Promoting investment and competition in fibre networks:

Initial consultation on the approach to modelling the costs of a fibre network.

Response submitted by CityFibre Infrastructure Holdings

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Non-confidential

CityFibre

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1.1 Introduction

1.1.1 CityFibre welcomes Ofcom's initiative to build a fibre costing model and, in particular, Ofcom's clearly stated objective of using the model to understand the costs of fibre deployment by both BT/Openreach (BT)[1] and market entrants. CityFibre has highlighted the need for a model to estimate the costs of a reasonably efficient operator (REO) for several years and is committed to working with Ofcom and industry to ensure that this model represents realistic and reasonable REO costs.

1.1.2 The need for Ofcom to model a full fibre REO has been highlighted by the recent publication of BT's financial statements for 2018/19. These suggest that, in large part as a result of regulated price controls, BT has been selling leased lines at below its efficiently incurred costs, and that it is very possible that the GEA WLA price will be below cost by the expiry of the current controls in 2021.

1.2 Executive Summary

1.2.1 The fibre costing model should be a critical tool for Ofcom, so it is essential that it is designed and populated to provide the correct inputs for Ofcom to design regulatory interventions that ensure that the UK gets the future-proof infrastructure required for it to support economic growth and empowerment of individuals.

1.2.2 The model must therefore reflect the costs of a modern future-proof network that is dimensioned to meet the needs of all market verticals, including residential and small business FTTP, mobile macro and micro cell connectivity and the connectivity needs of the public sector and business. For ease of reference in this response, we refer to such a model as a ring-based architecture. In reality no network is entirely tree and branch or ring-based, but it is important that any network built by a REO is designed to provide a resilient and future-proof basis for the UK's connectivity needs over the coming 40 years.

1.2.3 Achieving this involves ensuring that the model is structured optimally to reflect both the technical network characteristics of such a modern multi-service network and ensuring that demand is projected to include reasonably foreseeable requirements from all the market verticals. We do not believe that the model, as currently structured, reflects the architecture of a typical modern network build.

1.2.4 CityFibre also considers it inappropriate that Ofcom is consulting on the model features, structure and key functions without the model being populated with practical data, based on real world parameters that provides meaningful outputs. We note that some of the data inputs are nonsensical. We consider that there is a real risk that CPs may express preferences for specific options offered in the consultation

[1] In this response, we will use the term BT to refer to BT and Openreach collectively. Where a specific point is relevant to Openreach only, we will use the term Openreach.

document, but which are subsequently proven to not be suitable once the model is populated with real data. Ideally, we think Ofcom should issue a consultation on the principles for a fibre costing model and then only after that commission the model. However, given time constraints we urge Ofcom to, at the very least, reissue the model for consultation once the many issues we have identified are addressed and it is populated with sensible data.

1.2.5 CityFibre's analysis shows that the model cannot provide insights into the impact of changing the options discussed by Ofcom in the consultation document. For example, the outcome of applying different penetration assumptions is not rational. If the penetration for all services is adjusted from 100% to 50%, the unit cost for FTTP rental in Area 3 increases by a factor of more than 2, while the total cost (NPV over 40 years) actually increases whereas you would expect it to fall.

1.2.6 We mention this as an example of why the population of the model with nonsensical data is actually making it impossible to make sensible assessments of which of the options proposed by Ofcom are the most appropriate.

1.2.7 CityFibre urges Ofcom to address the issues we have identified, and which are set out in this document and its Annex, and then reissues the model for consultation with real data in the model[2], asking the same questions again as were asked in this consultation. When the model has meaningful data in it, CPs will be able to make meaningful assessments of the different options offered by Ofcom.

1.2.8 Once Ofcom has a model with an optimised design, assumptions and data inputs, it will be able to reassess the level of infrastructure competition that is viable in different parts of the UK. It is CityFibre's long-standing and strongly held view that Ofcom is misguided in pursuing multiple FTTP networks to be deployed simultaneously in the same towns and cities. We believe that a correctly designed and dimensioned fibre costing model will highlight that issue to Ofcom.

1.2.9 Having reviewed Ofcom's proposed model, we have identified a series of issues that we believe represent a mixture of errors and flaws in the model design. We are deeply concerned at these issues, particularly those that represent flaws in the model design for which there are no reasonable fixes that we have been able to identify. The most significant model design flaws are outlined briefly below:

The model reflects BT's tree and branch network design

1.2.10 The differences in costs and capabilities between tree and branch networks and the modern ring-based network topologies, which provide for long term secure and reliable networks, are significant and it is not reasonable to assume that Ofcom can use a model that calculates the costs of a tree and branch network to estimate the costs of a REO, which would build a modern ring-based network anticipating broadly future proofed infrastructure.

[2] The data can be a mixture of data from different providers, so that it does not reflect the data for any individual provider and thus does not give away confidential information.

1.2.11 Ofcom has suggested using an arbitrary uplift factor to some capex in the model to estimate the costs of a REO network. However, there is no data available to use to estimate what that factor would be and Ofcom has not been able to make any suggestions. Further, even if an uplift factor could be reliably estimated, the different network topologies generate different levels of costs as demand is increased. We can support Ofcom in the development of a module to define what a modern network architecture would look like.

The model is designed to offer BT's wholesale product portfolio

1.2.12 REOs are extremely unlikely to offer the same services as BT. Ofcom has suggested that, for REO costing, we can simply set the demand volumes to zero for products we do not expect a REO to offer, and we agree that this may work for excluding some products from a REO costing exercise. For example, we do not believe that a REO is likely to offer OSA wavelength services, so we would set volumes for this product to zero in a REO costing model.

1.2.13 There is, however, no means of reflecting products that a REO would provide which are not currently part of BT's portfolio, or which are provided differently from how they are provided on BT's network. The model offers scorched node and scorched earth network options (see below for further discussion of this), but the product portfolio is based on scorched node only, even if scorched earth is selected. Further, as the latest generation of communications providers (CPs) use a fundamentally different network architecture (using ring structures where appropriate as opposed to predominantly tree and branch), products provided over CP networks will be different and incur different costs than if they are provided on BT's network.

1.2.14 In addition to the model design flaws, there appear to be a number of errors and issues in the model. We understand that much of the data in the model is intended as placeholder data, but we also understand that the model is intended for CPs to be able to run different scenarios and the errors and issues we refer to below cause the model to produce counter-intuitive results and, therefore, make it impossible to understand the likely impact of different scenarios.

- The asset lives used are generally higher than we would expect;
- For a number of assets, such as leased line terminal electronics, the asset life defaults to an "unused" category of 1 year. This causes significant distortions in both the level of capex and depreciation, and in the EPMU allocation of common costs;
- Many of the network unit price trends provided in the control module are set to aggressive price declines, which results in a highly front-loaded profile for capital costs, and consequentially opex and final service unit costs as well;
- The model extends 40 years into the future but forecasts a 10G leased line product as the highest speed over this period. The costs of this 10G product are currently high due to the price of the terminal equipment, and this is expected to

reduce significantly over the next 3-5 years; the model does not reflect this price reduction but does migrate volumes increasingly to the 10G product. This is not logical, as it would be expected that electronic equipment costs remain reasonably stable over time while offering ever-increasing capacity. So, at any particular time there would be medium-speed products with high volumes, and high-speed product with much lower volumes and higher prices; experience suggests that while the speeds of these products would increase over time, the relative prices and volumes would remain stable.

- Operating costs are largely driven from a single percentage of capex and are thus recovered over time according to a similar profile to the capex. Where there are significant price declines in the assets, this results in reducing total opex, which may not reflect reality (price declines of equipment during its life do not tend to mean that maintenance costs are also reduced). We are also concerned that the total amount of opex would vary significantly according to the scale of deployment and the geographic market served, and a single input percentage is not adequate to reflect this. In any case, considerable analysis would be needed to set the correct value to use for each deployment scenario.

- Unit costs for FTTP services do not change in a rational way in response to changes in penetration (for example, for area 3 the unit cost increases by a factor of around 3 in response to a penetration change from 100% to 50%). Total costs (reflected by the npv of the total costs over 40 years) are also irrational in that they increase with reducing levels of penetration. This may be related to the very high level of shared costs which are distributed on an EPMU basis.

1.2.15 The work to produce this response has involved detailed analysis of Ofcom's proposed model and, as will become apparent from the response, we identified a number of significant issues and errors in the model that made it not fit for purpose to run scenarios as was intended by Ofcom. We have communicated some of these issues to Ofcom informally and Ofcom has accepted that the process of finding and (where possible) correcting these issues and errors has taken longer than anticipated, so this response is therefore submitted later than the formal response deadline.

The intended purpose of the fibre costing model

1.2.16 Ofcom states in section 2.2 its intended purposes of the fibre costing model. These can be summarised as follows: calculating the cost of deploying fibre networks and of individual services delivered over fibre networks under different scenarios of network design, in different geographies and at different scales.

1.2.17 Our analysis of Ofcom's model suggests, however, that the model does not support the modelling of those scenarios. This is because the key variables in the model that define such scenarios are to a large extent hard coded into the model. Finding and modifying those parameters is by no means straight forward. Ofcom has designed a

set of pre-defined scenarios that CPs can run in the model, but there is little scope for running other scenarios.

1.2.18 For example, CityFibre and other CPs have voiced significant concerns in relation to how Ofcom has defined Area 3[3], but the only way to run scenarios where the definition of Area 3 (and therefore by extension also of Area 2) is altered is to do detailed analysis of postcodes to identify towns of different sizes. CityFibre has undertaken that analysis identifying towns that fall into the following categories: 20,000 to 15.000 premises, 15,000 to 10,000 premises, and below 10,000 premises. The conclusion of that analysis is that towns and cities with between 10,000 and 20,000 are significantly more similar to the towns and cities Ofcom has included in Area 2, than to the remaining towns and cities in Area 3. In our view, Ofcom needs to reconsider whether it is appropriate to define an area where no significant competitive fibre deployment will take place, at this early stage in fibre deployment in the UK. If Ofcom decides that there are real net benefits of defining a non-competitive area at this time, the it is our strongly held view that the boundary must be set at towns and cities with less than 10,000 premises, or even lower than that. Ofcom's analysis and justification for how the area is defined should be transparent and subject to consultation.

1.2.19 The model does allow for some scenario analysis of different scale deployments of fibre network, but only by stating that a deployment will cover a specific proportion of the total market. It is not possible to select specific towns and cities for deployment. As we understand the way the model works, it selects the lowest cost postcode sectors for deployment first and our analysis of the model suggests that a scenario for covering (say) 25% of the total national premises would simply mean that the model picks the 25% lowest cost postcode sectors in the country and calculates the costs for fibre deployment in those postcode sectors. That is not a credible deployment scenario as the low-cost postcode sectors will be distributed across a number of towns and cities and it is unlikely that any one town or city would see full deployment under this scenario. CityFibre has undertaken analysis of the cost difference between Ofcom's approach (reflecting the lowest cost postcode sectors) and the same number of postcode sectors (with similar density characteristics) For whole towns and cities and found that the costs calculated using Ofcom's approach is more than 20% lower than the costs of building out to whole towns and cities.

1.2.20 Further, the model does not enable scenario modelling using different network configurations/topologies. Although the model allows CPs to model what is termed scorched earth and scorched node approaches to cost modelling[4], these two approaches are in fact not as different from each other as one would typically find.

[3] Area 3 is where Ofcom has determined that little or no significant deployment of fibre networks from competitive CPs will take place, so the primary purpose of Ofcom's regulatory interventions in that area is intended to create incentives for BT to invest in new fibre networks with no focus on encouraging investment by other CPs.
[4] Consultation para 2.15.

1.2.21 The model uses BT's current tree and branch network as the starting point. The scorched node scenario assumes that the physical design of BT's network remains unchanged but that the electronic equipment is replaced with equipment suitable to run a full-fibre network. That is how scorched node is typically represented in costing models and therefore as CityFibre would have expected. The scorched earth scenario, however, is not as one would typically define it in cost models. Scorched earth would typically mean that the entire network is designed in the most optimal manner, assuming no pre-existing network, whether passive assets or electronics. In Ofcom's model, however, the scorched earth scenario assumes that all of BT's physical network remains unchanged except for the positioning of the POP/exchange sites. CityFibre has drawn Ofcom's intention to this as a significant flaw in the model as it cannot calculate the costs of a modern fibre network, despite stating clearly that this is a significant purpose of the modelling exercise.

1.2.22 Modern fibre networks are not built to a tree and branch design, but rather using a ring-based architecture that makes the network significantly more resilient and which allows for more rapid capacity upgrades to meet future demands. CityFibre has expressed its severe concerns at the model not being able to model the costs of such a network. Ofcom has suggested that CPs can simply apply a cost uplift to represent the costs of ring-based networks, but doing so is by no means accurate. Further, even if such an uplift is applied, the model will not represent the costs of a ring-based infrastructure as demands are increased, but instead it reflects the high demand upgrade costs of a tree and branch network.

1.2.23 The model assumes that a provider will reuse existing physical infrastructure to the maximum extent it is available. CityFibre's experience with the current Physical Infrastructure Access product (PIA) is that the service is not fit for scale deployment and costs and time lost to repair existing infrastructure means that any advantages of using PIA are substantially reduced. There are also serious issues in relation to equivalence between the manner in which a CP can use PIA and how BT can use its own infrastructure. Additionally, using PIA extensively would result in potentially significant compromises in terms of network topology and design, so it is unlikely that a CP would in fact avail itself of PIA in all cases where capacity is available.

1.2.24 With regards to service demand forecasts, CityFibre considers Ofcom's approach to forecasting leased lines demand (which Ofcom derives as a fixed percentage as FTTP connections) and, in particular, Ofcom's approach to forecasting demand for different leased lines speeds and wavelength services to be inappropriate and we consider that these assumptions cause significant distortions to the model outputs. We have developed replacement assumptions for the demand of different leased lines speeds and wavelength services but have not been able to modify the base assumption that leased lines demand is a fixed percentage of the FTTP demand.

1.2.25 The model uses an inappropriately high level method of estimating the operating expenses of a fibre network operator, estimating around 70% of opex as a simple percentage of cumulative capex. CityFibre considers that Ofcom's approach to

estimating opex is likely to both over- and underestimate opex for different fibre operators of different types and sizes and at different stages of network deployment.

