Costing and pricing of passive access remedies

A REPORT PREPARED FOR THE PASSIVE ACCESS GROUP

January 2015

Costing and pricing of passive access remedies

Contents

Costing and pricing of passive access remedies

Executive Summary

BT's control of the network of fibre cable and underlying infrastructure (ducts, manholes and poles) allows it to leverage market power into downstream markets, including business connectivity markets. These markets include high quality connections to end users and backhaul from access networks. These are key inputs to competitive downstream markets for fixed and mobile broadband and for corporate networks.

Ofcom seeks to prevent BT exploiting its market power to increase overall wholesale prices through charge controls applied to the majority of active services. However, regulation is an imperfect substitute for competition. Mandating passive access would enable providers to compete with BT over more of the value chain and would remove the ability of BT to determine how passive infrastructure is used.

The benefits of regulating at a deeper level in the network are already well recognised by Ofcom. The introduction of effective Local Loop Unbundling ("LLU") regulation removed the bottlenecks imposed by BT on mass market broadband services. This led to a large expansion in the broadband market and increased quality and reduced prices for end users. The availability of LLU resulted in the rebalancing of prices to end users with a reduction in the premium charged for DSL services targeted at SMEs. Overall, due to the significant increase in demand, the average price of broadband services fell, while BT continued to fully recover relevant common costs. Over time the success of competition based on passive products meant Ofcom was able to partially withdraw from regulation of active products.

Providing passive access to the fibre network and underlying infrastructure could unlock a similar range of benefits, both to corporate customers buying high quality connections and fixed and mobile broadband users due to the increased competition in access markets if backhaul prices fell to competitive levels. In addition, competing providers could use passive access to deliver innovative solutions in access markets to segments which are not currently well served, such as SMEs.

When assessing the cost and benefits of passive access it is helpful to consider three forms:

- a special case based on a simple unbundling of the fibre underlying existing active products provided over fibre (akin to LLU);
- dark fibre access, allowing CPs to purchase segments of cable which may not originate/terminate in BT exchange sites or an end user's premises, for example between two chambers within the BT network; and

- access to the underlying infrastructure allowing CPs to install their own fibre cables within ducts, or on poles, owned by BT.

These forms of passive access can be complementary to each other and with existing active access products, forming a hierarchy of wholesale products[1]. If prices are set appropriately CPs would choose between different forms of access in a way which reduces the overall cost of provision and allows innovation. CPs would choose deeper level access: if they can provide equipment or carry out activities more efficiently than BT; where unbundling allows services to be delivered without duplicated or redundant network components; or which allows greater innovation which is not possible with high level network access.

While deeper levels of access to the network may incur additional costs in terms of setting up and operating the regime, the corresponding benefits are similarly much greater. Allowing CPs to replicate existing active products more efficiently and without artificial restrictions on bandwidth will allow significant reductions in CP's cost base which can be passed on to consumers. Furthermore, the benefits of greater levels of unbundling of infrastructure may also be significantly greater if CPs are permitted to build and extend their networks unconstrained by BT's current network topology, for example by creating fibre access rings to serve concentrations of corporate customers.

Over the longer term a successful passive access regime could allow Ofcom to withdraw from complex regulation of the business connectivity market, relying instead on simpler regulation of the access to the underlying passive components.

1 Similar to the 'ladder of investment' for delivery of broadband services.

1 Benefits of passive access

1.1 Forms of passive access

The passive elements of BT's network include copper and fibre cables and the infrastructure which supports these cables including ducts and poles; chambers and manholes allowing access to these chambers; street cabinets; and buildings and the infrastructure within these buildings. Passive access means allowing competitive providers (CPs) other than BT to gain regulated access to passive elements in order to deliver communications services.

This report focuses on the use of passive access to allow CPs to deliver fibre based transmission; in particular Ethernet based services covered by the BCMR. While there are a great number of potential forms of passive access, for the purposes of the following analysis it is helpful to divide the different forms of passive access into two general cases and a special case:

- a simple unbundling of the individual dark fibre circuits that underlie Openreach's active Ethernet products;
- a more general unbundling of dark fibre; and
- a general infrastructure access regime, which would allow CPs to buy access to lengths of duct and poles which do not need to correspond to existing active products.

While there are undoubtedly a large number of potential variants of passive access within the set of generalised passive access regimes, from an economic and costing perspective there are important distinctions between these three options.

For general dark fibre access, while there is not a simple one to one relationship between dark fibre and a given active access product, there is an underlying cost driver, fibre km, which can be used to consistently allocate costs between active products and passive products.

For simple fibre unbundling, there is a correspondence between a given active access product and a corresponding passive product. This means that the same cost stack can be used to determine the costs of active and passive products.

In the case of infrastructure access there may be a many to many correspondence between passive components and active products, i.e. multiple active services may be supported by a single piece of infrastructure, i.e. a duct segment, while any given active service may use a number of different duct segments. In this case deriving an efficient price for each component may require additional information and assumptions.

1.2 Passive access can unlock a range of benefits

It is well understood that passive remedies can be more effective than active remedies at promoting competition in downstream markets. Benefits of passive access are likely to derive from a range of sources:

- increased innovation in services;
- increased productive efficiency; and
- potentially simpler regulation with increased transparency.

Ofcom itself recognised in the 2013 BCMR decision[2] that passive remedies can have important benefits for consumers as they can:

"stimulate competition in a greater part of the value chain in regions where full infrastructure competition is unlikely to emerge by lowering barriers to entry; and provide more scope for product innovation and service differentiation in some cases."

This section discusses the potential benefits of passive access.

