gbit/s circuits as for 1Gbit/s circuits, given the TCO saving for these circuits.[205] Furthermore, it is unlikely that above 1Gbit/s circuits will be priced below the dark fibre price. We

[202] Even when we assumed a Main Link (radial) distance of 45km the TCO cost saving is around 25%.
[203] [✂]
[204] This includes 1Gbit/s circuits, given the additional benefits available from dark fibre.
[205] Furthermore, CPs wishing to acquire 10Gbit/s and OSA circuits will likely expect further increases in bandwidth requirement, thus would value the ability to more easily flex future bandwidth by using dark fibre now.

consider it likely that large OCPs can create optical services using dark fibre at similar cost to BT, whilst also gaining greater flexibility from using dark fibre.

A33.55 In light of the above, we have concluded that 100% is the maximum scope for cannibalisation of new EAD and OSA connections in a 'business as usual' scenario, based on current price incentives.

Ethernet Backhaul Direct (EBD)

A33.56 EBD is used to provide backhaul services between certain BT exchanges (ASNs). Although EBD offers some additional features compared to dark fibre, we start our analysis by comparing the prices for providing a circuit using EBD or dark fibre for a given bandwidth, to assess the potential for substitution, before considering whether such additional features affect the scope for substitution.

A33.57 In assessing the potential for new EBD circuits to be replaced by the dark fibre product, we take into account differences in the usage restrictions and charging structures of the products. For the purposes of our pricing analysis, we consider the key differences between EBD and the dark fibre products are that:

- EBD supports far longer distances than EAD – whereas the DFA remedy is restricted to a radial distance limit of 45km, EBD has been provided for circuits of up to [✂]km in length; and up to [✂]km with EBD Extended Reach; and
- EBD prices are distance independent whilst EAD circuits (and thus dark fibre) are priced based upon distance when they require a Main Link.

A33.58 We therefore consider EBD cannibalisation will depend upon the distribution of EBD circuit length as well as the price differential between EBD and dark fibre. Accordingly, we would expect that the propensity to switch from EBD to dark fibre will be stronger for shorter circuits, since longer circuits of dark fibre will incur a per kilometre Main Link charge.

A33.59 As part of our TCO analysis for EBD, we have calculated the distance at which dark fibre (and EAD) is no longer the lower cost option compared to EBD by:

- calculating the TCO differential, as we have done for EAD and OSA circuits;
- annualising this differential; and
- dividing this differential by the (per kilometre) Main Link charge.

A33.60 Having calculated the distance at which dark fibre (and EAD) is no longer the lower cost option compared to EBD, we assess what proportion of circuits fall under this distance threshold. We have used BT's EBD circuit data set and have assessed non-WECLA circuits only. We recognise that dark fibre will be available in the London Periphery (LP) part of WECLA. However, given the limited EBD volumes in WECLA overall it is unlikely that a significantly different distribution in the LP would have a large impact on the scope for cannibalisation of EBD circuits.[206]

[206] Furthermore, we have no reason to believe that the distribution of new EBD circuits would be significantly different (in terms of circuit lengths) than the distribution of existing EBD circuits outside of the WECLA.

A33.61 For our base case, we consider it reasonable to assume that CPs already have equipment at the BT exchange, even for new connections, since BT is only likely to extend the EBD network to exchanges where there is already significant presence. Furthermore, the current primary user of EBD (i.e. downstream BT) is likely to already have the appropriate equipment at the exchanges served by the EBD service. However, as a sensitivity test, we have also assessed the impact of dark fibre assuming CPs need to purchase suitable terminal equipment at both ends of the circuit.[207] This increases the cost of providing a given backhaul service via dark fibre and thus reduces the proportion of circuits that could be potentially cannibalised.

A33.62 We consider that an EBD service might be replaced with any other Ethernet service (EAD or OSA/OSEA) of equivalent bandwidth/capacity provided it supports the distance and resilience requirements for the particular application. We consider it likely that where there is cannibalisation of EBD circuits by EAD or OSA/OSEA circuits, this will be accounted for in our volume forecasts, absent dark fibre. We consider it appropriate to assess the incremental impact of dark fibre on BT's ability to recover its costs. Therefore, we have also assessed the scope for cannibalisation of EBD circuits by EAD 1Gbit/s and 10Gbit/s circuits.

Cannibalisation of EBD to EAD

A33.63 We have determined that there is currently limited scope for cannibalisation of new EBD connections from the use of EAD circuits, particularly for circuits with 10Gbit/s bandwidth. This is due to the relative prices that BT currently sets for EAD and EBD circuits combined with the fact that backhaul circuits are likely to be relatively long, and thus favourable to EBD. We have set out the full results of our TCO analysis for EBD connections in Table A33.5 below. Overall, we find that on average [✂] [up to 10]% of EBD 1Gbit/s and [✂] [up to 10]% of EBD 10Gbit/s new connections face a cost advantage if replaced with EAD 1Gbit/s and EAD 10Gbit/s respectively.

Table A33.5 – maximum distance at which EAD could replace a new EBD circuit, and the resulting scope for cannibalisation

EBD Product	Maximum distance at which EAD has a cost advantage over EBD		% EBD circuits that face a cost saving if replaced with EAD	
	1Gbit/s	10Gbit/s	1Gbit/s	10Gbit/s[208]
Band A	3km	0km	[✂]	[✂]
Band B	6km	4km	[✂]	[✂]
Band C	14km	18km	[✂]	[✂]
Weighted average	n/a		[✂]	[✂]

Source: Ofcom analysis of BT circuit data on EBD circuits (May 2015)

[207] We have not used this sensitivity when assessing the scope for cannibalisation of EBD by EAD. We consider it likely that CPs will face the same equipment cost regardless of the chosen active service.

[208] For EBD 10Gbit/s circuits, we note that Openreach offers a 60 month contract option for EAD 10Gbit/s at prices below the standard contract. Using this EAD 10Gbit/s price, we found that for new connections, up to [✂]% of EBD 10Gbit/s circuits are higher cost than the EAD equivalent. However, we consider it likely that most EAD 10Gbit/s circuits will use the standard price, given the average contract length for EAD circuits (see paragraph A1.291).

Cannibalisation of EBD to dark fibre

A33.64 A summary of our analysis for cannibalisation of EBD 1Gbit/s circuits by dark fibre can be found in Table A33.6 below. As well as our base case, we have also provided the relevant figures when we assume that a CP does not have existing equipment at BT's exchange which they can use to provide a new backhaul circuit via dark fibre rather than EBD. Overall, on average we find that [✂] [up to 15]% of EBD 1Gbit/s new connections and [✂] [up to 70]% EBD 10Gbit/s new connections face a cost advantage if replaced with dark fibre.

Table A33.6 – maximum distance at which dark fibre could replace a new EBD circuit, and the resulting scope for cannibalisation

Product		Maximum distance at which dark fibre has a cost advantage over EBD		% EBD circuits that face a cost saving if replaced with dark fibre	
		Existing equipment	No existing equipment	Existing equipment	No existing equipment
EBD 1Gbit/s	Band A	5km	5km	[✂]	[✂]
	Band B	8km	7km	[✂]	[✂]
	Band C	16km	15km	[✂]	[✂]
	Weighted average	n/a		[✂]	[✂]
EBD 10Gbit/s	Band A[209]	21km	17km	[✂]	[✂]
	Band B	26km	26km	[✂]	[✂]
	Band C	41km	40km	[✂]	
	Weighted average	n/a		[✂]	[✂]

Source: Ofcom analysis of BT circuit data on EBD circuits (May 2015)

A33.65 To illustrate our calculations for EBD 1Gbit/s, consider BT's current EBD 1Gbit/s circuit price with a rental charge for Band A of £5448 and a connection charge of £2100. This is compared against a 2015/16 dark fibre[210] rental charge of around £[✂], connection charge of around £2100, a Main Link charge of £372 per (radial) kilometre, and the total cost of two long distance transceivers (one at each end) for £[✂] [100-150] when we assume the use of existing equipment. This means that dark fibre is lower cost than EBD 1Gbit/s circuits for (radial) circuit distances of 5km or less.[211]

A33.66 To illustrate our calculations for EBD 10Gbit/s, consider BT's current EBD 10Gbit/s circuit price with a rental charge for Band A of £9773 and a connection charge of £7200. This is compared against a 2015/16 dark fibre rental charge of £[✂], connection charge of £2100, a Main Link charge of £372 per (radial) kilometre, and a cost of two long distance transceivers (one at each end) for £[✂] [800-1000] when

209 [✂].

210 Our 2015/16 dark fibre price is based upon the 2015/16 EAD price (Openreach price list) and Ofcom's analysis of cost data provided by BT in response to the 22nd s135 dated 18 August 2015.

211 This is calculated from [3*(5448 – 3410) + (2100 – 2100) - [✂] / 3*(372).

we assume the use of existing equipment. This means that dark fibre is lower cost than EBD 1Gbit/s circuits for (radial) circuit distances of 21km or less.[212]

A33.67 As set out above, we consider it reasonable to assume that CPs already have equipment at the BT exchange. We also expect up to:

- [✂] [10]% of EBD 1Gbit/s new connections to be cannibalised by EAD 1Gbit/s; and
- [✂] [10]% of EBD 10Gbit/s new connections to be cannibalised by EAD 10Gbit/s.

A33.68 Therefore, we have concluded that [✂]% and [✂]% are the appropriate maximum scopes for cannibalisation, due to dark fibre, of EBD 1Gbit/s and 10Gbit/s new connections, respectively. These are [✂] than BT's estimates but we note that BT has provided [✂] estimates for EBD cannibalisation. Therefore, we consider it appropriate to rely upon the estimates based on our own analysis, particularly since we know these are consistent with our other cannibalisation assumptions.

Summary of candidate circuits for which new connections may be dark fibre

A33.69 In the absence of aggregation, we assume no scope for cannibalisation of new connections in this review period for EAD circuits below 1Gbit/s. For other Ethernet circuits, we assume that there will be price incentives for CPs to purchase dark fibre instead of active circuits for some new connections but that this varies across circuits.

A33.70 In light of the price incentives set out above and the benefits of dark fibre, we consider it likely that in a 'business as usual' scenario[213] all new connections for EAD and OSA circuits at 1Gbit/s and above could potentially be cannibalised by dark fibre. However, we note that our final assumption will depend on individual CP incentives and that this is the maximum scope for cannibalisation.

A33.71 We assume relatively limited scope for cannibalisation of EBD circuits due to the distance related factors (see paragraphs A1.56 to A1.57 above) of EBD. More specifically, we consider that the maximum scope for cannibalisation of EBD 10Gbit/s is likely to be [✂] [approximately 60]%, compared to EBD 1Gbit/s of [✂]%.

Incentives, broken down by type of CP, to migrate to dark fibre for new connections that we consider to be susceptible to cannibalisation

A33.72 We expect CPs to have an incentive to use dark fibre for new connections in all cases, unless it was more expensive than the active alternative. Therefore, for the majority of circuits, we would expect CPs interested in using dark fibre to fully utilise our estimated scope for cannibalisation of new connections.

A33.73 However, we recognise that different CPs may have different incentives and capabilities to use dark fibre for new connections. For example, smaller CPs may be slower to adopt dark fibre if they do not have the technical expertise or scale to run the active equipment. By contrast, larger CPs may already have existing mechanisms, processes and expertise in place that can be used to manage the

[212] This is calculated from [3*(9773 – 3410) + (7200 – 2100) - [✂]/ 3*(372).

[213] We consider a 'business as usual' scenario to refer to when CPs are familiar with BT's dark fibre access product such that the use of dark fibre falls under the normal execution of operations within an organisation.

active electronics.[214] Therefore, we have also sought to reflect these differences in our analysis, by assessing take up by:

- **Downstream BT** – we expect downstream BT to have similar incentives to other larger CPs, particularly because it may wish to use dark fibre in order to compete with the offers provided by its competitors. However, we recognise that there may be some circumstances where BT has different incentives (e.g. cannibalisation of EBD as discussed below);

- **Non-BT CPs who we consider are likely to be interested in using dark fibre** – this includes OCPs who have indicated an interest in using dark fibre. Based upon responses to the consultations and our subsequent information requests, we would expect this to include Sky, GTC, Vodafone, Colt, [✂]. For new connections, we consider that these CPs will likely have the same incentives to use dark fibre as each other; and

- **Other CPs** – this includes smaller CPs that have not significantly engaged with Ofcom regarding the implementation of the dark fibre access remedy.[215] Although these CPs may ultimately use dark fibre, we expect them to have a slower adoption rate in this review period.

A33.74 We now set out our views on the incentives for take-up of dark fibre for each of these CP categories, using stakeholder comments where appropriate and in light of our pricing analysis above.

BT

A33.75 We expect downstream BT to have both the ability and incentive to fully take advantage of dark fibre where it is viable for EAD and OSA circuits. This view is supported by Virgin.

A33.76 However, we note that BT may have different incentives for EBD and that the majority of EBD circuits are used by BT ([✂]% of EBD circuits in 2014/15). For EBD circuits, we might expect downstream BT to be less willing to use dark fibre over the active equivalent given:

- the high sunk costs associated with the EBD network and thus the benefit of sharing these costs over a greater volume of circuits; and

- the proactive monitoring and resilience options that are provided by EBD services within a short lead time.[216]

A33.77 BT Wholesale has indicated that [✂].[217] We note that, in its response to the June 2015 LLCC Consultation, BT estimates that [✂]% of its new EBD connections will be

[214] See our assessment of productive efficiency in Annex 18 – Benefits of passive remedies, specifically where we set out opportunities to reduce equipment duplication.
[215] For example, we consider it likely that this group of other CPs will include [✂] amongst other communication providers.
[216] Openreach's promotional material emphasises that EBD is a proactively monitored network with resilience options (e.g. RO2) available and with a lead time for provisioning of 30 days. This could indicate that RO2 can be provided very quickly, and without ECCs since the WDM chains are pre-provided.
[217] See confidential [✂].

replaced with dark fibre in 2017/18. However, BT has also highlighted the distance independent pricing element of EBD and indicated that dark fibre is viable below 25km at 2017/18 prices.[218] BT argues that this equates to around [✂]% of routes being at least as attractive with dark fibre as EBD.

A33.78 Given that EBD is currently priced independently of distance, we consider it inappropriate to assume [✂] EBD new connections will be cannibalised by dark fibre. In a business as usual scenario, we would expect our maximum scope of EBD cannibalisation to apply to BT.

Non-BT CPs who we consider are likely to be interested in using dark fibre

A33.79 Broadly speaking, we expect these CPs to have both the ability and incentive to fully take advantage of dark fibre where it is viable. Therefore in a business as usual scenario, we expect the cannibalisation of new connections (in the absence of aggregation) for these CPs to largely mirror those rates set out in paragraphs A1.69 to A1.70 above.

A33.80 We note that CPs may find that dark fibre provides no additional benefits for some circuits[219] or be impractical to supply compared to the active equivalent. In these cases CPs might decide to simply obtain an active service from BT rather than dark fibre. This is supported by some CPs who have argued that our proposed cannibalisation rates in the June 2015 LLCC Consultation were too high. Our further analysis has resulted in a lower scope of cannibalisation for new connections than set out in the June 2015 LLCC Consultation for these CPs.

A33.81 We also note that some CPs have specifically commented upon the viability of dark fibre for 1Gbit/s circuits (see paragraph A1.21 above). However, we consider it likely that the majority of 1Gbit/s circuits would face additional benefits from being provided by dark fibre. Without quantitative evidence from non-BT CPs on their likely take-up, we have assumed that only a small proportion (e.g. 5%) of new connections for 1Gbit/s and above will not be cannibalised by these CPs. We note that assuming 25% rather than 5% does not have a significant impact on the LLCC, and that this assumption has no impact on the cost uplifts that we apply to the Ethernet basket.

A33.82 On balance we consider it appropriate to assume a 95% cannibalisation rate for new connections with bandwidth of 1Gbit/s and above in a ‘business as usual’ scenario. We consider this to be consistent with stakeholder responses, particularly given the interest shown by many CPs for the use of dark fibre.

Other CPs

A33.83 These other CPs may not have the ability to manage and maintain the equipment required with dark fibre access. We expect this to be particularly the case when the use of dark fibre requires the acquisition of expensive and/or complicated equipment. Therefore, we consider these CPs are likely to have lower cannibalisation rates than CPs interested in using dark fibre. This is consistent with the expectations that both Sky and BT said they have for the use of DFA by these other CPs.

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[218] [✂] confidential response to follow up questions to the 13th s135 notice dated 6 November 2015

[219] For example, circuits in areas where bandwidth is unlikely to rapidly increase over time or where the end customer is not interested in using innovative solutions for its business connectivity service.

A33.84 We expect there to be greater benefits from using dark fibre for very high bandwidth circuits (e.g. EAD 10Gbit/s). We consider it likely that this will mitigate the effect of above 1Gbit/s circuits requiring more expensive and/or complicated equipment.

A33.85 Therefore, we consider it appropriate to assume a significantly lower cannibalisation rates for these other CPs. We have not received any evidence from these CPs that allows us to estimate their relative incentives to cannibalise active Ethernet circuits with dark fibre. Without such evidence, we consider it reasonable to assume less than half the maximum scope for cannibalisation for these other CPs.

A33.86 For the purposes of obtaining an estimate to use in the LLCC model, we have assumed a third noting that these other CPs represent a small proportion of overall circuit volumes such that this assumption has a limited impact on the charge control.[220] Furthermore, we note that [✂].[221]

Summary of CP analysis

A33.87 In summary, we consider it likely that the majority of CPs (both BT and non-BT) will face the same ability and incentive for using dark fibre over an active equivalent for new connections.

A33.88 We expect there to be some CPs (most likely smaller CPs that have not voiced interest in dark fibre to date) who have a lower ability to use dark fibre for all of their circuits. However, these CPs represent a small segment of the Ethernet market and thus have a limited impact on the industry average rate of cannibalisation.

Impact of the timing of the introduction of dark fibre in 2017/18

A33.89 The above sets out our cannibalisation assumptions for business as usual. However, there is considerable uncertainty regarding the exact adoption rate of dark fibre, particularly in the period following the launch of the dark fibre access product since we consider that CPs will need to gain expertise, experience and knowledge of how best to use the product (i.e. using this as a period to test and trial the product).

A33.90 Whilst CPs have shown significant interest regarding the use of our proposed dark fibre access remedy, as argued by [✂], we also recognise that many stakeholders (e.g. [✂]) have indicated they will need time to test and trial dark fibre before widespread adoption. Following the testing and trialling period of dark fibre, we assume significant cannibalisation of EAD 1Gbit/s circuits, as well as EAD circuits above 1Gbit/s for new connections.

A33.91 Therefore, we consider it appropriate to estimate (for all CPs) lower cannibalisation of 2017/18 new connections than 2018/19 new connections. Although BT has estimated [✂], we recognise that there is uncertainty around the initial use and take-up of dark fibre (see paragraph A33.10 above). As with other CPs, we consider it likely that BT downstream is likely to test and trial the dark fibre product before fully adopting it for relevant new connections.

[220] We found that assuming any adjustment figure between 10% and 50% results in the same estimated industry average cannibalisation rates for EAD and OSA new connections.

[221] See [✂] confidential response (dated 6th November 2015) to our follow-up questions regarding its initial response to our 13th s135 information request.

A33.92 In the 2015 June LLCC Consultation, we estimated that half of eligible new connections would switch to dark fibre, reflecting the need for stakeholders to trial the product. Some stakeholders have argued that our rate of take-up was too rapid whilst others argued for a more rapid take-up of dark fibre. We consider it likely that there will be a lot of ‘inertia’ in the first year that dark fibre is introduced. CPs may need to update systems, go through procurement processes, and spend time developing new product offerings. We note that Sky has argued [✂]. However, we also note that, even if the appropriate systems were already in place, dark fibre is a new product and CPs may remain cautious until they have tested and proven the usability of the product. Therefore, on balance, we continue to consider halving our cannibalisation assumptions is an appropriate adjustment when estimating the take up of dark fibre in the initial trialling period (i.e. 2017/18). However, we make a further adjustment (i.e. on top of this initial halving) to take into account the delayed launch of dark fibre.

A33.93 We have decided to require BT to provide dark fibre by 1 October 2017 (as opposed to the proposed date of 1 April 2017 in the June 2015 LLCC Consultation). We retain our previous assumption that half of new active connections will be replaced with new dark fibre circuits in this time period, to reflect the need to trial dark fibre, but further adjust it to reflect that dark fibre will be available for half of the financial year. We therefore assume that a quarter of the maximum scope of new connections will switch in 2017/18.

A33.94 We have not adjusted our 2018/19 assumption to account for this later implementation date. We consider it reasonable to assume CPs will be relatively less tentative in their take-up of dark fibre in 2018/19, particularly given the longer time frame that BT has to implement dark fibre.

Final view of cannibalisation of new connections (in absence of aggregation considerations) in 2017/18 and 2018/19

A33.95 We note that estimating future dark fibre use is subject to uncertainty at this stage given the regulated product is not currently available from BT and there are still elements of product design to be negotiated. However, we have determined reasonable estimates for the cannibalisation rates that are used within the LLCC model. We also note that the total cost impact of our cannibalisation assumptions (i.e. including migration of existing circuits and stranded assets) is £2.1m which has an impact of just 0.25% on the charge control ‘X’. Therefore it is unlikely that the simplifying assumptions used when estimating cannibalisation of new connections will have a significant impact on the LLCC.

A33.96 We have received different views on the exact scope and rate of adoption of dark fibre, with regards to new connections being cannibalised. On balance, we consider our estimates in Table A33.7 below to be reasonable. Furthermore, we disagree with CityFibre and consider these assumptions are consistent with our dark fibre pricing approach that seeks to introduce dark fibre to circuits at 1Gbit/s and above.

Table A33.7 – cannibalisation assumptions for new connections (by type of CP, bandwidth and product) in 2017/18 and 2018/19

Product	BT and other CPs that have shown interest in dark fibre[222]		Others	
	2017/18	2018/19	2017/18	2018/19

[222] We expect these other CPs to include Sky, GTC, Vodafone, Colt, [✂].

EAD (standard and local access)	10/100Mbit/s				
	1Gbit/s	25%	100% (95% for OCPs)	8%	33%
WES/BES	1Gbit/s or below				
WES/BES, EAD and OSA	>1Gbit/s	25%	100% (95% for OCPs)	8%	33%
EBD	1Gbit/s	[✂]	[✂]	[✂]	[✂]
	10Gbit/s	[✂]	[✂]	[✂]	[✂]

Source: Ofcom analysis based upon stakeholder responses to consultation and s135 information requests

Impact of dark fibre on existing active rentals (in the absence of aggregation)

June 2015 LLCC Consultation

A33.97 We considered that migration of existing circuits was more likely to occur in the longer term. We considered that there were important factors that would significantly limit the migration of existing circuits to dark fibre in the forthcoming review period. Therefore we proposed that there would be no cannibalisation of existing circuits within this review period.

Stakeholders' comments

Scope for cannibalisation of existing circuits

A33.98 GTC[223] agreed with our consultation proposals that existing connections are unlikely to migrate. Whilst both BT[224] and Virgin[225] argued that there would be significant cannibalisation of existing circuits.

A33.99 BT stated that [✂][226] BT indicated that the cannibalisation potential for EBD circuits (for a given bandwidth) is limited relative to EAD. Table A33.8 below provides a summary of BT's estimates relating to cannibalisation rates of existing circuits.

Table A33.8 – [✂]

[✂]	**[✂]**	**[✂]**	**[✂]**
[✂]	[✂]	[✂]	[✂]
	[✂]	[✂]	[✂]
	[✂]	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]

223 See GTC's non-confidential response to the June 2015 LLCC Consultation, page 5.
224 See [✂].
225 See Virgin's non-confidential response to the June 2015 LLCC Consultation, page7.
226 [✂] However, this appears to be based on particular assumptions on the [✂], and does not seem to consider [✂].

	[✂]	[✂]	[✂]
	[✂]	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]
	[✂]	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]

Source: BT's confidential response to LLCC consultation (2015)

A33.100 The difference in EBD and EAD cannibalisation rates is driven by EBD circuits not incurring Main Link charges (i.e. a variable distance based charge). BT provided Ofcom with a dataset of EBD circuits (and their circuit lengths), with analysis for both 1Gbit/s and 10Gbit/s EBD circuits. BT's evidence around cannibalisation of EBD uses its analysis of circuit distance length. It argued that EBD circuits below a certain radial distance ([✂] using 2015/16 prices[227]) will be viable with dark fibre.