1.2.26 The largest single cost element in the model is duct costs (representing more than 60% of the total costs). Duct costs are considered to be shared/common costs by Ofcom and Ofcom proposed that duct costs should be received from individual services using a mark-up approach. CityFibre is concerned that a relatively arbitrary mark-up approach will determine the allocation of such a large proportion of costs and urge Ofcom to consider a causal cost allocation approach for duct costs. CityFibre agrees that duct costs are shared, but not that they are common costs. As shared costs they can be allocated between the services that use the duct using information already contained in the model such as the fibre count required for different services.

1.2.27 Applying the most commonly used mark-up approach (equi-proportionate mark-up – EPMU) would, for example, result in the duct costs allocated to an active leased line being much higher than the duct costs allocated to a dark fibre, even though the two services use exactly the same amount of duct space. Given that this model will be used to help set charge controls, we consider that kind of counter-intuitive result to be unacceptable as it could lead to arbitrage and market distortion.

1.2.28 Our scenario modelling in this response has attempted to overcome the issues outlined above, but we have severe concerns that the model simply is not fit-for-purpose. It is essential that Ofcom has a parallel network module developed for the model, so that costs for a REO using modern network topology can be calculated reliably and, where appropriate, compared to that of BT using its historical tree and branch network architecture.

About CityFibre

1.2.29 CityFibre is the UK's leading alternative provider of wholesale full fibre network infrastructure. With major fibre infrastructure projects across 51 towns and cities throughout the UK, we provide a portfolio of active and dark fibre services to our customers which include service integrators, enterprise and consumer service providers, local authorities and mobile operators. CityFibre is making significant investments in a number of cities across the UK as we look to rapidly expand the number of homes and businesses which have access to full fibre. CityFibre has recently partnered with Vodafone to bring ultrafast Gigabit-capable full fibre broadband to up to one million UK homes and businesses by 2021 and is targeting five million by 2025. This commitment has been reinforced by a £2.5bn investment programme which identifies towns and cities primed for FTTP expansion to reach nearly every home and business and build is underway. CityFibre is headquartered in London, United Kingdom, and is privately owned by a consortium of Antin Infrastructure Partners and West Street Infrastructure Partners.

2 Ofcom's approach to fibre cost modelling

2.1.1 CityFibre welcomes Ofcom's initiative to commission a model to calculate the costs of deploying fibre networks in the UK. We particularly welcome Ofcom's stated intention that the model should be able to calculate the costs of both the incumbent and of a new market entrant deploying fibre.

2.1.2 CityFibre has for several years expressed its conviction that it is imperative that Ofcom understands the costs of a reasonably efficient operator (REO) deploying fibre networks in the UK. The main rationale behind this conviction being that Ofcom can only expect a REO to invest in new fibre networks if the regulated price of the incumbent's existing services (primarily wholesale broadband access and wholesale leased lines, but also dark fibre if/where that is mandated) is not set at a level below that of the costs of a REO, including a reasonable rate of return[5].

2.1.3 Regulated prices set to reflect the incumbent's cost levels, where the incumbent's market share is at a level that is not replicable by a REO and (in a market characterised by significant sunk costs and therefore high levels of economies of scale and scope) will be a strong deterrent to any provider contemplating investment in new fibre networks. The most likely market outcome would be increased entrenchment of the incumbent's dominant position. Not only would this result in reduced choice and quality to end users, but also in delayed investment in new fibre networks, as the absence of any competitive threat the incumbent would be incentivised to sweat its existing assets for as long as possible and to seek maximum state subsidies to invest.

2.1.4 CityFibre is committed to working with Ofcom in the development of a fibre costing model that reasonably and transparently reflects the costs faced by the incumbent and REOs in the UK. This response is the first formal step on that path but is informed by a number of informal exchanges and meetings with Ofcom to gain a better understanding of the model and Ofcom's intentions of what the model should be able to do.

2.1.5 CityFibre is very concerned that Ofcom is asking CPs to express preferences for key approaches and assumptions to be applied in the model, by assessing these options on a model that is producing counter-intuitive outputs and which is populated with what Ofcom refers to a 'placeholder' data, but some of that data is clearly inappropriate and contributes to the model producing the counter-intuitive results.

2.1.6 We do not believe that a CP can provide informed feedback to Ofcom on the issues included in the consultation without being able to check the options outlined on a model that is populated with reasonably accurate data, so that the results from using the different options produce outputs to which the CP can relate. Ofcom has stated to CityFibre that we should be able to review the different options consulted on by

[5] The rate of return of a REO will change over time, as the perceived risk in the investment reduced with the operator's successful track record in fibre deployment and achievement of expected levels of payback.

simply reviewing the relativity of the model outputs, but, (as detailed in this response and Annex A) the model produces counter-intuitive results when different options are tested.

2.1.7 We present a detailed review of the proposed model and the assumptions proposed by Ofcom for how the model should be populated in Annex A, so in this section we simply summarise our main views and concerns.

2.2 The intended purpose of the model

2.2.1 We understand Ofcom's objective of building this model is to enable Ofcom to understand the costs of fibre deployment by both BT/Openreach (BT)[6] and market entrants[7]. We welcome this scope and purpose and believe that a model that could not fulfil all of those objectives would not be fit for purpose.

2.2.2 Additional objectives stated by Ofcom include: 1) helping Ofcom understand where competition will emerge[8]; 2) helping Ofcom to design charge controls[9]; and 3) assess costs for different geographic areas and for different scales of deployment.

2.2.3 To fulfil those objectives the model needs to be parameter driven and transparent, so that different scenarios and assumptions can be inserted and the consequences of those be traced transparently through the model. Unfortunately, we have found that Ofcom's model, despite being designed to compare a set of pre-defined scenarios, is not transparent enough for CPs to understand how the different scenarios are built up, nor does it allow for any modification of the pre-defined scenarios.

2.2.4 Significantly, the model cannot calculate the costs for a modern fibre network that is built on a ring-based network design. The model is deceptive in that it presents two network design scenarios – a scorched node and a scorched earth. The scorched node option is (as convention suggests) a network where the physical network and locations is as per the existing incumbent's network, but up-to-date electronics equipment and costs are added.

2.2.5 The scorched earth option does not deliver what one would conventionally expect. Scorched earth model assumptions are typically the same as what is known as greenfield assumptions – that is, a brand-new network that uses up-to-date network designs and equipment. However, in contrast to that, Ofcom's scorched earth option still assumes a network based on BT's existing tree and branch architecture, and simply offers an additional flexibility over the scorched node option of optimising the locations of exchange buildings and cabinets.

[6] In this response, we will use the term BT to refer to BT and Openreach collectively. Where a specific point is relevant to Openreach only, we will use the term Openreach.
[7] Consultation paras 2.1 and 2.1.
[8] Consultation para 1.3
[9] Consultation para 1.3

2.2.6 The benefits of ring-based network architecture are well understood and documented, so we are at a loss as to why Ofcom considers that it can present a model with the explicit aim of calculating the costs of a REO, but which cannot calculate the costs of the prevailing modern network design. When we queried this with Ofcom, we were told that we could simply apply an arbitrary uplift to the costs of the tree and branch network design on which the model is based. This is deeply unsatisfactory and any such adjustment is likely to be crude and will not compensate for the likely many other areas in the model where the dynamics of a tree and branch network topology is reflected.

2.2.7 Further, the model does not enable CPs to model geographic areas different from the Areas 1, 2 and 3 pre-defined by Ofcom. This is despite CityFibre and several other CPs having voiced strong concerns that Ofcom's proposed definition of market 3 (that is everywhere that does not qualify as either Area 1 or 2) does not reflect the actual market conditions. CityFibre is of the strong view that Ofcom's conclusion that approximately 33% of the UK's premises (and the majority of the UK by landmass) should be assumed as not viable for competitive CP fibre investment is wrong and will cause market distortions resulting in significant consumer harm. To overcome the lack of flexibility in the model, CityFibre has undertaken detailed analysis of postcode sector data and presents early evidence that significant parts of what Ofcom currently designates as Area 3 is viable for competitive CP investment.

2.2.8 With regards to the services and volumes included in the model, the service portfolio reflects the portfolio of BT, with no scope for adding services that a REO might offer. Whilst it is possible to set volumes to zero for services that a REO would not offer, the inability to include new services is a significant shortfall.

2.2.9 Service volumes are a further source of concern. Ofcom assumes that total market demand (described as take-up) for leased lines is a fixed proportion of FTTP take-up, but we do not believe this to be appropriate. While the model allows final penetration to be determined separately for the FTTP and leased line services, these penetration inputs can be misleading if the underlying total market forecast is not correct. It is also probable that different operators would have different deployment strategies; for example, CityFibre typically starts its network deployment by marketing leased lines and seeking a leased lines anchor tenant, so CityFibre's leased lines take-up is likely to be a higher percentage of its FTTP take-up at least until a material FTTP network presence has been established. Therefore, a fixed build-out profile based on adjustable final penetration may not be adequate to reflect the reality of an actual operator. It seems that Ofcom has unduly restricted the ability of CPs to represent their business models, as leaving it possible to vary those parameters is unlikely to cause any undue complexity to the model.

2.2.10 A further and very significant issue relating to the service volume assumptions in the model, is the fact that Ofcom is assuming that the currently highest speed leased line (10G) volumes increase gradually over a 40-year period, but that the very high terminal equipment costs for this service do not reduce over time. This causes very high LRIC costs for the 10G service which is unlikely to be realistic. In the telecoms

sector we tend to see that new speeds/products are launched in a 7-10-year cycle[10] and that the number of customers on the (at any point in time) highest speed product is relatively stable over time at around 10% with prices staying relatively constant between the standard and high-speed products. We have therefore created a new service demand scenario which represents these market conditions.

2.2.11 It is important to ensure that the network modelled is dimensioned to support the connectivity demand from all the different customer groups/verticals in the market[11]. This will influence the network design and the capacity built into the model from the outset, rather than assuming that only basic FTTP connectivity demand is built into the network.

2.2.12 We have also reviewed the costs included by Ofcom in the model and are concerned to find that significant cost elements of operating a local broadband network are not included. Such costs included, for example, the costs of establishing and operating a point of presence (POP). We do not believe that Ofcom can credibly assess whether a location is viable for competitive network investment without including such costs. CityFibre believes that a scorched earth approach should reflect a modern network with a small number of POPs per town/city rather than multiple local exchanges as per BT's current network architecture.

2.2.13 When using an Openreach wholesale FTTP (GEA) connection, a CP has to either purchase backhaul or co-locate at BT's local exchanges, whereas a modern network bypasses those elements, bringing all connections back to the POP for handover to the wholesale customer. To properly reflect the costs of a modern local broadband network, Ofcom needs to ensure that the modern network topology is reflected. Although the separate backhaul products needed by the operator when purchasing from BT are not required by customers buying from or using modern broadband access networks, the costs of the connectivity to the POP (and of the POP) need to be reflected in the costs of the FTTP service.

2.2.14 The largest part of the costs covered in the model are categories of shared costs, of which a large portion is the cost of ducts and poles. Ofcom has decided that it is appropriate to allocate the costs of ducts and poles (ducts costs) as a mark-up on the direct LRIC costs of each service provided across the network. We recognise that this is often the approach taken for LRIC models, but as the duct and related shared costs are such a large proportion of the total costs (more than 60%), the consequence of the mark-up approach selected is to cause extremely large variations in the resulting unit service costs. The version of the model issued by Ofcom was set to use the equi-proportionate mark up (EPMU) approach, which is widely used in the telecoms sector. Other options built into the model are allocation by volume (i.e. the number of connections) and price (Ofcom appears to reference BT's current wholesale price levels).

[10] Dell'Oro Ethernet Switch Forecast Report. July 2012. Figure 2.
[11] These include FTTP users, the mobile operators' needs for macro and micro cell connectivity, the connectivity needs of the public sector and also of the private business market.

2.2.15 We have considered the mark-up options proposed by Ofcom in principle and have found serious issues with them all. We explain that analysis in detail in Annex A, but as an example, if EPMU was to be used, it would cause much more duct costs to be allocated to an active leased line than to a dark fibre connection, simply because of the high cost terminal equipment used for the leased line. The actual use of the duct by the two services is however identical and this would therefore result in dark fibre being costed disproportionately lower than leased lines. Further, we are not sure how duct costs would be allocated to a DPA product if using EPMU, as there are very few direct costs of a DPA service and the service itself is duct access. It would seem ironic if a DPA service was costed in a manner that includes little or no duct costs.

2.2.16 If service volumes were to be used, an FTTP connection would carry as much duct costs as a leased line when, in reality, 32 FTTP connections are provided across each fibre[12], but a separate 4 fibre cable is used for each leased line – causing the leased line connection to use much more duct space than an FTTP connection.

2.2.17 As regards using BT's current wholesale service prices, we consider this arbitrary and could not support it being used to allocate costs to services.

2.2.18 Instead of using a largely arbitrary mark-up approach, it is our view that duct costs should be allocated using causal drivers for the different network segments. This will result in duct costs being allocated in accordance with the usage of the ducts (and poles) by the main service groups and would reduce the distortions that would inevitably result from the proposed mark-up approaches. We suggest that duct infrastructure costs should be removed from the shared cost pool and should instead be attributed to services using drivers to reflect space usage. In the case of FTTP and leased line services, this could be done by segment by reference to the fibre cable diameters and usage of each service, with an equivalent duct capacity being used for DPA services. We believe that this type of information is available from within the model, and the use of it should ensure a much more rational attribution of duct costs to services, which will be more suitable for providing the correct investment incentives to new market entrants. We consider that there is a real risk that the use of a simple mark-up approach could cause market distortions to the ultimate detriment of consumers.

2.2.19 Ofcom states that the version of the model accompanying the consultation is not intended to show indicative outputs/unit costs but is to enable CPs to analyse the impact of changing model assumptions[13]. The model is populated with data that in places is based on Ofcom's best understanding of the actual values, but which in other places is randomised, so we understand that the outputs from the model are not reliable indicators of the final outputs once the model has been populated with all final and validated data.

[12] This is correct for parts of the FTTP connection only but is still significant.
[13] Consultation para 1.14.