1.3 Passive access allows increased innovation

The current regulatory framework does not provide BT with strong incentives to innovate in the provision of active services, where BT has SMP:

- charge controls allow BT to make a reasonable return on relevant assets, subject to meeting efficiency targets, independently of the level of innovation;
- BT may be wary of introducing additional services, due to the risk that these products may be partial substitutes for existing products with relatively high margins;
- the relatively short duration of charge controls, driven by the market review process, and the process through which charge controls are set, where Ofcom does not actively scrutinise and approve BT's investment plans, means that BT's investments in innovation are likely to require a short pay-back period in order to increase BT's profitability;
- Openreach has little incentive to incur costs to offer additional services or capabilities that BT's downstream divisions will not make use of; and

2 Ofcom (2013) Business Connectivity Market Review: Review of retail leased lines, wholesale symmetric broadband origination and wholesale trunk segments Statement ("the 2013 BCMR decision").

- charge controls do not take account of improvements in wholesale service quality, encouraging BT to minimise costs by maintaining existing services even where additional functionality (for example improved network management capabilities) are available.

As a result the capabilities of the services offered by Openreach tend to lag those offered by competitors in those areas where there is (limited) competing infrastructure.

Allowing CPs control over more of the value chain can lead to better outcomes for end users as CPs would have more freedom to innovate, rather than relying on product specifications determined by BT. Product innovation can be on a number of dimensions:

- new products and enhancements to the capabilities of existing products;
- pricing; and
- quality.

1.3.1 New products

Dark fibre or infrastructure access would allow CPs to create new products[3], enabling new developments in downstream services and better serving groups of customers whose needs are not currently well met.

As demand for data grows in residential, SME and corporate segments, current network structures may need to adapt to deliver increased traffic volumes over mobile and fixed networks. For example in mobile markets, heterogeneous networks ("HetNets") using a range of traditional cellular networks, WiFi and small cells may be required to deliver a high quality of service to mobile devices. Current active wholesale products may not be suitable for providing backhaul for such distributed networks.

Similarly certain groups of SMEs may fall in the gap between existing access product offers, on the one hand high quality symmetric access for corporate customers (within the BCMR) and on the other hand lower quality asymmetric access for residential customers (within the WLA). Access to passive services on an unrestricted basis can allow CPs to develop their own access products which may fill in these gaps.

[3] While simple unbundling of active products would only allow CPs to broadly replicate BT's existing active products.

1.3.2 Innovation in pricing

Allowing CPs to decide how best to recover costs of the active equipment they operate will allow innovation on tariffs, rather than simply applying tariff gradients that reflect BT's decisions on wholesale pricing. For example, CPs could choose to introduce traffic based charging for corporate Ethernet services, allowing prices to be better tailored to customers' willingness to pay, and changing data requirements.

1.3.3 Improvements in service quality

Quality is a key dimension of competition. There could be a number of aspects of quality which customers might value:

- improved product characteristics;
- lower propensity of lines to fault,
- faster repair times; or
- improved levels of customer services.

Competition ensures that suppliers who offer a poor quality of service at the same price as other providers are forced to exit the market as customers switch to providers offering better quality services. Without having to compete for customers, firms are less incentivised to offer high quality products.

Allowing CPs control over a greater part of the value chain, in particular active equipment, should in itself bring an improvement in service quality. The removal of duplicate equipment[4], which may fault, will also tend to increase service quality. Finally allowing operators to roll out new network topologies, which may remove or concentrate active components, for example Cloud Radio Access Networks, could increase quality of service.

1.4 Increased productive efficiency

Firms with market power have less incentive to minimise costs than firms in competitive markets, where each firm needs to minimise costs in order to be able to fully recover their costs. While charge controls attempt to give some incentives to minimise costs, the incentives will not be as strong as those under competition. As a result, on a like for like basis, introducing competition in place

4 For example where CPs installed customer premises equipment alongside separate BT network termination equipment, where a single integrated piece of equipment would suffice. This may be a more significant issue for access services than backhaul services.

of regulation into part of the value chain could be expected to drive down costs of providing, operating and maintaining the associated assets.

In addition, where an operator such as BT has market power in an upstream market, it has little incentive to deliver services to competitors in downstream markets in a fashion that will minimise the overall end to end cost for those competitors[5] as increasing the cost to competitors could increase the market level of prices and hence BT's overall margins in the downstream market. For example BT may choose to provide wholesale services in ways which require duplication of equipment or inefficient routing when competitors use these wholesale services to compete with BT's retail businesses.

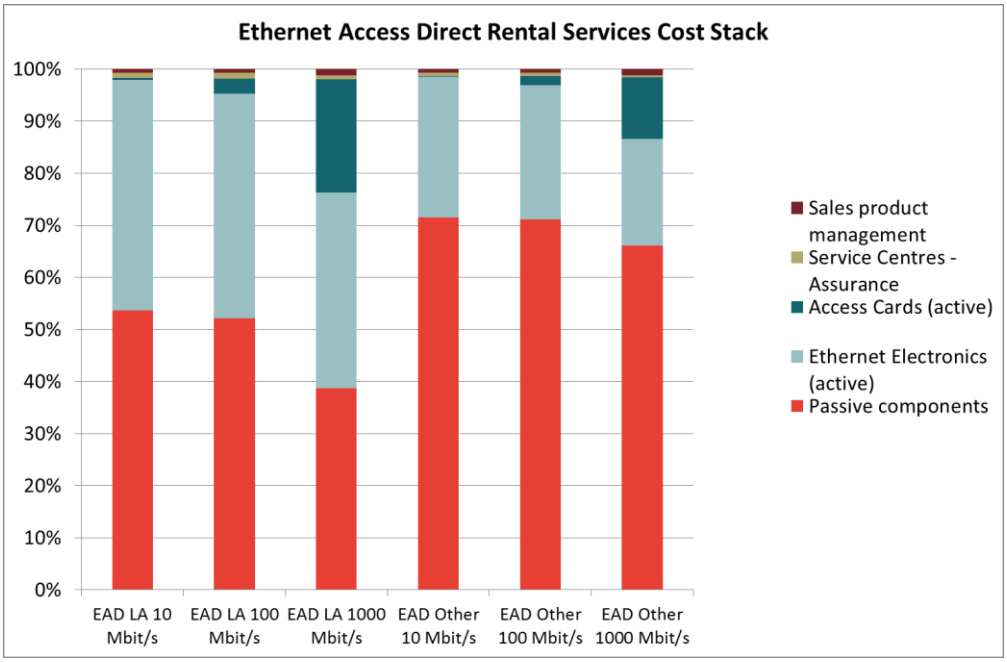
1.4.1 Competition over a greater part of the value chain