A33.101 In relation to the cannibalisation of existing EAD circuits[228], BT argued[229] that for:

- **1Gbit/s circuits** – BT estimated that around [✂] could be cannibalised by dark fibre. It argued that it would take around [✂] to get to this potential cannibalisation rate. It also estimated that [✂][230]; and

- **10Gbit/s circuits** – BT estimated that around [✂], could be cannibalised by dark fibre. It argued that it would take around [✂] to get to this potential cannibalisation rate. It also estimated that [✂] could be cannibalised by dark fibre. BT has also argued that [✂].

<u>Rate of dark fibre take-up for existing circuits</u>

A33.102 BT has argued that there would be a rapid adoption of dark fibre, [✂]. [✂].[231]

A33.103 Other stakeholders highlighted barriers to replacing or upgrading existing circuits and have stated preferences for not migrating existing circuits. [✂] informed us that its current network policy when upgrading routes is to retain existing lower bandwidth circuits when ordering new and higher bandwidth circuits.[232] We note that comments made by other CPs are not consistent with BT's estimates. For example, BT has assumed that [✂] faces similar incentives for migrating existing circuits as other CPs but this is not supported by [✂] response to our 13th s135 information request.

A33.104 Several CPs ([✂]) referred to the restrictions from existing contractual obligations for active circuits as well as migration costs in their respective responses to our informal questions. Although, one CP stated that it would seek to migrate

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[227] BT has argued that this distance is longer by the end of the review period.
[228] BT argued that cannibalisation of below 1Gbit/s circuits would occur due to the ability to aggregate these circuits on to a single dark fibre.
[229] See [✂] confidential response to our follow-up questions to our 13th s135 notice dated 6 November 2015.
[230] This estimation results in a [✂].
[231] [✂] confidential response (dated 25 September 2015) to BCMR 13th s135 information request.
[232] [✂] confidential response (dated 9th October 2015) to BCMR thirteenth s135 request.

existing services to passives, it noted it would wait until active circuits were out of term before migrating them to passives.[233] Towerhouse LLP[234] highlighted two types of costs associated with product migration:

- **product adoption costs** – the cost of having to adapt to new services. It argued that this is small for near perfect substitutes, although the incremental benefits are also low, which means that having low migration process costs are important. It argued that migration process costs can be large where the customer operates a large and complex system which can only accommodate a specific technical interface, and/or the very specific performance characteristics of their current leased line service; and

- **migration process costs** – the cost associated with the actual process of switching (e.g. service interruption).

A33.105 Some CPs explicitly stated they would expect dark fibre to first be used for new connections.[235] Furthermore, Vodafone and Virgin suggested that migration would occur following a customer led event, such as contract renewal, bandwidth change requirements, or technology upgrade.[236]

Our conclusions

A33.106 In light of stakeholder responses and further analysis, we have re-assessed our cannibalisation assumptions for existing circuits. Our analysis for existing circuits differs to new connections for several reasons due to the extra costs (financial and otherwise) associated with migrating circuits, which we discuss further below.

A33.107 Although we are not specifying a migration service for dark fibre, CPs can in effect migrate through cease and re-provide.[237] We note that any migration service will be decided by negotiation with industry[238], so for the purposes of our analysis we have assumed migration occurs with a cease and re-provide.

<u>Underlying assumptions</u>

A33.108 We have used similar underlying assumptions and analytical approach for assessing the potential cannibalisation of existing circuits in the absence of aggregation as we did for new connections (see paragraphs A33.31 to A33.35 above). In particular, we have considered price incentives, as well as how the incentives may vary by CP in a business as usual scenario, and then considered the impact of the need to trial the remedy.

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[233] [✂].

[234] Towerhouse LLP, *Leased line product migrations,* report prepared for Vodafone in response to the June 2015 LLCC Consultation, P.17.

[235] TalkTalk stated that initial use of dark fibre is likely to focus on new/upgraded circuits rather than migrating existing circuits. Paragraph 7.10, TalkTalk's non-confidential response to November 2014 BCMR Passives Consultation. [✂].

[236] Vodafone's and Virgin's confidential responses to LLCC informal questions (February 2015).

[237] This is where CPs terminate their existing active circuit and request a new connection using dark fibre access.

[238] See Annex 22 – Design of the dark fibre remedy, where we set out that the requirements for migration processes are best agreed by negotiation between CPs and BT during the implementation process.

A33.109 However, when considering the potential for existing circuits to migrate, we also need to take into account the costs associated with migrating an existing circuit. Existing circuits may be subject to contractual obligations in the shorter term, and there are also likely to be costs associated with any active circuit migration, which will affect the incentive to migrate circuits.[239] Costs could be both:

- **financial** – for example, CPs will likely need to purchase additional equipment and be faced with an additional connection charge for the new service; and

- **non-financial** – for example, CPs will likely face service downtime when switching to the new service which could disrupt the end customers use of their existing service.[240]

A33.110 We consider it reasonable to expect CPs to prefer replacing existing services following a 'customer led event' such as a contract renewal, bandwidth change requirements, or technology upgrade. This is because of the disruption that pro-active switching could cause, which could result in the customer switching provider. Even if the customer did agree to a migration of its service, they may expect the CP to pass on the majority of the cost saving. This would limit the CP's incentive to switch existing active services, particularly given the additional financial barriers to switching. This view was supported by several stakeholders (e.g. ([✂] and Towerhouse LLP).

A33.111 Therefore we have undertaken further analysis to assess the rate at which CPs could seek to migrate any existing circuits that would benefit from the use of dark fibre over their current active option. To do this, we have considered:

- whether there is evidence of non-price barriers to migration even in the presence of price incentives by observing the rate of migration from WES to EAD; and

- the average contract length for Ethernet services purchased by end customers, as this influences the frequency of customer led events which some CPs have indicated drives migration.

A33.112 Similar to our analysis for new connections, our cannibalisation analysis for existing circuits in the absence of aggregation is structured as:

- analysis of price incentives;

- analysis of non-price considerations, and potential impact on speed of migration even in the presence of price incentives;

- analysis of incentives by CP type;

- impact of the timing of DFA introduction in 2017/18; and

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[239] Several CPs ([✂]) referred to the restrictions from existing contractual obligations for active circuits as well as migration costs in their respective responses to our informal questions. One CP stated it would seek to migrate existing services to passives, it noted it would wait until active circuits were out of term before migrating them to passive. [✂].

[240] We note that a CP could mitigate the cost of disruption to some services by making the changeover out-of-hours (e.g. at the weekend) but this would essentially convert the non-financial cost into a financial cost (e.g. paying engineers overtime).

- final view of cannibalisation of existing rentals in the absence of aggregation in 2017/18 and 2018/19.

Analysis of price incentives for existing rentals

A33.113 In relation to a CP's decision whether to switch an existing active circuit to dark fibre we have compared the TCO of dark fibre with that of the relevant active circuit. We have used similar assumptions (see paragraphs A33.36 to A33.49 above) when assessing price incentives for cannibalisation of existing circuits in the absence of aggregation as we did for new connections.

A33.114 However, when considering the cannibalisation of existing active circuits, an important factor is that the CP will have already incurred the connection charge. This may reduce the incentives for a CP to replace the circuits with a new dark fibre circuit. When a CP compares the TCO for maintaining an existing active circuit with using dark fibre for that existing circuit it will account for the fact that replacing the circuit will result in an additional connection charge. Therefore, at a high level the cost elements of our price differential analysis for existing circuits is set out below in Table A33.9:

Table A33.9 – high level breakdown of cost elements involved in TCO analysis of existing circuits

	EAD/WES/BES	OSA	EBD
Active TCO	• Three years of the annual rental charge for the relevant active circuit • Assumed Main Link charge[241]		• No Main Link charge
Dark fibre TCO	• Three years of the dark fibre annual rental charge • One dark fibre connection charge • Assumed Main Link charge • Cost of upgrading existing equipment	• Cost of active equipment (i.e. not simply upgrading existing) • Sensitivity test assuming use of dual fibre option	• Calculated Main Link charges (using BT circuit data on EBD)

Source: Ofcom's TCO analysis to inform analysis of cannibalisation of active circuits due to dark fibre

A33.115 As with new connections, we split this analysis between EBD and other Ethernet circuit types.

EAD, WES, BES and OSA circuits

A33.116 It is likely that there will still be existing WES and BES rentals for very high bandwidth circuits in this review period. Therefore, we have applied cannibalisation rates to existing WES and BES circuits. As with the equivalent (i.e. similar bandwidth) EAD circuits, we have assumed the same price incentives to migrate existing circuits also applies to WES and BES circuits.

A33.117 We note that there is a greater price differential between WES and dark fibre than EAD and dark fibre, which could indicate more rapid migration of WES and BES

[241] For EAD and OSA circuits, the percentage saving from dark fibre over actives (on a TCO analysis) is lower when Main Link is included in the TCO, but the absolute saving per circuit does not change.

circuits than EAD. However, historically a greater TCO cost saving has not necessarily increased the rate of migration from WES/BES to EAD. Furthermore we note that assuming a faster rate of migration for WES and BES 1Gbit/s circuits does not have a significant impact on the total common cost uplift. This is because the LLCC model assumes MEA volumes for the purposes of modelling the costs of legacy WES and BES services up to and including 1Gbit/s (as set out in Annex 26).[242]

A33.118 The results of our TCO price analysis are set out in Table A33.10 below, broken down by product and bandwidth. For EAD circuits we have initially assumed no Main Link charge but have also assessed the TCO cost saving when assuming a Main Link of 45km (radial distance) and found it does not affect whether a cost advantage exists or not. [243]

A33.119 In our base case, we assume that CPs already have the necessary equipment when replacing existing active circuits[244], except for OSA circuits.[245] We have also run a sensitivity test to assess the impact if we assume CPs do not already have equipment available for that service.

Table A33.10 – three year TCO analysis of active circuits vs. dark fibre for existing, in the absence of aggregation

Product	Bandwidth	Average % cost saving from using dark fibre rather than active equivalent (3 year TCO)	
		Existing equipment	No existing equipment
EAD[246]	10 / 100Mbit/s	No cost saving	
	1Gbit/s	Indifferent on a TCO basis	No cost saving
	10Gbit/s	Around 60% (when excluding Main Link[247])	Around 45% (when excluding Main Link)
OSA	>1Gbit/s		No cost saving

Source: Ofcom analysis of Openreach price list (2015); BT's 2014/15 Regulatory Financial Statement

A33.120 Based on this analysis, we consider there to be no price incentives for CPs to migrate existing low bandwidth (i.e. 10Mbit/s and 100Mbit/s) circuits to dark fibre in the absence of aggregation.

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[242] Even if we did not assume MEA only volumes, we would forecast there to be [✂] volumes of cannibalised WES and BES circuits at 1Gbit/s in 2018/19 (around [✂] and [✂] circuits respectively).
[243] The percentage saving from dark fibre over actives (on a TCO analysis) is lower when Main Link is included in the TCO, but the absolute saving per circuit does not change.
[244] This is consistent with our assessment of productive efficiency in Annex 18 – Benefits of passive remedies, specifically where we set out opportunities for dark fibre to reduce equipment duplication.
[245] Given that OSA equipment is more complicated and expensive than a standard EAD, we consider it unlikely that a CP would duplicate BT's optical equipment. Therefore we consider it unlikely that a CP include the components required to run an optical service within its terminal equipment.
[246] We note that WES circuits are priced above their equivalent EAD circuit. Therefore the TCO cost saving for WES circuits would be even greater than indicated by our EAD TCO analysis.
[247] When we assume a Main Link (radial) distance of 45km the TCO cost saving is around 20%.

A33.121 We consider there to be limited price incentives to migrate 1Gbit/s EAD circuits within this review period. Our TCO analysis indicates that where CPs already have existing equipment (which is likely for many existing 1Gbit/s circuits) there is a cost saving from switching to dark fibre. We recognise that not all CPs will have existing equipment for their current EAD 1Gbit/s circuits, nor will some CPs have existing equipment for each and every EAD 1Gbit/s.

A33.122 For EAD 10Gbit/s circuits, we consider there to be strong price incentives (20-60% TCO cost saving based on 2015/16 price) for CPs to migrate existing services on to dark fibre. We recognise the scale of this price incentive could reduce over time depending on how BT sets its price in the future.

A33.123 For existing OSA circuits, our pricing analysis found no price incentives for CPs to switch to using a dark fibre alternative (even with the single fibre option). We note that OSA circuits are currently priced with a relatively high connection charge and thus low rental charge.[248] We consider it unlikely that BT would choose to significantly change its pricing structure for OSA circuits, particularly if it would result in migration to dark fibre. We also note that CPs may require the dual fibre option from BT[249], in which case we find the dark fibre alternative becomes a significantly higher cost option.

A33.124 Furthermore, we note that OSA circuits also benefit from flexible bandwidth and thus one of the benefits from dark fibre is already realised, to an extent, with an OSA active circuit. Although a CP is likely to receive some added benefits from using dark fibre instead of an existing OSA circuit, we consider it unlikely that there will be sufficient incentives to switch these circuits in this review period.

EBD circuits

A33.125 As set out in paragraph A1.62 above, we consider it appropriate to first assess the potential cannibalisation of EBD circuits from other Ethernet services such as EAD. We found the scope for cannibalisation of existing EBD 1Gbit/s and 10Gbit/s, by the equivalent EAD service, to be <1% and 0% respectively. Therefore we have assumed that the scope for cannibalisation set out below is entirely incremental to dark fibre.

A33.126 Using similar assumptions as for new EBD connections (see paragraphs A1.56 to A1.60 above), we have assessed current price differentials to estimate future incentives for cannibalisation of EBD circuits. The results of this analysis are set out in Table A33.11 below.

Table A33.11 – maximum distance at which dark fibre could replace existing EBD 1Gbit/s and 10Gbit/s circuits, and the resulting scope for cannibalisation

Product	Maximum distance at which dark fibre has a cost advantage over EBD	% EBD circuits that face a cost saving with dark fibre

[248] OSA circuits have an average connection charge of £12,800, compared to the standard EAD 10Gbit/s connection charge of £6,000. The average rental charge for OSA is £6,482, compared to the standard EAD 10Gbit/s rental charge of £10,500.

[249] As set out in Annex 23, the dual fibre price option will allow a CP to order two unlit fibres on the same route and it will be priced at up to double the single fibre rental and connection charge, but will continue to face a single Main Link charge.

		Existing equipment	No existing equipment	Existing equipment	No existing equipment
EBD 1Gbit/s	Band A	3km	3km	[✂]	[✂]
	Band B	6km	6km	[✂]	[✂]
	Band C	14km	13km	[✂]	[✂]
	Weighted average	n/a		[✂]	[✂]
EBD 10Gbit/s	Band A[250]	14km	11km	[✂]	[✂]
	Band B	20km	19km	[✂]	[✂]
	Band C	34km	34km	[✂]	
	Weighted average	n/a		[✂]	[✂]

Source: Ofcom analysis of BT circuit data on EBD circuits (May 2015)

A33.127 This pricing analysis indicates that for existing circuits, and assuming that CPs can upgrade their existing equipment at the exchange:

- **EBD 1Gbit/s circuits** – a small proportion ([✂] [up to10]%) of EBD 1Gbit/s circuits (across all Bands) could face a lower three year TCO if a CP switched to using an equivalent dark fibre circuit; and

- **EBD 10Gbit/s circuits** – a significant proportion ([✂] [up to 50]%) of EBD 10Gbit/s circuits (across all Bands) could face a lower three year TCO if a CP switched to using an equivalent dark fibre circuit.

Summary of candidate circuits for which there may be a price incentive to migrate to dark fibre

A33.128 In the absence of aggregation, we assume no cannibalisation of existing circuits in this review period for:

- EAD circuits below 1Gbit/s;

- WES and BES circuits below 1Gbit/s; and

- OSA circuits.

A33.129 For existing EAD 1Gbit/s circuits, we note that there is very limited or no TCO saving. However, we also recognise that dark fibre provides additional benefits to CPs which we consider will incentivise migration but over a longer time period than we assumed for new connections.

A33.130 Similarly, for existing WES and BES circuits at 1Gbit/s and above, we expect that there will be significant scope for cannibalisation by dark fibre in the long term. We would expect all WES and BES existing circuits to be cannibalised by dark fibre but over a longer time period than assumed for new connections.

[250] Band A circuits are the majority (over 95%) of EBD 10Gbit/s circuits.

A33.131 We assume relatively limited scope for cannibalisation of existing EBD circuits due to its distance related factors (see paragraphs A33.57 and A33.58 above). Furthermore, we assume greater scope for cannibalisation of EBD 10Gbit/s ([✂]%) than EBD 1Gbit/s ([✂]%).

A33.132 Having set out the scope for cannibalisation, we go on to consider the non-price factors that could act as barriers or enablers to migration to dark fibre and determine the speed of migration for these existing circuits to dark fibre. This is because we consider it unlikely that all of the existing circuits that can potentially be cannibalised by dark fibre will migrate in this review period.

Analysis of non-price considerations, and potential impact on speed of migration even in presence of price incentives

A33.133 Our analysis above indicates where there are price incentives to migrate existing circuits but we also need to take into account non-price considerations. It is unclear that a price incentive alone will necessarily result in existing circuits migrating to dark fibre.

A33.134 When responding to the LLCC, stakeholders have highlighted barriers to switching existing circuits (see paragraphs A33.102 to A33.105 above). We note that existing circuits face additional barriers to switching (see paragraphs A33.109 to A33.111 above) which will influence a CPs willingness to switch, compared to using dark fibre for new connections. We consider it appropriate to assume that these barriers will limit the rate at which existing circuits will be cannibalised, given the maximum scope of cannibalisation for these circuits.

A33.135 We note that determining the rate of migration of existing circuits to dark fibre is subject to uncertainty, particularly given the additional non-price considerations. Therefore as well as considering stakeholder information, we have conducted analysis to infer the potential impact of non-price barriers to migration. We have considered two key pieces of analysis:

- historic WES/BES to EAD migration; and
- average contract cycles.

Historic WES/BES to EAD migration

A33.136 We note that WES volumes remain despite the existing price differentials between WES/BES and EAD circuits, which suggests that CPs will not respond immediately to price incentives. Therefore to infer the impact of non-price barriers to migration, we have assessed the rate of migration for WES/BES to EAD circuits against the price differentials between WES/BES and EAD circuits of the same bandwidth.[251]

A33.137 For instance, in 2014/15 the 3-year TCO differential between a 1G WES circuit (£4,299 average rental*3 years*2 local ends = £25,794) and a 1G EAD

[251] Where a CP seeks to migrate to a higher bandwidth they will likely be willing to pay a higher price for the additional value of the higher bandwidth. It is unlikely that we would be able to accurately quantify this willingness to pay for higher bandwidth. Therefore we consider it appropriate to only assess the rate of migration where there is TCO cost saving when migrating from WES to EAD of the same bandwidth.

Standard circuit (£5,664 average rental*3 years + £3,352 average connection = £20,344) was 27%. In 2014/15, WES 1Gbit/s volumes fell by around 18%.

A33.138 We used prices from Openreach's pricing list for standard offers (i.e. not migration offers) because it is not clear that migration offers actually involve a significant discount when considering migration of WES to EAD of the same bandwidth. Our analysis of WES/BES to EAD migration looks at annual volume changes for WES/BES circuits, broken down by bandwidth and the weighted average WES/BES to EAD (three year) TCO differentials for each year.[252]

A33.139 This analysis supports the view that CPs will not immediately respond to price incentives, and the actual annual migration is likely to be lower than the maximum scope.

Table A33.12 – average WES/BES (at 1Gbit/s) to EAD volume changes for given TCO differentials, 2009/10 to 2015/16[253]

	Average annual change in WES/BES volumes[254]	
	TCO differential <0%	TCO differential >=0%
WES 1Gbit/s	12%	-17%
BES 1Gbit/s	9%	-29%

Source: Openreach price list; WES, BES and EAD volumes as provided by BT in response to LLCC formal information requests

A33.140 This shows that when there is a positive TCO cost saving, on average 17% of WES circuits and 29% of BES circuits have migrated to the lower cost EAD option. We note that there may be several drivers for the observed WES and BES annual change in volumes. We consider it likely that, similar to migration from active circuits to dark fibre, these volume changes are primarily driven by:

- pricing incentives;
- bandwidth upgrades; and
- a desire to change the active equipment used.

A33.141 Therefore we consider the rate of migrations set out in Table A33.12 above to be appropriate for EAD to dark fibre migration.

A33.142 We note that WES provides the connection between a CP's site and an end user site, whilst BES provides a connection between an exchange and a CP site. We consider it reasonable to assume that WES circuits are more akin to an access circuit than a backhaul circuit, and vice versa for BES circuits. Therefore as a simplifying assumption, we have assumed that:

[252] For some years, BT has set more than one price for a given Ethernet product therefore we have determined a weighted average price differential for each year (where prices are available).
[253] For 2015/16, we have used forecast volumes from the LLCC volumes model.
[254] The volume data that we received from BT does not allow us to exactly match a migrating WES circuit to its respective EAD circuit.

- the observed migration rate of WES circuits provides an indication of the rate of migration for access circuits; and

- the observed migration rate for BES circuits provides an indication of the rate of migration for backhaul circuits, of the same bandwidth.

A33.143 Therefore we consider 17% per annum to be a reasonable estimate of the churn rate for migration of access circuits (such as EAD LA) to dark fibre, and 29% per annum to be a reasonable estimate of the churn rate for migration of backhaul circuits to dark fibre.

Average contract cycles

A33.144 [✂] have indicated that migration of existing circuits is a customer led event. We consider contract renewals are likely to be a key customer led event which would lead to CPs obtaining a different wholesale product (e.g. dark fibre) and therefore influence the rate of cannibalisation. As a result, we have assessed the average contract lengths for Ethernet services that end customers purchase. We have determined the average contract length for Ethernet services purchased by end customers is 2-3 years.[255] Large businesses tend to have longer contracts with less than one in ten (9%) having a contract under a year in length, and nearly half (45%) having 3-5 year contracts.

A33.145 This is lower than [✂]. We note that contract renewal creates an opportunity for end customers to request new services. However, this does not mean that a CP will migrate to a different wholesale product at the end of every contract. Therefore we would expect a churn rate lower than that implied by a three year average contract length. This is supported by our WES to EAD migration analysis which indicates a churn rate of 17% as this approximately represents a migration every other contract renewal.

A33.146 Furthermore, our BES to EAD migration analysis indicates a churn rate of 29% that is approximately represented by migrations occurring at the end of one contract cycle.

Final view on speed of migration even in the presence of price incentives

A33.147 We expect CPs will focus on replacing the existing circuits that would benefit the most from the use of dark fibre. Therefore we consider it appropriate to assume:

- slower migration of EAD 1Gbit/s circuits in this review period relative to EAD 10Gbit/s circuits (we have assumed a quarter of the migration rates for EAD 10Gbit/s);

- faster migration of backhaul circuits relative to access circuits; and

- for EBD we have applied the backhaul rate of migration of 29% to the maximum scope of cannibalisation for existing EBD circuits.

[255] A third of respondents to the BDRC consumer survey estimated they were on 1-2 year (37%) or 2-5 year (33%) contracts with an existing supplier for a BCS, while a quarter (24%) had contracts of up to one year. See page 50 of the BDRC consumer survey.

A33.148 Based on the analysis above we have assumed the following maximum rate of cannibalisation for existing EAD and EBD circuits in a given year:

Table A33.13 – Ofcom's maximum rate of migration for existing EAD, EAD LA, and EBD circuits at 1Gbit/s and above bandwidth

Product		Proportion of existing circuits that migrate to dark fibre (per annum %)
EAD LA	1Gbit/s	4%
	10Gbit/s	17%
EAD	1Gbit/s	7%
	10Gbit/s	29%
EBD	1Gbit/s	0%
	10Gbit/s	[✂]%[256]

Source: Ofcom analysis

A33.149 We consider it reasonable to estimate a slower rate of cannibalisation of EAD 1Gbit/s circuits relative to EAD 10Gbit/s circuits, due to the lower cost savings for EAD 1Gbit/s. We consider it reasonable to assume a quarter of the EAD 10Gbit/s migration rates, which results in consistent migration rates as [✂].

A33.150 We have assumed for simplicity that EAD circuits (that are not local access) face the rate of migration for backhaul circuits (as determined by our analysis of BES to EAD migration). We find that the majority of current EAD circuits (excluding EAD LA) at 1Gbit/s and above are used for backhaul. [✂]. We have assumed that the level of complexity to install a backhaul circuit is similar to that for an access circuit. Therefore, on balance, we expect faster rates of migration for backhaul 10Gbit/s circuits than 10Gbit/s access circuits. We have used the same proportional increase in the rate of migration for backhaul circuits relative to access as used for EAD 1Gbit/s circuits.