2.2.20 It is concerning to find that the model produces results that do not, in fact, enable the comparison of different model assumptions. A simple example of this is that if the penetration assumption for FTTP in the model is changes from the 100% in Ofcom's model to 50% and 33%, the NPV of the total costs in Area 3 go up. It is clear that although there is a significant element of fixed cost in the deployment of broadband fibre infrastructure, there is also a not insignificant cost involved in the connection of each customer. The NPV of total costs should clearly be lower for a 50% take-up scenario than for a 100% take-up scenario, and lower again for a 33% take-up scenario.

2.2.21 In addition to the significant issues briefly outlined above[14], we have identified a series of errors in the model, which we do not believe can be assigned to it being populated by randomised data, and which result in outputs that are substantially distorted compared with what could reasonably be expected. One such error is that the asset lives of terminal electronics to support leased lines and wavelength services were directed to an 'unused' category, set at 1 year[15]. This resulted in the LRIC service costs for those services being hugely overstated (as the equipment was replaced every year), resulting in turn in an overallocation of common costs (when using the EPMU common cost recovery method). This resulted in a significant distortion of overall and service costs between FTTP and leased lines services.

2.2.22 We list the issues or errors we have identified in Annex A and we explain how we have created a new base case from which to model scenarios. The most significant issues and errors are outlined briefly below:

- The asset lives used are generally higher than we would expect;
- For a number of assets, such as leased line terminal electronics, the asset life defaults to an "unused" category of 1 year. This causes significant distortions in both the level of capex and depreciation, and in the EPMU allocation of common costs;
- Many of the network unit price trends provided in the control module are set to quiet aggressive price declines, which results in a highly front-loaded profile for capital costs, and consequentially opex and final service unit costs as well;
- The model extends 40 years into the future but forecasts a 10G leased line product as the highest speed over this period. The costs of this 10G product are currently high due to the price of the terminal equipment, and this is expected to reduce significantly over the next 3-5 years; the model does not reflect this price reduction but does migrate volumes increasingly to the 10G product. This is not logical, as it would be expected that electronic equipment costs remain reasonably stable over time while offering ever-increasing capacity. So at any particular time there would be medium-speed products with high volumes, and high-speed product with much lower volumes and higher prices; experience

[14] Our detailed comments on the model are set out in Annex A.
[15] Resulting in these assets being replaced every year, even if the connection is no longer in use.

suggests that while the speeds of these products would increase over time, the relative prices and volumes would remain stable.

- The majority of operating costs are calculated, as a total, from a single percentage of cumulative capex (set by year). This total is then recovered over time according to a similar profile to the capex recovery. Where there are significant price declines in the assets, this results in reducing total opex, which may not reflect reality (price declines of equipment during its life do not tend to mean that maintenance costs are also reduced). We are concerned that the total amount of opex would vary significantly according to the scale of deployment and the geographic market served, and a single input percentage is not adequate to reflect this. In any case, considerable external analysis would be needed to set the correct value to use for each deployment scenario.

- Unit costs for FTTP services do not change in a rational way in response to changes in penetration (for example, for Area 3 the unit cost increases by a factor of around 3 in response to a penetration change from 100% to 50%). Total costs (reflected by the NPV of the total costs over 40 years) are also irrational in that they increase with reducing levels of penetration. This may be related to the very high level of shared costs which are distributed on an EPMU basis.

2.3 Calculating operating expenses

2.3.1 Operating costs incurred by an operator of a wholesale fibre network result from a wide range of activities such as network maintenance, repair, sales, planning, office rental and corporate overheads. The costs of these activities have many different drivers, and accurately forecasting them is a challenge.

2.3.2 CityFibre recognises that Ofcom's model is not designed to reflect the costs of a particular operator with a particular business model, but at a more general level aims to identify the overall levels of operating cost needed to run wholesale fibre networks at different scale and penetration levels. We also are aware that Ofcom's model is limited in scope to the access part of the network and does not capture other per-town or national costs that would be necessarily incurred by any operator.

2.3.3 While accepting the need for a relatively high-level approach to opex modelling, we are concerned that, in Ofcom's model, around 70% of total opex is calculated as a simple percentage of cumulative capex. While this percentage can be varied by year, we do not believe that opex can be calculated robustly for networks of varying scale and penetration using this driver. In any case, identifying the correct percentage to be used for a particular deployment scenario would require considerable analysis to be performed outside of Ofcom's model. We also note that operating costs may vary considerably at different stages of network deployment as, for example, the numbers of staff engaged in planning and sales activities changes; these factors are not captured by Ofcom's methodology.

2.3.4 We further note that after calculation of the total opex, the recovery of this cost is determined using a profile similar to the capex recovery profile (based on CCA or economic depreciation). This has the effect of recovering costs in line with demand, and hence gives relatively stable unit costs; however, the viability of investment in fibre networks depends on the impact of actual opex cashflows, which will affect the returns that can be generated. These cashflows would be expected to be much more front-loaded than they are in Ofcom's model.

2.3.5 We also note that, in order to assess the economic viability of deploying fibre networks in an area, it is necessary to consider costs beyond the access network which may vary considerably under different deployment scenarios.

2.3.6 Operating costs amount to around 30% of total costs in Ofcom's model, and it is therefore important that these costs are calculated via a robust and transparent methodology. CityFibre does not believe that the approach to opex calculation and recovery in Ofcom's model is adequate to support the objectives of the model, either in accurately calculating service unit costs or in providing a view of the viability of competitive investment in different areas of the UK.

2.4 The structure of the model

2.4.1 Ofcom has commissioned Cartesian to build parts of the overall model, namely the network infrastructure modules, and a separate geo-spatial module (the latter not provided as part of the consultation). The remainder of the model was developed by Ofcom itself and the structure of the modelling is based to a significant extent on models developed by Ofcom for past charge controls.

2.4.2 Ofcom has designed the model to calculate unit costs year-by-year, using three asset depreciation options. This approach is appropriate for some applications, such as charge control analysis where unit costs by year are a key output. However, we believe that Ofcom should consider extending the model to allow other forms of analysis. For example, investors in new fibre networks would typically look at a DCF analysis based on net cashflow in order to determine the likely returns (IRR) over a defined period. While this would go beyond being purely a cost model, as it would require more extensive demand and revenue modelling, it would provide a more appropriate tool for assessing, for example, whether a geographic area is contestable by a new entrant operator. This approach also ensures that a full demand assessment has been undertaken, with consequences for the most appropriate network architecture and dimensioning.

2.4.3 As outlined briefly above, we consider that the model is not transparent. Ofcom told us in an early correspondence that the WACC was set to 1% and that the penetration level was set to 100% and we were guided to how to change those key assumptions[16]. Further, it is not possible to vary the definitions of areas 1, 2, and 3

[16] Adjustment of the WACC could be achieved from the input sheet, but the penetration rate (which is a parameter that all CPs would be likely to wish to change to see the impact of total and service costs) was not easily identifiable.

as the mapping is deep inside the model. We would have expected a model intended for CPs to run scenario analyses to have a set to transparent inputs in an input sheet that could be easily adjusted by CPs. Further, when making what seem straight forward adjustments to assumptions (such as the penetration assumptions outlined above), the model produces clearly counter-intuitive and unlikely results and it is difficult to trace the cause of, despite spending considerable efforts to understand the model.

2.4.4 The model has been extremely difficult to use. Some of the modules are very large, and there is a large degree of interlinking between modules, often with array formulas being used across the links. As a result, even on a high-performance laptop (i7, 32G RAM, 64-bit excel) the model is slow to load, slow to calculate results, and unstable (often crashing). This makes it extremely difficult to run a variety of scenarios in order to understand and identify issues with the modelling approach. We suggest that consideration be given to optimising the module structure and interlinking along with the calculation methods (for example, use of array formulas, sumproduct function etc) so that it is possible for stakeholders to effectively review future versions of the model.

3 The significance of the fibre costing model

3.1.1 CityFibre has for some years made representations to Ofcom that Ofcom needed to develop a model to calculate the costs of a REO, in order that it can understand the impact on market entrants of how it regulates BT's wholesale charges.

3.1.2 For many years, until the change in strategic direction in July 2018, Ofcom's primary focus was to secure short-term consumer benefits in the form of reduced prices. This was achieved at the cost of ensuring that providers in the market were incentivised to invest in new fibre infrastructure to support the UK economy in the future. This resulted in the UK being at the very bottom of comparisons with European and other leading economies with regards to the existence of fibre access infrastructure.

3.1.3 In July 2019, BT published its regulatory financial statement for 2018/19. Those accounts showed that Ofcom's past aggressive downward price regulation in both broadband and leased lines markets (among other factors) had resulted in significant reductions in the rate of return earned by BT in those markets. For example, for the CISBO market (<=1Gbps) BT's ROCE was 3.9%, against a prescribed WACC of 9.8%. This implies that BT has been selling leased lines services below its efficiently incurred costs[17]. For the WLA copper market, the ROCE was 7% (against a WACC of 8.1%), and for the WLA GEA 40/10 basket it was 14.2% (against a WACC of 9.3%). With 2 years still to run of the CPI-X% charge control, it is very possible that the WLA GEA price will be at or below cost by the expiry of the charge control in 2021.

3.1.4 It stands to reason that, if the regulated prices for BT's wholesale broadband and leased lines services are below BT's efficiently incurred costs, then they will be even further below the costs of a REO (which will have a lower level of network utilisation).

3.1.5 It is clear that a market in which regulated pricing is below cost is unlikely to provide investment incentives to deploy new fibre infrastructure the UK, for BT and market entrants. Whilst a number of factors (including business rates) may have contributed to the very low rate of return from BT, it is clear that policy decisions around pricing have been significant contributors to this situation.

3.1.6 It is widely accepted that the fixed telecoms markets are characterised by a high level of common/shared costs and therefore also by significant economies of scale (and scope between different fixed telecoms markets using the same fixed infrastructure). BT's market share in fixed telecoms markets average between 60 and 70%, a scale that simply cannot be replicated by any other provider[18] so, even without sophisticated cost analyses, it is obvious that BT's unit costs would be substantially lower than those of a REO with substantially lower market share. Using newer technologies and more efficient networks for (for example, fibre is characterised by lower operational costs than copper) would mean that REO costs

[17] Economic costs include a reasonable rate of return.
[18] For the avoidance of doubt, this is because only a total of 100% market share is available for sharing between all providers.

would be a bit lower that BT's costs at the same level of utilisation, but modern ring-based fibre networks involve a higher initial up-front investment than BT's historical tree and branch network, so it cannot be assumed that the costs of a REO are substantially lower that BT's at the same level of utilisation. The benefits of ring-based network architecture are well document and understood and include, among others, increased resilience through the use of self-healing rings and the ability to quickly upgrade the network capacity to meet future demand.

3.1.7 Given the uncertainty of exactly how REO costs compare to BT's costs[19], and the evidence that BT's costs now exceed the level at which Ofcom has set BT's regulated wholesale prices, it is imperative that the fibre costing model is used to understand the costs of both BT and a REO and that regulated pricing is set at a level from 2021, that will make further investment viable.

3.1.8 The proposals of CPI-0 charge controls for both the leased lines and broadband markets[20] starting April 2021 set out in Ofcom's 'Approach to Remedies' consultation earlier this year, are evidently no longer appropriate. Ofcom's stated objectives for those charge controls is to preserve any remaining investment incentives once the current charge controls have expired, but there will be no remaining investment incentives, rather prices set below costs. It therefore seems that Ofcom will have no alternative but to allow BT to increase its prices to enable it to earn the rate of return Ofcom has explicitly stated as being appropriate for each of those markets.

3.1.9 In addition to allowing BT to increase its price, it will also be necessary for Ofcom to ensure that BT does not price below the costs of a REO, as doing so would cause substantial harm to investment incentives for market entrants. With the clearly stated objective of providing investment incentives for market entrants (and BT) to deploy new fibre networks, it is imperative that Ofcom recognises the substantial risk to achieving that objective of BT pricing voluntarily at a level (whether nationally, locally, in special offers or volume/loyalty deals) that cannot be replicated by efficient market entrants.

3.1.10 The fibre costing model will be an important tool to set both the maximum price levels that BT will be allowed to charge and the minimum levels BT must not charge below.

3.1.11 Whilst the fibre costing model appears to not be designed with the explicit objective of setting regulated prices[21], the recent evidence from BT's RFS means that the model now must be considered as a significant contributor to the calculation of the regulated charges for the period 2021-26.

3.1.12 In addition to calculating price ceilings and floors for the 2021-26 period, CityFibre urges Ofcom to consider whether both the current CPI-CPI charge control for leased lines and the CPI-X charge control for wholesale local access should be replaced

[19] Although there is no disagreement in principle about the significant effect of BT's scale and scope economies.
[20] For area 2 in the broadband market.
[21] Although para 1.3 of the consultation document explicitly states that one purpose of the model is to assist Ofcom in setting charge controls.

immediately with CPI-0 controls, so as to at the very least stop further reductions, which will without doubt be detrimental to the achievement of Ofcom's objectives of incentivising investment.

3.1.13 Given the evident increased importance of the fibre costing model for designing the immediate and future price regulation for fixed telecoms services, it is critical that the model is transparent and well understood. This lends further weight to the points we have summarised above in this response and which are set out in more detail in Annex A.

3.1.14 In order to fulfil the purpose of assisting Ofcom in designing the optimal charge controls, the fibre costing model must have the following characteristics:

- It must be transparent so that assumptions made for both BT and the REO[22] can be reviewed, adjusted, and traced through the model;
- It must reflect the service portfolios and network topologies relevant to both BT and the REO;
- It must take a reasonable view of future product, volumes and pricing developments; and
- It must have a fit-for-purpose user interface and be able to run effectively on standard computers.

3.1.15 Another benefit from a fibre costing model is the potential for a more accurate understanding of the underlying economics of full fibre investment and the potential, or otherwise, of network-level competition to drive widespread rollout. As you are aware, it is CityFibre's longstanding view that a model that encourages duplication of local access full fibre networks in large parts of the market, at this early stage in market evolution, may not be best placed to deliver the Government's objective of accelerating nationwide rollout, because of duplication weakens the return on investment for a REO and discourages further rollout. It is CityFibre's view that the insight gathered from a model which more closely reflects and captures the cost reality of a REO, will cause Ofcom to review its position of encouraging parallel, simultaneous deployment of fibre network deployments in the same towns and cities.