Passive access, with CPs able to provide the active equipment themselves, would allow the CPs to compete in provision of this equipment and the associated provisioning, operations and maintenance of the equipment.

Even if competition is not possible across the whole value chain, passive access enables competition across a greater degree of the cost stack than is possible with active remedies. This can be seen in **Figure 1** which illustrates the cost stack for Ethernet Access Direct services. Depending on the service, between 40% and 70% of the cost stack reflects the duct and fibre costs and costs associated with operating and maintaining duct and fibre. This means that if customers were offered services through dark fibre access, between 30% and 60% of the cost stack (including the costs of access cards and Ethernet electronics) would be contestable, and rivals could compete by delivering these elements more efficiently than BT. Infrastructure access would even more of the cost stack contestable, including the capital and operating costs of fibre.

5 To the extent that this may differ from costs for BT's own downstream business due to differences in network structure, the level of demand or lack of full equivalence.

Figure 1. Breakdown of EAD product costs



Source: Frontier Analysis of BT RFS

1.4.2 More direct routing

While simple fibre unbundling allows CPs to more efficiently replicate BT's services, other forms of passive access such as dark fibre or duct access could allow CPs to deliver services without being bound to BT's network structure and topology.

By requiring current wholesale products to reflect BT's network topology, the current regulatory regime may encourage inefficient network architecture. The important feature of fibre based networks is that they can use passive components over long distances. This means that aggregation can occur at fewer points in the network, requiring less investment in expensive network equipment. Ofcom illustrates this by showing how Cloud Radio Access Networks could offer significant cost reductions for mobile operators compared to traditional architectures.

In addition, many CPs have existing infrastructure of their own. Using short fibre lengths to connect customers to their existing infrastructure may be more efficient than routing traffic from these customers through BT's network.

Benefits of passive access

1.5 Simplifying regulation

All forms of regulation incur a cost. These costs include the direct costs for the regulator and regulated firms in implementing regulations, and wider economic costs associated with unintended regulatory failures which result from incomplete information.

Regulation of active products is complex and can increase scope for unintended regulatory error. Regulating the underlying infrastructure could allow for more stable and predictable regulation in the long run even if there is increased complexity in the short run due to the need to regulate active and passive access in parallel.

The wide variety of active services within the scope of the BCMR and the continued evolution on both the demand and supply side results in Ofcom being involved in detailed and prescriptive regulation on an ex ante basis and leads to complex disputes on an ex post basis. For example, charge control design is complicated by the inclusion or exclusion of services which are partial substitutes on both the supply and demand side in the coverage of the charge control. The forecasting of revenues and costs is also challenging due to the migration between services within (and between) baskets and the introduction of new services.

There are a limited number of variants of dark fibre and infrastructure access and the rate of technical evolution is slower in the passive infrastructure than active components.

Passive remedies could decrease scope for regulatory error. For example Openreach returns in past charges controls have deviated from that forecast due to errors in accurately forecasting migration between services. Forecasts of passive service volumes, which should be largely independent of the technology used to provide services, should be more robust.

Gradually, as the use of passive remedies becomes more significant and established, then some active remedies could be withdrawn.

LLU offers a text book example of how passive remedies over time can lead to the withdrawal of remedies at the active layer. Indeed, one of the key justifications for implementing the LLU remedy was precisely to remove complex layers of regulation which did not necessarily support sustainable and effective competition. Ofcom, for example, noted its rationale for LLU based competition was that:

> *"Past regulatory attempts to secure fair access at wholesale level to BT Group plc's networks and facilities have also led to a large and growing range of detailed regulatory interventions, and at times regulatory micro-management of BT Group plc at different points in the value chain, which can set conflicting incentives both for BT Group plc*

> *and its competitors and encourage commoditised competition on the basis of regulatory arbitrage."*[6]

The pricing and processes for LLU when it was initially introduced limited its use to niche services. However when LLU pricing was moved into line with other copper based services such as wholesale line rental, and the creation of Openreach resulted in processes which could be used in the mass market, its use took off rapidly as competition took hold. Ofcom noted that:

> "*it took six years to achieve take-up of the first million LLU lines; take-up of the second million took only 6 months*."[7]

This meant that consumers were offered significant choice from a wide range of providers. It is now taken for granted that in the consumer broadband market almost all premises are served by a number of different broadband providers using passive access. The 2013 WBA consultation found that 90% of premises are in areas where there are three or more Principle Operators present or forecast to be present.[8] In 2007 Ofcom noted that:

"*the significant expansion of choice and, consequently, take up have been attributable in large part to the changes in the wholesale pricing regime and the implementation of the Undertakings entered into by BT."*[9]

As competition took hold, Ofcom gradually was able to withdraw regulation at downstream parts of the value chain, for example regulation of Wholesale Broadband Access in most of the UK.