A33.151 We have assumed no cannibalisation of EBD 1Gbit/s circuits due to there being a limited existing price advantage which is further limited by potential (non-monetary) barriers to switching. We note that BT has provided its own estimates for cannibalisation that assume no migration of existing EBD 1Gbit/s circuits to dark fibre over this review period.

A33.152 For EBD 10Gbit/s circuits, we have taken the maximum scope for cannibalisation of existing EBD circuits (i.e. [✂]%) and applied the same per annum conversion rate as applied to backhaul EAD 10Gbit/s circuits (i.e. 29% per annum). We note that some of these circuits will have relatively low pricing incentives[257], similar to that found with migrating existing EAD 1Gbit/s backhaul circuits to dark fibre. However, unlike with EAD 1Gbit/s circuits, this limited pricing incentive will only

[256] This is calculated by applying the backhaul migration rate of 29% to the maximum scope for cannibalisation rate of [✂]%.

[257] The maximum scope for EBD cannibalisation is based upon the proportion of circuits that fall under the distance at which a CP is indifferent between continuing to use EBD and switching to dark fibre. Therefore, any existing circuits that have a similar distance to the estimated point of indifference distance will face a low TCO saving from migrating to dark fibre.

apply to a small proportion of EBD 10Gbit/s circuits.[258] Therefore we consider it unlikely that the overall rate of migration will be significantly impacted by the fact that some EBD circuits will face limited pricing incentives for migration to dark fibre.

Incentives by CP to migrate to dark fibre for existing circuits that we consider to be susceptible to cannibalisation

A33.153 We would expect CPs to have an incentive to use dark fibre for existing circuits, unless it was more expensive than the active alternative or the barriers to switching were sufficiently large.

A33.154 However, we recognise that different CPs have different business models and capabilities that may affect their incentives and abilities to utilise dark fibre in this review period. Therefore, we have examined more closely the likely incentives and ability of broad groups of CP to switch existing circuits to dark fibre.

BT

A33.155 Our underlying assumption is that active services are cannibalised by dark fibre, if there is a price incentive to do so. In the long term, we would expect BT to have the incentive and ability to switch existing active circuits in line with the maximum scope.

A33.156 We note that the primary user of EBD circuits is BT, in particular for EBD 10Gbit/s circuits. Furthermore we note that BT may have different incentives, with regards to cannibalising existing EBD circuits, than OCPs since:

- Downstream BT's behaviour is to some extent affected by the incentives and objectives of BT Group (i.e. BT end-to-end) which has invested in the EBD network.

- Unlike EAD circuits, EBD equipment is largely pre-installed and to a significant extent EBD equipment costs are non-variable on a circuit basis[259]. This means that BT has a limited ability to reduce its EBD equipment costs as EBD volumes decline.[260]

A33.157 However, we consider it likely that BT will also respond to the price incentives set out in paragraphs A1.126 and A1.127 above in order to remain competitive. We expect non-BT CPs to migrate existing EBD circuits to dark fibre, given the price incentives, resulting in lower cost backhaul services that BT will compete with. We consider it appropriate to assume that any response by BT will have a similar impact, with regards to common cost recovery, as migrating existing circuits to dark fibre.[261]

A33.158 We also consider it is appropriate to not assume a more rapid replacement by BT of the EBD platform using dark fibre in this charge control period since:

[258] We find that around [✂]% of existing EBD 10Gbit/s circuits would face a three year TCO saving of 5% or more if they were migrated to dark fibre, compared to the maximum scope of [✂]%.

[259] The nature of the EBD network is such that each EBD circuit shares equipment and fibre with other EBD circuits due to the use of WDM. Furthermore, due to the daisy chain structure of the network, BT is limited in its ability to incrementally reduce the number of EBD routes/links.

[260] This is supported by [✂].

[261] For example, BT can migrate its existing short distance EBD 10Gbit/s circuits, as non-BT CPs do. Alternatively, BT could (subject to the constraints of the LLCC) create a lower priced EBD Band for short distance circuits that competes with the backhaul services provided via dark fibre.

i) It is yet unclear whether dark fibre would lead to a corporate decision by BT to deploy a replacement backhaul solution. [✂].[262]

ii) BT continues to [✂], suggesting that BT is [✂].[263]

iii) The future use of EBD is within BT's direct control. Therefore accounting for EBD cannibalisation following a strategic move to a more efficient backhaul solution could be contrary to the fair bet, by allowing recovery of those costs.

iv) We consider that a move to a more efficient EBD solution (i.e. assuming a more rapid migration) would primarily benefit BT, as the main user of EBD. Therefore we consider it likely that changing this assumption would primarily benefit BT, rather than the market as a whole, potentially resulting in an anti-competitive effect.

Non-BT CPs who we consider are likely to be interested in using dark fibre

A33.159 For non-BT CPs that have stated an interested in dark fibre, we have assumed the maximum scope for cannibalisation, except for Vodafone and [✂]. This is because we consider it likely that, with no evidence to suggest otherwise, these CPs will seek to fully utilise dark fibre where it is viable to do so.

A33.160 Some stakeholders (e.g. [✂] and Vodafone have indicated limited willingness to replace certain existing circuits. [✂] told us that [✂]. Vodafone indicated an uncertainty regarding its use of dark fibre for 1Gbit/s circuits at customer access tails in this review period.[264]

A33.161 Unlike the other CPs, we received evidence from Vodafone and [✂] to suggest that they would take-up dark fibre at a lower rate than the maximum scope for cannibalisation. Therefore we have assumed half the scope for cannibalisation of EAD LA 1Gbit/s for Vodafone[265], and 0% cannibalisation of all EAD 1Gbit/s circuits for [✂].

A33.162 BT has assumed that [✂]. However, [✂] stated that [✂]. It is unclear that these expectations are in line with [✂], as suggested by BT, and so we have assumed the maximum scope for cannibalisation for Virgin. Furthermore, it is unclear that tech-engaged CPs face the same incentives for using dark fibre as [✂] and so we have assumed the maximum scope for cannibalisation for CPs that we consider are more likely to use dark fibre to replace existing circuits.

A33.163 We consider that the EBD specific resilience and monitoring features might not be particularly important to CPs buying individual links. This may be supported by the fact that few CPs other than BT use EBD. Therefore we have assumed the full cannibalisation rate for EBD circuits (as set out in paragraph A1.131 above) for these CPs.

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[262] See confidential [✂].
[263] See confidential [✂].
[264] Vodafone's confidential response (dated 25 September 2015) to BCMR 13th s135 request.
[265] We note that[Vodafone] has stated an uncertainty regarding its use of dark fibre for 1Gbit/s circuits at customer access tails in this review period. Therefore we consider it appropriate to assume a lower rate of migration for EAD LA 1Gbit/s for this CP but note that its response is unclear on how much lower this should be. Therefore we consider it appropriate to assume 50% (i.e. a mid-point between full scope for cannibalisation and no cannibalisation).

Other CPs

A33.164 We consider these other CPs to generally be less incentivised to replace existing circuits with dark fibre than suggested by our maximum scope for cannibalisation. Some smaller CPs may not have the technical ability to manage the boxes (see paragraphs A1.83 and A1.84 above) meaning switching barriers are likely to be even greater. Therefore we consider these CPs are likely to have lower cannibalisation rates than CPs interested in using dark fibre. This is consistent with the expectations that both Sky and BT have for the use of DFA by these other CPs.

A33.165 We have not received any evidence from these CPs that allows us to estimate their relative incentives to cannibalise active Ethernet circuits with dark fibre. Without such evidence, we consider it reasonable to assume less than half of the maximum scope for cannibalisation for these other CPs. However, for EAD 1Gbit/s circuits we have assumed no migration given the limited price incentives combined with the fact that smaller CPs may not have the technical ability to manage the electronic equipment required when using dark fibre.

A33.166 For the purposes of obtaining a figure to use in the LLCC model, we have assumed a third noting that these other CPs represent a small proportion of overall circuit volumes such that this assumption has a limited impact on the charge control.[266] Furthermore, we note that [✂].[267]

Summary of CP analysis

A33.167 In conclusion, we expect similar incentives and ability for many CPs to cannibalise existing circuits but note that for some specific CPs and circuits this may differ:

- For other CPs that have not stated an interest in dark fibre, we have applied a third of the migration rate to all circuit types (following similar reasoning as for new connections);
- For Vodafone, we have assumed 0% cannibalisation of EAD LA 1Gbit/s; and
- For [✂], we have assumed 0% cannibalisation of all EAD 1Gbit/s circuits.

<u>Impact of the timing of DFA introduction in 2017/18</u>

A33.168 The above analysis sets out our cannibalisation assumptions in a ‘business as usual’ state of the world[268] but there is considerable uncertainty regarding the exact adoption rate of dark fibre.

A33.169 As with new connections (see paragraph A1.89), following the launch of the dark fibre access product, we consider that CPs will need to gain expertise, experience and knowledge of how best to use the product (i.e. using this as a period

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[266] We found that assuming any adjustment figure between 10% and 50% results in the same estimated industry average cannibalisation rates for EAD, WES/BES and OSA existing circuits.
[267] [✂] confidential response (dated 6th November 2015) to our follow-up questions regarding its initial response to our 13th s135 information request.
[268] We consider ‘business as usual’ to refer to when CPs are familiar with BT’s dark fibre access product such that the use of dark fibre falls under the normal execution of operations within an organisation.

to test and trial the product). However, we consider that this is likely to be of even greater importance for existing circuits than new connections, given the risk of customer disruption. Therefore we consider it appropriate to assume 0% cannibalisation for all existing circuits in 2017/18.

A33.170 As with other CPs, it is likely that BT downstream would wish to test and trial the dark fibre product before seeking to replace existing active circuits. Following the testing and trialling period of dark fibre, we assume the business as usual rates of cannibalisation as set out in paragraph A1.148 above.

Final view of cannibalisation of existing circuits (in absence of aggregation considerations) in 2017/18 and 2018/19

A33.171 We note that estimating future dark fibre use is subject to uncertainty at this stage given the regulated product is not currently available from BT and there are still elements of product design to be negotiated. However, we have determined reasonable estimates for the cannibalisation rates that are used within the LLCC model. We also note that the total cost impact of our cannibalisation assumptions (i.e. including migration of existing circuits and stranded assets) is £2.1m which has an impact of just 0.25% on the charge control ‘X’. Therefore it is unlikely that the simplifying assumptions used when estimating cannibalisation of new connections will have a significant impact on the LLCC.

A33.172 In conclusion, we consider it appropriate to assume no cannibalisation of existing circuits in 2017/18. For 2018/19 we have assumed the following rates of cannibalisation in 2018/19, by product, bandwidth and CP (see Table A33.14 below).

Table A33.14 – 2018/19 cannibalisation assumptions for existing circuits in the absence of aggregation (by CP, bandwidth and product)[269]

Product		BT[✂]	[✂]	[✂]	Others
EAD LA & WES	10 / 100Mbit/s				
	1Gbit/s	[✂]	[✂]	[✂]	[✂]
	10Gbit/s	17%	17%	17%	6%
EAD & BES	10 / 100Mbit/s				
	1Gbit/s	[✂]	[✂]	[✂]	[✂]
	10Gbit/s	29%	29%	29%	10%
OSA	>1Gbit/s	0%			
EBD	1Gbit/s	0%			
	10Gbit/s	[✂]	[✂]	[✂]	[✂]

Source: Ofcom analysis based upon stakeholder responses, observed historic WES to EAD migration rates with significant price differentials, and average contract lengths for business connectivity services

[269] These cannibalisation rates are applied to existing circuits in 2018/19, having already accounted for new connections that are cannibalised by dark fibre in 2017/18.

Assessment of scope for aggregation

June 2015 LLCC Consultation

A33.173 In the June 2015 LLCC Consultation we proposed to assume one-for-one substitution between active circuits and dark fibre.[270]

Stakeholders' comments

A33.174 Only BT specifically commented on our assumption of one-for-one substitution. However, in response to our information request [✂].[271] [✂] has informed us that one of its reasons to not consolidate circuits is due to unaligned contract timing and bandwidth constraints and that dark fibre may reduce this constraint.[272]

A33.175 BT argued that assuming a one-for-one substitution is not appropriate. It considered that its analysis shows [✂]% of circuits share a route with at least one other circuit from the same CP, within the rest of UK/London Periphery.[273] It argued that at the proposed dark fibre price, it would be commercially viable for a CP to aggregate two EAD 10/100Mbit/s circuits on the same route (to realise a cost saving). However, [✂].[274]

A33.176 Some stakeholders have highlighted the difficulty of consolidating circuits. [✂].[275] [✂].[276] [✂].[277]

A33.177 BT also argued that CPs could use dark fibre to cannibalise Main Link by replacing EAD standard circuits with EAD LA variants and dark fibre for backhaul. It noted that the impact of this form of aggregation is uncertain, particularly given that the loss in revenue to Openreach would be partly compensated by the procurement of two EAD LA circuits. BT noted in its response to the June 2015 LLCC consultation[278]:

"[✂]"

A33.178 BT argued that cannibalisation of below 1Gbit/s circuits would occur due to the ability to aggregate these circuits on to a single dark fibre. BT estimated that around [✂].[279]

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[270] In other words, a CP would replace one active connection with one dark fibre circuit (it would not aggregate multiple active circuits on one dark fibre circuit).
[271] [✂] confidential response to the 13th BCMR s135 information request.
[272] See [✂] [] confidential response to our 13th BCMR s135 information request.
[273] BT further argued that if aggregation is made possible across circuits of different CPs then this risk will substantially increase to around [✂]% of circuits. BT argued that [✂].
[274] [✂] confidential response to the 13th BCMR s135 information request.
[275] [✂] confidential response to the 13th BCMR s135 information request.
[276] [✂] confidential response to the 13th BCMR s135 information request.
[277] [✂] confidential response to the 13th BCMR s135 information request.
[278] This is in relation to [✂].
[279] [✂] confidential response (dated 6 November 2015) to our follow-up questions for the 13th BCMR s135 information request.

Our conclusions

A33.179 We have re-assessed the potential for aggregation in light of stakeholder responses and further analysis of the current scope for aggregation (i.e. with the use of active circuits and the existing circuit base).

A33.180 We first consider the scope for circuit aggregation with dark fibre and the likely impact this has on the LLCC. We then consider BT's specific arguments in relation to Main Link aggregation (as summarised in paragraph A1.177).

Circuit aggregation

A33.181 There may well be price incentives to aggregate circuits using dark fibre. However, in line with the analysis of cannibalisation of new and existing active circuits set out above, we are interested in assessing the incremental impact of dark fibre on aggregation.[280] We consider that there are a number of non-price reasons to believe that incremental dark fibre aggregation will be limited in this review period.

A33.182 Firstly, we consider aggregation to be a more complicated process (as supported by stakeholder views) than migration of an existing circuit on a one-for-one basis. There are a range of issues which need to be assessed when considering whether to aggregate circuits, for example:

- inconvenience and disruption/downtime for end customers;
- end customer requirements (e.g. different end customers may want to keep their traffic separate from that of other customers);
- contract periods not aligning between circuits on the same route (e.g. if they are not aligned for the circuits being aggregated, it may make aggregation more complex and/or disruptive), as indicated by [✂];
- resilience reasons, as supported by [✂]. This can mean that it may not be optimal to reduce all routes to a single circuit; and
- internal planning and process management requirements of aggregation, including associated time as well as costs (e.g. to co-ordinate the mismatch of contract periods), as supported by [✂].

A33.183 Secondly, the dark fibre remedy will only be available from October 2017. As set out above, we expect (and therefore have assumed) that CPs will trial the new dark fibre remedy in the initial period with new connections. Given the additional complications and network planning involved in aggregation described above, we consider that aggregation using dark fibre is unlikely to be a short term/immediate priority for CPs. However, we do note that it may form part of a longer term strategy, beyond this review period.

A33.184 Thirdly, we consider that the evidence on multi-circuit routes suggests that there are barriers to aggregation. Aggregation can already occur using active circuits, and incentives to do this are already likely to exist (broadly speaking, the greater the number of circuits on the same route, the greater the pricing incentive for aggregation

[280] In our analysis, we refer to the incremental impact that dark fibre has on the aggregation of circuits in this review period as 'incremental dark fibre aggregation'.

is likely to be).[281] Indeed, we note that it is often cheaper to aggregate all circuits onto an active circuit of the next bandwidth up once you have three or more of a given bandwidth.

A33.185 However, our own analysis (which we describe further below) indicates that a significant minority of non-EBD circuits are on multi-circuit routes, and thus would already be candidates for aggregation (subject to the price incentives). For example, as illustrated in Table A33.15 below, our analysis suggests that approximately a third of EAD LA circuits are already on a route with more than one EAD LA circuit. This indicates that not all existing aggregation potential is instantly realised and we consider this suggests significant barriers to aggregation at the wholesale level.[282]

A33.186 In addition, we consider that the fact that aggregation is already possible with active circuits means that the active volume forecasts we use will already reflect aggregation expected using actives. For example, to the extent that multiple lower bandwidth circuits are expected to be replaced by a new active connection at 1Gbit/s or above, this aggregation will already be captured by our assumption on new connections.

Table A33.15: Distribution of circuits by route size and circuit type

Number of circuits on a route	1	2	3	4	5	More than 5
Local access	[✂]%	[✂]%	[✂]%	[✂]%	[✂]%	[✂]%
Non local access	[✂]%	[✂]%	[✂]%	[✂]%	[✂]%	[✂]%
EBD	[✂]%	[✂]%	[✂]%	[✂]%	[✂]%	[✂]%

Source: Ofcom analysis of BT circuit data

A33.187 As such, for all of these non-price considerations, we would not expect material incremental dark fibre aggregation in the first full year dark fibre is available (i.e. the final year of this review period).

A33.188 Nonetheless, BT has claimed that there is material scope for aggregation. We have conducted our own analysis to assess the extent of this potential and its likelihood of occurring during the charge control period. To do this, we have analysed BT's circuits (as of May 2015)[283] by route (where routes are identified using the postcodes of the circuit end points) to determine:

- how many circuits each CP has on each route; and
- the aggregate bandwidth provided by these circuits (i.e. the total bandwidth on a given route).[284]

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281 However, we also note that a greater number of circuits on the same route may also mean that the barriers to migration are higher too. For example, aggregating several circuits with different customers and contract terms will likely result in greater disruption and the need for significantly more planning than aggregating two circuits with the same end customer and contract period.

282 We consider it likely that the main reasons for CPs to not realise potential scope for aggregation is the risk of disrupting the end customer, contract misalignments and resilience. These are barriers that apply to the CP providing the leased line, rather than the end customer who can request the CP to aggregate their circuits to a higher bandwidth.

283 BT response to Q7, 13th BCMR s135 information request, dated 24 September 2015

284 For simplicity, we have omitted data on resilience circuits, given their more specific requirements.

A33.189 We have assessed the scope for incremental dark fibre aggregation for individual CPs, as contrary to BT's view, we consider there are likely to be significant barriers to CPs aggregating their circuits with those of other CPs where they share common routes. This is because, as well as the general reasons for limited aggregation described above, it would require a lot of coordination between CPs to achieve (which we have limited evidence of to date) as well as agreement on how costs would be shared. Instead, we expect that to the extent that CPs have incentives to aggregate circuits, this will be in relation to their own circuits only, at least in this review period.

A33.190 For the purposes of analysis we have segmented the routes into three groups based on circuit types:

- Local Access circuits (LA) – circuits providing connectivity between a customer premise and the serving BT exchanges. This group includes EAD Local Access and WES Local Access circuits;

- Non Local Access circuits (non-LA) – circuits with interexchange connectivity other than EBD circuits. This group includes EAD, EAD Extended Reach and WES circuits.

- EBD circuits (EBD) - this group only includes EBD circuits.

A33.191 Given the dark fibre pricing approach (i.e. 1Gbit/s EAD and EAD LA minus) we consider that dark fibre will likely only materially affect the price incentives where the total route bandwidth is greater than 1Gbit/s, as there will be no incremental price advantage from aggregating onto a dark fibre circuit compared to an EAD 1Gbit/s circuit.[285] This has different implications for the incremental impact on incentives to aggregate EBD circuits using dark fibre compared to the other circuits analysed, and so we now consider each separately.

A33.192 We have also assumed no scope for aggregation between different circuit types on the same route e.g. between EBD and EAD. This is because we would expect there to be a reason why the CP has adopted this approach of deploying multiple circuit types for the same route.[286] To the extent CPs have plans to aggregate these different circuit types, we would expect this aggregation to already be factored into our active forecasts given incentives are likely to exist with actives.[287]

Scope for incremental dark fibre aggregation of LA and non-LA circuits

A33.193 We recognise that, in principle, dark fibre may increase aggregation incentives (and therefore affect total active volumes) in this review period. However, our analysis indicates that the majority of the existing scope to aggregate LA and non-LA circuits appears to fall into the category where the total route bandwidth required is 1Gbit/s or below (i.e. where we would not expect dark fibre to have a

[285] This is because we consider it likely that CPs would be indifferent, with regards to pricing incentives, between using an EAD 1Gbit/s active circuit and a dark fibre circuit to aggregate a route with a total bandwidth of 1Gbit/s or below.
[286] We note that an EAD LA route cannot also be an EBD route, and we consider it likely that where an EAD LA and EAD circuit share the same route there is already an opportunity to aggregate using actives.
[287] We've considered the sensitivity of this assumption and found that given the characteristics of these routes (in terms of circuits and bandwidths) it does not have a significant impact on our estimated volume effect of incremental dark fibre aggregation.

significant impact on the price incentives to aggregate). This, therefore, materially reduces the scope for incremental dark fibre aggregation to approximately [✂]% of LA and [✂]% of non-LA circuits which are on a shared route with a total bandwidth of above 1Gbit/s (i.e. this is where we might expect dark fibre to increase the price incentives for aggregation relative to the active-only world).

Table A33.16 – Scope for incremental dark fibre aggregation of EAD LA and non-LA circuits

		Total	Circuits on a route with two or more circuits	Circuits on a route with two or more circuits and bandwidth >1Gbit/s
LA circuits	Count	[✂]	[✂]	[✂]
	Share of all circuits	[✂]%	[✂]%	[✂]%
Non- LA circuits	Count	[✂]	[✂]	[✂]
	Share of all circuits	[✂]%	[✂]%	[✂]%

Source: Ofcom analysis of BT circuit data

A33.194 We also note, in any event, that even if this [✂]% of LA and [✂]% of non-LA circuits were aggregated by each CP where they share the same route, the maximum impact on total circuit volumes is likely to be relatively modest. Our analysis indicates that the average number of circuits per route is approximately three (as illustrated by Table A33.17 below). Therefore, even if the [✂]% of LA and [✂]% of non-LA circuits were aggregated on the average basis of three active circuits to one dark fibre, the overall impact would be to reduce total circuit volumes for each circuit type by 7% if the maximum scope were realised.

Table A33.17 – Potential volume impact of incremental dark fibre aggregation of LA and non-LA circuits

	Number of circuits on a route with two or more circuits and total bandwidth of >1Gbit/s	Number of routes with two or more of the circuit type and aggregable bandwidth of >1Gbit/s	Average number of circuits per route (where there are two or more circuits on the route with aggregable bandwidth of >1GBit/s)	Impact on total volume of circuit type
LA circuits	[✂]	[✂]	[✂]	-7%
Non- LA circuits	[✂]	[✂]	[✂]	-7%

Source: Ofcom analysis of BT circuit data

A33.195 We consider it likely that the scope for incremental dark fibre aggregation is lower than estimated in Table A33.17 above. This is because we expect a proportion of these circuits to already face a significant price incentive to aggregate using actives. Therefore we consider it likely that some of this aggregation potential will already be accounted for within our forecasts. Nonetheless, we have estimated the effect that these volume impacts have on the LLCC, specifically the charge control X, in paragraphs A1.205 to A1.207 below.

Scope for incremental dark fibre aggregation of EBD circuits

A33.196 As with the EAD LA and non-LA analysis above, we recognise there is potentially some scope for aggregation of EBD circuits as a result of dark fibre. However, in 2015 a significantly larger proportion of EBD circuits were on multi-circuit routes relative to these other circuit types. We find that approximately [✂]% of EBD circuits are on a route with two or more EBD circuits, and [✂]% on a route with three or more. This indicates that CPs who require more backhaul have frequently purchased additional circuits rather than aggregated onto a single higher capacity circuit.