3.1.16 This approach would ensure the fastest possible fibre deployment across the country and would ensure that networks are deployed wherever commercially viable, depending on the individual business models of providers.

3.1.17 There is a real risk that Ofcom's current approach to the fibre costing could result in misleading outputs, suggesting that multiple parallel fibre networks would be viable

[22] There is likely to be a number of REO profiles that Ofcom should model in order to understand the impact of each of them on potential future charge control designs. For ease of drafting we simply refer to the collective of REO profiles as the REO.

in some areas, but leaving the UK with a series of networks that are not capable of meeting the nation's future connectivity needs.

4 Assessing the costs of fibre deployment at different scales

4.1.1 Ofcom states as an explicit objective of the model that it should be able to model the costs of fibre deployment at different scales[23], yet the model is not structured to allow CPs to select a number of towns to assess the costs of fibre deployment in those towns. In fact, the model only allows for the assessment of costs in the three pre-set geographic areas, which cannot be considered an assessment of costs of network deployment at different scales.

4.1.2 Although the model allows for setting scenarios of a provider deploying network to a percentage of each of Ofcom's pre-defined geographic areas, the model does not allow for the selection of towns for deployment, but instead simply selects the lowest cost postcode sectors in the selected geographic area until the specified percentage of premises has been reached. That results in a patchwork on individual or small groups of postcode sectors across many towns and cities and most likely not a single town or city in its entirety.

4.1.3 CityFibre has analysed how the model selects postcodes across a number of towns and found that the model has costed the deployment of single postcode sectors across the selection of towns, simply to arrive at the lowest possible deployment costs for the number of premises across those towns. CityFibre considers this approach untenable and highly misleading as it would, by design, result in potentially significant understatement of costs for deployments that cover less than 100% of selected areas and also artificially moves all high cost areas to the end of the deployment, hence again artificially enhancing the cost profile.

4.1.4 The table below shows a comparison of costs between the build profile used in Ofcom's model, based on least-cost postcode sectors, and an alternative, more realistic profile with a similar number of premises covered based on building whole towns. The more realistic profile costs 20-25% more.

	# towns built (fully or partially)	# premises covered	Average premises per town	FTTP unit cost FY 2024/25 (£/month)	EADLA 1G unit cost FY 2024/25 (£/year)	EAD 10G unit cost FY 2024/25 (£/year)	Total NPV cost (£'m)
Scenario 3a: Ofcom build profile	120	801,141	15,405	12	1,974	9,607	1,409
Scenario 3b: Build complete towns only	53	805,770	15,336	15	2,350	11,504	1,726
Change				25%	19%	20%	22%

4.1.5 We are sure that Ofcom will agree the model does not reflect realistic fibre deployment scenario. The costs for partial coverage will therefore always be understated, based on only the lowest cost postcode sectors. CityFibre's long term

[23] Consultation para 2.2 among others.

plan is to deploy fibre to between 100 and 120 towns and cities in the UK, not to the lowest cost postcode sectors in the UK that represent the number of premises that are covered by our target towns and cities.

4.1.6 There are CPs in the UK specialising in the deployment of networks in small urban as well as rural areas, we cannot see how the model has been designed to assist the assessment of the cost of such networks. This is important as such providers have very specific business models that make deployment in what is often considered commercially unattractive areas commercially viable. If Ofcom does not invest in understanding those business models then it cannot determine the likelihood of commercial invest in in areas that BT is likely to not prioritise and for which BT is likely to await the arrival of state aid.

4.1.7 CityFibre has plans to deploy fibre networks in more than 50 towns and cities across the UK by 2025, which represent a mixture of sizes and population/business densities. We have not identified a way in which we can use Ofcom's model to calculate the costs of our planned networks. Not only can the model not calculate the costs of our modern ring-based networks, it also does not allow for the selection of locations in which we plan to build.

5 Assessing the costs of fibre deployment in different geographies

5.1.1 Ofcom's model allows for analysis of the fibre deployment costs in three different re-defined areas. Those are the areas proposed by Ofcom in its 'Approach to Geographic market definition' consultation earlier this year.

5.1.2 In its response to the geographic market consultation, CityFibre (and a number of other CPs) expressed several concerns that Ofcom's proposed delineation between Areas 2 and 3 (where infrastructure competition is and is not likely to emerge, respectively) would include a significant number of locations in Areas 3 which are, in fact, viable targets for competitive fibre investment.

5.1.3 We explained in that submission that there are considerable economic benefits deriving from leaving as much of the country open for competitive investment as possible. In brief those benefits fall into two categories:

5.1.4 Benefits from competition in the market. Even if each specific town or area cannot sustain three independent physical networks, the existence or potential for entrance of one provider provides incentives for the existing provider in place to invest, innovate and price its services in a manner to keep the custom of as many customers in the area as possible;

5.1.5 Benefits from competition for the market. Even if only one physical fibre network can be sustained by the prevailing local market conditions, a provider with the ambition of serving that area is incentivised to deploy its network as quickly as possible in an attempt to avoid another provider getting established there first.

5.1.6 It is CityFibre's view that open access wholesale-only networks deployed by independent commercial providers (that is not by Openreach, which provides wholesale access only due to it being under regulatory obligations to do so), will enable a number of dynamic and competitive downstream markets and that the benefits of additional physical fibre networks will be limited.

5.1.7 The benefits of competition for the market are substantial and relevant not only to Area 3. Competition in downstream markets deliver further consumer benefits in terms of service-level innovation and pricing.

5.1.8 In summary, we believe that the majority of Area 3 is contestable – that is, providers can and will compete to serve the vast majority of locations in Area three, even if a location can only support one FTTP network. CityFibre believes that a single wholesale-only fibre network should be the initial objective for Ofcom's regulatory interventions.

5.1.9 At the moment, Ofcom's proposals for remedies in Area 3 would effectively reserve all locations in Area 3 for BT to serve, with no incentives on BT to deploy fibre network quickly as it would feel confident that the regulatory interventions would deter deployment by competitive providers. Ofcom's proposed remedies for Area 3

is also likely to result in a need for increased public subsidies as it would be natural for BT to hold back from investing in the least attractive locations, waiting for public subsidies to be allocated.

5.1.10 Ofcom proposed a set of three criteria for determining whether a location[24] should be allocated to Area 2 or 3. The criteria for inclusion in Area 2 are:

- A provider has already started deploying fibre network in that location; or
- A provider has firm plans to deploy fibre network in the area; or
- The location has 20,000 or more premises

5.1.11 CityFibre (and others) argued that locations with less than 20,000 premises can be attractive as investment opportunities for market entrants and also that the Government's local full fibre network (LFFN) initiative has caused a number of local authorities to issue tenders for fibre networks covering one or more towns along with several villages or semi-rural area. Local authorities are using the LFFN scheme to extent the coverage of new fibre networks beyond the most attractive town locations to include less attractive neighbouring locations. The consequence of this is that several locations classified by Ofcom as Area 3 are included in LFFN contracts or tenders, but the regulatory measures proposed by Ofcom for Area 3 could make the fulfilment of the LFFN contracts unviable.

5.1.12 Reverting to the model and its scope and limitations, CityFibre was very concerned to find that there was no scope built into the model for analyses to be conducted of the effect of changing the boundary between Areas 2 and 3. The model does not allow for CPs to check whether the criteria developed by Ofcom for which locations are allocated to Area 2 are correct.

5.1.13 Due to its very significant concerns that Ofcom has defined Area 3 in a manner that is directly detrimental to consumers and which limits the scope of competitive fibre investment, we have undertaken separate off-line postcode analyses to understand what the effect would be if we were to include locations with more than 15,000 premises in Area 2 and also the impact of moving that limit to 10,000 premises. Having identified the postcode sectors that cover the three categories of locations stated above, we have run scenarios, using our revised base case assumptions to correct for the significant problems and errors in the model as issued by Ofcom.

5.1.14 Below are the results of the scenarios we have run. It is clear from this analysis that postcode sectors in locations with between 10,000 and 20,000 premises are characterised by cost levels that are significantly more similar to postcode sectors included in Area 2, that those of postcode sectors included in Area 3 as currently defined by Ofcom.

[24] We use the term location instead of 'town' as sometimes several small towns may be grouped or a small area outside a town may be grouped with the town.

5.1.15 We then defined four scenarios, to assess the impact of changes to the Ofcom mapping:

- Base case: as for the analysis in paragraphs 9.1.5 and 9.1.6 of Annex A, using 50% penetration;
- Scenario 1a: move all postcodes for towns with >20,000 premises from area 3 to area 2 (we understand they should have been in Area 2 anyway, as per Ofcom's definition);
- Scenario 1b: move all postcodes for towns in area 3 that already have two or more postcodes in area 2 into area 2;
- Scenario 1c: based on Scenario 1a above, move all postcodes of towns with between 20,000 and 15,000 premises into area 2;
- Scenario 1d: based on Scenario 1c above, move all postcodes for towns with premises count between 15,000 and 10,000 into area 2.

5.1.16 The results of this analysis are shown below:

	Area 1-2			Area 3		
Scenario	FTTP unit cost FY 2024/25 (£/month)	EADLA 1G unit cost FY 2024/25 (£/year)	Total NPV cost (£'m)	FTTP unit cost FY 2024/25 (£/month)	EADLA 1G unit cost FY 2024/25 (£/year)	Total NPV cost (£'m)
Base case	12.08	2,682	34,231	30.53	3,979	13,940
1a	12.08	2,683	34,260	30.62	3,986	13,943
1b	12.10	2,686	34,422	30.97	4,013	13,916
1c	12.10	2,685	34,591	31.64	4,060	13,870
1d	12.15	2,690	35,005	31.20	3,887	13,017

5.1.17 We also ran some scenarios to assess the unit costs of towns of 10-15k and 15-20k premises in isolation. The scenario definitions are as follows[25]:

- Scenario 2a: define Area 3 as only towns with between 15,000 and 20,000 premises (includes all such towns whether previously in Area 2 or 3);
- Scenario 2b: define Area 3 as only towns with between 10,000 and 15,000 premises (includes all such towns whether previously in Area 2 or 3).
- Scenario 2c: Area 3 is as defined by Ofcom, but with all postcodes relating to towns greater than 10k excluded, and state-funded lines included.

[25] Note that in these scenarios, Area 3 is being used simply as a convenient way of identifying costs of the mapped towns, and to allow comparability with Area 1-2, we have set all of the input parameters in the control module (such as duct re-usage) to be identical to those used in the Area 1-2 base case.

- Scenario 2d: Area 3 is as defined by Ofcom, but with all postcodes relating to towns greater than 10k excluded, and state-funded lines excluded.

5.1.18 The results of this analysis are shown below:

Scenario	Area 3		
	FTTP unit cost FY 2024/25 (£/month)	EADLA 1G unit cost FY 2024/25 (£/year)	Total NPV cost (£'m)
2a - towns 15-20k premises	15.31	2,329	2,407
2b - towns 10-15k premises	15.71	2,346	2,460
2c - area 3 without towns >10k premises incl state funded lines	33.03	3,408	20,821
2d - area 3 without towns >10k premises excl state funded lines	21.19	2,514	8,888

- The FTTP unit costs are slightly higher for the smaller towns;
- The FTTP unit costs are a little higher than the average for Area 1-2 (from paragraph 5.1.16), but much lower than the average for Area 3. This suggests that, from a cost perspective, the towns may align more with Area 2 than Area 3.
- The unit costs for Area 3 with towns greater than 10k premises removed are much higher than the unit costs for just the towns.

5.1.19 It is CityFibre's view that it is premature to define Area 3 at this time. We consider it unlikely that the incentives Ofcom has outlined in its 'Approach to Remedies' consultation for BT to deploy fibre in Area 3 as early as possible are unlikely to cause BT to prioritise those locations over Area 2 locations where competitive fibre deployment is more likely in the short term. It is our strongly held view that there will be real economic benefits resulting from leaving the whole country regulated in a manner that encourages competitive fibre deployment, and that there will be incremental costs from adopting Ofcom's propose area 3 definition and proposed remedies.

5.1.20 Should Ofcom not be persuaded to abandon the Area 3 concept and separate regulation for the 2021-26 period, the CityFibre encourages Ofcom to change the definition of Areas 2 and 3 along the lines set out below:

- Towns that have 2 or more postcodes in the current Area 2 should have all relevant postcode sectors moved to Area 2;
- All towns with 10,000 or more premises should be in Area 2.

5.1.21 CityFibre agrees with the other current Area 2 criteria[26] (providers have, are in the process of, or have firm plans to deploy fibre networks) but with the proviso that prevents towns straddling Area 2 and 3 and with a default that part fibre deployment in a town means that that town is included in Area 2 in its entirety.

[26] Although we do not agree that it is appropriate to define the separate market 3 at this time.

6 The model cannot calculate the costs of a ring-based network architecture

6.1.1 As outlined above, CityFibre is very concerned that Ofcom's model is designed to only reflect the costs of an outdated tree and branch network topology deployed by BT for entirely historical reasons.

6.1.2 Ofcom has suggested that CPs can adjust the model to reflect the costs of a modern resilient ring-based network by applying an uplift factor to the costs of the tree and branch network. However, this modification would, at best, be a crude approximation of the costs of building a ring-based modern resilient network and it does not overcome the incompatibility of the costs of provisioning services on the tree and branch network and the ring-based network. CityFibre configures its ring-based metro network to cater for future demand, so the total incremental NPV costs of provisioning a new leased line is significantly lower than incremental cost of that same activity in model of approximately £32,000.

6.1.3 Making the adjustment of the up-font costs for a ring-based network does therefore not result in a model in which we can compare costs of providing different demand scenarios between tree and branch and ring-based networks. CityFibre is of the very strong view that Ofcom's fibre costing model MUST be able to cost a modern ring-based network. Without that capability the model is really only a means of calculating BT's costs of deploying new fibre networks, using its own existing fixed infrastructure assets, which is in clear conflict with the stated objectives of the model.

6.1.4 CityFibre has attempted to correspond with Cartesian to gain an understanding of the incremental work required to build a parallel network module reflecting ring-based network architecture, and any other changes required for that module to interface with the other modules of the model to calculate total and service costs.