---

6 TSR 2 Foreword.

7 A New Pricing Framework for Openreach. Paragraph 3.3.

8 Principle operators are defined as BT, Sky, TalkTalk and Virgin Media. WBA consultation paragraph 1.18, and 4.61.

9 A New Pricing Framework for Openreach. Paragraph 3.9.

2 Implications of current regulated pricing framework on the passive access pricing

The potential introduction of passive remedies would occur in a market where a subset[10] of downstream active products produced by Openreach are currently price regulated.

As set out in Annex 1, the treatment of the costs of passive components in arriving at regulating prices broadly consists of three steps:

1. infrastructure costs at each level of the network are pooled and allocated to the different types of cables that use this infrastructure;
2. costs of different types of fibre cables, including a mark-up for infrastructure costs, are allocated across different services based on the average length of fibres used for each of the services[11];
3. charge controls are set based on forecasts of the resulting costs for basket of services, given BT the freedom to de-average prices, for example setting tariff gradients with respect to bandwidth.

In this section we consider what the implications are for the recovery of the costs of dark fibre and infrastructure from passive access services.

A key finding is that a cost of dark fibre access can be derived from the BT's regulatory costing system on a consistent basis to the costs used to determine the charge control.

The treatment of infrastructure costs as a fixed and common cost in BT's regulatory costing system means that the infrastructure costs for a given set of infrastructure would generally differ from the equivalent recovery of infrastructure costs from active services using that set of infrastructure. This inconsistency could be addressed either some further de-averaging of downstream prices or by geographic de-averaging infrastructure access prices.

2.1 Implications for simple fibre unbundling

2.1.1 Access fibre

The total cost of access fibre consists of the costs of the fibre cable itself plus a share of the costs of BT's ducts. The share of duct is the result of an allocation

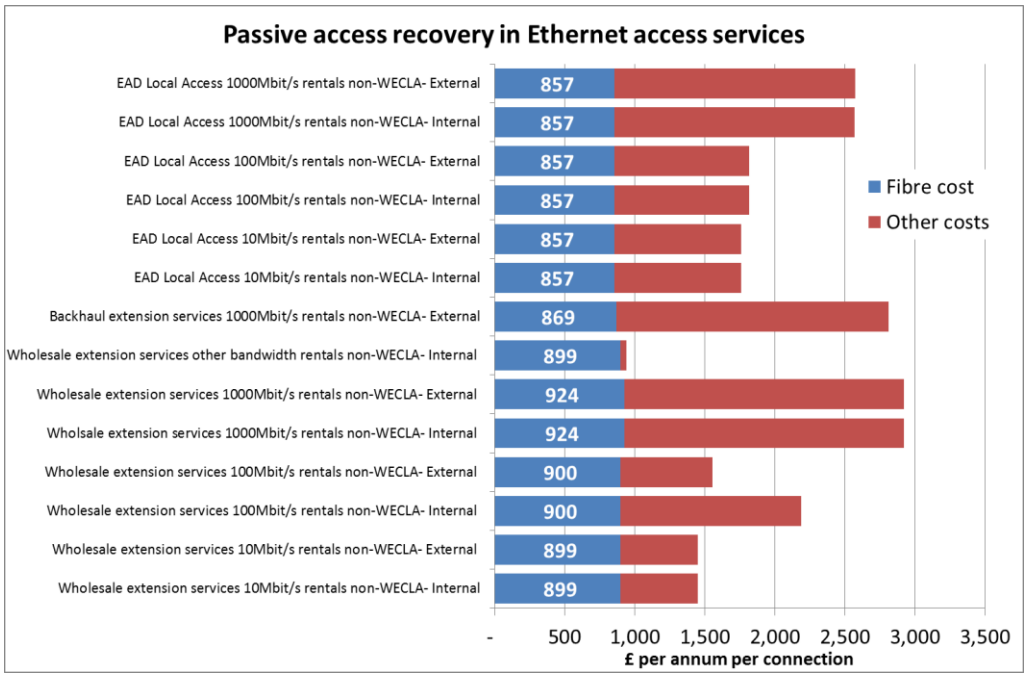
10 The pricing of the regulated products will also influence the pricing other services which are partial substitutes.

11 With the exception of main link 'per km' charges where a unit price per km is used.

between core and access and then an allocation within access between access fibre and copper[12].

Access fibre and the associated duct is then allocated across Ethernet services on the basis of the number of fibres used and a weighting factor which differs between WECLA and non-WECLA lines[13]. As a result the cost of passive elements allocated per local end (inside or outside WECLA) is approximately equal for all services delivered[14] as shown in the chart below.

Figure 2. Allocation of passive costs



Source: Frontier

Differentials in FAC cost between different Ethernet access services are largely driven by differential allocations of the non-passive elements of the service: the electronics which are allocated partially on the basis of capacity; and non-network activities (e.g. wholesale specific costs). The degree to which these differences in allocation reflect true differences in incremental costs is unclear. However, the allocation of access cards – based on capacity – does not appear to reflect the costs of the underlying equipment (Ethernet switches) as the cost of a Gigabit access port is not 100 times the cost of a 10 Mbit/s port.

12 There may be an element also allocated to GEA fibre but this is unclear.

13 It is unclear how this weighting factor is derived, for example whether this is based on line length

14 There is a small amount of variation but the reason for this variation is not clear.

Implications of current regulated pricing framework on the passive access pricing

2.1.2 Backhaul fibre

Part of the cost of BT's duct network is allocated to backhaul fibre based on the relative usage of duct by backhaul fibres.