A33.197 Our analysis indicates that the incentives for incremental dark fibre aggregation may be greater for EBD circuits. This is because all multi-circuit routes have an aggregable bandwidth of above 1Gbit/s.[288] Dark fibre priced on a 1Gbit/s active minus basis may increase price incentives to aggregate relative to the active-only world for all [✂]% of circuits which share a route. However, we do not consider that dark fibre will necessarily result in a significant increase in EBD aggregation.

A33.198 We note that aggregating three existing EBD 1Gbit/s circuits on to an EBD 10Gbit/s circuit results in a TCO saving of around 25% (using Openreach prices as of February 2016) for Band A. This therefore suggests that for those circuits with three or more EBD 1Gbit/s circuits, the price incentives to aggregate using actives are already significant.

A33.199 We have examined our LLCC model volume forecasts (absent dark fibre) and consider that our model already forecasts aggregation of EBD circuits. Most of the scope for aggregation that we identified in 2015 is for EBD 1Gbit/s circuits and our charge control model already forecasts substantial aggregation for these circuits. In particular, between 2014/15 and 2018/19, we forecast the volume of EBD 1Gbit/s circuits to decline by [✂]%. Although we forecast EBD 10Gbit/s circuits to rise, the overall impact is for EBD circuits to fall by [✂]%, even as capacity expands. We have set out the forecasted volume changes for EBD circuits between 2014/15 and 2018/19 in Table A33.18 below.

Table A33.18 – forecast volume change for EBD rentals (mid-year) from 2014/15 to 2018/19 (pre-cannibalisation adjustment)

	2014/15	2018/19	Volume change
EBD AISBO (i.e. 1Gbit/s) Non WECLA	5693	[✂]	[✂]%
EBD MISBO (i.e. 10Gbit/s) Non WECLA	1843	[✂]	[✂]%
EBD (1Gbit/s and 10Gbit/s) Non WECLA	**7535**	[✂]	**[✂]%**

Source: Ofcom analysis of 2016 LLCC volume forecasts

A33.200 This suggests that much of the scope for aggregation of EBD circuits (as found in 2014/15) is already accounted for within the LLCC active volume forecasts. The incremental impact of dark fibre on this forecast aggregation would already be captured by our cannibalisation assumptions for new and existing EBD 10Gbit/s circuits. Therefore, to avoid the risk of double-counting this impact, we consider it appropriate to exclude the aggregation which is already forecast to occur, and instead assess the incremental impact of dark fibre.

A33.201 We consider that the incremental incentives from dark fibre are material only for circuits which fit a particular profile. In particular, the total bandwidth by route that could be aggregated will affect the scale of the existing price incentives, and thus the likelihood that dark fibre will have an incremental effect. We note that there may be limited current incentives to aggregate multiple EBD 10Gbit/s circuits on a route using actives (e.g. OSA), particularly on a three year TCO basis. In this case, the incremental impact on aggregation due to dark fibre (priced on a 1Gbit/s active minus basis) might be significant.

[288] This is unsurprising given the lowest EBD bandwidth available is 1Gbit/s.

A33.202 We therefore consider that the incremental impact of dark fibre on aggregation incentives is restricted to those routes with two or more EBD circuits, and aggregable bandwidth of >20Gbit/s. Given the wide variety of circuit combinations in this category, we have not sought to identify the distance cut-off for this category, and instead assessed all routes with a distance of less than 45km (i.e. the dark fibre distance limit). We find that approximately [✂]% of EBD circuits are on an EBD route that could potentially be aggregated (by a given CP) due to the incremental impact of dark fibre. This equates to an approximate 7% reduction in EBD circuit volumes overall. We consider this to be the maximum scope for the incremental dark fibre aggregation of EBD circuits, particularly given paragraph A1.200 above. Furthermore, this is a maximum scope for aggregation, and the rate that this would happen in any one year would be much less.

Table A33.19 – Potential volume impact of incremental dark fibre aggregation of EBD circuits

Number of circuits on routes with aggregable bandwidth of >20Gbit/s, <45km route length and 2+ EBD circuits	Average number of circuits per route	Impact on total volume of EBD circuits
[✂] **([✂]% of EBD circuits)**	[✂]	-7%

Source: Ofcom analysis of BT circuit data

A33.203 We note that the non-price factors in relation to aggregation (such as resilience) will further limit the likelihood that a CP will fully realise any scope for aggregation. We also note the current significant unexhausted potential for aggregation of EBD circuits and the forecasted aggregation of EBD 1Gbit/s circuits. We consider it likely that this will significantly reduce the scope for incremental dark fibre aggregation of EBD circuits in 2018/19, relative to any scope found in May 2015.

A33.204 Nonetheless, we set out below how the estimated volume impacts (on LA, non-LA, and EBD circuits) due to incremental dark fibre aggregation might impact the LLCC.

Estimated impact on the LLCC

A33.205 As we note above, we consider it likely that our analysis provides upper bound estimates for the scope for incremental dark fibre aggregation in this review period. In light of these upper bound estimates, we have tested the potential impact that aggregation due to dark fibre might have on the LLCC.

A33.206 We have made some assumptions to estimate the possible impact of aggregation due to dark fibre and consider it likely that these assumptions result in an upper bound estimate. In particular, we have made the following assumptions:

- We have used the scope for aggregation due to dark fibre as calculated above. We note that these estimates are likely to overstate the incremental impact that dark fibre has for aggregation, which suggests upper bound estimates of the scope.

- We have used the estimated migration rates for backhaul and access circuits as calculated for one-for-one substitution of actives with dark fibre (see paragraphs A1.142 and A1.143 above).[289]

- We have assumed that the estimated circuit volumes that are lost due to aggregation using dark fibre in 2018/19 are primarily within the Ethernet basket. This is based upon the bandwidth breakdown for the circuits that we found to be within the scope of incremental dark fibre aggregation.

- We have also estimated a cost uplift to account for the loss of EBD 10Gbit/s circuits due to aggregation incremental to dark fibre.[290]

- We have assumed that incremental dark fibre aggregation is in addition to our one-for-one substitution. In other words, we have assumed that there is no overlap between the circuits estimated to migrate to dark fibre via one-for-one substitution and those estimated to migrate via incremental dark fibre aggregation. This assumption overstates any impact.

A33.207 Given these assumptions, our analysis estimated that aggregation may result in a decline in circuit volumes of up to 4.1k circuits and an EBD cost uplift of up to £0.2m in 2018/19. We note that our upper-bound estimate for the impact of incremental dark fibre aggregation does not have a material impact on the LLCC and does not change the value of X. We also consider it likely that this is an overestimate.

Scope for aggregation of Main Link

A33.208 Contrary to BT, we do not consider it likely that dark fibre will impact the incentives for CPs to aggregate Main Link by purchasing multiple local access circuits and aggregating backhaul traffic on to a single dark fibre.

A33.209 In relation to aggregation of Main Link, the price incentives are not purely driven by comparisons of rentals and connections. For example, in order to aggregate Main Link circuits, a CP needs to pay for accommodation in the Exchange, and would likely need to use more costly equipment (e.g. WDM). These additional costs are likely to further reduce the incentives and viability to aggregate.

A33.210 In addition, we consider it likely that aggregation incentives are likely to exist today in an actives-only world, and so are not only likely to be driven by the introduction of dark fibre. For example, Main Link can potentially be cannibalised by the use of EAD LA with EBD active circuits, particularly for routes with multiple circuits and/or long Main Link distances.

A33.211 We consider it likely that the financial incentives to aggregate Main Link may already exist today with the use of actives (such as EAD LA and EBD). We note that dark fibre could further increase the savings from aggregating Main Link than with the use of individual EAD LA circuits with an aggregated backhaul circuit (e.g. EBD). However, the extent to which Main Link can be cannibalised (using actives or dark

[289] We note that CPs may have additional non-price reasons for not choosing to aggregate circuits (some examples are described above) even when there is scope to do so, which might suggest that these are an upper bound estimates for the rate of aggregation, for a given scope for aggregation.
[290] This is because EBD 10Gbit/s circuits provide a significant per circuit cost contribution and have relatively large volumes in 2018/19. Therefore it is unclear whether the biggest impact on the charge control X is to assume that EBD 1Gbit/s circuits are lost due to aggregation with dark fibre.

fibre) is difficult to assess, both for existing circuits and new connections. For existing circuits, it is difficult to assess due to the many different factors[291] that will influence whether a CP would seek to cannibalise Main Link.

A33.212 In addition, we consider that the aggregation of Main Link requires CPs to obtain two local access variants to replace the standard variant which would mitigate any impact that aggregation of Main Link might have, as supported by [✂].

A33.213 Therefore, due to the generally limited potential for aggregation in this charge control period and the requirement to obtain two LA variants to aggregate Main Link, we consider it reasonable to assume that aggregation of Main Link will not have a material impact on BT's ability to recover its costs in this charge control period.

Final view on incremental dark fibre aggregation

A33.214 When constructing a model we exercise our judgement to balance the need for an appropriate degree of accuracy with considerations of practicability and proportionality. For this reason, our model is necessarily an abstraction from reality to some degree.

A33.215 There is a significant degree of uncertainty around the use of dark fibre in this review period to further aggregate circuits (i.e. beyond that already forecasted in the absence of dark fibre) and it is therefore not practicable to model with precision the impact of aggregation on the LLCC.

A33.216 We expect incremental dark fibre aggregation to be limited in this review period, particularly due to:

- non-price related reasons for choosing to not aggregate (e.g. resilience);
- the fact that dark fibre will be a new product that requires trialling (and may require additional planning for aggregation); and
- the already significant potential for aggregation using actives (as well as the already forecasted aggregation of EBD 1Gbit/s in the absence of dark fibre).

A33.217 Based on this analysis, we do not consider it necessary or proportionate to include additional complexity and/or arbitrary assumptions within the LLCC model to account for aggregation, particularly as our (upper bound) estimate for incremental dark fibre aggregation is low and does not impact the charge control X. Therefore we have assumed, as a modelling simplification, that there is no incremental aggregation of active circuits as a result of dark fibre in this review period.

Our final cannibalisation assumptions (including aggregation)

A33.218 We have adjusted our cannibalisation assumptions for both existing circuits and new connections in light of stakeholder responses (as set out in our analysis above). However, in order to determine the industry average cannibalisation rates (to then be applied to the total industry volumes) for each product by bandwidth, we have applied 2014/15 volume shares (set out in Table A33.20 below).

[291] These factors include, for example, Main Link distance, number of circuits on the same route and the aggregate bandwidth of circuits.

A33.219 The BT circuit data available to us does not allow us to distinguish between other CPs that have stated an interest in dark fibre and those that have not. Therefore in Table A33.20 below, "Other CPs" includes CPs such as Colt and Gamma, as well as CPs that have not directly indicated to us that they would be interested in the use of dark fibre. We have assumed that half of "Other CPs" will include CPs that are interested in using dark fibre. We expect the volume share for other CPs that are not interested in dark fibre to be relatively small. Therefore, it is likely that this assumption does not have a significant impact on our weighted average cannibalisation rates.

Table A33.20 – volume share breakdown of Openreach (non WECLA) sales by product, bandwidth and CP (2014/15)[292]

Product		BTW	BTGS	Sky	[✂]	[✂]	Vodafone	Other CPs
EAD LA	10 / 100Mbit/s	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
	1Gbit/s	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
	10Gbit/s	[✂]		[✂]				
EAD	10 / 100Mbit/s	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
	1Gbit/s	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
	10Gbit/s	[✂]		[✂]				
OSA	>1Gbit/s	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
EBD	1Gbit/s	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
	10Gbit/s[293]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]

Source: BT data on circuit volumes by product, bandwidth, and CP

A33.220 We consider that the CPs set out in Table A33.20 above relate to the CP incentives set out in paragraph A1.72 above in the following way:

- **Downstream BT** – this consists of BT Wholesale (BTW) and BT Global Services / Retail (BTGS).
- **Non-BT CPs who we consider are likely to be interested in using dark fibre** – this consists of Sky, Vodafone, [✂], as well as a proportion of "Other CPs" (e.g. GTC, Colt and [✂].
- **Other CPs** – this consists of the remaining proportion of "Other CPs".

A33.221 Ideally, we would use the volume shares for the years that dark fibre is available (i.e. 2017/18 and 2018/19) but our forecasts are only split by internal and

[292] Based upon 2014/15 database from BT [✂].
[293] We note that although TalkTalk's current share of EBD 10Gbit/s circuits is low, we would expect this to increase in the future as it requires more than 1Gbit/s of bandwidth for its EBD circuits.

external supply rather than by CP. However, we have compared these 2014/15 volume shares against the forecast 2018/19 internal and external volumes in the charge control and found that:

- For non-LA EAD volume shares (excluding WECLA), we found a similar internal/external split for our 2018/19 forecasts as our 2014/15 actuals.
- For EBD and OSA circuits we forecast different internal/external splits but we consider it unlikely that this will have a significant impact on the LLCC.[294]
- For 1Gbit/s EAD LA we found that the 2018/19 internal/external split is significantly different than the 2014/15 split (see Table A33.21 below), such that it impacts our cannibalisation assumptions.[295]

A33.222 Therefore we consider it reasonable to use the 2014/15 volume shares for all services except for 1Gbit/s EAD LA, where we have used the following adjusted 1Gbit/s EAD LA volume shares[296]:

Table A33.21 – 2014/15 and 2018/19 internal and external volume shares for EAD LA 1Gbit/s and adjustment to take this into account

		BTW	BTGS	Sky	TalkTalk	Virgin	Vodafone	Other CPs
EAD LA 1Gbit/s	2014/15 volume shares	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
	2018/19 internal/ external split	[✂]		[✂]				
	2018/19 adjusted volume shares	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]

Source: Ofcom adjustment to BT data on 2014/15 circuit volumes by product, bandwidth, and CP

A33.223 Given the circumstances and balance of risk, in terms of over- and underestimating, we consider our final cannibalisation assumptions provide a reasonable estimate. These are set out in Table A33.22 below.

Table A33.22 – Ofcom's final cannibalisation assumptions for all circuits[297]

Product		Existing circuits (17/18)	Existing circuits (18/19)	New circuits (17/18)	New circuits (18/19)
EAD LA	10/100M	0%	0%	0%	
	1G		4%	25%	95%
	10G		17%	25%	95%

[294] In order for this change in internal/external split of volumes to have a significant impact on our assumptions, a substantial proportion of the increase in external volumes would need to be driven by CPs not interested in dark fibre. It is unclear that this would be the case.
[295] We note that the EAD LA 10Gbit/s volume shares already use BT forecasts and that we assume no cannibalisation of below 1Gbit/s circuits.
[296] We have proportionately increased/decreased the external/internal volume shares to ensure a consistent 2018/19 internal/external volume split.
[297] For new EAD and OSA connections, we have rounded our estimates to the nearest 5% recognising the uncertainty around forecasting dark fibre volumes.

EAD & WES/BES	10/100M		0%	0%	
	1G		6%	25%	95%
	10G		29%	25%	95%
OSA	>1G		0%	25%	95%
EBD	1G		0%	[✂]%	[✂]%
	10G		[✂]%	[✂]%	[✂]%

Source: Ofcom analysis

A33.224 On the basis of the above, we have forecast the 2017/18 and 2018/19 dark fibre volumes as well as reduced active volumes by making adjustments to our forecasts.

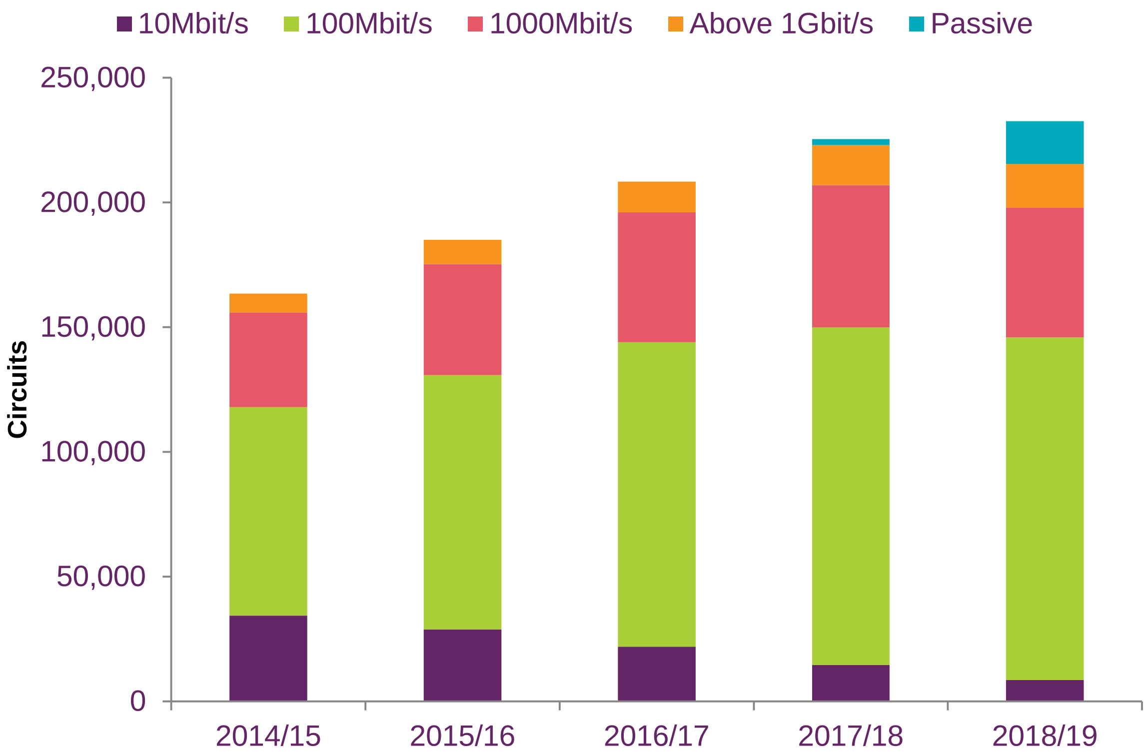
A33.225 By applying a cannibalisation rate to active connections in a given year, we have calculated the absolute number of new connections that year that are expected to be dark fibre rather than active products. We have reduced the active rental volume by this amount but applied a 0.5 adjustment factor, recognising that connections are always fully recovered in a given year whilst rentals are calculated as a mid-year average.[298] Where we have reduced active volumes by our cannibalisation rates, we have increased dark fibre volumes by the equivalent amount (for rentals and connections). We carry forward the full year reduction in active volumes (and subsequent increase in dark fibre volumes) into later years.[299]

A33.226 By applying the cannibalisation rate to existing circuits in a specific year (i.e. 2018/19), we have calculated the number of ongoing rental volumes (i.e. removing rentals due to new connections) that are expected to be dark fibre rather than active products.[300] This adjustment is made having already taking into account the new connection cannibalisation in the prior year.

A33.227 These cannibalisation assumptions result in the following forecast of Ethernet circuit volumes (see Figure A33.1 below), as also set out in Annex 32. These volumes include rentals and connections.

[298] We have assumed that cannibalisation of new connections will occur evenly throughout the year and the rentals resulting from those connections are not terminated in their initial year. Therefore, on average, the expected proportion of the initial year (i.e. year that cannibalisation occurs) that the new connection will be in place as a rental is 0.5.
[299] We note that this does not take into account any ceases of dark fibre services after their initial year of use. This is likely to overstate the impact of our cannibalisation assumptions with regards to the volumes forecasted. However, since we assume connection cannibalisation only in the last two years of the control, the potential issue with ceases would only be relevant in the last year of the control. We consider it likely that this impact is not significant.
[300] We have not modelled any volumes for potential migration or connection services for dark fibre circuits that have cannibalised existing active rentals. Given that these services would be outside of the charge control, the only effect that their volumes would have is on the modelled economies of scale. We consider it likely that the impact on the economies of scale would not be significant and so we consider it reasonable, as a simplification, to not model these volumes for the purposes of the LLCC.

Figure A33.1 – Ethernet and dark fibre circuit volume forecasts[301]



Source: Ofcom forecasts

Common cost recovery at risk

Introduction

A33.228 When regulating BT's wholesale services our general approach is to seek to provide BT with an opportunity to recover its efficiently incurred costs. We are therefore mindful of this when introducing any remedies, as well as when setting any pricing obligations for regulated services.

A33.229 In order to ensure that BT continues to have the opportunity to recover efficiently incurred costs of supplying regulated Ethernet services, we have taken into account three items in our cost forecasts:

- cannibalisation of active circuits by the dark fibre remedy;
- stranded assets due to cannibalisation of existing circuits; and
- implementation costs of the dark fibre remedy.

A33.230 We consider that all of these may justify uplifting the forecast costs in the Ethernet basket, as otherwise there is a risk that the dark fibre remedy could undermine BT's opportunity to recover its efficiently incurred costs.

[301] This includes all Ethernet rentals, split between active and passive circuits, and converting WES/BES local ends into circuits.

A33.231 In this sub-section, we set out the rationale for applying a common cost uplift to ensure recovery of efficiently incurred common costs, and summarise how we have calculated these for the 2016 LLCC Model.

June 2015 LLCC Consultation

A33.232 In the June 2015 LLCC Consultation, we considered that BT's ability to recover the lost contribution to common costs from the cannibalisation of above 1Gbit/s active circuits elsewhere was likely to be limited. This was because:

- Services within the charge control will be subject to a FAC-based constraint based on active volumes with dark fibre available. This means that there would not be scope to recover the difference in contributions from services within the charge control.

- Under the proposed dark fibre pricing approach, BT would not be able to recover these costs from the dark fibre price given the overall constraint on the Ethernet basket, which also limits the scope for their recovery from the cannibalised circuits themselves.

- There was a risk that BT would not be able to recover them from active circuits above 1Gbit/s outside of the control, as it would be undercut by competitors offering services using dark fibre.

A33.233 In light of the above, we considered that there was a risk that common costs could go unrecovered, and so the proposed dark fibre could undermine BT's opportunity to recover its efficiently incurred costs.

A33.234 We proposed that, based on the differences in common cost contributions from these circuits and our estimated cannibalised volumes, there was a risk that our dark fibre remedy could prevent BT from recovering £4.6m of its non-avoidable efficiently incurred costs in the final year of the charge control. Therefore, this £4.6m was used to set the level of the common cost uplift in the LLCC.

Stakeholders' comments

A33.235 TalkTalk, Sky and Vodafone disagreed with Ofcom's use of a common cost uplift which would allow BT to recover an additional £4.6m. BT disagreed with our cannibalisation assumptions (as set out in the cannibalisation sub-section above) and our assessment of the 'minus' for the dark fibre price (as discussed in Annex 23). Beyond this, BT did not directly disagree with our assessment of the common cost uplift.

A33.236 TalkTalk argued that whilst OSA circuits make a lower contribution to non-avoidable costs, the overall contribution more than recovers total non-avoidable costs. It further argued that the majority of non-avoidable costs (e.g. fixed costs) are in the infrastructure layer not the active layer and therefore will not be affected by the introduction of dark fibre.

A33.237 Vodafone noted that very high bandwidth (VHB) CISBO services of above 1Gbit/s are not included within the scope of the Ethernet basket and that accounting for the cost of these services would be fundamentally incompatible with Ofcom's overall approach to charge control modelling.

A33.238 Sky argued that it was unclear how the cost uplift was calculated or why it was necessary, stating that any additional allocation of common costs appears to lead to the risk of over-recovery of common costs.