6.2 Designing the model to meet foreseeable demand

6.2.1 Although the consultation document refers to the need for increased fibre infrastructure to support 5G[27], the model makes no effort to include the network capacity or the costs of doing so. For example, the assumption of a constant relationship of leased lines to the number of broadband connections served by a provider is clear evidence that Ofcom is foreseeing no increase in leased lines as a consequence of 5G. CityFibre's analyses, using Ofcom's model with adjustment for the costs of a ring-based network, demonstrates clearly that to meet the needs of 5G fibre connectivity, a ring-based network is better suited than the tree and branch network modelled by Ofcom.

6.2.2 5G is one reason why significantly more dense fibre network coverage will be required, but there are many others, including connectivity to support 'smart city' applications, autonomous vehicles and other such innovations which are already

[27] Consultation para 1.5 among others.

advanced in their development. Ofcom's demand assumptions make no effort to reflect these radical changes in connectivity needs in the foreseeable future, never mind in the more distant future given that this is a 40-year model.

6.2.3 As mentioned above, the costs of adding a new EAD connection in Ofcom's model (using the tree and branch network architecture) is very costly compared with the costs of adding the same kind of connection in a ring-based network.

6.2.4 Below we attempt to illustrate the costs of meeting the 5G connectivity demand with a tree and branch network and a ring-based network. This analysis is subject to all the caveats set out above, but is the best we can do with the model provided by Ofcom. The scenarios covered are as follows:

- Base case: model set to Area 1-2, WACC = 10%, penetration 50%
- Base case plus feeder capex (segment 1) increased by 40% to provide some indication of incremental cost of ring-based architecture
- Scenario 1: reflects the base case plus extra resilient fibre connections to all 5G macro sites (scaled from 50,000 sites UK-wide)
- Scenario 2: As scenario 1, but also with small cell sites at a rate of 4 sites per macro site with single (non-resilient fibre)
- Scenario 3: as scenario 1, but also with a higher density of small cell sites at a rate of 1 site per 60 premises with single (non-resilient fibre)

Scenario	FTTP unit cost FY 2024/25 (£/month)	EADLA 1G unit cost FY 2024/25 (£/year)	Change from base npv (£'m)	Overall NPV impact 5G ring structure (£'m)	Overall NPV impact 5G Ofcom model (£'m)	NPV difference (£'m)
Base case (area 1-2, 50% penetration, WACC=10%)	12	2,682	0			
Base + feeder capex 40% incr	13	2,710	1,484			
Scenario 1: macro sites	12	2,702	1,045	1,517	1,045	-472
Scenario 2: macro sites plus medium density microcells	13	2,747	3,158	1,583	3,158	1,575
Scenario 3: macro sites plus dense microcells	14	2,804	5,382	1,649	5,382	3,733

6.2.5 The scenario above models only 5G demand, and shows that as soon as there is a need to connect small cells, the ring-based configuration is significantly more efficient. In CityFibre's view a rational investor in new fibre networks starting afresh would not build a tree and branch network.

6.2.6 This supports CityFibre's view that Ofcom needs to introduce a separate network infrastructure module that models the costs of a ring-based network and undertake a comprehensive demand forecasting exercise to ensure that the network modelled is dimensioned to deliver on that demand.

7 Comments on specific proposals in Ofcom's consultation document

7.1.1 In this section we respond to some of the many specific structural modelling proposals as well as to key assumptions made by Ofcom in its model. Subjects that have already been addressed above are not repeated in this table, unless considered critical for completion:

Paragraph #	Ofcom proposal	CityFibre comment
1.3	The model is intended to assist Ofcom in understanding where competition is likely to emerge	The model only allows for analysis of Ofcom's pre-set geographic areas 1, 2, and 3. This does not enable assessment of where competition is viable. The model should allow the assessment of smaller geographic areas, defined by selecting towns or towns of a particular size.
2.6	Ofcom proposes to use a bottom-up model	CityFibre agrees with this approach.
2.9	Ofcom proposes that all BT/Openreach services should be included in the model	CityFibre agrees that all BT/Openreach services should be covered, but the model must also have the facility of adding other services that other CPs offer or plan to offer. Not doing so makes the model unduly focused on BT and limits its ability to reflect the costs of other CPs.
2.14	Ofcom uses postcode sectors as the smallest geographic modelling unit	CityFibre agrees with this approach.
2.15	Model offers scorched node and scorched earth scenarios	CityFibre agrees with this in principle, but the Ofcom scorched earth option is not in fact scorched earth, but some form of enhanced scorched node that only enables optimisation of cabinet and exchange locations but still assumes BT's outdated tree and branch network architecture.
2.18	Ofcom assumes that a provider building a new network will reuse as much existing passive infrastructure as possible	Whilst CityFibre agrees that this makes sense in principle, the reliance on BT's existing infrastructure can compromise the network design, so it is likely that CPs will prefer to build new ducts in some instances. It is also very unlikely that BT's existing infrastructure has the space required for the high fibre count required for metro rings of a ring-based network architecture. We also note that the DPA product is as yet unproven for use at that scale and Ofcom should be cautious about assuming it will be a significant component in new fibre network deployment.

2.19	Ofcom proposes to apply PIA charges for the use of existing physical infrastructure. This would apply to BT as well as other CPs.	CityFibre considers this to be a reasonable approach.
2.2	Ofcom seeks to understand how the costs of deploying a fibre network vary in response to decision to re-use existing PI.	As the largest CP using DPA it is our experience that the product is not fit-for-purpose for scale deployment. We are encountering significant difficulties in the current scalability of some of the processes including (but not limited to): the scalability of the systems design, the efficacy of the network adjustment process and its integration with our current design process. As an example of the issue, as a network provider who seeks to rollout to a whole city, the scale of the endeavor means we must have high-level designs completed thirteen months prior to commencement of the build. The current PIA product does not provide us with the commercial confidence that the capacity is and/or will be made available in the time between design completion and rollout. Furthermore, we are also experiencing that BT is able to deploy network more rapidly that we can. As such we are finding that the overall effect is that there is little or no cost savings due to the need to, in effect make repairs to BT's infrastructure so to preserve the benefit of speed and/or ultimately to re-design and re-route our network around locations where BT's network is not available.
2.27	Ofcom proposes to calibrate the model using outputs from CP models as well as models from other NRAs.	Whilst this seems a reasonable approach, it is difficult to see how it will be done as Ofcom's model does not reflect the costs of modern networks.

3.6 and 3.12	Ofcom is assuming that leased lines volumes are a static percentage of the number of FTTP subscribers in that area.	CityFibre does not agree with this assumption. CityFibre has entered towns and cities focusing initially on the leased lines market only, so it is likely that we will have a high leased lines penetration (relative to FTTP penetration) for several years after entering a town, and potentially also in the long term. Also, the ratio of leased lines customers to FTTP premises varies over different sizes and types of towns and cities. CityFibre considers that this assumption unduly restricts the ability of providers to reflect their business models and should be changed. We further note that the leased lines volumes assume that 10G remains the highest speed service for the next 40 years and that the volumes of 10G customers increases, but the terminal equipment costs do not reduce correspondingly as the service matures. Finally, we note that Ofcom uses the OSA bandwidth services as a 'sweep' item to make up the numbers in the total leased lines forecast. We do not agree that this is a reasonable approach. As set out in Annex A, we have created a new leased lines demand assumption. It retains the fixed relationship to FTTP customers (as changing that would be complex and we do not understand the model sufficiently well to feel we can do that without potentially disrupting other parts of the model) but establishes a more stable and reasonable demand profile of leased lines over time.
3.7	Ofcom states that it wants to model costs of both BT and competitive providers.	CityFibre agrees that the model MUST be able to do this but disagrees that the model can in fact fulfil that requirement. Our reasons for that are detailed throughout this response.

3.10 and footnote 7	The model can exclude 3m premises from Area 3 to reflect the Government's plans to offer state aid to reach this number of premises.	CityFibre agrees with excluding 3m premises but disagrees with how Ofcom proposes to do this. Ofcom simply removes 3m premises from Area 3, whereas we believe that Ofcom should remove the 3m highest costs premises from Area 3. Doing so would cause a radical change to both total and average service costs in market 3.
Footnote 8	Ofcom assumes that providers prioritise towns for deployment to address lowest cost locations first.	This maybe how BT decides how to prioritise deployments, but for CityFibre this is a much more complex and demand-driven process. Further, some high-density locations may not be attractive from a revenue generating perspective
3.18	Ofcom claims that the model reflects the costs of a hypothetical provider.	CityFibre considers that the model reflects the costs of BT, not a hypothetical provider.
3.19	The model assumes that the same proportion of FTTP and leased lines are provided using DPA.	CityFibre does not consider this to be a sound assumption as leased lines are demand-driven and the use of DPA will be assessed on a case by case basis.
4.12	The model assumes that FTTP is deployed first, followed by leased lines	CityFibre's business model is the opposite of that assumption. The model should allow for different deployment scenarios.
4.14	Leased lines capacity is not planned into the network but is added as demand increases.	This is not an efficient way to dimension a network. It could result in a CP having to build new duct infrastructure after using up DPA capacity, when forward planning could have overcome that problem at the start. A ring-based network builds in capacity for estimated future demand and is much more efficient because of that.
4.22	Shared opex is set as a fixed percentage of Gross Replacement Costs	That percentage will vary with the scale of deployment. We do not believe that is reflected in the model. This is another example of the model not being suitable to calculating costs for deployment at different scales.
5.13-14	Ofcom plans to consult on WACC at a later stage.	The WACC is critical to investment incentives. The cost of capital changes over time for market entrants, reducing as they gain a track record in delivering networks and a reasonable return on the investments made. Ofcom needs to recognise that the WACC for BT is unlikely to be appropriate for a REO.

Annex A: Detailed model review

CityFibre

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Contents

Annex A

1 Introduction

1.1.1 CityFibre has undertaken detailed analysis of the model issues by Ofcom alongside the consultation document. This annex sets out the analysis we have performed and our findings. the work performed was done in the spirit of investing in getting the model into as good a state as possible before Ofcom starts using it to support its decisions relating to the regulation in the fixed telecoms market review (FTMR).

1.1.2 We understand that the model was populated with placeholder data but have found that some of the data in the model caused it to produce incorrect and erroneous outputs. When attempting to run the different scenarios pre-set by Ofcom, we found that in some cases when costs could be expected to increase, they decreased, and vice versa, and that in general, movements in output costs did not match expectations.

1.1.3 We have identified some areas where the methodologies used in the model are not appropriate, and this suggests that fundamental changes may be necessary before the model can be regarded as fit-for-purpose.

1.1.4 We are aware that our analysis is not comprehensive and welcome the opportunity to continue working with Ofcom on the development of the model. We hope to get the opportunity to discuss our analyses and findings with Ofcom in some detail.

2 Asset lives

2.1.1 Asset lives in the model are assigned to assets in two stages. Firstly, the control module allows definition of asset lives according to scenario, and all scenarios were preset with the following lives:

Asset lives	
Opto-electronic Equipment	11
Rack and Frames	10
Fibre cable	22
Duct	47
Optical Passive Equipment	21
Civils	47
Unused	1
Unused	1

2.1.2 Secondly, in the “Input_Planning” sheet of the network cost module, there is a mapping table (which is not configurable from the control module). Each of the above asset groups is mapped to a network element; an extract is shown below:

Asset Planning by Element

Network Elements	Lifetime Category
EXCH_FTTP_OLT_Chassis	Opto-electronic Equipment
EXCH_FTTP_OLT_SBCard	Opto-electronic Equipment
EXCH_FTTP_OLT_NBCard	Opto-electronic Equipment
EXCH_Eth_LA_NTE_1G	Unused
EXCH_Eth_LA_NTE_10G	Unused
EXCH_Eth_Bckhl_NTE_1G	Unused
EXCH_Eth_Bckhl_NTE_10G	Unused
EXCH_OPT_NTU	Unused
EXCH_DF_PatchPanel	Optical Passive Equipment
EXCH_All_Accommodation	Rack and Frames
EXCH_OCR_Tie_Cable	Fibre cable
EXCH_OCR_Chassis	Optical Passive Equipment
EXCH_OCR_Sub-rack	Optical Passive Equipment
EXCH_CCJ_Tie_Cable	Fibre cable
EXCH_Cable Chamber Joint	Optical Passive Equipment
BCKH_Business_Serv_Mainlink_Fibre	Fibre cable
BCKH_Business_Serv_Mainlink_Fibre_Testing	Fibre cable
SEG1_FTTP_UG_Fibre	Fibre cable
SEG1_FTTP_OH_Fibre	Fibre cable
SEG1_FTTP_Fibre_Testing	Fibre cable
SEG1_Business_Serv_UG_Fibre	Fibre cable
SEG1_Business_Serv_OH_Fibre	Fibre cable
SEG1_Business_Serv_Fibre_Testing	Fibre cable
SEG1_FootwayBox_Aggreg_Node	Civils
SEG1_Aggregation_Node	Optical Passive Equipment
SEG1_FootwayBox_UG_Track_Joint	Civils
SEG1_UG_Track_Joint	Optical Passive Equipment
SEG1_OH_Track_Joint	Optical Passive Equipment

2.1.3 While it would be reasonable to assume that the “Unused” asset category from the control module was not assigned to any assets within the model, this is not the case. It can be seen that several of the network elements are mapped to the “Unused” category, which is set via the control module to 1 year. This has the unfortunate effect of assigning an asset life of 1 year to a range of assets including terminating equipment for leased lines. This results in high levels of capex being renewed on an annual basis, causing a large distortion in the capex and opex total amounts and allocations to services.

2.1.4 We also note that the placeholder values for asset lives of other categories seem rather higher than might be expected in a costing model, although we do not have a definitive view on this at this early stage of the model development.

2.1.5 In order to run scenarios with inputs which show degree of reasonableness, we have therefore adjusted the asset life inputs in the control module as follows, with the “unused” category change being the most significant:

Asset lives	
Opto-electronic Equipment	8
Rack and Frames	10
Fibre cable	20
Duct	40
Optical Passive Equipment	20
Civils	40
Unused	5
Unused	5

2.1.6 By setting the “Unused” category to 5 years instead of 1, the worst effects of the incorrect mapping in the network module are mitigated, and we believe that the above provides a reasonable initial set of placeholder values for the purposes of assessing the functioning of the model. However, it is clear that the mapping error will need to be solved properly by either mapping all the network elements in use to one of the existing categories, or creating new categories as needed. Please note that CityFibre is not suggesting that the above asset lives are correct or appropriate; they have been selected simply to allow the running of scenarios for this initial evaluation exercise.