The cost of backhaul fibre and the associated duct is then allocated between Ethernet fibre and SDH fibre.

The costs of SDH fibre are allocated between services based on a complex allocation based on the length and capacity of links and the utilisation of the underlying fibre. This takes account of the fact that under the SDH hierarchy the capacity on a single fibre can vary and this capacity can be divided across a number of bearers, each carrying a separate service or application. For example the cost per km for TISBO links varies depending on the capacity of the links.

The proportion of costs allocated to Ethernet transmission is allocated on the basis of the number of links and the length of these links, i.e. the assumption is that there is one link per fibre. As a result there is a single per link cost for Ethernet backhaul services.

2.1.3 Conclusion

For Ethernet services, in both the access and backhaul segments, dark fibre costs can be derived in BT's regulatory costing system for the active services, as fibre is a separate component in the 'cost stack' used to derived the active service unit cost. This dark fibre cost includes a contribution to the cost of the duct network. The unit cost is broadly similar for different Ethernet based active access services but is likely to differ between access services and backhaul services due to the differentiation between access and backhaul/core cable and duct costs in BT's RFS.

Introducing regulated dark fibre access for use for Ethernet services based on this costing would allow BT to recover common costs on a proportionate basis. However, the margins between these dark fibre prices and the current prices of active services would differ considerably from service to service in a way which did not reflect the incremental costs of the active equipment required to deliver the active service. This would incentivise BT to rebalance active prices to reflect the underlying differences in incremental costs.

2.2 Implications for dark fibre

Underlying the pricing of active Ethernet products is a cost per link for the fibre used to provide this service. This in turn appears to be based on a single unit cost (per km) of fibre used for each type of fibre, multiplied by the (average) fibre length used. This per fibre km cost could be used as the basis for setting the price of dark fibre access on a per km basis.

To the extent that link length varies and this is not reflected in the pricing of active Ethernet services, for example EAD prices do not vary by link length, there could be different margins between the dark fibre prices on a per km basis and the allocation of fibre costs for individual links, based upon an average link length. For example if the average access line is 1 kilometre in length, the dark fibre cost calculated on a per km basis would be lower than the average cost used to determine active prices for premises within 1 km of the exchange, and higher for those premises further away.

While the current allocation methodologies appear to allow for different fibre costs by usage, e.g. SDH vs. Ethernet vs. GEA, and by location in BT's network topology, e.g. access vs. backhaul vs. "inner core", it is unclear from information in the public domain to what degree the unit cost per km may differ between the different types of fibre. Furthermore it is unclear the degree to which any differentiation may reflect true difference sin incremental costs or are simply an artefact of the cost allocation methodology and the use of out-dated survey information. Given that demand side characteristics, such as willingness to pay, play no part in the cost allocation methodology, there is little reason to believe that the resulting recovery of fixed and common costs between "core" and "access" services is efficient (in a Ramsey sense), except by coincidence.

Some benefits of a dark fibre access regime, in particular the ability of CPs to reflect the most efficient network topologies rather than BT's legacy network topology, would be facilitated by a simple uniform pricing of dark fibre, which did not distinguish prices based on the location of the fibre in BT's network hierarchy. To the degree that this was reflected in the pricing of active products, this could lead to shifts in the recovery between parts of the network (although the net impact on end users for end to end services may be relatively low as reductions in cost recovery in one part of the network would be offset by increases elsewhere).

As a result a more uniform dark fibre pricing structure could require some changes in the current recovery of common costs from existing services, but there is no evidence that any such shifts would have an adverse effect on efficiency in the long run.

2.3 Implications for infrastructure access

2.3.1 Duct cost recovery reflects cable usage rather than underlying duct cost

The key supporting infrastructure for fibre based services is BT's national network of ducts and as such this section focuses on the recovery of duct costs.

Implications of current regulated pricing framework on the passive access pricing

BT's current service costing methodology does not separately identify duct as an input to individual services. Instead duct is treated as a supporting infrastructure to the cables which run through the duct.

Allocation of duct costs within different types of cable (fibre access, copper access, backhaul fibre, inner core fibre, etc.) reflects the relative usage of duct based on a 1996 survey, updated with expenditure since 1996. With the types of cable, duct costs are effectively recovered as a mark-up on the costs of cable, in that cost allocation methodologies reflect the incremental costs of cable (cost per fibre) rather than the incremental costs of the duct that supports that fibre.

The implication of the current costing methodology is that duct is treated as a common cost with the recovery of this common cost made from services through the allocation of cable costs. This means the recovery from services is on the basis of type and length of cable used.

There is no direct link between the cost and usage of infrastructure and services. For example, even where a particular access duct does not contain any cables used to deliver Ethernet services, the cost of that duct may be included in a cost pool which is partially recovered from Ethernet services.

Conversely the contribution to fixed and common cost recovery of infrastructure reflects the cables used within that duct rather than the cost of the duct itself. For example consider the simple case of a network with two ducts

Figure 3. Illustrative example of duct recovery

Route A		Route B
10	Duct cost (£000s)	10
4	Cable cost (£000s)	1
16	Number of fibres	4
20	FAC (£000s based on £1,250/fibre)	5
16	Route's contribution to (common) duct costs (£000)	4

Source: Frontier

In this example the total cost of duct and fibre (£25,000) is pooled and allocated between the routes on the basis of cable dimension (number of fibres). As there are 20 fibres in total, £1,250 is allocated per fibre (total cost = £10k + £10k + £4k + £1k = £25,000 across 20 fibres = £1,250). Subtracting the direct cost of the fibre cable from the fully allocated cost gives the implicit recovery of duct costs from each route. This recovery of duct costs is in proportion to the dimension of the cable rather than based on the actual duct costs on each route.