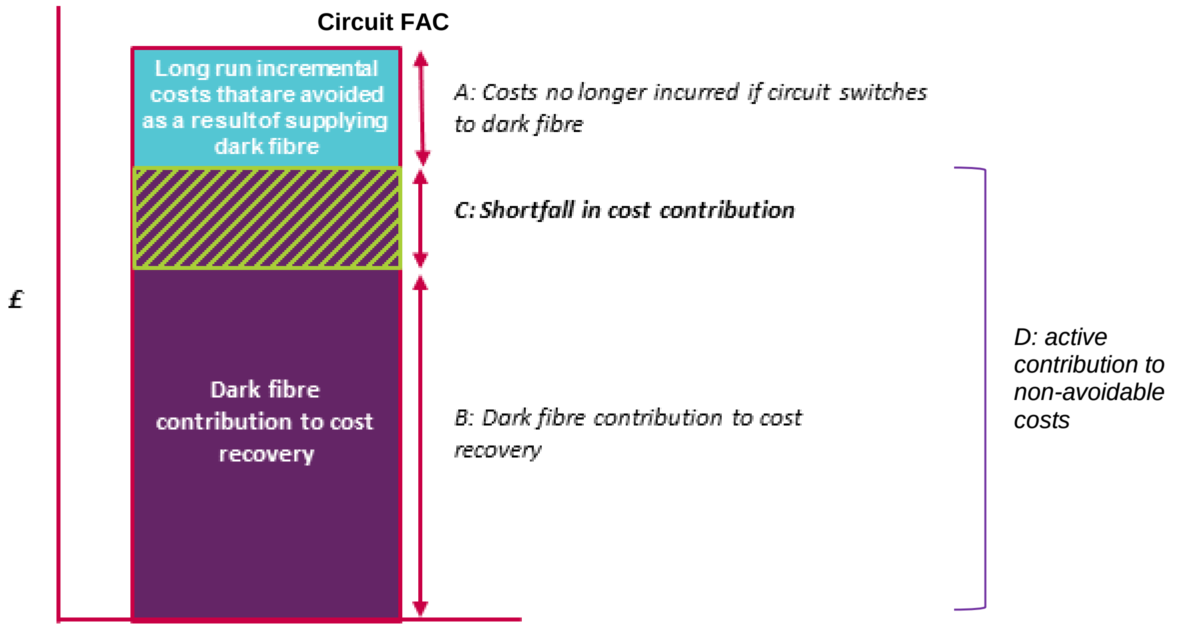
Our conclusions

Requirement for common cost uplift

A33.239 When we set charge controls, we seek to set revenues so they equal forecast costs (FAC in the case of the LLCC) for the whole basket by the end of the charge control period.[302] Therefore when considering the potential impact of cannibalisation of active circuits by the dark fibre remedy on cost recovery, we consider it appropriate to assess it with reference to forecast costs overall, and in particular, circuit contributions to cost recovery on a cost (rather than price) basis.[303]

A33.240 We are concerned that BT's opportunity to recover its efficiently incurred costs could be undermined as a result of the cannibalisation of active circuits by the dark fibre remedy. More specifically, where active circuits are forecast to make a greater contribution to recovery of non-avoidable costs than dark fibre, there is a risk to BT's cost recovery if these circuits are cannibalised by dark fibre. This is illustrated in Figure A33.2 below, where the full bar represents the cost recovery by an active circuit, and C illustrates the potential shortfall in cost contribution as a result of cannibalisation by dark fibre which we are concerned about.

Figure A33.2: Illustration of potential risk to cost recovery as a result of cannibalisation of active circuits by dark fibre



[302] In other words, there is an overall FAC-based constraint, with BT free (subject to any sub-caps) to set prices within this overall constraint.
[303] This is because, if the total FAC constraint is achieved, BT should have an opportunity to recover its efficiently incurred costs (and still be able to flex its prices across services to adjust how it recovers them).

A33.241 To address this, we include our estimate of the shortfall in costs recovered due to the cannibalisation of active circuits by dark fibre in the Ethernet basket. This is calculated by:

- Calculating the contribution to non-avoidable costs by dark fibre (i.e. B in Figure A33.2 above);
- Calculating the lost contribution to non-avoidable costs from cannibalised active circuits (i.e. D in Figure A33.2 above);
- Calculating the differential between the two (i.e. C in Figure A33.2 above), and where there is a shortfall, multiplying this by the volume of cannibalised active circuits.

A33.242 As suggested by TalkTalk, some of these costs will be avoidable, i.e. no longer incurred as a result of the dark fibre remedy being supplied instead of an active circuit. However, the remaining costs will, broadly speaking, still be incurred irrespective of whether an active circuit or the dark fibre remedy is provided, and so will need to be recovered.[304]

A33.243 In many cases, this loss in contribution to non-avoidable costs from cannibalised active circuits will be offset by sales of the dark fibre remedy.[305] Indeed, if the dark fibre circuit makes the same absolute contribution to these non-avoidable costs as the active circuit it replaces, then BT will continue to have the opportunity to recover its efficiently incurred costs and no adjustment will be required. However, if a dark fibre circuit makes a lower contribution, and no allowance is made in the charge control, then BT could be denied the opportunity to recover its costs overall. Contrary to comments made by Sky and Vodafone, we consider it appropriate to ensure that BT can recover its overall costs for all regulated products.

A33.244 Therefore, we have considered the scale of costs which may be affected as a result of the dark fibre remedy, and also whether there is scope for BT to recover such non-avoidable costs associated with cannibalised active circuits. We consider the costs potentially affected by the introduction of the dark fibre remedy to be equivalent to the differences in the non-avoidable costs of cannibalised active circuits compared to the dark fibre remedy price.[306]

A33.245 Contrary to TalkTalk's comment, we consider that BT's ability to recover these non-avoidable costs elsewhere is likely to be limited. This is because services within the charge control will be subject to a FAC-based constraint based on active volumes with dark fibre available. This means that there would not be scope to recover the difference in contributions from services within the charge control. Furthermore, given the dark fibre pricing approach, BT would not be able to recover these costs from the dark fibre price given the overall constraint on the Ethernet basket. Similarly, we consider there is a risk that BT would not be able to recover these costs from active circuits above 1Gbit/s outside of the control, as it could be undercut by competitors offering services using dark fibre.

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[304] For simplicity, we abstract here from whether such costs may partially vary with active volumes.

[305] Given our pricing approach, the dark fibre contribution would be equivalent to the non-avoidable costs of 1Gbit/s EAD or EAD LA circuits.

[306] We set out a fuller description of the costs we consider should be included in Annex 23.

A33.246 Therefore we consider that there is a risk that these costs could go unrecovered, and so dark fibre could undermine BT's opportunity to recover its efficiently incurred costs.

Calculation of common cost uplift

A33.247 We note that the value of 'X' is calculated to gradually bring revenues in line with costs such that in the final year of the control revenues equal our forecast of efficiently incurred costs (including a return on capital employed). Given our reasons set out above, we consider it appropriate to adjust the costs within the Ethernet basket to ensure that BT has the opportunity to recover its efficiently incurred costs. Therefore we have calculated the common cost uplift (due to cannibalisation) for 2017/18 and 2018/19.

A33.248 Our pricing analysis, set out above, uses Openreach's 2015/16 price list rather than average revenue per circuit.[307] However, the cost and volume data we use is a blend across variants[308] which will ensure the variants are sufficiently adjusted for in terms of the volume and cost impacts of dark fibre.

A33.249 Given our pricing approach for the dark fibre remedy (as discussed in Annex 21), we would expect a dark fibre circuit to make the same contribution to non-avoidable costs as a cannibalised EAD 1Gbit/s and EAD LA 1Gbit/s active circuit. However, there are variations in contributions to common costs between other circuit types where we expect some cannibalisation by the dark fibre remedy. In some cases, these other circuits recover more common costs than an EAD 1Git/s circuit. If these circuits are forecast to switch to dark fibre, the amount of common costs that BT would recover may fall below the previously allocated level.

A33.250 If this shortfall in common cost recovery is not taken into account in our charge control, there is a risk that BT's opportunity to recover its common costs may be undermined.

A33.251 Given that EAD 10Gbit/s is a new product, we do not have reliable cost information that can be used to determine the per circuit common cost uplift for these services. We consider it reasonable, in the absence of reliable cost data, to assume that the main difference between the cost of an EAD 1Gbit/s and EAD 10Gbit/s circuit is the electronic equipment. Therefore, we consider there is no common cost recovery concern for cannibalised EAD circuits at 1Gbit/s and above.

A33.252 We now set out our view of each of these steps. For the purposes of this analysis, we use the aggregated product data supplied by BT, which is a blend of several variants (for example, the EAD 1Gbit/s data will reflect all EAD 1Gbit/s variants, including resilience options and extended reach). We consider this reasonable to ensure all variants are sufficiently accounted for and so provide BT with an opportunity to recover its efficiently incurred costs.

A33.253 Our analysis is structured as follows:

- Set out the reference products used to calculate the dark fibre FAC.

[307] The only exception to this is for OSA, where we have used average revenue as this implicitly allows us to assume the average wavelength and bearer per circuit.
[308] For example, our EAD cost and volume data includes a variety of specific circuit types such as EAD ER, EAD RO1 and RO2, EAD Enable etc.

- Forecast the contribution to cost recovery from dark fibre.
- Forecast the lost contribution from cannibalised active circuits.
- Calculate the total shortfall in cost recovery.

A33.254 For simplicity, we have set out our approach to calculating the common cost uplift for 2018/19, but we use a similar approach for calculating the 2017/18 uplift, except that we use the forecast 2017/18 cannibalisation volumes and costs.

Reference products used to calculate the dark fibre FAC

A33.255 In order to calculate the uplift to the Ethernet basket required to reflect the lost contribution from cannibalised active circuits, we need to make an assumption on the level of costs that BT could be expected to recover from dark fibre in 2018/19 (i.e. B in Figure A33.2 above).

A33.256 As explained in Section 9 and Annex 21, we are requiring BT to set dark fibre prices on an EAD and EAD LA 1Gbit/s active price minus basis, where the minus reflects the avoided costs of the active circuit (i.e. A in Figure A33.2 above). While the charge control will permit BT to set EAD and EAD LA 1Gbit/s 2018/19 prices above or below our forecast FAC so long as the FAC constraint is satisfied for the basket as a whole, for the purposes of calculating the uplift we have assumed that EAD and EAD LA 1Gbit/s prices will equal their forecast FAC in 2018/19. We consider that this assumption is appropriate as our charge control is set on the basis that charges will reduce to forecast FAC (including a ROCE) on average by the end of the control. We have therefore estimated the non-avoidable cost contributions of active circuits by deducting the forecast long run incremental costs that are avoided as a result of supplying dark fibre from the forecast EAD and EAD LA 1Gbit/s FAC.

A33.257 We carried this out by, first, obtaining forecasts of 2018/19 FAC for EAD 1Gbit/s from the model. As we set out in our dark fibre pricing guidance (in Annex 23), we would expect BT to determine the dark fibre price based on an average across internal and external services.[309] However, for the purposes of our modelling, we have focused on external costs for estimating the dark fibre FAC, since it simplifies the modelling (relative to an average approach to the dark fibre FAC) and has an immaterial impact on the level of the cost uplift described below. We have therefore chosen the external (and non-WECLA)[310] variants of EAD 1Gbit/s standard and local access as the reference products, as shown in Table A33.23 below.

[309] It is 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. For example, BT may purchase more or less of different service variants (e.g. resilience options) which are combined under a single service code.
[310] As set out in Section 9 of Volume I, dark fibre will apply only outside of the CLA.

Table A33.23: 1Gbit/s reference products used to calculate dark fibre FAC (given chosen pricing approach in Annex 21)

Service code	Service description
SD126	EAD 1000mb Rental-External-non-WECLA
SD129	EAD LA 1000b Rental-External-non-WECLA
SD135	EAD 1000mb Conn-External-non-WECLA
SD138	EAD LA 1000b Conn-External-non-WECLA

Forecast contribution to cost recovery from dark fibre

A33.258 Having established the appropriate 1Gbit/s reference products, we estimated the long run incremental costs that are avoided as a result of supplying dark fibre for the reference products (i.e. A in Figure A33.2 above). This calculation effectively replicates the dark fibre pricing guidance set out in Annex 23. As set out in Annex 23, on the basis of information gathered from BT, we analysed the component costs that are used to provide EAD 1Gbit/s to determine how these might be split into 'passive' (e.g. costs associated with the physical infrastructure such as duct and fibre) and 'active' (e.g. costs specifically related to the purchase of an active service from BT) elements. We identified the following cost components as containing active-specific costs[311]:

- **Ethernet Electronics (CO485)** – based on information provided by BT, we have assumed that [✂] of the costs of these components are active. We calculated the active incremental costs of CO485 using the 2016 LLCC Model. First, we calculated the forecast 2018/19 FAC of CO485 attributable to the reference products by applying usage factors to the forecast FAC of those products. Second, we multiplied these figures by the relevant CVEs and AVEs to calculate the forecast 2018/19 LRIC of CO485 attributable to the reference products. Finally, we multiplied this figure by [✂] to calculate the active incremental costs.

- **OR Service Centre - Assurance Ethernet (CL578)** – this covers the costs of fault reporting and fault resolution processes. Based on information provided by BT, we have assumed that [✂] of the costs of this component are relate to the active service. We calculated the active incremental costs of CL578 using the base year data gathered from BT and the 2016 LLCC Model. First, we used the base year data to calculate CL578 component costs as a proportion of the reference products' 2014/15 FAC. We applied these proportions to our forecast of the reference products' 2018/19 FAC.[312] Second, we multiplied these figures by the relevant CVEs and AVEs to calculate the forecast 2018/19 LRIC of CL578 attributable to the reference products. Finally, we multiplied this figure by [✂] to calculate the active incremental costs.

- **Sales product management (CP502)** – this covers costs associated with activities such as choosing equipment, specifying active functionality, managing

[311] The detail behind this is set out in Annex 23.
[312] We used this method as CL578 is an admin component. It is not possible to apply usage factors to directly calculate how much of a component's cost is attributed to particular services.

product change requests and sales overheads. While we consider that this component is at least partly used for active-specific activities, it was not possible to directly estimate the proportions to allocate to the active incremental layer. We have therefore estimated the share which relates to the active service based on the share of active incremental CO485 and CL578 costs relative to the overall EAD 1Gbit/s cost stack. First, we used the base year data to calculate CP502 component costs as a proportion of the reference products' 2014/15 FAC. We applied these proportions to our forecast of the reference products' 2018/19 FAC. Second, we calculated that the active incremental costs of CO485 and CL578 accounted for approximately [✂] of the EAD 1Gbit/s FAC in 2018/19. Third, we applied this percentage to the forecast of the reference products' CP502 2018/19 FAC, and multiplied this by the relevant CVEs and AVEs to calculate the active differential.

- **Openreach non copper (CW901)** – this covers the costs of Revenue debtors, which are part of the working capital for a service.[313] As with SPM, while we would expect this component to contribute to the active incremental costs, it was not possible to directly estimate the proportions to allocate. We have therefore estimated the CW901 costs which are active incremental on the basis of the share of active incremental CO485 and CL578 costs relative to the overall EAD 1Gbit/s cost stack. First, we used the base year data to calculate CW901 component costs as a proportion of the reference products' 2014/15 FAC. We applied these proportions to our forecast of the reference products' 2018/19 FAC. Second, we calculated that the active incremental costs of CO485 and CL578 accounted for approximately [✂] of the EAD 1Gbit/s FAC in 2018/19. Third, we applied this percentage to the forecast of the reference products' CW901 2018/19 FAC, and multiplied by the ratio of revenue receivable costs to revenues for EAD and EAD LA 1Gbit/s rental services.

A33.259 In addition, we consider that cumulo rates should be considered as an active incremental cost (as set out in Annex 23). The 2016 LLCC Model does not forecast cumulo as a separate line item. However, using the base year cost data, we have been able to calculate cumulo costs as a proportion of non-pay operating costs in 2013/14. We multiplied these proportions by forecast 2018/19 non-pay costs for each reference product to calculate the active incremental costs.

A33.260 The total incremental costs of active elements were calculated by summing the shares of the forecast CO485, CL578, CP502 and CD999 component costs and the forecast cumulo costs.

A33.261 Finally, the dark fibre cost contribution (B in Figure A33.2 above) was then calculated by subtracting the forecast 2018/19 LRIC of active elements from the forecast 2018/19 FAC of the active reference products (as shown in Table A33.24 below). We apply these calculated FAC to the separately forecast dark fibre rental and connection volumes (for both local access and standard).

[313] Revenue debtors are an estimate of the debts owed for each service based on BT's standard payment terms and assuming that the service is sold externally. See also BT's 2014 DAM p. 29.

Table A33.24: Calculation of dark fibre FAC contribution (£)

Dark fibre product	Reference product	A: 2018/19 EAD 1Gbit/s FAC	B: 2018/19 active incremental costs	Dark fibre FAC (A - B)
Dark Fibre Rental – Standard	EAD 1000mb Rental-External-non-WECLA	[✂]	735.60	[✂]
Dark Fibre Rental – Local Access	EAD LA 1000mb Rental-External-non-WECLA	[✂]	710.01	[✂]
Dark Fibre Connection – Standard	EAD 1000mb Conn-External-non-WECLA	[✂]	0.06	[✂]
Dark Fibre Connection – Local Access	EAD LA 1000mb Conn-External-non-WECLA	[✂]	0.05	[✂]

Source: Ofcom analysis using costs and volumes from the 2016 LLCC Model

A33.262 We consider that the dark fibre cost contribution calculated using this method will reflect the 2018/19 forecast FAC of the passive components (e.g. relating to physical infrastructure such as duct and fibre) of EAD 1Gbit/s, as well as the fixed and common costs attributed to active components.

A33.263 While this covers the cost contribution from dark fibre for the 1Gbit/s EAD and EAD LA type dark fibre variants, it does not reflect the following which could have implications for the contribution to non-avoidable costs by dark fibre:

- Dual-fibre dark fibre pricing; and
- Ethernet Main Link, for which there is also an active-minus dark fibre charge (as set out in Annex 23).

A33.264 In relation to dual-fibre dark fibre pricing, we consider it likely that only dark fibre circuits that require WDM (e.g. cannibalised OSA circuits) will utilise the dual-fibre dark fibre option. As set out in Annex 23, the dual fibre price option will allow a CP to order two unlit fibres on the same route and it will be priced at up to double the single fibre rental and connection charge, but will continue to face a single Main Link charge.

A33.265 In relation to Ethernet Main Link, where Main Link exists for the active circuit (i.e. for non-EBD circuits) we assume that BT will recover similar unavoidable costs from the dark fibre Main Link as it would have from the active Main Link when cannibalised by dark fibre.[314] We consider there is no reason to assume that a dark fibre circuit replacing an active circuit will have a different Main Link distance. Furthermore, our cannibalisation assumptions assume one-for-one substitution. Therefore, for these circuits we do not consider it necessary to consider the contribution to non-avoidable costs for dark fibre Main Link relative to the active Main Link.

[314] We found that the unavoidable costs for a non-WECLA Main Link service does not vary significantly across the different circuit types (e.g. EAD, OSA, etc.) it can be purchased with.

A33.266 This is not the case for EBD circuits. These are distance independent and so do not involve a Main Link charge when provided. However, where these are cannibalised by dark fibre, they may (depending on distance) be replaced by a dark fibre circuit which includes Main Link. We have therefore accounted for the additional costs recovered from the appropriate dark fibre Main Link charge.

A33.267 In order to do this, we first need to estimate the non-avoidable costs recovered from the dark fibre Main Link. As set out in Annex 23, we consider the only active element of Main Link to be cumulo, and so have removed these costs from the forecast 2018/19 Ethernet FAC, in order to obtain the contribution to non-avoidable costs by dark fibre Main Link.

A33.268 We then need to estimate an average Main Link distance for the dark fibre circuits that have cannibalised EBD. We have estimated the average Main Link distances for cannibalised new connections and existing circuits[315], using:

- BT's EBD circuit data set (as of May 2015); and

- the maximum distance at which dark fibre has a cost advantage over EBD (see analysis for EBD cannibalisation above).

A33.269 We multiplied the calculated average EBD circuit distances, for existing circuits and new connections, by the forecasted 2018/19 contribution to non-avoidable costs for dark fibre Main Link, and added this to the per circuit dark fibre contribution figure for dark fibre circuits that have cannibalised EBD circuits.

A33.270 We calculated the total dark fibre cost contributions by multiplying the above per circuit contributions by the forecast dark fibre volumes. We set out our results in Table A33.25 below.

[315] We note that cannibalisation of existing circuits results in a lower maximum distance at which dark fibre has a cost advantage over EBD relative to that found for cannibalisation of new connections.

Table A33.25: Calculation of total dark fibre FAC contribution

	Cannibalised from	Dark fibre FAC per circuit (£)	2018/19 forecast volumes	Total dark fibre FAC contribution (£m)
Dark Fibre Rental – Standard	All circuits excl. EBD & EAD LA	[✁]	[✁]	[✁]
	EBD AISBO	[✁]	[✁]	[✁]
	EBD MISBO	[✁]	[✁]	[✁]
Dark Fibre Connection – Standard	All circuits excluding EAD LA	[✁]	[✁]	[✁]
Dark Fibre Rental – Local Access	EAD LA	[✁]	[✁]	[✁]
Dark Fibre Connection – Local Access	EAD LA	[✁]	[✁]	[✁]

Source: Ofcom analysis using costs and volumes from the 2016 LLCC Model

Forecast lost contribution from cannibalised active circuits

A33.271 Having identified the contribution to non-avoidable costs from dark fibre, we then needed to identify the cost contribution forgone from the active circuits forecast to be cannibalised. To do this, we have estimated the long run incremental costs that are avoided as a result of supplying dark fibre for each of the other CISBO active circuits forecast to be cannibalised.[316] This is because BT will still incur the remaining costs when CISBO active circuits migrate to dark fibre, and so will need to be recovered.

A33.272 We have sought to do this for all circuit types which we forecast will experience some cannibalisation. However, we note that for some of the cannibalised circuits we forecast dark fibre to make the same contribution to non-avoidable costs as the active. We have set this out below:

Cannibalised circuit		Cost recovery concern	Explanation why the active does not make a greater contribution than dark fibre
EAD	10 / 100Mbit/s	No	No cannibalisation
	1Gbit/s	No	We consider it reasonable to assume there will be no impact on cost recovery of cannibalisation of these circuits, given our dark fibre pricing approach.
	10Gbit/s	No	In the absence of reliable cost data (given it is a new product type), we consider it reasonable to assume the main difference between the cost of an EAD 1Gbit/s and EAD 10Gbit/s circuit is the electronic equipment.
WES/BES	10 / 100Mbit/s	No	No cannibalisation

[316] Therefore, in practice, this calculation replicates the calculation of dark fibre FAC contribution set out above, but for the cannibalised circuits (rather than EAD and EAD LA 1Gbit/s).

	1Gbit/s	No	The LLCC model assumes MEA volumes for the purposes of modelling the costs of legacy WES and BES services up to and including 1Gbit/s (as set out in Annex 26)
	10Gbit/s	Yes	n/a
OSA	>1Gbit/s	No	An OSA service that is replaced with a dual-fibre dark fibre option will result in BT recovering additional common costs (relative to the active equivalent). Only a very small proportion of OSA circuits need to utilise the dual fibre option to ensure that BT recovers its non-avoidable OSA costs.
EBD	1Gbit/s	Yes	n/a
	10Gbit/s	Yes	n/a

A33.273 In summary, we found the following cannibalised active circuits to make a higher contribution to non-avoidable costs in 2018/19 than the relevant dark fibre product:

- EBD circuits at 1Gbit/s and above; and
- WES circuits with bandwidth above 1Gbit/s.

A33.274 In light of this, we have only set out the non-avoidable costs for these CISBO services. The active specific costs for WES services are found in the same components as those set out when calculating the dark fibre reference price. However, EBD services do not utilise the Ethernet Electronics (CO485) component but instead utilise the Ethernet Backhaul Direct components (CN616, CN617 and CN618).

A33.275 On the basis of information gathered from BT, we analysed the EBD specific components to determine how these might be split into ‘passive’ (e.g. costs associated with the physical infrastructure such as duct and fibre) and ‘active’ (e.g. costs specifically related to the purchase of an active service from BT) elements.

A33.276 We have calculated the active and passive splits for these three EBD components, using data provided by BT which split FAC CCA operating costs and MCE by cost sector for the plant groups used to provide these components.[317] We then combined this with LRIC and FAC data by cost sector for these components[318] to estimate LRIC costs by cost sector by plant group.[319] We then classified each plant group as being either active or passive costs on the basis of the cost and assets within each plant group. For example, we categorised plant groups comprising mainly duct and fibre costs as being “passive” plant groups, whilst we categorised those comprising mainly equipment as “active”.

A33.277 Using this classification, LRIC and FAC data, and data provided via formal information requests, has enabled us to calculate active and passive FAC and LRIC costs for each of the three EBD components. We found that these EBD components contain the following proportion of active-specific costs:

[317] This data was provided for 2014/15 by BT in response to the 27th s135 question D2.
[318] Data provided to us as part of its annual Additional Financial Schedules, schedules AFI2 and AFI4.
[319] We assume cost/MCE split across plant groups is the same for LRIC as it is for FAC within each component.

- **Ethernet Backhaul Direct (CN616)** – we found that [✂]% of this component's LRIC is from active-specific costs.

- **Ethernet Backhaul Direct Extended Reach (CN617)** – we found that [✂]% of this component's LRIC is from active-specific costs.

- **Ethernet Backhaul Direct Resilience (CN618)** – we found that [✂]% of this component's LRIC is from active-specific costs.