3 Capex prices and trends

3.1.1 Within the control module, price trends for purchase of assets can be defined. The model was pre-set with the values in the table below, and the low, medium, high and spare categories can be selected from the scenarios sheet.

3.1.2 During discussions with Ofcom in the early stages of the consultation, CityFibre raised concerns that the profile of the unit costs appeared to be heavily front-loaded; Ofcom responded that the profiles were actually relatively flat. CityFibre subsequently discovered that the flat profiles result from looking at the cost recovery module in isolation, before linking the modules together; in this case, the module as downloaded uses the “spare” category, which has a constant 2% nominal price appreciation, which is approximately flat in real terms. But once the modules are linked and calculated, the “medium” trend is selected for all of the pre-set scenarios, and this does result in extreme front-loading of the costs.

3.1.3 CityFibre believes that this “medium” set of price trends is far removed from what might be expected in reality. For example:

- Fibre cable prices are set to decline at 2% per year (i.e. around 4% in real terms); this is completely out of line with the trend CityFibre is seeing in fibre cable installation costs.
- OLT, ONT and NTE costs have very sharp declines which are not plausible over an extended time period.

Capex Trend	LOW	MEDIUM	HIGH	Spare
Labour	2.1%	3.1%	4.10%	2.00%
OLT Chassis	-4.0%	-3.0%	-2.00%	2.00%
OLT Southbound Card	-11.0%	-10.0%	-9.00%	2.00%
OLT Northbound Card	-6.0%	-5.0%	-4.00%	2.00%
OLT to OCR Tie Cable	-4.0%	-3.0%	-2.00%	2.00%
Racks and Space	-1.0%	0.0%	1.00%	2.00%
OCR to CCJ Tie Cable	-1.0%	0.0%	1.00%	2.00%
Cable Chamber Joint	-2.0%	-1.0%	0.00%	2.00%
Unused	-1.0%	0.0%	1.00%	2.00%
Unused	-1.0%	0.0%	1.00%	2.00%
Fibre testing	-1.0%	0.0%	1.00%	2.00%
Track Joint	-1.0%	0.0%	1.00%	2.00%
Aggregation Node	-3.0%	-2.0%	-1.00%	2.00%
Unused	-1.0%	0.0%	1.00%	2.00%
Civils	0.0%	1.0%	2.00%	2.00%
Unused	-1.0%	0.0%	1.00%	2.00%
Duct	1.0%	2.0%	3.00%	2.00%
Unused	-1.0%	0.0%	1.00%	2.00%
Unused	-1.0%	0.0%	1.00%	2.00%
Unused	-1.0%	0.0%	1.00%	2.00%
Fibre Cable	-3.0%	-2.0%	-1.00%	2.00%
Sub-Duct	1.0%	2.0%	3.00%	2.00%
Pole	1.0%	2.0%	3.00%	2.00%
Microtrench	1.0%	2.0%	3.00%	2.00%
Splitter Node	-3.0%	-2.0%	-1.00%	2.00%
Unused	-1.0%	0.0%	1.00%	2.00%
Network Termin Equipment	-4.7%	-3.7%	-2.71%	2.00%
FTTP ONT	-4.7%	-3.7%	-2.71%	2.00%

3.1.4 We also note that the definition of a constant annual price trend over a 40 year model would prevent the model from reflecting reality, whereby price trends change from year to year. For example, for leased lines the 10G NTEs are currently far more expensive than 1G NTEs. We expect that the 10G prices will fall rapidly over the next 3-4 years to a level more comparable with the 1G NTEs; yet it is not possible to capture this within the currently defined model structure. Far from being a detail, this limitation has a major impact on the unit cost outputs.

3.1.5 In order to provide a more reasonable set of price trends, allowing us to assess the operation of the model, for all of our scenarios we have used the “Spare” price trend. This provides an overall trend that is approximately flat in real terms for all assets; while this does not reflect CityFibre’s view of the correct price trends for the assets, it does provide a better basis for review of the model. The rationale for this is further discussed in paragraph 7.1.1 on service definitions and volumes.

4 Recovery of shared costs

4.1.1 We note that the model implements a methodology for the recovery of shared costs whereby different categories of shared cost are identified (depending on the product groups to which they relate) and these costs are attributed to the relevant services in the relevant groups according to either already-allocated LRIC costs, service volumes or service value (effectively revenue, calculated from price x volume).

4.1.2 The definition of the shared capex is from the table below, from the cost recovery module. The majority of network elements shared between WLA, LL and DPA services are related to duct. LL fibre is also shared, but only between different LL services. The model extract below shows the inputs which associate network elements with shared cost product groups.

Shared Capex Network Elements

This table identifies the capex network elements which are shared across services

	Cross DPA, WLA and L	Cross WLA and LL	Cross DPA and WLA	Cross DPA and L	Intra WLA	Intra LL	Intra DPA	Incrementa
19 EXCH_All_Accommodation		1						0
20 EXCH_OCR_Tie_Cable		1						0
21 EXCH_OCR_Chassis		1						0
22 EXCH_OCR_Sub-rack		1						0
23 EXCH_CCJ_Tie_Cable		1						0
24 EXCH_Cable Chamber Joint		1						0
33 SEG1_Business_Serv_UG_Fibre						1		0
34 SEG1_Business_Serv_OH_Fibre						1		0
35 SEG1_Business_Serv_Fibre_Testing						1		0
36 Unused		1						0
37 SEG1_FootwayBox_Aggreg_Node		1						0
38 SEG1_Aggregation_Node		1						0
39 SEG1_FootwayBox_UG_Track_Joint		1						0
40 SEG1_UG_Track_Joint		1						0
41 SEG1_OH_Track_Joint		1						0
43 SEG1_Existing_Duct	1							0
44 SEG1_Sub-duct in Existing_Duct	1							0
45 SEG1_Existing_Pole	1							0
46 Unused	1							0
47 SEG1_New Microtrench	1							0
48 SEG1_Soft_Duct in New_Duct	1							0
49 SEG1_Footway_Duct in New_Duct	1							0
50 SEG1_Carriageway_Duct in New_Duct	1							0
53 SEG2_FootwayBox_Splitter_1:32		1						0
54 SEG2_Splitter_Node_1:32		1						0
55 SEG2_FootwayBox_Splitter_1:16		1						0
56 SEG2_Splitter_Node_1:16		1						0
61 SEG2_Business_Serv_UG_Fibre						1		0
62 SEG2_Business_Serv_OH_Fibre						1		0
63 SEG2_Business_Serv_Fibre_Testing						1		0
65 SEG2_FootwayBox_UG_DP		1						0
66 SEG2_UG_Distribution_Point		1						0
67 SEG2_OH_Distribution_Point		1						0
69 SEG2_Exisiting_Duct	1							0
70 SEG2_Sub-duct in Existing_Duct	1							0
71 SEG2_Existing_Pole	1							0
73 SEG2_New Microtrench	1							0
74 SEG2_Soft_Duct in New_Duct	1							0
75 SEG2_Footway_Duct in New_Duct	1							0
76 SEG2_Carriageway_Duct in New_Duct	1							0
86 SEG3_Existing_Duct	1							0
87 SEG3_Existing_Pole	1							0
89 SEG3_New Microtrench	1							0
90 SEG3_Soft_Duct in New_Duct	1							0
91 SEG3_Footway_Duct in New_Duct	1							0
92 SEG3_Carriageway_Duct in New_Duct	1							0

4.1.3 The remaining network elements are considered to be incremental and are defined in the same table; an extract of the network elements treated as incremental is shown below. The incremental costs include fibre cables and electronics related to FTTP (all segments), and LL (but only segment 3 fibre, with segments 1 and 2 being shared as shown in the shared cost table above).

Shared Capex Network Elements

This table identifies the capex network elements which are shared across services

		Cross DPA, WLA and L	Cross WLA and LL	Cross DPA and WLA	Cross DPA and L	Intra WLA	Intra LL	Intra DPA	Incrementa
1	EXCH_FTTP_OLT_Chassis								1
2	EXCH_FTTP_OLT_SBCard								1
3	EXCH_FTTP_OLT_NBCard								1
6	EXCH_Eth_LA_NTE_1G								1
7	EXCH_Eth_LA_NTE_10G								1
10	EXCH_Eth_Bckhl_NTE_1G								1
11	EXCH_Eth_Bckhl_NTE_10G								1
12	EXCH_OPT_NTU								1
17	EXCH_DF_PatchPanel								1
26	BCKH_Business_Serv_Mainlink_Fibre								1
27	BCKH_Business_Serv_Mainlink_Fibre_Testing								1
30	SEG1_FTTP_UG_Fibre								1
31	SEG1_FTTP_OH_Fibre								1
32	SEG1_FTTP_Fibre_Testing								1
58	SEG2_FTTP_UG_Fibre								1
59	SEG2_FTTP_OH_Fibre								1
60	SEG2_FTTP_Fibre_Testing								1
79	SEG3_FTTP_UG_Fibre								1
80	SEG3_FTTP_OH_Fibre								1
81	SEG3_FTTP_Fibre_Testing								1
82	SEG3_Business_Serv_UG_Fibre								1
83	SEG3_Business_Serv_OH_Fibre								1
84	SEG3_Business_Serv_Fibre_Testing								1
95	SEG3_FTTP_Connection_Civils								1
96	SEG3_FTTP_ONT								1
97	SEG3_BusServ_Connection_Civils								1
98	SEG3_Eth_NTE_1G								1
99	SEG3_Eth_NTE_10G								1
100	SEG3_Opt_NTU								1
101	SEG3_DF_PatchPanel								1

EPMU recovery method

4.1.4 If cost-based recovery of shared costs is selected (the EPMU option), then the shared costs are distributed to services based on the LRIC costs, i.e., the incremental costs from the network elements in the second table above. So if we consider the allocation of shared costs in the Cross WLA and LL group (which consist of ducts, passive exchange equipment and associated infrastructure), then that will be attributed to FTTP and LL services based on the LRIC costs of segments 1-3 fibre and active equipment for FTTP, and segment 3-only fibre and active equipment in the case of LL. This gives rise to two significant problems:

- The costs for active equipment for leased lines are very much higher than for FTTP, and this distorts the allocation of shared costs (which are mainly duct-related), so that LL gets a disproportionately high share.

- The exclusion of segments 1-2 fibre from the incremental costs of LL results in a lower allocation of shared costs (mainly duct) to LL than would be expected.

These distortions represent a significant departure from the causal relationship which exists between duct usage and fibre cable deployment; while we understand that mark-up schemes are not intended to reflect a causal linkage, we believe that the use of EPMU in this way is likely to be a major cause of the irrational unit cost results we are seeing from the model.

4.1.5 For the Cross DPA, WLA and LL group there is a further problem with EPMU allocation, as the DPA services do not include any fibre nor any active costs (incremental or shared). In fact, there are no incremental network costs at all for DPA, with the result that even where DPA volumes are present, if EPMU recovery is selected then no costs are attributed to the service.

4.1.6 The Intra-LL group also has a serious problem if EPMU is selected. The LRIC costs for LL include active equipment as well as segment 3 fibre cable. If we consider OSA or 10G LL services, these have very high active costs compared with 1G or 100M services and the EPMU method will attribute much higher fibre cable costs to these higher speed services as a result. This results in a significant over-statement of the unit costs of higher speed LL services compared to lower speed and dark fibre services.

Volume recovery method

4.1.7 For the Cross WLA and LL group, the volume method may be considered to give a rational outcome where fibre cable usage is equivalent between FTTP and LL services. This may possibly be an acceptable approximation for segments 2 and 3 where one fibre pair is in use per end user connection, given the modelling assumptions whereby each leased line connection is made using a 4-fibre cable, it seems likely that the duct capacity usage by LL services would be higher than suggested by the volumes. For segment 1, where the FTTP fibres are shared 1:32, the volume method is inappropriate and will lead to excessive duct allocation to FTTP services. As the model only allows a single method to be selected for the product group (for all segments), the volume method does not seem viable.

4.1.8 For the Cross DPA, WLA and LL group the volume method succeeds in attributing costs to the DPA products; however, as the DPA products are defined by segment, each segment receives the same duct allocation as a single line for LL or FTTP. So, the sum of DPA unit costs for segments 1, 2 and 3 would be three times the shared unit costs for FTTP or LL. This is irrational and should not be regarded as an appropriate method.

4.1.9 For the Intra-LL group, it appears that the volume method may be a reasonable approach. As each LL connection of whatever speed uses a single fibre pair, then it is reasonable to attribute fibre cable costs in proportion to volumes.

Value recovery method

4.1.10 We note that the prices used for this method are based on Openreach's current price list. Whilst other more representative prices could be used, we believe there is a fundamental problem with the circularity that results from using prices (which should be an output from the process) in order to attribute a significant proportion of network costs within the model.

Summary

4.1.11 We have compared the results of each of the mark-up scenarios provided by Ofcom in the table below. For simplicity, in each case the same mark-up scenario was applied to all of the shared cost groups.

	Area 1-2			
	FTTP unit cost FY 2024/25 (£/month)	EADLA 1G unit cost FY 2024/25 (£/year)	EAD 10G unit cost FY 2024/25 (£/year)	Total NPV cost (£'m)
Base case (EPMU)	12	2,682	14,536	34,231
Per line	20	850	3,232	34,231
Per price	17	202	6,584	34,231

- As one might expect, in moving from EPMU to per line mark-up the FTTP costs increase and the LL costs decrease. The extent of the change is perhaps more than might be expected, however given the issues we have identified above that is not altogether surprising.
- In moving from per line mark-up to per price, there is an increase in the higher-speed LL cost, with decreases in the lower speed LL and FTTP, which is as expected given the input prices used for these products.

4.1.12 For the reasons outlined above, none of the three methods for recovery of shared costs can be regarded as acceptable. While EPMU may be a suitable method for recovery of genuine common costs (which cannot be attributed via causal drivers and are generally a small proportion of total costs), it is not an appropriate way to attribute shared costs to services which have very different usage characteristics of the shared assets, and a different underlying structure of incremental costs. Volume allocation is suitable only for a small subset of the shared costs (i.e., the LL fibre cables), but not for the wider inter-service group costs. Value allocation suffers from the same problems as volumes, but with the additional conceptual issues that prices are outputs rather than inputs.