On a larger scale, the common cost recovered by Openreach on a given route, i.e. the margin between wholesale revenues and incremental costs, is a function of the services transported over the cables on that route. Routes with a high cable (fibre) count will make a disproportionate contribution to the recovery of duct costs while routes with a low cable (fibre) count will make a low[15] contribution to the recovery of duct costs. It would clearly be infeasible to map all services to the

15 Possibly negative

Implications of current regulated pricing framework on the passive access pricing

underlying infrastructure used in order to estimate the cost recovered per component.

2.3.2 Reflecting underlying duct costs in end user pricing is unlikely to be efficient

As noted above, there is no direct linkage between the incremental cost of infrastructure and the pricing of active wholesale services that used that infrastructure. At first sight, this would appear to be inefficient, in an allocative sense, as efficient prices should reflect incremental costs. However from the perspective of individual customers, infrastructure costs are fixed and common.

Infrastructure costs are common, in that in general infrastructure serves a number of customers. Infrastructure costs are also fixed in that the continuing universal service requirements placed on BT means that it cannot avoid the fixed cost of infrastructure[16] required for ubiquitous coverage even if the revenues generated do not cover the costs of the infrastructure.

Recovering fixed and common costs in a way which reflected the costs of different parts of the network, for example recovering the costs of a network which serves a given geographic area from the customers in that geographic area, would only be efficient from an allocative perspective if the costs were by coincidence aligned with willingness to pay, which is unlikely.

2.3.3 Conclusion

The pooling of duct and cable costs in BT's regulatory costing system, and the resulting geographic averaging of active prices, are likely to have positive distributional and allocative efficiency effects in maximising demand and promoting equality between different regions.

The uneven mapping between active products and the underlying infrastructure means that the implicit recovery of infrastructure costs, which are treated as fixed and common, in the costing system varies widely between components. It is not feasible to determine this cost recovery on a component by component basis.

While setting uniform (i.e. geographically averaged) infrastructure access pricing could simplify regulation, it could not be consistent with current costing and pricing of active services. This could lead to a further degree of geographical de-averaging in addition to that which currently occurs[17].

---

16 In the case of duct the fixed costs required to provide coverage are of the order of 90% on average.

17 Under the current regulatory framework, the degree of competition for BCMR services differs on a geographic basis, for example between WECLA and non-WECLA reflecting differences in the density of demand meaning that in some areas it is feasible to build alternative infrastructure. This has resulted in some geographical de-averaging of prices.

If Ofcom were to introduce infrastructure access based on uniform pricing it would need to balance the benefits resulting from infrastructure access with the potential risks resulting from inconsistencies between the pricing of active products (and any dark fibre access product) and infrastructure access which could lead to further de-averaging.

2.4 'Active minus' approach

Our understanding of an 'active minus' approach is that for passive products would be determined by subtracting the avoidable costs of operating and maintaining active components from the wholesale prices of active services. Such a pricing approach would be akin to the 'retail minus' approaches used in a number of other jurisdictions to set wholesale prices[18].

The average level of avoidable costs, on an FAC basis, could be derived from BT's existing FAC accounts.

The purported benefit of such an approach is that it enables price discrimination to be maintained in active products, while allowing competition for the active elements of the service, albeit at the expense of limiting the active products that can be offer by CPs to BT's existing portfolio, restricting innovation.

Such an approach requires a one to one correspondence between passive products and active services. This would mean that physically identical passive products could have different wholesale prices depending on the use to which the service was being put. For example an access fibre would have different prices depending on whether it was used for a 10 Mbit/s service or a 1000 Mbit/s service. This means that the approach would only be feasible for a simple unbundling dark fibre service, as for full dark fibre unbundling and infrastructure access it would not be possible to identify a corresponding active product (or products) which could be used to set the price of the relevant passive product.

Ofcom would have to regulate both active products and the margin between active and passive products. It is likely that there would need to be detailed regulation applied to the dark fibre products to ensure that CPs only used the dark fibre for the specified applications (as the price would vary by service). Such an approach would require that the access seeker declared the service that was being delivered using each dark fibre in order to pay the relevant price. This would also limit the services that could be delivered over the dark fibre to services where there was an equivalent Openreach active product.

---

18 For example the BEREC Report 'Regulatory Accounting in Practice 2013' noted that in the EU the most used price control method for Wholesale Line Rental is retail minus.

While such an approach is, on the face of it straightforward, the application could be complex. For example disputes could arise on the appropriate price where the CP wished to deliver a service which did not directly correspond to an Openreach active service.

3 Ofcom's concerns

Ofcom has set out a number of concerns about the introduction of further passive access remedies related to economic issues:

- that the introduction of passive access may make the current structure of BT's pricing unsustainable, leading to increases in the prices of some services, potentially including services outside the scope of the market review;
- that the relative pricing of passive and active products may distort CPs build or buy decision;
- that the availability of passive access may lead to a risk that BT cannot fully recover its fixed and common costs, thus dampening investment incentives; and
- that BT and other CPs' existing investments may be stranded.

In this section we set out our assessment of these concerns. This builds on the analysis in section 2. In particular, we focus on the impact of the introduction of passive remedies based on cost based pricing which reflects BT's existing regulatory cost accounting.

3.1 BT may increase its charges, including for other services

As noted above in section 5.2, Ofcom allows BT to price discriminate over and above cost differentials resulting from the regulatory cost accounting system, by setting charge controls based on baskets, rather than separate controls on individual services.