A33.278 For each of the services above, we calculated the forecast 2018/19 incremental costs of active elements of the CO485, CN616, CN617, CN618, CL578, CP502 and CD999 components and cumulo costs, using the 2016 LLCC Model and base year data on the basis of the methodology described above. These were summed to calculate the total long run incremental costs that are avoided as a result of supplying dark fibre for above 1Gbit/s services migrating to dark fibre. To calculate the contribution to non-avoidable costs by these active circuits, we then subtracted this figure from the forecast 2018/19 FAC of these services.

Calculation of the total shortfall in cost recovery

A33.279 As we set out above, we are concerned that BT's opportunity to recover its efficiently incurred costs could be undermined as a result of the cannibalisation of these active circuits by the dark fibre remedy. We set out our final shortfall in cost recovery in Table A33.26 below.

Table A33.26: Calculation of shortfall in cost recovery as a result of migration to dark fibre in 2017/18 and 2018/19 (£m)

	Shortfall in cost recovery (£m) in 2017/18	Shortfall in cost recovery (£m) in 2018/19
WES MISBO rent-Internal-non WECLA	n/a	[✂]
WES MISBO rent-External-non WECLA	n/a	[✂]
EBD ONBS Rentals MISBO Internal Non WECLA	[✂]	[✂]
EBD MISBO Rentals External Non WECLA	[✂]	[✂]
EBD ONBS Connections MISBO Internal Non WECLA	[✂]	[✂]
EBD MISBO Connections External Non WECLA	[✂]	[✂]
Total	[✂]	[✂]

Source: Ofcom analysis using costs and volumes from the 2016 LLCC Model

A33.280 In conclusion, we consider there to be £4.5m of non-avoidable costs that BT should be allowed to recover. We discuss how this cost is recovered, within the charge control, in paragraphs A1.321 to A1.350 below.

Stranded assets

A33.281 The risk of stranded assets arises when existing active circuits migrate to dark fibre. In the May 2015 BCMR Consultation, we considered the risks of stranded assets to be low, and given we did not expect migration of existing circuits, we did not consider the risk to be relevant. However, given we now assume some migration, we have reconsidered this issue.

Stakeholders' comments

A33.282 Only BT provided a response to the May 2015 BCMR Consultation that discussed the risk of stranded assets. BT argued that stranded assets would not be limited to duct but also equipment and fibre. It provided some indicative calculations[320] to show that not accounting for stranded assets could create significant irrecoverable costs for BT. It assessed the risk of stranded electronic assets by:

i) considering all new EAD, EBD, WES/BES10G and optical circuits supplied between 2012/13 and 2016/17, i.e. five years prior to the introduction of dark fibre; then

ii) applying 2015/16 equipment costs to these volumes with depreciation applied over a five year life cycle; then

iii) applying its current understanding of CPs' demand for migrating their existing base of circuits to dark fibre in order to compute the Net Book Value (NBV) of the stranded assets in 2017/18, 2018/19, and 2019/20.

A33.283 BT estimated that dark fibre access resulted in stranded assets totalling £[✂] across 2017/18, 2018/19, and 2019/20.

Our conclusions

A33.284 In theory, there is a risk that fibre and equipment becomes stranded when circuits migrate and/or are aggregated. However, we consider it reasonable to only anticipate stranded equipment for the purposes of this LLCC. BT's fibre and duct costs are spread across circuits that are in use, and thus will continue to be recovered even when active circuits migrate to dark fibre.

A33.285 Furthermore, we consider it appropriate that BT has a 'fair bet' of recovering efficiently incurred costs. We accept BT's argument, in principle, that it should be able to recover the cost of stranded assets resulting from the cannibalisation of existing circuits in this review period. If we did not allow BT to recover the cost of stranded assets as a result of the introduction of the dark fibre remedy this could contravene the 'fair bet' principle.

A33.286 Due to the introduction of the dark fibre remedy, we consider it appropriate to account for stranded assets within this market review and charge control. The asset life of BT's equipment (e.g. the active electronics) is around five years. The aim of our charge control is to set a value of X such that BT's prices are in line with our forecast of efficient costs in 2018/19, including a cost of capital. In the absence of migration

[320] See BT's non confidential response to the May 2015 BCMR Consultation, paragraphs 17.91 to 17.94.

due to the dark fibre remedy, BT would have continued to recover some of these depreciated equipment costs in 2018/19.

A33.287 BT has provided its own estimate of the stranded asset cost due to switching from existing active circuits, which we have assessed. We consider cannibalisation of new connections due to dark fibre would not result in stranded assets, [✂].[321] We also consider it appropriate to make the following assumptions when calculating stranded assets:

i) We have only included the estimated cost of stranded assets for circuits that switch within this review period, [✂].

ii) We consider it appropriate to apply an average annual depreciation rate to the estimated volumes of new connections in each financial year.[322] We have used end of year volumes and note that not all of the equipment in a given year will have depreciated by the same amount.

iii) We have used mid-year book values to estimate the cost of stranded assets for each year that dark fibre is available in this review period. We consider it likely that migration to dark fibre will be spread over a given year. Therefore, we consider that the mid-year book value represents the appropriate average depreciated equipment cost for a migrating service.

iv) We have applied our final cannibalisation assumptions for existing circuits to the stranded asset calculation.

A33.288 We have used the 2015 equipment costs that [✂] [323], where it sets out the equipment (e.g. number of transponders, network termination equipment, etc.) that each circuit requires as well as the cost of each piece of equipment. We have assessed BT's calculations and have concluded that they provide a reasonable estimate of the per circuit equipment costs. We found that allowing for annual price changes for the equipment cost lowers the estimated stranded asset value. However, allowing for a reasonable downward price trend (e.g. 5% saving per year) results in our £1.89m estimate falling to £1.88m.[324] Therefore, we consider it a reasonable simplifying assumption to use the average 2015/16 equipment cost figure for all years.

A33.289 For completeness our analysis is broken down (incrementally) for each of our assumptions that differ from BT's (see Table A33.27 below). For example, we have set out the impact of assuming BT's cannibalisation figures for existing circuits in 2018/19. However, we consider our assumptions to be appropriate and have provided this breakdown to illustrate the sensitivity of each of our assumptions.

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[321] We consider it likely that the loss of a new active connection would not result in any stranded assets since BT would not have needed to deploy active equipment for the cannibalised new connection.

[322] We assume a uniform distribution of depreciation over a year and thus apply half of a full year's worth of depreciation in the first year, and a full year's worth for each subsequent year.

[323] BT has provided its calculations for the average 2015 equipment cost for each circuit as part of the 27th LLCC s135 request.

[324] Due to the use of average annual depreciation rates, more of the stranded asset cost for 2018/19 is from 2016/17 equipment rather than equipment from 2014/15 and before. For example, the equipment obtained in 2012/13 is fully depreciated by 2018/19. Therefore, by applying an annual downward price trend to the equipment cost, the decrease in the 2016/17 equipment costs is more significant than the increase in the 2014/15 equipment costs.

Table A33.27 – impact of Ofcom's assumptions relative to BT's stranded asset estimation

Incremental adjustment to BT's estimate	Total estimated cost of stranded assets
None (i.e. BT's estimate as submitted)	£[✂]
+ [✂]	£45m
+ [✂]	£31m
+ Using BT's migration rates for 2018/19[325]	£20m[326]
+ Using Ofcom's migration rates	£1.9m

Source: BT's response to s135 request with Ofcom adjustments

A33.290 We note that Openreach sets termination charges for 10Gbit/s circuits with five year contract periods. These termination charges can be reasonably large dependent on the rental price for that circuit. We recognise that for any circuits under long term contract periods, BT could potentially recover the cost from its stranded assets from those services via its early termination charges. However, we note that many of the circuits obtained from Openreach (in particular EBD[327] and WES) are for one year contracts only, and thus not subject to early termination charges.

A33.291 Furthermore, BT has provided us with average contract lengths for 2013/14. This showed that AISBO and MISBO circuits, installed in 2013/14, had an average contract length of [✂] and [✂] years, respectively.[328] Therefore even recently installed circuits will on average likely have a contract length of 1-3 years. We also note that after the initial contract term is completed, AISBO and MISBO contracts move to a rolling one-month term (i.e. with no early termination charges).

A33.292 Therefore, we do not consider we have a reasonable basis to reflect early termination charges (to the extent they are paid) to adjust the scale of stranded assets. In conclusion, we consider £1.9m to be a reasonable estimate of the additional cost to be recovered by BT due to stranded assets.

Implementation costs

June 2015 LLCC Consultation

A33.293 In the June 2015 LLCC Consultation, we said that BT will incur additional costs as a result of implementing a dark fibre remedy, over and above those incurred in providing active services only. We said that these costs relate to the implementation of the dark fibre product and include system development costs, training and operational costs and additional management overhead. We proposed

[325] We continue to assume no migration in 2017/18 as we consider this will likely be a period of testing and trialling for dark fibre. Furthermore, we account for the impact of stranded assets by ensuring that we forecast BT's efficiently incurred costs in 2018/19. Therefore we are interested in the impact of strand assets in 2018/19 in any case.
[326] We note that around [✂]% of this £20m is due to migration from OSA.
[327] We note that migration of EBD 10Gbit/s accounts for around [✂] of the total 2018/19 cost from stranded assets.
[328] These figures do not include contracts now on rolling one-month terms. See BT's confidential response to the 2nd Tranche of the LLCC 2nd s135 request.

that BT should be able to recover its efficiently incurred dark fibre implementation costs.

A33.294 We looked at Statement of Requirement (SoR) 8434 submitted by Vodafone on 18 November 2014 which requested that BT provides general dark fibre connectivity. We recognised that the estimates within this SoR were based on a dark fibre product as requested by Vodafone rather than the specific remedy we proposed in the May 2015 BCMR Consultation.[329] However, we considered that these provided a reasonable estimate for the 2015 LLCC Model given the similarities between the two.

A33.295 Based on the information BT provided, we estimated a reasonable level of the costs that BT would incur for the implementation of a dark fibre product to be [✂] [£5m to £10m] in each year of the charge control.

Stakeholders' comments

A33.296 BT responded that the actual dark fibre implementation costs are likely to be higher than indicated in the consultation, and would only be understood on full completion of the design of the remedy. It proposed that where actual implementation costs differ from forecasts, any shortfall is recovered as a premium on the dark fibre price.[330]

A33.297 TalkTalk agreed that BT should be allowed to recover its dark fibre implementation costs. However, it considered the figure of £5 to £10 million to be excessive given that dark fibre is merely a sub-set of the existing Ethernet product (i.e. EAD without the boxes) rather than a brand new product.[331]

Our conclusions

A33.298 As noted in the June 2015 LLCC Consultation, BT is likely to incur a range of implementation costs associated with the introduction of dark fibre. For example, BT is likely to have to make changes to its internal systems (planning and build systems, billing systems, etc.) and incur additional operational and training spend.

A33.299 However, as set out in Annex 22, BT will be required to provide dark fibre circuits in similar configurations to some of the existing active services. Therefore BT's processes and systems for providing EAD and EAD LA should be capable of adaptation to include the provision of dark fibre access. As a result, we expect that implementation costs incurred will largely be for adaptations of existing processes and systems, rather than substantial development of new ones.

A33.300 Since the June 2015 LLCC Consultation, BT has provided an updated estimate of its expected dark fibre implementation costs.[332] BT estimated that:

- its system development costs are likely to be between [✂] [£0-10m] which are going to be depreciated over a five year lift time period; and

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[329] BT has also informed us that the data has a lower level of accuracy as it was derived from its Rapid Impact Assessment.
[330] BT response to the June 2015 LLCC Consultation, paragraph 176.
[331] TalkTalk response to the June 2015 LLCC Consultation, paragraph 8.24.
[332] BT's response dated 19 February 2016 to Section C of the 33rd s135 Notice dated 17 February 2016.

- its operational costs are likely to be between [✂] [£0-10m] which would not be capitalised.[333]

A33.301 Overall, BT anticipated these costs to be [✂] in total which is [✂] than its estimate of [✂] of product development costs required to deliver the dark fibre product requested in Vodafone's SoR. BT explained this difference by saying that [✂].

A33.302 We have assessed the updated dark fibre implementation costs that BT submitted. While we consider BT's estimate of system development costs to be reasonable, we disagree with its estimates for additional operational costs.

We have rejected BT's request to recover additional costs for new provision engineers

A33.303 BT stated that it expects to recruit, train and equip approximately [✂] new provision engineers which will incur a cost of [✂]. BT explained that this estimate is based on its forecast for a net increase in Ethernet provisions due to the introduction of a dark fibre product.[334]

A33.304 We agree in principle that BT should be able to recover its efficiently incurred operational costs which result from an increase in Ethernet provisions. We note that the effect on costs from changes in volumes is generally captured by the volume forecast we use to model BT's costs over the period of the charge control. Thus, everything else being equal, if there is an increase in volumes in a given year, we would also be forecasting higher costs that BT will incur in that year.

A33.305 We consider that the effect of introducing dark fibre on BT's operational costs is captured by our volume forecasts, including but not limited to our analysis on the potential for cannibalisation of active circuits. On that basis, we expect that BT will be able to recover all of its efficiently incurred dark fibre operational costs related to the recruitment of new provision engineers over the charge control period without making a specific cost uplift to allow for this.

A33.306 Therefore, we have rejected BT's request to recover additional costs for new provision engineers.

We have rejected BT's request to recover additional costs for new repair engineers

A33.307 BT also explained that it expects to recruit, train and equip approximately [✂] new repair engineers and that as a result of this, it will incur a cost of [✂]. BT explained that the increased repair resource is needed to support the dark fibre product because all dark fibre faults would require a truck roll (visit by BT engineer in order to determine the exact fault).

A33.308 We disagree with BT that the introduction of dark fibre would require an increased repair resource. As noted in Annex 23, we consider it likely that if BT were only to provide a dark fibre service it would have to handle fewer fault reports. We consider it likely that BT would not have to deal with faults associated with active

[333] BT did not provide any management overheads.

[334] In particular, BT has indicated that it expects a number of migrations to take place via a "provide then cease" route which increases the overall volumes of "new provides" and requires an increased number of dark fibre engineer support.

equipment failures and CPs would operate the network equipment that would therefore enable them to take a bigger role in fault diagnosis. We therefore consider that there is likely to be a reduction in BT's costs related to fault repair if a dark fibre rather than an active service is provided.[335]

A33.309 Furthermore, for those faults where the work is not covered within BT's terms of service, if there is an increase in BT's costs for fault repair due to additional truck rolls, we consider that BT would be able to recover the efficient level of these costs through its TRC charges. As noted in Vol II Section 8, we consider it unlikely that there will be a material difference between the costs incurred for dark fibre TRCs relative to active TRCs, and so set the same regulated charges for TRCs relating to dark fibre as we do for active products.[336] Finally, as set out in Vol I Section 8, there may be faults requiring TRCs that other CPs can reasonably provide, which are therefore contestable and therefore it is not necessary for BT to provide these TRCs. Therefore, we have rejected BT's request to recover additional costs for new repair engineers.

A33.310 Based on the information BT provided and by applying the above adjustments, we have estimated the level of costs that BT would incur for the implementation of a dark fibre product. Table A33.28 below shows a breakdown of our estimate, including the life time of any capitalised costs.

Table A33.28: Estimate for BT's dark fibre implementation costs

Type of cost	Total cost	Life time
System Development	[✂]	[✂]
Operating costs	[✂]	[✂]
Total	[✂]	[✂]

Source: Ofcom, BT response dated 19 February 2016 to Section C of the 33rd s135 notice dated 17 February 2016

A33.311 Therefore we have calculated that BT will incur in total approximately £[✂] related to dark fibre implementation costs. Given that our estimate of BT's implementation costs is lower than previously provided, we consider this to be consistent with TalkTalk's response that our previous estimate was too high.

A33.312 We note that some of these costs are capitalised over a life time that is longer than the review period. We consider it appropriate that these capitalised costs are amortised and recovered over their expected lifetimes.[337] This results in £[✂] of system development costs to be recovered per annum within the review period.

A33.313 We now discuss, in the sub-section below, how the common cost uplift, stranded assets and implementation costs that apply to this review period are recovered within the charge control.

[335] See Annex 23, paragraph 23.69.
[336] See Section 8, paragraph 8.106.
[337] This is in line with BT's normal approach to these costs, which means that such development costs are likely to form part of BT's regulated cost base beyond this charge control.

Recovery of common cost uplift, stranded assets and implementation costs

June 2015 LLCC Consultation

A33.314 To address the risks to BT's common cost recovery, we proposed to add the non-avoidable cost differentials between cannibalised active circuits and dark fibre into the Ethernet basket cost forecast.[338] This provided BT with an opportunity to recover these costs from the Ethernet basket, and had the benefit of providing BT with some flexibility over how it then sets charges to recover them, including how they are recovered across dark fibre as well as active circuits. We considered it appropriate to include an additional £4.6 million in the Ethernet basket FAC in the final year of the control.

A33.315 We also proposed to include the dark fibre implementation costs in the Ethernet basket, so in effect they were recovered across all (active and dark fibre) circuits. This ensured that competition, between dark fibre and active services, was not distorted thus allowing the development of competition based on dark fibre access. We considered it appropriate to include [✂] [£5m to £10m] in dark fibre implementation costs in each year of the charge control.

A33.316 We did not consider recovery of stranded assets in the June 2015 LLCC Consultation.

Stakeholders' comments

A33.317 BT and KCOM argued that implementation costs are likely to occur regardless of demand for passives and should be recovered from both the active and passive products.[339] This is to avoid the additional risk of under-recovery of these costs if passive usage is over-estimated.

A33.318 BT disagreed with our approach of spreading non-capitalised one-off development costs over the duration of the charge control, stating that it would lead to under-recovery of these costs over the charge control period.

A33.319 TalkTalk agreed that development costs should be recoverable by BT and should be recovered across all active and dark fibre circuits. If these costs were only recovered from dark fibre this would distort competition and ultimately reduce consumer benefits. [340] [✂].[341]

A33.320 Vodafone proposed recovery of development costs only from dark fibre and internal BT equivalents. It argued that the implementation costs are clearly incremental to dark fibre services and not active Ethernet services as a whole, and that it cannot be assumed that every CP will use dark fibre access equally. It also argued that downstream BT should make a contribution to these costs, even if it does

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[338] In other words, we multiply the difference in non-avoidable costs by the volume of cannibalised active circuits.
[339] See page 39 of BT's response to the June 2015 LLCC Consultation. See page 4 of non-confidential KCOM response the November 2014 Passives consultation.
[340] TalkTalk's non-confidential response to the June 2015 LLCC Consultation, paragraph 8.24.
[341] [✂].

not end up using dark fibre, similar to Ofcom's treatment of PPC points of hand-over costs and LLU development costs.[342]

Our conclusions

Recovery over time

A33.321 In order to allow BT to recover its efficiently incurred costs, we need to adjust costs in the Ethernet basket, as otherwise the dark fibre remedy would undermine BT's opportunity to recover its efficiently incurred costs. This requires a departure from setting the LLCC to only account for costs for active services in the Ethernet basket.

A33.322 Furthermore, aside from on-going operating costs, BT is likely to incur most of its dark fibre implementation costs before the product is launched, i.e. in year one of the charge control. If we allocate all of those costs in that year, the use of a glide path would mean that the value of X would not vary depending on the inclusion of these implementation costs. This is contrary to our aim to incorporate these costs in the charge control.

A33.323 Therefore we need to consider how to spread the recovery of the common cost uplift, stranded assets and implementation costs in the charge control, such that there is a reasonable opportunity for their recovery.

A33.324 Under our incentive regulation approach, we use glide paths to give BT an incentive to make efficiency savings as high returns are only eroded gradually. However, the cost uplift we are considering does not relate to efficiency gains, and so we do not consider that such an approach is appropriate in this case. We also note that these costs are not strictly related to active services only and so may not form part of the active services cost base in 2018/19.

A33.325 The purpose of our dark fibre related cost adjustments is to give BT the opportunity to recover these costs, which otherwise risk going unrecovered. We note that an approach where all the costs are allocated to 2018/19 would, through a glide path approach, mean that BT would be likely to over recover these costs. This is because it would allow additional recovery of costs in 2016/17 and 2017/18.[343] Given these factors, we consider it appropriate to spread the recovery of the common cost uplift, stranded assets and one-off operational dark fibre implementation costs across the charge control period. This is because we consider it will allow BT the opportunity to recover these costs, without leading to over-recovery.

A33.326 Furthermore, we consider it appropriate to spread these costs equally across the charge control period. We note BT's concerns of annualising the one-off implementation costs[344], but we consider this to be appropriate as our controls are based on forecast costs (not revenues) and seek to preserve BT's opportunity to

[342] Vodafone's non-confidential response to the June 2015 LLCC Consultation, paragraphs 4.9-4.15.

[343] BT will have the opportunity to not only recover all of the common cost uplift, stranded assets and implementation costs in 2018/19, but will also face a less negative X and thus a less aggressive movement of prices to costs.

[344] We note that this approach results in the uplift to forecasted revenues in the LLCC model being lower than the uplift to the forecasted costs. This is a product of the glide path approach whereby revenues are brought down gradually to forecasted costs, and so an uplift to forecasted costs does not necessarily equate to the same uplift in forecasted revenues (particularly when current revenues are above costs).

recover its efficiently incurred costs. As noted above, we have amortised the capitalised dark fibre implementation costs. This results in the following annualised dark fibre implementation costs to be recovered within the review period:

Table A33.29: Ofcom's estimated per annum dark fibre implementation cost for BT to recover in the LLCC

Type of cost	Cost per year of the control
One-off costs	£[✂]
Capex (amortised)	£[✂]
Total	£[✂]

Source: Ofcom analysis of BT response dated 19 February 2016 to Section C of the 33rd s135 notice dated 17 February 2016.

Recovery over product type

A33.327 We believe that BT should be able to recover the common costs that are no longer recovered from the cannibalised active circuits, as well as the efficiently incurred dark fibre implementation costs and stranded assets. However, there is a question of where these costs should be recovered from. Given our use of an active minus pricing approach for the dark fibre remedy, we have considered two options for recovery of the common cost uplift, stranded assets and implementation costs:

- recovery from dark fibre circuits only; and
- recovery as part of the Ethernet charge control basket, which would allow recovery from both active and passive circuits.

A33.328 We consider it appropriate to allow recovery of the common cost uplift, stranded assets and implementation costs from both actives and dark fibre. This ensures that competition, between dark fibre and active services, is not distorted, thus allowing the development of competition based on dark fibre access. Furthermore, this is consistent with the approach we have used in previous charge controls (e.g. LLU system set-up costs and LLU line testing costs).[345]

A33.329 We consider it appropriate to set a safeguard cap on very high bandwidth services rather than a charge control (see Section 8 in Volume 1). Therefore we are not seeking to model and set costs for these services. Given this, we consider it

[345] In the November 2005 LLU Statement, we decided that LLU line testing costs should be pooled with public switched telephone network (PSTN) line test costs and spread across all lines (see paragraph 4.62 in Ofcom, *Local loop unbundling: setting the fully unbundled rental charge ceiling and minor amendment to SMP conditions FA6 and FB6 - Statement*, 30 November 2005, http://stakeholders.ofcom.org.uk/binaries/consultations/llu/statement/llu_statement.pdf (November 2005 LLU Statement). Also, in the December 2004 WLA Statement, we decided that if possible, LLU system set-up costs should be pooled together with equivalent BT Digital Subscriber Line (DSL) system set-up costs and spread across all local loops used to provide DSL services (see paragraph 8.25 in Ofcom, *Review of the wholesale local access market. Identification and analysis of markets, determination of market power and setting of SMP conditions - Explanatory statement and notification*, 16 December 2004, http://stakeholders.ofcom.org.uk/binaries/consultations/rwlam/statement/rwlam161204.pdf (December 2004 WLA Statement)

would be inappropriate to allocate the common cost uplift, stranded assets and implementation costs to these services.

A33.330 We have reviewed the application of the six principles of cost recovery in order to determine the appropriate option for recovery of the common cost uplift, stranded assets and implementation costs.[346] This has been considered within the context of our overall analysis for the introduction of a dark fibre remedy.

A33.331 In conclusion, we consider that our six principles of cost recovery indicate that the common cost uplift, stranded assets and implementation costs should be recovered from both dark fibre and active circuits. Our assessment of the appropriate products to recover these costs is set out below.