4.1.13 CityFibre therefore believes that Ofcom should completely rethink the methodology for the definition of shared costs and their recovery across products. This is intrinsically related to the LRIC methodology employed, which is discussed in Section 0.

5 LRIC methodology and increment definitions

5.1.1 Ofcom notes the model is a long run incremental cost (LRIC) model, but there is little discussion or rationale provided in the documentation for the high level LRIC methodology that has been chosen. It appears that insufficient consideration has been given to definition of increments and sub-increments, with the result that the methodology is incoherent; this contributes to the erroneous response of the model outputs to changes in inputs that is described in Section 9.

5.1.2 From one view of the model, increments are defined at the service level, with each separate service treated as a distinct increment. Volumes of services are used to dimension network elements (involving a detailed geographical analysis), and hence identify the costs of each network element required to deliver the services. In this view, the incremental costs would then ideally include costs of fibre cables to deliver the service (which may be dedicated to that service), as well as extra costs of shared assets such as ducts (i.e., duct dimensions may need to be increased in order to deliver the extra service, and the extra cost would be considered incremental to that service).

5.1.3 However, the model also introduces a different view, whereby certain costs which are actually variable with respect to service volumes are treated as non-incremental. This applies to duct costs in segments 1 and 2, which are treated entirely as shared costs. The model does not generate any information to determine what proportion of the duct costs is driven by different services; if it did, then this information could be used to determine the LRIC costs of ducts, and then allocate duct common costs in a more meaningful way. It would be possible to achieve this by running the model separately for each service in turn, and so calculate the pure LRIC in each case.

5.1.4 The key problem is that incremental costs comprising very different asset types (fibre cable, terminal electronics, other active equipment) are aggregated to each service as a single pool, before being used to drive shared costs to the services. The shared costs are more than 60% of total costs and are being driven by LRIC costs of assets to which, in some cases, they have no causal relationship. A detailed consideration of how to solve this problem is beyond the scope of the current response, but we suggest that Ofcom may wish to consider the following options:

- Adopt a more sophisticated approach to the LRIC calculations as outlined in paragraph 5.1.3, whereby all variable LRIC costs are identified and used as the basis for multi-level mark-ups.

- Introduce a layer split to the model, whereby LRIC costs of duct, cables and active elements are calculated separately. Common costs (mainly the remaining, shared duct) could then be driven to the relevant layer by an appropriate method (EPMU or volumes), such that they are allocated without undue distortion from, for example, the active LRIC costs.

- Move even further away from a purely LRIC methodology, and develop cost stacks for the services, including shared costs, using causal drivers. For example, duct costs could be attributed based on cable area x length for the services, or perhaps better subduct area x length which would allow correct attribution for DPA services.

6 Service usage factors

6.1.1 During our detailed review of the model, we discovered some important aspects of the service usage factors which are not clearly described in the documentation.

6.1.2 Firstly, it appears that, although usage factors are provided for the whole range of network elements, the factors only operate for those elements which are mapped as incremental costs. This is because the model aggregates shared costs from the shared network elements and allocates them to services according to the selected mark-up scheme, not via usage factors. In order to avoid confusion and aid transparency, we suggest that Ofcom should document this, and flag in the relevant modules where the input usage factors are bypassed in this way.

6.1.3 Secondly, it is reasonable to assume that the absolute level of the usage factors for incremental network elements is used to determine the dimensioning of costs. For example, 1G EAD services have a usage factor of 2 for 1G NTEs, as one NTE is required for each end of the circuit. However, this is not how the model currently works. The usage factors are used only to attribute network element costs to services in the correct proportions and play no role in the dimensioning of the network and determination of network element costs.

6.1.4 This can be demonstrated by scaling up all the factors for a network element by the same proportion (eg. 1000); it makes no difference to the model outputs. This is primarily an issue of transparency and documentation rather than an error in the model; however, it also gives rise to another concern. The dimensioning of network elements, whilst not achieved via the usage table, is implemented via hard-coded formulas in the network cost module (for example, the usage of 2 NTEs per EAD circuit appears in a formula on this sheet). This will calculate correctly as long as the hard-coded formulas remain consistent with the usage defined in the usage factors; but any changes to the usage defined in the usage matrix will not automatically flow through to the network dimensioning calculations and would introduce an error.

7 Service volume forecasts

Services modelled

7.1.1 The model takes its services from Openreach's current all-fibre product set; these include FTTP, EAD and EADLA at speeds up to 10Gbps, OSA, DPA and dark fibre services. CityFibre notes that, while these services broadly reflect what Openreach provides today, they do not constitute a reasonable portfolio for the future, especially in a model extends for 40 years. In particular we note that:

- 10G LL services are currently at the leading edge, priced significantly higher than services up to 1G which form the bulk of the volumes. The costs of electronic equipment for 10G services is currently much higher than for 1G. However, there is a seven-year product cycle whereby services at a lower speed tend to be replaced by services at a higher speed, while maintaining the lower price. At the same time, higher speed services (eg. 100G) enter the market at the leading edge, with a significant cost/price premium.

- Rather than attempting to forecast volumes and equipment prices by speed for a 40 year period, a more robust and practical approach would be to define a basic product (equivalent to today's up to 1G LL and with the same equipment costs) and a premium product (equivalent to today's 10G LL and with the same equipment costs). It could then be assumed that the speeds of these products would increase over time (according to the seven-year trend), but that the real-terms costs would remain fairly constant and that the volume proportions between basic and premium products would remain similar.

- OSA is an Openreach product with limited current take-up; CityFibre does not believe that complex, active and expensive LL products such as OSA will form a significant part of a typical operator's portfolio in the future.

Volume forecasts

7.1.2 The volume forecasts used in the model are based on an s-curve, achieving FTTP coverage to all premises over a 10-15 year period. The overall volumes for active LL are then based on a fixed percentage of total fibre deployment, which is input as a separate assumption for each of Areas 1, 2 and 3. CityFibre does not believe that this fixed percentage assumption can provide the basis for a robust forecast of business connectivity volumes; there are many anticipated developments such as 5G, driverless cars and internet of things which will require high degrees of connectivity, potentially at high speeds and low latency. Ofcom's rather current forecasting approach does not address these developments, with the potentially disastrous outcome of incentivising the development of networks which are unable to efficiently meet such demands.

7.1.3 The overall LL volumes are further broken down into local access-only and backhaul-only circuits using ratios from Openreach forecast data projected forward, and a

balancing proportion is used to determine the remaining circuits (i.e., non-access but with access elements).

7.1.4 A further break-down is made into different speeds of circuit: 100M, 1G, 10G using Openreach forecasts projected forwards. It also appears that OSA circuits are forecast as a balancing figure between the Openreach total LL and 100M, 1G and 10G forecasts. With the placeholder data provided, this leads to a strongly increasing share of OSA, rising to 35% for access circuits and 42% of backhaul circuits by 2059. The resulting volume profile is shown below:

	Units		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2057/58	2058/59	2059/60
Proportion of local access circuits	%		50%	53%	57%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
Proportion of circuits with only backhaul element	%		20%	19%	18%	17%	16%	15%	15%	15%	15%	15%	15%	15%	15%
Proportion of non-LA circuits with access elements	%		30%	28%	25%	23%	24%	25%	25%	25%	25%	25%	25%	25%	25%
			TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Proportion of 100Mbit/s circuits	%	Access	66%	65%	63%	58%	54%	49%	44%	39%	36%	33%	22%	22%	21%
Proportion of 1Gbit/s circuits	%	Access	23%	26%	28%	32%	34%	37%	39%	40%	40%	39%	39%	39%	39%
Proportion of 10Gbit/s circuits	%	Access	3%	3%	3%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
Proportion of optical circuits	%	Access	8%	5%	6%	6%	8%	10%	13%	16%	20%	23%	35%	35%	35%
			TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Proportion of 100Mbit/s circuits	%	Backhaul	8%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Proportion of 1Gbit/s circuits	%	Backhaul	77%	76%	75%	71%	66%	61%	55%	51%	46%	42%	28%	28%	28%
Proportion of 10Gbit/s circuits	%	Backhaul	16%	17%	19%	23%	27%	29%	29%	29%	30%	30%	31%	31%	31%
Proportion of optical circuits	%	Backhaul	0%	4%	6%	7%	7%	10%	15%	20%	24%	28%	42%	42%	42%
			TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE

7.1.5 While we understand that the numbers in the supplied model are based on placeholders for the Openreach forecast, and that real numbers may give a very different result, CityFibre does not believe that the method used to produce this forecast is either valid or robust. In particular, the forecast of optical circuits as a balancing figure will always be prone to significant error, and the combination of high active costs and an unstable volume forecast undermines the integrity of the model outputs across all services.

8 Operating costs

8.1.1 Operating costs form a significant part of the service costs, amounting to around 30% of the total costs; it is therefore essential that the modelling of opex is robust and transparent, with a well-articulated methodology.

8.1.2 Operating costs relating to specific input drivers, such as FTTP site installation, SLGs or DPA usage are modelled by taking a unit cost input and multiplying by the driver volumes. These costs amount to less than 30% of total opex with the input data provided. This seems to be a reasonable approach, provided that the input unit costs are valid.

8.1.3 The remaining opex, which does not have a specific driver and is described as "other opex", is determined as a proportion of capex. This opex amounts to more than 70% of total opex using the inputs provided. The proportion used can be set in the control module and may vary over time; in the model provided, the ratio starts at 10% and gradually reduces to 3%. CityFibre is concerned that this is not a robust way to determine the overall level of opex, for the following reasons:

- CityFibre does not believe that cumulative capex is a valid driver for the majority of operating costs; while we understand the need to identify simplifying assumptions for modelling purposes, the method used in Ofcom's model for "other opex" is not robust for a model which has many different input scenarios.
- There is no clear way to determine or validate the correct percentage to be used without considerable analysis outside of the model;
- The percentage would be expected to change between Areas 1, 2 and 3, yet the model does not provide a way to determine how this should change, beyond providing high/medium/low scenarios which simply select different input percentages;
- The percentage would be expected to change as the scale of deployment changes within an area, and also as the penetration (market share) changes. Again, the model does not support this, simply applying fixed input percentages.

8.1.4 After calculation of the total opex, described above, the opex is redistributed using the selected asset depreciation method, so that the opex costs are recovered using a similar profile over time to the capex recovery. The resulting opex is treated as either incremental (where there is a direct service driver) or shared and allocated to services in a similar way to the capex. While this latter stage of opex calculation appears reasonable as a method of aligning recovery of opex with demand profiles, from an investment perspective it would be necessary to consider the actual opex cashflows, which would be considerably more front-loaded than in Ofcom's model.

8.1.5 Given these serious flaws and considering that opex comprises around 30% of total costs, CityFibre is unable to support the overall methodology used to calculate and attribute opex in the model.

9 Counter-intuitive results from scenarios

Base case

9.1.1 In order to run scenarios to assess the behaviour of the model given varying inputs, we first made some changes in order to define a base case with more reasonable starting assumptions. Firstly, the WACC was adjusted to 10% (c.f. 1% as delivered). This 10% WACC has been used in all of our scenarios; 10% has been chosen purely as a modelling assumption and should not be taken to imply that CityFibre believe this to be a reasonable value.

9.1.2 In our scenario modelling, we have chosen to focus mainly on 3 products: FTTP, EAD LA 1G and EAD 10G rentals. Due to the serious problems we have found with the model, both in its methodology and also the unstable and slow nature of the excel implementation, we have not gone further to consider backhaul or connection (rather than rental) services. As discussed in Section 0, we have strong reservations about the service definitions and volume forecasts which Ofcom has used for LL, and we have therefore modified these in our base case as follows:

	Units		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2057/58	2058/59	2059/60
Proportion of local access circuits	%		50%	53%	57%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
Proportion of circuits with only backhaul element	%		20%	19%	18%	17%	16%	15%	15%	15%	15%	15%	15%	15%	15%
Proportion of non-LA circuits with access elements	%		30%	28%	25%	23%	24%	25%	25%	25%	25%	25%	25%	25%	25%
			TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Proportion of 100Mbit/s circuits	%	Access	66%	65%	63%	58%	54%	49%	44%	39%	36%	33%	22%	22%	21%
Proportion of 1Gbit/s circuits	%	Access	23%	24%	27%	31%	35%	40%	45%	50%	53%	56%	67%	67%	68%
Proportion of 10Gbit/s circuits	%	Access	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%
Proportion of optical circuits	%	Access	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
			TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE

- OSA access volumes have been removed, as we do not believe it will be a significant service in the future;
- 10G access volumes have been held at a constant proportion of total LL. This reflects an assumption that a premium LL product will continue to exist at ever-increasing speeds, with costs similar to 10G today;
- 1G access volumes are used as a balancing figure. This reflects an assumption that a basic product will costs similar to 1G LL will continue to be sold, but with ever-increasing speeds.
- We have not altered the total volumes for LL in our base case, although we do not agree with Ofcom's approach to estimating the demand of leased lines as a percentage of FTTP premises.

9.1.3 As discussed in paragraph 3.1.5, we do not believe that the placeholder capex trend data provided by Ofcom in the model is reasonable, as it results in strongly front-loaded unit costs. We have therefore, in all of our scenarios, switched the capex trend to the "Spare" scenario of 2% nominal increase for all asset groups.

Effect of penetration changes

9.1.4 By changing the take-up profiles for FTTP and LL in the "Deployment scenarios" sheet of the volumes module, we were able to observe the effect of penetrations of 100%, 50% and 33% on the unit costs and total cost.[28] The unit costs are for the year 2024/25, to provide a representative number from the middle of the deployment period.

9.1.5 For Areas 1 and 2, the results are shown below:

	Area 1-2		
Penetration	FTTP unit cost FY 2024/25 (£/month)	EADLA 1G unit cost FY 2024/25 (£/year)	Total NPV cost (£'m)
100%	6	1,635	42,116
50%	12	2,682	34,231
33%	17	3,124	28,164

- We note that the FTTP unit costs are doubled as the volumes halve from 100% to 50% penetration. This is counter-intuitive, as the economies of scale present in FTTP networks should ensure that unit costs change at a slower rate than volumes.
- The total NPV changes look more reasonable, with around a 20% reduction for a 50% reduction in volumes.