BT recovers a disproportionate amount of its common costs from high bandwidth leased lines (compared to the cost recovery in BT's regulatory costing system). If passive access products were available, the relatively high margins on these services, compared to the underlying fully allocated costs, would incentivise substitution of these services based on self-supply using passive access over and above any general incentive related to increase productive efficiency. Therefore if demand for these services were disproportionately reduced by self-supply using passive remedies, BT may have to increase charges for other services, to the degree that they are priced at a discount to FAC. This could have distributional or efficiency implications, this would depend on the extent to which the current pricing structure was efficient.

Under certain, specific conditions, a regulated monopolist would have incentives to price discriminate in a way which maximised overall end user demand, and

hence allocative efficiency. However, price discrimination at a wholesale level would be an inefficient way to achieve this, as BT has no control of the use that Openreach wholesale products will be put to. For example an Ethernet Backhaul Direct service could be used to provide backhaul for fixed DSL broadband, for VULA based broadband, for mobile backhaul or for backhaul of corporate networks.

BT's incentives to maximise demand subject to an overall charge control set for a basket of services may also be distorted. From BT's perspective, optimal prices will take account of super-elasticities of services which will be affected not only by end users' willingness to pay[19] but also the degree to which services outside the basket may be substitute services. Openreach may have incentives to increase the prices of those regulated services which are partial substitutes for unregulated ones in order to maximise the profitability of the unregulated services. For example the high tariff gradient for regulated 1 Gbit/s services may reflect BT's incentive to maximise profits for unregulated MISBO services as some purchasers may have a choice between buying MISBO services or high bandwidth AISBO services As a result increases in prices for high bandwidth AISBO services may allow increases the prices for MISBO services to be increased without prompting substitution of MISBO services by high bandwidth AISBO services. As such the overall revenue effect of prices increases in high bandwidth services may be proportionately greater than an equivalent (in charge control terms) increase in lower bandwidth services.

In any case, where there is a tariff gradient based on bandwidth (as in Ethernet services), demand and revenues tends to be concentrated in lower bandwidths. For example Openreach's reported revenues for MISBO services in 2014 (which includes Ethernet services above 1Gbit/s), amounted to only 10% of revenues for AISBO services (including servicers at 1 GBit/s and below). This reflects the fact that the sharp tariff gradients imposed by BT reduce demand for higher bandwidth services from CPs[20], leading to wholesale customers, and by extension retail customers, having access to lower bandwidths than would be the case in competitive markets. As such the impact on pricing for current users of low bandwidth services may be relatively small:

- The need to increase prices at low bandwidths to reflect reduced margins for high bandwidth services is diluted by the relatively high

19 To the degree that wholesale price increases are fully passed through to end users, which may not be the case where BT has market power in downstream markets.

20 This choking off of demand for high bandwidth services may explain BT's relatively low market share in high bandwidth 'MISBO' services, despite having much greater network coverage and capability than competitors.

Ofcom's concerns

number of users at low bandwidths compared to the number of users at high bandwidths;

- Even in the absence of passive remedies unit costs are decreasing rapidly over time as a result of increased demand for Ethernet services and reductions in BT's (previously very high) returns on these services due to charge controls; and
- The benefits of passive access in terms of innovation and productive efficiency should increase the number of attractive alternatives for these users which could offset the impact of any price rises on overall demand

As a result while the introduction of passive access could make current tariff gradients unsustainable in the long turn, there is little evidence that this will cause a material reduction in allocative efficiency nor any significant negative distributional effects. The increase in competition brought by passive access would lead to large offsetting benefits to consumers, through productive efficiency and innovation in services.

3.2 Distortions in build or buy decisions

Setting the regulated prices of passive remedies consistent with the recovery of passive costs in active products in BT's regulatory costing system should ensure appropriate build or buy decisions. This is analogous to the linked Ofcom charge controls for passive access (local loop unbundling) and active services (wholesale line rental) for copper based services which aim.

While current active prices show varying margins it is likely that active prices would move into line with dark fibre pricing as dark fibre access was introduced, at which point investment decisions should reflect productive efficiency considerations. There may be some short term inconsistencies in prices between active services and passive services following the introduction of passive remedies. However, as competitors will base their build and buy decisions on expectations of post-entry pricing, any short term inconsistencies should not distort build or buy decisions

3.3 Risk that BT would not be able to fully recover fixed and common costs

Basing both the active and passive access pricing regime on BT's regulatory costing system (potentially with modifications), should provide BT with the

expectation that it can recover a proportionate[21] share of fixed and common costs from BCMR services.

To the degree that any modifications to the cost accounting system, for example to support a uniform prices for fibre, are reflected in both passive prices and downstream active prices, the resulting change in cost recovery should not have a significant effect on cost recovery overall. From an end user perspective, shifts in how costs are recovered within BT's network may have relatively small net impact on overall prices paid.

In summary, if both passive and access prices are set to reflect fully allocated costs, the risk of BT not being able to recover common costs due to the introduction of passive remedies appears to be limited.

3.4 BT and other CPs' existing investments may be stranded

There are a range of assets that could be stranded by the introduction of passive remedies.

Some BT investment in active equipment could be stranded if CPs rapidly migrated existing active links to passive infrastructure. However, taking into account the contract terms and the relatively high one off costs of migrating existing services to passive links, the migration of existing circuits is likely not be a significant driver of demand. Most of the demand for passive access is likely to come from the demand for new circuits, including capacity upgrades. Coupled with the relatively short economic lives of electronic equipment due to technological advances, the scope for stranded BT active equipment is relatively low.