Cost causation - costs should be recovered from those whose actions cause the costs to be incurred at the margin

A33.332 The cost causation principle is that costs should be recovered from those whose actions cause the costs to be incurred at the margin. Although the common cost uplift, stranded assets and implementation costs are incurred by the supply of dark fibre generally, they are not marginal to any individual connection. In addition, as supported by Vodafone, we consider that BT will incur these costs due to the activities of providers wishing to have wholesale access to its dark fibre.

A33.333 This may suggest that the costs should be recovered by the users of dark fibre, rather than any specific dark fibre connection. However, most CPs that have engaged in this BCMR have expressed their interest in using dark fibre. Moreover, we expect most CPs to start using dark fibre, to some extent, once the product is developed. Therefore, we consider that the users of dark fibre also represent a significant majority of the users of BT's active leased lines services.

A33.334 In these circumstances, we are of the view that the cost causation principle does not provide decisive guidance on the allocation of the common cost uplift, stranded assets and implementation costs. The costs are not marginal to individual connections and the group of dark fibre users is anticipated to be largely the same as the group of active circuit users. This suggests that the other principles should be carefully considered before reaching a conclusion.

Distribution of benefits - costs should be recovered from the beneficiaries, especially where there are externalities

A33.335 Wholesale access to BT's fibre is expected to foster competition in the provision of downstream active leased line services, increasing the choice of services available to consumers, as well as, generating pressure on the level of prices and on the quality of these services. Hence, we believe that all leased line customers can be expected to benefit from this increased competition, not just those served by CPs using BT's dark fibre.[347]

A33.336 We consider this indicates that both dark fibre and active circuits recover these costs. The alternative of recovering all of the common cost uplift, stranded

[346] These principles were endorsed by the Monopolies and Mergers Commission (MMC), Telephone Number Portability: A report on a reference under s13 of the Telecommunications Act 1984 (MMC, 1995).

[347] See Annex 18 for our detailed analysis of the benefits of passive remedies.

assets and implementation costs from only dark fibre customers would mean that a group of customers would benefit from the increased competition, but would not contribute towards these costs. Furthermore, we consider it appropriate to recover these costs from 1Gbit/s circuits in particular, since they are likely to gain from the dark fibre access remedy in this review period.

Effective competition - the mechanism for cost recovery should not undermine or weaken the pressures for effective competition

A33.337 This principle suggests that the common cost uplift, stranded assets and implementation costs should be recovered in a way which is competitively neutral. We consider this to mean that there should be a level playing field for all providers of active services, irrespective of the means they use to provide them.

A33.338 As noted in Annex 23, these costs do not relate to the active layer; they do not form part of the 'minus' element in our 'active minus' approach to pricing dark fibre. If only dark fibre recovered these costs, then once the dark fibre price had been calculated on an active minus basis it would then need to be adjusted upwards to allow for these costs. This could create a distortion in the purchase decision between active and passive services, and so could undermine take-up, e.g. 1Gbit/s services may no longer be viable with dark fibre. Furthermore the relatively low dark fibre volumes when it is first introduced could lead to a large per circuit mark-up, leading to price volatility. In addition, uncertainty over take-up of dark fibre, and therefore the volumes over which these costs could be spread across, may pose a risk of under- or over-recovery and a degree of price instability, which could further undermine take-up. We consider that this would have the effect of undermining competition resulting from dark fibre.

A33.339 In addition, there are some providers who seek to provide passive access services only, rather than active services. We have decided to price dark fibre on an active minus basis, which results in a higher dark fibre price than if it were provided on a cost-plus basis. This ensures that other providers of dark fibre services can recover their costs, as long as they are at least as efficient as BT.

A33.340 Including the common cost uplift, stranded assets and implementation costs in the basket will likely increase the price of both active and dark fibre services. Therefore it is likely that this approach will ensure effective competition between CPs that use different wholesale products.

Cost minimisation - the mechanism for cost recovery should ensure that there are strong incentives to minimise costs

A33.341 We consider there to be limited ability for BT to minimise costs for the common cost uplift and stranded assets. These costs are linked to dark fibre volumes and so a minimisation of these costs would likely involve a limitation of dark fibre take-up. We do not consider this type of cost minimisation to be beneficial to the market given that it may limit the benefits from introducing dark fibre. We set out our decision on the scope of the dark fibre remedy in Section 9 of Volume 1. Therefore recovery of all of the common cost uplift, stranded assets and implementation costs from dark fibre only would result in cost minimisation that we consider to be detrimental to the market.

A33.342 One way to provide BT with incentives to minimise dark fibre implementation costs would be for it to bear all or some of these costs on its own services. If BT did not contribute to these costs, it would have little incentive to minimise these costs. In particular, increasing such costs would affect the viability of the business case of its competitors and reduce the probability of increased competition in associated downstream markets. On the other hand, there should also be an incentive on potential dark fibre users to avoid inefficiently expensive solutions, as they have some ability to influence the technical specification to be implemented. Such incentives would be absent if BT were to bear all the costs.

A33.343 Therefore we consider it likely that spreading the common cost uplift, stranded assets and implementation costs across both BT and dark fibre users will create the greatest incentives for cost minimisation. We expect most CPs to start using dark fibre, to some extent, once the product is developed.

Practicability - the mechanism for cost recovery needs to be practicable and relatively easy to implement

A33.344 The pattern of migration and long term level of demand for passive circuits is difficult to forecast. Therefore recovery of the common cost uplift, stranded assets and implementation costs from dark fibre only may raise practicality concerns and could result in uncertainty and volatility in pricing.

A33.345 We consider that recovery of the common cost uplift, stranded assets and implementation costs across both active and dark fibre circuits should allow a smoother and more predictable opportunity for their recovery. Given the nature of the pricing approach for dark fibre, this would in effect result in these costs being recovered across both active circuits and dark fibre. As noted above, the common cost uplift, stranded assets and implementation costs do not form part of the LRIC associated with the imposed dark fibre product, i.e. they do not form part of the 'minus' element. We consider our approach allows BT to recover these costs from both its active and passive products, which is likely to be more practical and also allow BT some flexibility in their recovery.

Reciprocity - where services are provided reciprocally, charges should also be reciprocal

A33.346 The reciprocity principle does not provide any useful indication in this case, because dark fibre services are not going to be provided reciprocally.

Calculating the allocation to be included in the Ethernet basket

A33.347 In light of Ofcom's six principles of cost recovery, we consider it appropriate to recover the common cost uplift, stranded assets and implementation costs from both active and dark fibre circuits.

A33.348 In terms of recovery from active circuits, we consider it appropriate to recover these costs from those circuits that are likely to benefit the most from dark fibre. Those circuits are likely to be the 1Gbit/s circuits in the Ethernet basket that will switch to dark fibre in the long term.[348] Therefore we consider it appropriate to account for recovery of the common cost uplift, stranded assets and implementation costs from:

[348] We also note that in the short and medium term, these circuits might benefit from dark fibre due to lower prices and/or higher quality of service as a result of dark fibre potentially being a viable alternative.

- non-cannibalised circuits with bandwidth of 1Gbit/s; and
- dark fibre circuits.

A33.349 We note that non-cannibalised circuits with bandwidth above 1Gbit/s could also benefit from dark fibre, and that these circuits are not charge controlled. However, we do not consider it appropriate to assume recovery of the common cost uplift, stranded assets and implementation costs from these services. This is because we do not set the prices of these services to equal forecasted costs, since they are not in the charge control.

A33.350 As dark fibre is priced to recover the same common costs as 1Gbit/s, we split the costs proportionately between dark fibre and 1Gbit/s circuit volumes. This proportion is calculated using the ratio of:

$$\frac{\text{Forecast EAD 1Gbit/s active circuits (that are not cannibalised)[349]}}{\text{Forecast volume of all dark fibre and EAD 1Gbit/s [350]}}$$

A33.351 This ratio assumes that within the Ethernet basket, BT will only recover the common cost uplift, stranded assets and implementation costs from EAD and EAD LA 1Gbit/s circuits. We have taken this into account when setting the EAD 1Gbit/s sub-basket (see Vol II Section 5), which will allow BT the opportunity to recover these costs from EAD 1Gbit/s. Furthermore, we note that assuming recovery from all 1Gbit/s circuits within the Ethernet basket does not significantly change the ratio (it results in a ratio of 0.88 rather than 0.87).

Final conclusion on the impact of dark fibre to the LLCC

A33.352 Given the circumstances and balance of risk, in terms of over- and underestimating, we consider our final cannibalisation assumptions provide a reasonable estimate. These are set out in Table A33.30 below.

Table A33.30 – Ofcom's final cannibalisation assumptions for all circuits[351]

Product		Existing circuits (17/18)	Existing circuits (18/19)	New circuits (17/18)	New circuits (18/19)
EAD LA	10/100M	0%	0%	0%	
	1G		4%	25%	95%
	10G		17%	25%	95%
EAD & WES/BES	10/100M		0%	0%	
	1G		6%	25%	95%
	10G		29%	25%	95%

[349] This is the forecast volume of EAD 1Gbit/s circuits in the LLCC Ethernet basket, following a reduction due to cannibalisation from dark fibre, across the entire charge control period.
[350] This is the total forecast volume of EAD 1Gbit/s circuits within the Ethernet basket and dark fibre circuits across the entire charge control period.
[351] For new EAD and OSA connections, we have rounded our estimates to the nearest 5% recognising the uncertainty around forecasting dark fibre volumes.

OSA	>1G		0%	25%	95%
EBD	1G		0%	1%	6%
	10G		12%	14%	57%

Source: Ofcom analysis

A33.353 Given these cannibalisation assumptions, we consider there to be £4.5m of non-avoidable costs that BT should be allowed to recover (primarily driven by cannibalisation of EBD 10Gbit/s circuits). On top of this, due to cannibalisation of existing circuits, we consider it appropriate to account for £1.9m of stranded assets. We also consider it appropriate to allow BT to recover £[✂] of implementation costs.

A33.354 We consider it appropriate to allow the recovery of costs due to cannibalisation (i.e. the common cost uplift and stranded assets) across the charge control period. With the implementation costs, we consider it appropriate to spread the capitalised costs over their asset life and the non-capitalised (one-off) costs over the charge control period.

A33.355 Finally, we consider it appropriate to recover the common cost uplift, stranded assets and implementation costs across both active and dark fibre services. We have therefore allocated a proportion of these costs to the Ethernet basket costs based upon the relative volumes of EAD 1Gbit/s and dark fibre rentals, calculated across the entire period of the charge control. This results in 87% of these costs being allocated into the Ethernet basket.

A33.356 In conclusion, we therefore consider it appropriate to uplift the 2018/19 forecast costs for the Ethernet basket by including:

- **Common cost uplift** – approximately £1.3m in total, or about 0.3% of the Ethernet basket costs.
- **Stranded assets** – approximately £0.7m in total, or about 0.2% of the Ethernet basket costs

A33.357 Implementation costs – approximately £[✂] in total, or about [✂]% of the Ethernet basket costs.

Annex 34

Discounts

A34.1 In Volume I of this statement, we conclude that BT should be allowed to offer discounts for TI and CISBO services, subject to the non-discrimination obligations imposed.352 In this Annex we set out our conclusions as to whether such discounts should be allowed to count towards BT's compliance with the Ethernet and TI charge controls.

A34.2 There are four main types of discounts that BT can offer its leased line customers:

- **volume discounts** – discounts offered on the basis of the volumes bought by the customer;
- **geographic discounts** – discounts offered for services consumed in particular geographic areas;
- **time-limited discounts** – discounts offered for a limited period of time; and
- **term products** – offered for committing to buy a service for a certain period of time, typically beyond the standard contractual period.

A34.3 In this Annex we set out our decisions that:

- volume discounts will not count towards compliance;
- geographic discounts will not count towards compliance;
- time limited discounts will count towards compliance[353];
- three and five year term products subject to our Total Costs of Ownership (TCO) restriction[354] will count towards compliance. No other forms of term product will count towards compliance; and
- discounts will not be included in our starting charges.

A34.4 Below, we discuss how we have decided to assess whether discounts should be allowed to count towards BT's compliance in the charge controls and then the reasons for our decision in relation to each type of discount in turn.

[352] Volume I, paragraphs 8.93-8.97. In the event of an allegation that BT offered unduly discriminatory discounts, we would judge each alleged breach of the no undue discrimination obligation on a case by case basis.

[353] Time limited discounts will not count towards compliance with the control on sub-caps. We explain this further in our section on time limited discounts below.

[354] Only those three and five year term products that comply with our Total Cost of Ownership (TCO) restriction will be allowed to count towards BT's compliance with the charge control. We explain this restriction further in our sub-section on term discounts below.

Allowing discounts to count towards compliance

We will only restrict BT's ability to offer discounts where the potential risks appear to outweigh the potential benefits, and these risks cannot be mitigated

June 2015 LLCC Consultation

A34.5 In the May 2015 BCMR Consultation, we proposed that BT should be allowed to offer discounts for TI and CISBO services, subject to the non-discrimination obligations proposed. We therefore considered in the June 2015 LLCC Consultation whether such discounts should be allowed to count towards BT's compliance with the charge control.

A34.6 In deciding on our proposed treatment of the various types of possible discount, we considered the following questions in the June 2015 LLCC Consultation:

- Do the potential benefits of discounts outweigh the potential risks associated with them? and,
- If we allow discounts to count towards compliance, can the risks (e.g. to competition) be mitigated?

Stakeholders' comments

A34.7 BT argued that discounted products are important for it to be able to generate the volumes it forecasts. Furthermore, it argued that "*[f]undamentally Openreach is increasingly only able to achieve the overall forecast volumes used by Ofcom in calculating the charge control through targeted price offerings including discounts of various types*". In BT's view, its commercial incentives to offer price discounts are reduced when they are not included in the basket for compliance purposes as, if they are not included in the basket, there is a significant risk that any discount schemes would lead to returns below the cost of capital.

A34.8 BT did not agree with our test to decide whether certain discounts should be allowed to count towards BT's compliance in the charge control. BT argued that all forms of discount which are compliant with competition and regulatory law should be allowed to count as they cannot be considered as unduly benefiting BT. It argued that any anti-competitive risks associated with such compliant discounts will either be immaterial or outweighed by their benefits. It therefore considered the first question in paragraph A34.6 above to be superfluous.

A34.9 Vodafone suggested that we should put in place "clear reporting that provides transparency on the BT / Non-BT split of discounting benefit as well as details of the discounts that have been made available."[355]

A34.10 TalkTalk commented that it would be useful if BT provided details of average discounts applied within its *ex post* compliance reporting.

Our conclusions

A34.11 The provision of discounts and different tariffs is common in competitive markets. They can often be beneficial for end-users and lead to improvements in economic

[355] Vodafone response to the June LLCC consultation, paragraph 3.18.

welfare. For example, where they are used as a form of second or third degree price discrimination,[356] they can increase total output by making products affordable to end-users that would not be willing or able to purchase a product or service if there was uniform pricing.

A34.12 However, in markets where there is a vertically-integrated firm with SMP upstream, discounts at the wholesale level can be used to stifle or otherwise distort competition (both upstream and downstream). For example, by designing a discount scheme that its downstream operation is disproportionately better placed to benefit from, the vertically-integrated firm can enhance the competitive position of its downstream operation. Even in circumstances where notionally a discount is available to all downstream operators, the use of conditions or limitations can limit the extent to which certain downstream operators are able to take advantage of it.

A34.13 The use of discounts can have distributional impacts beyond those that are anti-competitive in nature. The charge control restricts BT's overall cost recovery. If discounts are allowed to count towards BT's compliance with the charge control they are unlikely to lead to lower prices overall, but they may change the distribution of cost recovery across customers. For example, if BT were able to offer a discount that was more suitable for their downstream business than other CPs (and this discount were able to count towards compliance) then prices would likely be higher for other products to compensate for this discount. This would decrease the amount paid by BT downstream but increase the amount paid by external CPs (with the same amount of revenue still being recovered overall). This could reduce the effectiveness of the control.

A34.14 While competition law can be effective in addressing anti-competitive (or exploitative) behaviour, *ex ante* remedies can be a useful complementary constraint, particularly when there are identified risks of anti-competitive behaviour. Furthermore, *ex ante* regulation is likely to be more effective where distributional concerns arise. In our view, it is therefore appropriate to separately assess whether discounts should contribute towards BT's compliance with the charge control.

A34.15 If we consider for a particular type of discount in question that the benefits of the discount outweighs the potential risks, and we are able to sufficiently mitigate any potential risks associated with the discount, we will allow that type of discount to contribute towards compliance with the charge control without requiring further *ex ante* restrictions or tests each time BT offers the discount.[357] If this is not the case, we will not allow the discount to contribute towards compliance with the charge control. Disallowing discounts from the assessment of BT's compliance with the charge control is likely to reduce BT's incentives to pursue such discounts, as BT also noted in its response in the context of geographic discounts.

A34.16 Our approach, in which we have only not allowed the discount to contribute towards compliance with the charge control where the potential risks appear to outweigh the potential benefits, and these risks cannot be mitigated, strikes this appropriate balance in our view

[356] A firm engages in second degree price discrimination when it charges a different price depending on the quantity purchased. Third degree price discrimination means charging a different price to different customer groups.
[357] Although we note that BT still needs to comply with its other regulatory obligations and competition law.

A34.17 Regarding Vodafone and TalkTalk's suggestions on reporting, we note that we are able to request information on the details of discounts offered by BT where there are particular concerns about inappropriate behaviour. It is therefore not clear that additional reporting requirements would be proportionate or appropriate. As we noted in our 2014 Regulatory Financial Reporting Statement, we did not consider that the published Regulatory Financial Statements can or should provide stakeholders with all the information necessary for them to determine whether an SMP provider has complied with its obligations. It is for BT to demonstrate its compliance to us.[358] If CPs are concerned about specific practices, there are established ways to raise such issues with Ofcom.

A34.18 In the paragraphs below we set out our conclusions in relation to each of the four types of discounts set out above.

Volume discounts

We have decided that volume discounts should not count towards BT's charge control compliance

June 2015 LLCC Consultation

A34.19 We proposed that volume discounts should not count towards compliance with the charge controls.

Stakeholders' comments

A34.20 We received no specific stakeholder responses relating to volume discounts.[359]

Our conclusions

A34.21 In the March 2013 BCMR Statement, we did not allow volume discounts to count towards BT meeting the charge control. Our reasoning was that BT would be the main beneficiary given its high market shares downstream and, therefore, there was a risk such discounts could distort competition downstream. BT has not offered any volume discounts in the current charge control period.

A34.22 Table 5.1 below shows that BT still generally consumes a higher proportion of the key services compared to all other CPs combined.

[358] Paragraph 2.32 of the 2014 Regulatory Financial Reporting Statement, available at http://stakeholders.ofcom.org.uk/binaries/consultations/bt-transparency/statement/financial-reporting-statement-may14.pdf

[359] In its response to our June consultation, BT argued that [✂]. We discuss this in more detail in Annex 23

Table 5.1: Internal/External Rental Volume Split by Product, 2014/15

Service	Internal %	External %
EAD	59	41
EAD LA	73	27
OSA/OSEA	62	38
EBD	77	23
PPC	65	35

Source: BT[360]

A34.23 This evidence suggests that BT would be the primary beneficiary of any volume discounts. This could give it a significant competitive advantage in downstream markets, implying that the risks of undesirable effects on competition associated with volume discounts could be significant.[361] We have not identified an approach to implementing volume discounts that would mitigate these risks, nor were any provided in response to our June 2015 LLCC Consultation. We therefore conclude that volume discounts should not count towards BT's charge control compliance.

Geographic discounts

We have decided that geographic discounts should not count towards compliance with the charge control

June 2015 LLCC Consultation

A34.24 In the March 2013 BCMR Statement, we allowed BT to offer geographic discounts, but decided that they should not count towards BT's compliance with the charge control. [✂].[362] [363]

Stakeholders' comments

A34.25 We received no specific stakeholder responses relating to geographic discounts.

Our conclusions

A34.26 The charge control will apply to all geographic areas in the UK where we have found BT to have significant market power. However, competitive conditions and the costs of provision for wholesale leased lines are not completely homogenous outside the CLA and Hull.[364]

A34.27 BT is allowed to offer geographically differentiated pricing under the control, and indeed does already for EBD products with its Band A, B and C pricing. Currently there is scope for BT to have different prices which reflect underlying conditions, and we are making changes in this control which will increase its flexibility to do so. We therefore consider that BT already has sufficient scope to reflect costs in its charges.

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[360] Taken from BT's 2014/15 RFS.
[361] No stakeholder challenged this concern in response to the June 2015 LLCC Consultation.
[362] [✂].
[363] [✂].
[364] See Volume 1, Sections 4 and 5

A34.28 However, if geographic discounts are allowed to count towards the charge control then BT could have the ability and incentive to use discounts in an anti-competitive manner in areas where it faces more competition, by cross-subsidising those discounts with higher standard prices in areas where it faces less competition while still complying with the control. This could prevent the emergence of sustainable competition in areas outside the CLA, e.g. in metropolitan areas. Furthermore, geographic discounts could also be used in areas where its downstream operation is a disproportionate beneficiary.

A34.29 We have not identified an approach to implementing geographic discounts that would mitigate these potentially significant risks. Nor were any suggested by stakeholders in response to our June 2015 LLCC Consultation.

A34.30 Based on these potentially significant risks to competition, and distributional concerns, we have concluded that geographic discounts should not count towards compliance with the charge control. BT has the opportunity to respond to competitive constraints in certain areas where reducing prices would be self-financing, i.e. the losses from unit margin reductions are outweighed by the gains from increased sales, but our approach restricts BT's ability and incentives to use geographic discounts for anti-competitive reasons.

Time limited discounts

We have decided to continue to allow time-limited discounts to count towards BT's compliance with the charge control

June 2015 LLCC Consultation

A34.31 We proposed that time-limited discounts should count towards compliance, as long as they do not have any other restrictions (such as geographical or volume limitations).

Stakeholders' comments

A34.32 BT[365] [✂] and TalkTalk agreed with our proposal to allow time-limited discounts to contribute towards its compliance with the charge control for the reasons set out in our June 2015 LLCC Consultation.[366] BT argued that such discounts enable it to test the market and are key to delivering migrations from legacy services, which will remain a significant focus as the WES/BES support ends in 2018.

Our conclusions

A34.33 Time limited discounts reduce prices for customers for a limited period of time only. For example in 2013/14, BT offered a temporary discount on EAD 100Mbit/s services for a five month period, where the connection fee was waived.[367]

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[365] Additionally, in response to our question 10.1 on our proposals for implementation, BT made some comments in relation to how time-limited discounts would affect their compliance with the sub-cap control. We have addressed this comment below.

[366] Paragraphs 5.68 to 5.70.

[367] Openreach, *Price List, Ethernet Access Direct (EAD) EAD 100Mb connection special offer*, https://www.openreach.co.uk/orpg/home/products/pricing/loadProductPriceDetails.do?data=LNo28YE

A34.34 In the March 2013 BCMR Statement, we allowed time-limited discounts to count towards BT's compliance with the charge control. We explained that such discounts can be used to test the impact of potential permanent price reductions. They also provide BT with some flexibility to make time-limited offers to encourage migration from legacy services.

A34.35 We continue to consider that time-limited discounts do not give rise to material anti-competitive or distributional concerns. We have therefore decided to continue to allow time-limited discounts to count towards BT's compliance with the next leased lines charge control.

A34.36 In order to ensure that BT is able to offer time limited discounts, we have also decided that the sub-cap of CPI-CPI that applies to each and every charge will not apply where the increase in price is due to a time-limited discount coming to an end.[368]

Term discounts

We have decided that three and five year term products, subject to our TCO restriction, will count towards compliance

Background

A34.37 As part of its engagement with Ofcom in advance of the publication of the June 2015 LLCC Consultation, Openreach argued in favour of allowing term discounts to count towards its charge control compliance.[369] In particular, it believed that around [✂]% of their circuits purchased by end customers are sold by CPs on a three year term (with five years more common for backhaul) and it argued that CPs have been asking for a three year term product on access circuits. Openreach stated that it would like to establish a variant of its EAD 100Mbit/s product with a lower connection price, which would need to be sold on a three year term to ensure payback. It also believed that this would be attractive to smaller CPs who may struggle with cash flow and that other CPs could use the released cash flow and price certainty to fund other investments. Openreach also argued that it wants to use discounts to compete with other operators and so it would likely result in increased competition downstream and improved investment certainty.

A34.38 On this basis, Openreach suggested that Ofcom should allow three year term discounts for access products and five year term discounts for backhaul products to count towards its charge control compliance. It argued that offering term discounts in the current regulatory framework would reduce its revenues to below its regulated return. This is because the discounts need to be provided over and above those required by the control.