9.1.6 For Area 3, the results are shown below:

	Area 3		
Penetration	FTTP unit cost FY 2024/25 (£/month)	EADLA 1G unit cost FY 2024/25 (£/year)	Total NPV cost (£'m)
100%	11	1,923	11,148
50%	31	3,979	13,940
33%	45	4,570	12,797

- In this case, the irrational behaviour of the FTTP unit cost is even more marked. As the volumes halve, the unit cost increases by a factor of 2.8.

[28] Note that in these scenarios the total cost is expressed as an NPV at the WACC of the LRIC+ outputs over 40 years. This is done simply to show the present value of the total cost recovered (and hence revenues if prices were set at cost) to allow comparison of scenarios.

- The total NPV is also irrational – it increases as volumes reduce to 50%, then reduces slightly as volumes further reduce to 33%, but remaining above the 100% level.

9.1.7 These results are highly counter-intuitive and suggest that, regardless of the use of placeholder input data, there is a serious problem with the methodologies being used in the model. As a further check, in order to ensure that the changes we made for our base case are not introducing problems, we ran the same scenarios but with Ofcom's placeholder inputs left as per the model downloaded from Ofcom's website (with the exception of the WACC, which we changed from 1% to 10%). The results for this are shown below:

	Area 1-2			Area 3		
Penetration	FTTP unit cost FY 2024/25 (£/month)	EADLA 1G unit cost FY 2024/25 (£/year)	Total NPV cost (£'m)	FTTP unit cost FY 2024/25 (£/month)	EADLA 1G unit cost FY 2024/25 (£/year)	Total NPV cost (£'m)
100%	3	2,021	60,522	5	2,120	12,807
50%	6	2,373	39,227	14	4,320	14,623
33%	8	3,015	31,097	22	5,336	13,096

- While the cost levels are very different, the behaviour of the model in response to penetration changes is very similar, with FTTP unit costs doubling for a halving of volumes in Area 1-2 and increasing by a factor of 2.8 in Area 3. The total NPV also shows a similar irrational trend in Area 3.

9.1.8 While we fully understand that the model provided by Ofcom is using placeholder data, and that the outputs are therefore not expected to be at all accurate, CityFibre believes that these results demonstrate that the methodologies used in the model are not fit for purpose at a very basic and fundamental level. This makes it difficult to provide meaningful comments on more detailed aspects of the model, given the inability to run simple scenarios and obtain rational outputs. Nevertheless, we have attempted to proceed further, and look into other aspects of the modelling.

10 Calculating costs for different geographic areas

10.1.1 Ofcom's definitions of areas 1, 2, and 3 are hard-coded into the model via a mapping table. CPs have not been given access to Ofcom's analysis which underpins this mapping, and it is therefore difficult to assess the impact of alternative market definitions. This is surprising, as CityFibre had understood that a key purpose of the model was to provide information to determine and/or support this market definition.

10.1.2 In order to better understand this, CityFibre has performed its own postcode sector analysis to understand the costs resulting from different definitions of the boundary between areas 2 and 3, and also to understand the differences in unit costs for different sizes of settlement.

10.1.3 Our analysis took the following initial steps:

- From publicly available data, we identified a list of towns of different sizes, and categorised them into <10k, 10-15k, 15-20k and >20k premises.
- For each of these towns, we identified postcode sectors which fell largely within town to form a mapping of towns to postcode sector.[29]
- This mapping was then compared to Ofcom's mapping of postcode sectors to Areas 2 and 3.

10.1.4 We then defined four scenarios, to assess the impact of changes to the Ofcom mapping:

- Base case: as for the analysis in paragraphs 9.1.5 and 9.1.6, using 50% penetration;
- Scenario 1a: move all postcodes for towns with >20,000 premises from area 3 to area 2 (we understand they should have been in Area 2 anyway, as per Ofcom's definition);
- Scenario 1b: move all postcodes for towns in area 3 that already have two or more postcodes in area 2 into area 2;
- Scenario 1c: based on Scenario 1a above, move all postcodes of towns with between 20,000 and 15,000 premises into area 2;
- Scenario 1d: based on Scenario 1c above, move all postcodes for towns with premises count between 15,000 and 10,000 into area 2.

[29] This is not an exact science and is a laborious process but was achieved with the help of publicly available data and maps. A cross-check was made to ensure that the ratio of town population to premises in the mapped postcode sectors was within reasonable bounds.

10.1.5 The results of this analysis are shown below:

	Area 1-2			Area 3		
Scenario	FTTP unit cost FY 2024/25 (£/month)	EADLA 1G unit cost FY 2024/25 (£/year)	Total NPV cost (£'m)	FTTP unit cost FY 2024/25 (£/month)	EADLA 1G unit cost FY 2024/25 (£/year)	Total NPV cost (£'m)
Base case	12.08	2,682	34,231	30.53	3,979	13,940
1a	12.08	2,683	34,260	30.62	3,986	13,943
1b	12.10	2,686	34,422	30.97	4,013	13,916
1c	12.10	2,685	34,591	31.64	4,060	13,870
1d	12.15	2,690	35,005	31.20	3,887	13,017

- The trends in unit costs and total costs are as expected, with slight increases in Area 1-2 and reductions in Area 3.
- The very small increases in Area 1-2 unit costs suggest that there is little difference between the unit costs to serve the towns transferred from Area 3 and the average costs of Area 1-2 under Ofcom's mapping.

10.1.6 We also ran some scenarios to assess the unit costs of towns of 10-15k and 15-20k premises in isolation. The scenario definitions are as follows[30]:

- Scenario 2a: define Area 3 as only towns with between 15,000 and 20,000 premises (includes all such towns whether previously in Area 2 or 3);
- Scenario 2b: define Area 3 as only towns with between 10,000 and 15,000 premises (includes all such towns whether previously in Area 2 or 3).
- Scenario 2c: Area 3 is as defined by Ofcom, but with all postcodes relating to towns greater than 10k excluded, and state-funded lines included.
- Scenario 2d: Area 3 is as defined by Ofcom, but with all postcodes relating to towns greater than 10k excluded, and state-funded lines excluded.

10.1.7 The results of this analysis are shown below:

[30] Note that in these scenarios, Area 3 is being used simply as a convenient way of identifying costs of the mapped towns, and to allow comparability with Area 1-2, we have set all of the input parameters in the control module (such as duct re-usage) to be identical to those used in the Area 1-2 base case.

Scenario	Area 3		
	FTTP unit cost FY 2024/25 (£/month)	EADLA 1G unit cost FY 2024/25 (£/year)	Total NPV cost (£'m)
2a - towns 15-20k premises	15.31	2,329	2,407
2b - towns 10-15k premises	15.71	2,346	2,460
2c - area 3 without towns >10k premises incl state funded lines	33.03	3,408	20,821
2d - area 3 without towns >10k premises excl state funded lines	21.19	2,514	8,888

- The FTTP unit costs are slightly higher for the smaller towns;
- The FTTP unit costs are a little higher than the average for Area 1-2 (from paragraph 5.1.16), but much lower than the average for Area 3. This suggests that, from a cost perspective, the towns may align more with Area 2 than Area 3.
- The unit costs for Area 3 with towns greater than 10k premises removed are much higher than the unit costs for just the towns.

11 Calculating costs of different scales of deployment

11.1.1 During the analysis conducted in Section 0, it became apparent that many of the towns we identified fell partly into Area 2 and partly into Area 3. In order to investigate this further, we defined a scenario using a reduced scale of deployment within area 3. The purpose of this was to investigate the deployment methodology being used in the model, rather than the cost outputs.

11.1.2 The process followed was:

- The 232 towns we identified in the analysis in paragraph 10.1.3 were all mapped to Area 3 in the model (only these were mapped, amounting to around 3.4m premises);
- Penetration was set to 50%;
- The deployment scale was adjusted in the volumes module so that 25% of premises were covered.
- The model was run, and the postcode sectors deployed to were identified from the "Calc_CovScen" sheet in the network cost module.
- The deployed postcode sectors were then compared with the town-postcode mapping to determine the extent of coverage achieved in each town after 40 years.

11.1.3 An extract of some of the results of this analysis is shown below:

Town	Postcodes built	Postcodes	Premises	Business premises	Total premises
Frome	1	BA111	3,230	43	3,273
Frome	0	BA112	4,713	8	4,721
Frome	0	BA113	2,436	9	2,445
Frome	0	BA114	2,889	24	2,913
Perth	0	PH11	4,021	12	4,033
Perth	0	PH12	6,098	12	6,110
Perth	1	PH15	4,639	139	4,778
Perth	0	PH20	3,945	26	3,971
Rhyl	1	LL181	2,070	87	2,157
Rhyl	0	LL182	3,887	37	3,924
Rhyl	0	LL183	2,303	12	2,315
Rhyl	0	LL184	4,969	4	4,973
Fleetwood	1	FY76	3,915	54	3,969
Fleetwood	1	FY77	4,038	10	4,048
Fleetwood	0	FY78	4,264	11	4,275
Newton Ab	0	TQ121	5,791	17	5,808
Newton Ab	1	TQ122	2,926	97	3,023
Egham	0	TW208	3,351	23	3,374
Egham	1	TW209	3,317	49	3,366
Thatcham	0	RG183	2,889	16	2,905
Thatcham	0	RG184	1,957	6	1,963
Thatcham	1	RG193	3,117	13	3,130
Thatcham	0	RG194	2,854	24	2,878
Congleton	0	CW121	2,676	72	2,748
Congleton	0	CW123	4,544	9	4,553
Congleton	0	CW124	5,039	20	5,059
Kidsgrove	0	ST71	5,225	44	5,269
Kidsgrove	0	ST74	6,563	21	6,584
Stalybridge	1	SK151	4,407	11	4,418
Stalybridge	1	SK152	4,382	25	4,407
Ferndown	0	BH228	4,883	8	4,891
Ferndown	0	BH229	4,689	50	4,739
Hertford	0	SG137	5,011	27	5,038
Hertford	1	SG141	2,121	61	2,182
Hertford	0	SG142	3,381	11	3,392

11.1.4 The table below shows summarised results for all of the towns analysed:

% coverage (premises passed) in town	Number of towns
Not started	112
0-20%	15
20-40%	48
40-60%	23
60-80%	22
80-100%	12
Total	232

11.1.5 We understand from the model documentation that the deployment sequence is based on the costs of each postcode sector (proxied by required infrastructure length), with the lowest-cost sectors being built first. The results above are consistent with this approach, and suggest that the relationship between postcode sectors and towns does not factor in to the sequence of building network. As a result, when scales of less than 100% are specified, the model assumes that network is built in many isolated postcode sectors, and leaves the vast majority of towns only partially built.

11.1.6 This deployment scenario is completely unrealistic. CPs building fibre networks address whole, or almost whole towns or cities in order to maximise the economies of scale and scope and build an efficient network business. By basing deployment on postcode sectors in this way, we believe that the model is likely to understate the costs of building access networks for scales of less than 100%, as only the lowest cost postcode sectors will be modelled, not the higher cost sectors that form key parts of an economically viable town.

11.1.7 Even where the scale is set to 100%, this suggests that the order of build will not be determined by building complete towns but will be fragmented in favour of low-cost sectors being built first. This suggests that costs in the early stages will be understated, with the more expensive sectors being deferred until the later stages of the build.

11.1.8 In order to assess the cost impact of building network by lowest-cost postcode sector, as opposed to building complete towns, we have run some scenarios in Ofcom's model in conjunction with our postcode analysis.

- Scenario 3a uses the same postcode mapping as above (defined in paragraph 11.1.2), whereby our list of towns is mapped to Area 3, with coverage set to 25%;
- Scenario 3b identifies a number of complete towns from our list, chosen to give approximately the same number of premises covered as in Scenario 3a, but at 100% coverage.

11.1.9 The results from this analysis are shown below:

	# towns built (fully or partially)	# premises covered	Average premises per town	FTTP unit cost FY 2024/25 (£/month)	EADLA 1G unit cost FY 2024/25 (£/year)	EAD 10G unit cost FY 2024/25 (£/year)	Total NPV cost (£'m)
Scenario 3a: Ofcom build profile	120	801,141	15,405	12	1,974	9,607	1,409
Scenario 3b: Build complete towns only	53	805,770	15,336	15	2,350	11,504	1,726
Change				25%	19%	20%	22%

- The building of 53 complete towns rather than parts of 120 towns results in an increase in costs of 20-25%, despite the total premises covered and average premises per town being similar;

- Such a fragmented approach to building networks is not viable for new entrant operators, and unlikely to be optimal for an incumbent upgrading to all-fibre networks, so it appears that Ofcom's model will materially understate the costs of real-world network deployments.

11.1.10 Given this situation, we do not believe that the Ofcom model in its current form can accurately reflect the costs of building a new fibre network by a new entrant CP. Even in the case of BT, with its established presence in all locations, an FTTP upgrade programme may well focus on targeted areas, rather than being fragmented by postcode area.

12 Calculating the costs of a modern resilient ring-based network

12.1.1 In discussions with Ofcom, we have noted that the cost model reflects the model architecture of BT's tree and branch network and not the combination of rings and tree and branch structure which characterises a modern network designed to build in resilience and flexibility as well as capacity to meet uncertain but foreseeable demand. Ofcom has suggested that it may be possible to deal with this issue by increasing the capex to reflect an initial build of a ring network and comparing the cost impact of doing this with upgrading an entirely the tree-and-branch structure to meet extra demand at a later stage.

12.1.2 CityFibre believes it is not possible to apply such modifications in a meaningful and robust way without providing a completely new geo-spatial network analysis module for the model. However, we have attempted to provide an indicative scenario based on some high-level assumptions, and this is described here.

12.1.3 The stages in the analysis are as follows:

- Our base case is as described in paragraph 9.1.5 using a penetration of 50%.
- [✂]

12.1.4 [✂]

12.1.5 Our analysis indicates that there may be economic advantage in investing more in the early stages of network deployment in order to provide flexibility to meet future demand. However, Ofcom's model does not have the capability to test this robustly, as it does not include the option of a modern, resilient network design in its analysis. We urge Ofcom to consider commissioning a network module which does include this analysis; otherwise CityFibre believes that the model will never be suitable for assessing the costs of a reasonably efficient operator using modern approaches to network deployment.