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[368] Using annual volumes adjusted for the number of days the offer is available for

[369] BT presentation, *LLCC 2016 Basket Design Discussions*, 3 November 2014. BT presentation, *Term Discounts and the AI/MI basket(s)*, 5 February 2015.

A34.39 We also received two submissions in the run up to the June 2015 LLCC Consultation from a CP [✂] in favour of allowing term discounts to qualify within the charge control formula. [✂].[370]

June 2015 LLCC Consultation

A34.40 We proposed that only three year term products (that reflect the cost of a one year connection charge plus three times the annual rental charge, for the equivalent standard one year term product, spread over three years) can count towards compliance with the charge control. We refer to this below as our Total Cost of Ownership (TCO) restriction. Furthermore, given the restriction ensures that the TCO is the same for a three year term as a one year term (over three years), we referred to three year term '*products*' rather than '*discounts*'.

Stakeholders' comments

Three year terms

A34.41 BT supported our proposals for a three year term product variant. It considered that the proposals "*could meet the needs of selected CPs who have expressed an interest in not paying the connection upfront*". BT further considered that our proposed three year product has the merits of simplicity, transparency and prevents potential issues of distortion between one year pricing and term product pricing as "*customers know at any point in time what they should be paying and they have confidence that they will benefit from future price reductions*". However, BT also noted that [✂].

A34.42 BT also queried whether we have taken into account the fact that Openreach will be investing upfront when calculating the cost of capital and modelling the value of X. BT also offered to provide estimates of costs of the 'operational implications' of introducing a term product.

A34.43 [✂].

A34.44 GTC and [✂] agreed with our proposals to limit term discounts as part of the charge control to three years.

Five and seven year terms

A34.45 BT argued that five and seven year term discounts are beneficial to both Openreach and its customers provided they are offered in compliance with competition and regulatory law. It argued that it has offered such products and they represent a significant proportion of its revenues. It also claimed that "*Openreach has regularly refused requests from CPs to make more significant reductions to the five and seven year products, given these do not count towards its compliance with the charge control and commercial grounds alone do not justify further price reductions than those performed on one-year term products*".

A34.46 BT estimated that the Ethernet revenues associated with its five and seven year term discounts in the existing non-WECLA area in the absence of any price controls between 2015/16 and 2017/18 will be around £[✂]m, which is around an extra [✂]%

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[370] [✂].

of revenues compared to revenues for Ethernet up to and including 1Gbit/s outside the WECLA.

A34.47 BT argued that downstream (from Openreach) BT does not have an advantage in consuming more term products. It argued that the requirement for term discounts differs between end user market segments rather than whether or not they are provided by internal or external CPs. It also provided an analysis of the distribution of term discount uptake for Optical Spectrum Access/Optical Spectrum Extended Access (OSA/OSEA) products, and argued that the propensity to consume term products for these products is the same or higher with external CPs.

A34.48 Given these arguments, BT suggested that "*at the least*" Ofcom should apply similar principles to five-year term products as to those principles proposed for three-year term products (i.e. allow the connection fee to be spread over five years with no upfront charge).

A34.49 Further to that, BT argued that it should be able to waive the connection charge, which would "allow Openreach to compete on a level-playing field" and "has the merits of transparency, offers a slight discount to customers, and could further stimulate adoption of Ethernet connectivity".

A34.50 Vodafone commented on BT's practice of "*negative discounting*"[371] where BT offers term products with prices higher than BT's standard pricing. Vodafone states that "*[i]t is unclear if this 'negative' discounting would be included within charge control compliance measurements or indeed if it would pass the obligation not to discriminate*".

Our conclusions

A34.51 Term discounts reduce prices for customers that sign up for longer contracts, either via lower rental charges, lower connection fees or both. Openreach has offered term discounts for five and seven year commitments, but the scale of the discounts has reduced in recent years (this is discussed further below). BT Wholesale [✂].[372]

A34.52 In the March 2013 BCMR Statement, we did not allow term discounts to count towards charge control compliance because of competition concerns, but we did not stop BT from offering them outside of the charge control if they were self-financing.[373]

A34.53 Term discounts have potential benefits for BT's customers, such as savings in transaction costs, e.g. re-contracting, and, where a discount lowers the upfront connection cost, assisting with potential cash flow constraints. There are two main anti-competitive risks associated with allowing term discounts. First, they may raise barriers to entry or expansion by increasing switching costs, because OCPs would be disincentivised from switching away from BT and expanding their own network or switching to an alternative operator. By contrast, BT's downstream operators are unlikely to ever switch from its upstream business.

A34.54 Second, BT downstream may be in a stronger position to get its end user customers to commit to longer-term contracts than other operators. For example, BT downstream may require leased lines for its broadband backhaul services. As it is

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[371] Vodafone response to the June 2015 LLCC consultation, paragraph 3.17
[372] [✂].
[373] March 2013 BCMR Statement, paragraphs 18.164-18.168.

most likely to purchase within BT Group, then it may be willing to commit to longer term contracts than other operators. This could mean that it would benefit more from term discounts than other operators and strengthen its position in downstream markets.

A34.55 Finally, if a wide gap opened up between term discounts and standard products, then the minimum term may de facto increase. This may have the undesirable consequence of raising switching costs.

A34.56 As we set out in the June 2015 LLCC Consultation, in principle, there are potentially a number of benefits to BT's customers associated with the introduction of term discounts. We also acknowledged that there may be further benefits if greater use of term discounts by BT enhanced competition between Openreach and its competitors.

A34.57 We have therefore considered whether there is evidence to support anti-competitive or distributional concerns in relation to term discounts. We start by considering the evidence in relation to a three year term products, and then consider the case for the five and seven year term products.

Three year term discounts

A34.58 Given that BT has not historically provided a three year term discount, we do not have data on historical take-up rates upon which to base our judgements on likely anti-competitive or distributional impacts. However, we do have evidence from surveys and information requests sent to Openreach's customers which we consider in the paragraphs below.

A34.59 We consider the main potential for anti-competitive or distributional effects associated with term discounts arises where there is a difference between BT downstream's ability and willingness to commit to the term period and that of its competitors downstream. If BT downstream is typically better able and willing to commit for a term period, then we would expect it to be disproportionately able to benefit from the term discount, thus raising risks of competitive distortions and distributional effects downstream. However, if such differences are not material, we would not generally expect competitive distortions or distributional impacts to be associated with the term discount.

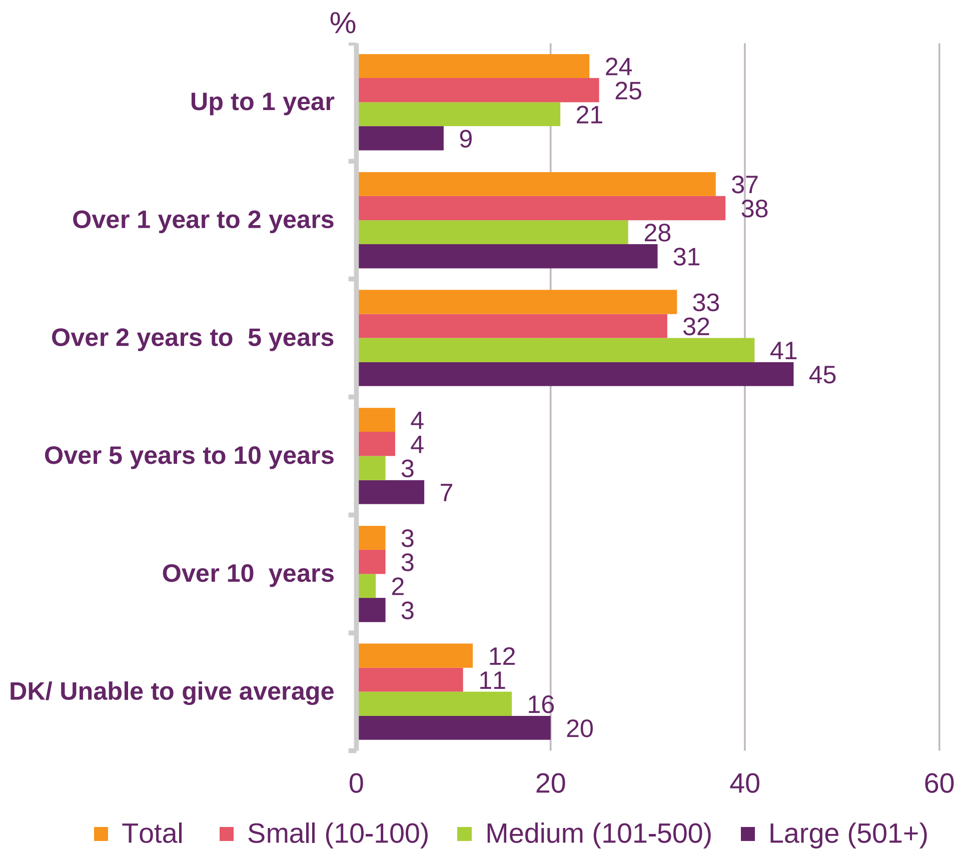
A34.60 The willingness of different operators to commit to particular term periods may differ between circuits bought for backhaul purposes and those bought for access services. For example, in the case of access circuits, i.e. circuits that have at least one end terminating at an end-user site, which form the majority of Openreach's circuits, we would expect the maximum term that an operator would be willing to agree to with Openreach would be related to the length of the contract the operator has with its customer.

A34.61 As part of the BCMR, Ofcom commissioned a survey of businesses on their use of leased lines. The survey was designed to obtain responses from small, medium and large businesses.[374] Figure A34.1 below presents the proportion of respondents taking different contract lengths. This data suggests that BT may be better placed than OCPs to benefit from three year discounts, given that more than half of

[374] Section 8.2, A report for Ofcom by BDRC available at: http://stakeholders.ofcom.org.uk/binaries/consultations/bcmr-2015/annexes/BCMR_2014_report-bdrc.pdf (BDRC Survey)

contracts are less than two years and almost a quarter only last one year. However, we note that there are also a large proportion of contracts that are likely to extend to three years and beyond and, in these cases, OCPs are likely to be able and willing to commit to a three year term period.

Figure A34.1: Typical length of a Business Connectivity Service Contracts



Base: *All respondents naming a BCS supplier (Total n=580; Small n=179; Medium n=217; Large n=184 (multiple coding as respondent was asked about each company used))*

Question: *QG1 From start to end, how long is your current business connectivity service contract with [SUPPLIER]*

Source: BDRC Survey

A34.62 For backhaul circuits there is not the same linkage with end user demand. Rather, operators' willingness to engage in longer term contracts with Openreach are more likely to be affected by, for example, the value they place on keeping open options to switch to other suppliers in the future. In such a case, given that BT downstream is less likely to switch to other suppliers in the future, it is likely to place a lower value on such options and therefore may be more willing than other downstream operators to enter into longer term contracts with Openreach. This is consistent with what we observe with Openreach's five and seven year term contracts.

A34.63 We recognise that there may be benefits associated with three year discounts. However, our survey evidence shows that the majority of customers have a contract of less than three years in length and in addition we consider that BT downstream may be more willing than other downstream operators to enter into longer term backhaul contracts with Openreach. This suggests that many customers would receive less benefit from the control if price cuts are concentrated only on longer term contracts and that BT may be better placed than OCPs to benefit, thus raising risks of competitive distortions, distributional effects downstream, and regulatory gaming.

A34.64 Furthermore, as we noted in our June 2015 LLCC Consultation, there could be undesirable distributional impacts if there are no constraints on BT's ability to change the balance between the one year and three year term offer. Therefore, we consider that three year discounts should not be allowed to count towards compliance with the charge control.

A34.65 We note that in its response BT argued that [✂]. However, none of the responses by BT's customers to our June 2015 LLCC Consultation stated a requirement for a discount to a three year term product. Therefore, there does not appear to be significant demand for a three year product with a discount from BT's customers (as opposed to the three year term product we proposed). This is consistent with the evidence we gathered prior to the June 2015 LLCC Consultation.

<u>Three year term products</u>

A34.66 We recognise that several CPs have expressed a desire for EAD services without an upfront connection fee. Ahead of the June 2015 LLCC Consultation we sent informal requests to other CPs regarding their interest for term discounts. Responses to these are summarised in Table 5.3 below. Although several larger CPs did not respond, of those which did respond, there was interest in having the connection cost spread over a three year term.

Table 5.3: Summary of CP responses on term discounts

Operator	Interest	Preferred structure	Typical contract length	Will demand increase?
[✂]	[✂]	[✂]	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]	[✂]

Source: Responses from operators

A34.67 Based on the above evidence, and in light of the generally positive response from stakeholders to our June 2015 LLCC Consultation proposal, we have decided to allow three year term products, which spread the connection fee over the rental term, to count towards BT's charge control compliance for the 2016 LLCC.

A34.68 As proposed in the June LLCC consultation, in order to mitigate the risk of undesirable distributional impacts for those term products that count towards the charge control, we have decided to set a limit based on the three year TCO, whereby the total cost of a three year term should be related to the combined connection and rental cost of a standard one year product that is consumed over three years. We refer to this below as the TCO restriction. While allowing a pricing structure whereby connection costs are spread over a three year term, which appears to fit with stakeholder preferences, this approach also helps to mitigate the risk of both regulatory gaming and any negative distributional impacts, since the TCO approach does not disadvantage those on a one-year term.

Implementation of the TCO restriction

A34.69 In order to ensure that customers consuming three year term products benefit from the charge control, we have also decided that such customers should benefit from reduced charges during their three year contract if BT reduces the price of the standard product. To illustrate why this is necessary, suppose that BT offered a three year term product in the first year of the control that was taken by all of its customers. If the rental charge was fixed over the next three years and BT did not have any new connections, then BT's revenues would not fall during the control period and so it would not comply with the charge control.[375]

A34.70 There are different ways in which the TCO restriction could be implemented. We consider that there is a trade-off between having a clear compliance framework, which limits the ambiguity about what BT needs to do in order to comply, on the one hand and, on the other, giving BT the flexibility to adjust the structure of three year term charges, perhaps reflecting customer preferences.

A34.71 In our June Consultation, we consulted on two options. The first option, in order to maintain a simple and transparent compliance formula, is that the TCO restriction should tie the three year term charge to the standard charge in such a way that, at any given time, the three year term product should have no connection charge and the annual rental should be the three year TCO of a one year product divided by three.[376] This is relatively straight forward to implement in compliance terms and it also ensures that reductions in one year term charges are passed through to customers in three year contracts.[377]

A34.72 Another option is giving BT flexibility to vary the connection and rental charges of the three year term. For example, instead of having no connection charge it could set an upfront charge, albeit one that is lower than the standard product. Also, instead of assuming that the rental in each of the three years would be the same, absent any changes in one year charges that would subsequently feed through, BT could charge a different rental in years 1, 2 and 3 of the contract. This flexibility might allow BT to offer three year term products that are better suited to the needs of customers. However, the disadvantage is that it is much more difficult to enforce in compliance terms and it might not control the difference between one year term and three year term charges as tightly as the first approach.

A34.73 As discussed above, the evidence we have obtained from BT and other operators suggests that the majority of demand for three year term products stems from operators wanting to spread connection charges over a three year contract term in order to ease cash flow constraints. We consider that both of the options set out above mitigate the risk of undesirable distributional impacts while allowing BT and its

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[375] An alternative option would be for BT to reduce the annual rental for three year term products separately, in order to comply with the charge control. However, if the reduction in three year term charges is not tied to reductions for the standard products then BT may set higher overall charges for the latter (over a three year period) which we do not consider to be desirable.

[376] For example if the standard connection charge was £900 and the rental was £2,000, giving a three year TCO of £6,900, then the annual rental for the three year term would be £6,900/3=£2,300.

[377] For example, suppose a customer purchased a three year product in the first year of the control and the annual rental that year was £2,300. In the second year of the control, BT reduces the one year connection to £600 and the one year rental to £1,800. The annual rental of the three year term should now be (600/3) + 1800 = £2,000. This will be paid by both new customers and existing customers on three year term products; so the customer that purchased a three year product in the first year and paid £2,300 would pay £2,000 in the second year. Similarly, if further reductions were made in the third year of the control, these would also pass through to new and existing three year term customers.

customers to realise the benefits. We therefore consider that the first approach has an additional benefit in that it is straightforward to implement and it provides a compliance framework that is transparent and relatively easy for BT and its customers to understand.

A34.74 Consistent with our proposed approach in the June 2015 LLCC Consultation, we have therefore decided to allow only the first option above to count towards compliance with the charge control. As such, at any given time during the control, a three year term product should have no connection charge and the rental should equal the three year TCO of a one year product divided by three. This means that, at any given time, there is only one (rental) charge for a three year term product and it is the same for all customers on three year contracts, i.e. both new and existing customers. In its response BT appeared to consider this to be an appropriate choice. No other stakeholder directly commented.

A34.75 In its response BT asked for clarification as to whether we had included an allowance in our charge control modelling for the cost of capital associated with the upfront investments by BT to provide three year term products. It also noted that there may be costs associated with providing such a new service (e.g. in terms of order entry and billing systems). We do not believe such costs to be large, and adjusting for such costs would significantly complicate the monitoring of compliance with the remedy. Our decision to allow BT to offer three year term products is in response to an Openreach request. BT is under no requirement to offer the TCO product, and should the costs of introducing the TCO product be prohibitive, then it can decide not to do so. We have therefore decided not to include such costs, to the extent that they would actually arise, in our charge control modelling.

Five and seven year term discounts

A34.76 In our June 2015 LLCC Consultation we proposed not to allow any term products other than the specific three year products set out above to count towards BT's compliance with the charge control. Our proposal was based on concerns that downstream BT would disproportionately be able to benefit from such products. In particular, we noted that in 2013/14, Openreach offered five and seven year term discounts on EAD 1Gbit/s products, and [✂].[378]

A34.77 As set out above, in its response to our June 2015 LLCC Consultation BT disagreed with our proposals.

A34.78 Although BT's response implies that there is significant demand from its customers for term products beyond three years, we note that none of the stakeholders other than BT argued that our proposals should be relaxed in this respect. Indeed, as noted above, the two CPs other than BT that commented on our term product proposals agreed with limiting term products to three years for the purposes of the charge control.

A34.79 However, notwithstanding this point, we have considered the available evidence on the extent to which BT may be able to disproportionately benefit from longer term products. In its response BT provided evidence of the internal and external take up of term products for OSA/OSEA to demonstrate that it does not have an advantage in taking up such products. We consider that these products are not directly comparable with those covered by the LLCC as they have not been subject to a charge control to

[378] BT response dated 5 September 2014 to question A4 of the 1st s135 notice dated 7 August 2014.

date. However, Openreach offered seven year term discounts on its EAD LA 1Gbit/s products in 2014/15, where the connection fee for the discounted services was higher than the standard one-year service, but the rental was lower.[379] [✂].[380] [✂]. In our view, while understanding the relative take-up of term products for different services to those under consideration in the charge control is of some interest, evidence of the differences in take-up for those services actually covered by the charge control is more relevant. We therefore remain of the view that BT is likely to be able to disproportionately benefit from longer term products. Such a benefit could give BT an advantage when competing downstream and therefore risks distorting competition. It also gives rise to distributional concerns.

A34.80 As we set out above, our understanding is that the longer term products are more likely to be used for providing backhaul services rather than access services. For backhaul circuits, we would expect operators' willingness to engage in longer term contracts with Openreach would likely be affected by, for example, the value they place on keeping open options to switch to other suppliers in the future. In such a case, given that BT downstream is less likely to switch to other suppliers in the future, it is likely to place a lower value on such options and therefore may be more willing than other downstream operators to enter into longer term contracts with Openreach. This is consistent with what we observe with Openreach's five and seven year term contracts.

A34.81 In considering the appropriate approach to longer term discounts we are also mindful of the potential impacts of such products on BT's wholesale competitors. On the one hand, greater use of longer term products by BT may be of some benefit to wholesale competitors. As set out above, we received two submissions in the run up to the June 2015 LLCC Consultation from a CP [✂] in favour of allowing term discounts to qualify within the charge control formula. [✂].[381] However, if BT was able to count discounted longer term products towards its charge control compliance, it would have both the incentive and ability to use such discounted products to the detriment of wholesale competition.

A34.82 Given such risks, we have decided not to allow five or seven year term discounts to be included towards BT's compliance with the charge control, which would allow BT to recover the discounts from other controlled services.

A34.83 We have also carefully considered BT's request to allow a five year term product, along the lines of the three year term product discussed above, to count towards its charge control compliance. Such a product would not involve BT waiving the connection charge, but rather it would involve spreading the connection charge over the five year term of the product. This product would operate in the same way as the three year term product, but the annual rental would include one fifth of the connection charge, rather than one third. Again, consistent with the three year term product, the charges for the five year term product would change as the charges for the one year term product change, therefore customers of the longer term product would still benefit from the charge control.[382]

[379] Data taken from Openreach's price list, available at https://www.openreach.co.uk/orpg/home/products/pricing/loadProductPrices.do?data=2qYKQipGu8lEldEpdH2SyFnqs1m6OcKz301sgolk8P2FdiaKKPEfrCsJCb3sZkzJ
[380] [✂].
[381] [✂].
[382] As set out above, in its response to the June 2015 LLCC Consultation Vodafone comments on BT's practice of "negative discounting", where BT offers term products with prices higher than BT's

A34.84 For the reasons set out above, we consider that downstream BT is likely to be more willing than other downstream operators to enter into longer term (e.g. five year) contracts with Openreach. However, we consider that a five year term product (with the TCO restriction) would not present the same distributional risks or risks to competition as a five year product with a discount or waived connection charge, as the total cost of the product would not be discounted[383] from the price of the one year products taken over a five year period. Furthermore, our survey evidence demonstrated that while there is more demand for three year products, there is some demand for five year products, so we can see that some of BT's customers may derive benefits from Openreach providing such a product. We have therefore decided to accept BT's suggestion and BT will be able to count five year term products[384] towards its compliance with the charge control.[385]

Treatment of discounts in starting prices

We have decided that discounts will not be included in our starting charge adjustments

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A34.85 We proposed that our starting charges for calculating the value of X should not include discounts.

Stakeholders' comments

A34.86 We received no stakeholder comments on the treatment of discounts in starting prices.

Our conclusions

A34.87 As BT has been offering discounts during the current charge control period, even though they have not been allowed to contribute to charge control compliance for the current period,[386] we have considered whether to take such pre-existing discounts into account in the starting revenues for the 2016 charge control period.

A34.88 We set the value of X for the price cap so as to bring revenues into line with costs, including a return on capital, by the final year of the charge control. If we were to ignore discounts prevailing in the starting revenues, then it is possible that the charge control may require BT to reduce its prices to below its cost, including the cost of capital, over the control period.

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standard pricing. Vodafone states that "*[i]t is unclear if this 'negative' discounting would be including within charge control compliance measurements or indeed if it would pass the obligation not to discriminate*". Under the 2013 LLCC the assessment of BT's compliance with the charge control does not take into account any term products offered by BT. For compliance purposes all term products are treated as one-year term services. Therefore, "negative discounting" along the lines described by Vodafone is not taken into account in assessing compliance with the control. We note that no other stakeholder raised the issue of "negative discounting" with us in response to the June 2015 LLCC Consultation. It therefore does not appear to be a significant concern amongst stakeholders.

[383] With the exception of any financing benefits associated with such products.

[384] These products will be subject to the equivalent TCO restriction and other restrictions/compliance conditions as the three year term product.

[385] As with three year term products, BT will be required to separately report volumes sold through five year term products for compliance purposes.

[386] With the exception of time-limited discounts.

A34.89 However, a potential drawback of taking discounts into account is that, if BT were to reverse or remove its existing discounts, then it may be able to reduce prices by less than required under the charge control. BT could then earn more than its cost of capital by the end of the charge control period. This risk could arise if reducing the level of the discount would have little impact on volumes.

A34.90 In the June 2015 LLCC Consultation we proposed not to include discounts in BT's prices when forecasting basket revenues. This was to ensure consistency with our policy on discounts in the March 2013 BCMR Statement. We are also mindful of the risks of over-recovery from unanticipated removal of the limited discounts currently in place. We received no comments from stakeholders on this approach. We have therefore decided not to include discounts in our starting charges.

Summary of decisions

A34.91 Based on the analysis set out above, we have decided the following in relation to discounts:

- volume discounts will not count towards compliance;
- geographic discounts will not count towards compliance;
- time limited discounts will count towards compliance;
- three and five year term products subject to our TCO restriction will count towards compliance. No other forms of term product, including three and five year discounted term products will count towards compliance; and

A34.92 discounts will not be included in our starting charges.