Arguably some investment by CPs in their own passive infrastructure could be stranded if Ofcom were to provide access to BT's passive infrastructure. However, this does not appear to be material:

- a number of CPs who have significant investments in passive infrastructure (e.g. COLT) have responded to Ofcom consultations arguing for passive access, which would not be the case if they believed that passive access would strand their existing investments; and
- investments in infrastructure by competitors should have largely been on the basis of sustainable cost advantages. As such the investment by

[21] Proportionate to the use of fibre cables by BCMR services and the use of the underlying infrastructure by these cables compared to cables used to deliver services in other markets.

CPs in infrastructure should not be predicated on any particular access regime.

3.5 Summary

Most of the concerns raised by Ofcom can be mitigated by an appropriate pricing regime.

The one area where introducing passive remedies based on a cost plus approach would lead to lasting changes in the market is in reducing BT's market power in active services and hence its ability to price discriminate. However, it is not clear that BT's current price discrimination is efficiency enhancing. In any case past examples of where changes in regulation have resulted in rebalancing[22], shows that the overall benefits of increased competition far outweighed any adverse effects on particular customer groups of increases in the price of some services.

22 For example the rebalancing of line rental and call tariffs following full liberalisation or the rebalancing of ADSL prices following large scale roll out of LLU.

4 Economic assessment of potential regulatory approaches for passive access

In this section we assess the costs and benefits of different potential passive access remedies. We assess the costs and benefits of each of the approaches with respect to a number of factors:

- the likely level of regulatory complexity in implementing a pricing regime for the service and the scope for simplifying long term regulation;
- the scope for increased competition leading to increased efficiency and a high quality of service;
- the scope for innovation in service delivery;
- the need for rebalancing either across products (bandwidth) or between geographic areas; and
- the degree to which the approach would send appropriate build or buy investment signals that the resulting prices would send to operators.

The conclusions are that all forms of access could provide positive net benefits, with the increased costs of forms of access that allow competition at a deeper level in the network balanced by potential dynamic efficiency gains, that cannot be achieved with more restricted forms of passive access.

4.1 Simple dark fibre unbundling

Due to the one to one relationship between active services and a corresponding simple dark fibre unbundling could be regulated on a 'cost plus' approach, where prices are regulated directly based on costs determined by the regulator, or an 'active minus' approach where regulated prices are set relative to other active prices (which may or may not be regulated on a cost plus basis). In this section we assess both options.

4.1.1 Regulatory complexity

Cost plus

The calculation of the cost stacks for active Ethernet services includes a unit cost for fibre costs, which includes a contribution to the cost of the duct network[23].

[23] For access fibre this unit cost is already shown as a separate component in the published version of the RFS

The cost is the same for any service over the route (i.e. is independent of the service bandwidth).

This could be the basis of a relatively straightforward charge control which would be transparent and more predictable that the current leased line charge controls. The accuracy of the charge control forecast would be unaffected by migration between different Ethernet services or between active services and passive services, as all services would make the same contribution to the costs of the fibre and duct.

The relatively simple undifferentiated nature of the service would limit the need for additional price regulation such as non-discrimination controls or sub-caps. In the long run, regulation of active services could be withdrawn if take up of dark fibre was sufficient, in a similar way to the withdrawal of regulation in WBA markets.

Active minus

If the intention were to minimise any changes to the pricing of active products then one approach, as set out in Ofcom's consultation, would be to set prices on a 'active minus' methodology, that is: price dark fibre based on the active price less the incremental (avoidable) cost of the active components used to provide this service.

For example, if the fibre was to be used for a 10 Mbit/s Ethernet access service then the charge would be set based on Openreach's price for a 10 Mbit/s Ethernet access service less the avoidable cost of the active service (for example the incremental cost of 10 Mbit/s electronics).

Ofcom would have to regulate both active products and the margin between active and passive products. It is likely that there would need to be detailed regulation applied to the dark fibre products to ensure that CPs only used the dark fibre for the specified applications (as the price would vary by service). Such an approach would require that the access seeker declared the service that was being delivered using each dark fibre in order to pay the relevant price. This would also limit the services that could be delivered over the dark fibre to services where there was an equivalent Openreach active product.

As set out in section 2.4, while such an approach is, on the face of it straightforward, the application could be complex. For example disputes could arise on the appropriate price where the CP wished to deliver a service which did not directly correspond to an Openreach active service.

In addition there would be a need to estimate avoidable costs on a service by service basis (or basket by basket basis) on a forward looking basis. This is not straightforward as the appropriate recovery and costing of active equipment and the associated activities would be complex. There would likely need to be controls to prevent margin squeeze between active and passive products.

Economic assessment of potential regulatory approaches for passive access

There would also be a lack of predictability in the resulting passive prices which would be a function of BT's active pricing and the calculation of avoidable costs, both of which would be unpredictable to a degree.

4.1.2 Increased competition

Dark fibre access, whether on a cost plus or active minus basis, would allow competition over a greater part of the value chain compared to active products bring benefits in terms of productive efficiency and quality of service.

However, CPs would be still be limited to delivering services which reflected the structure of BT's network with the consequent lack of efficiency if they wanted to extend their own infrastructure.

4.1.3 Innovation in services

Cost plus

Under a cost plus approach, operators would be free to develop innovative services on routes that could be used for an active product, for example new pricing models and or technological developments such as high bandwidth services or greater network management capabilities.

Active minus

The need to match any passive access with a corresponding active service provided by BT will severely limit the scope for service innovation under an active minus approach. CPs would be limited to reproducing BT's product portfolio with similar discounts.

4.1.4 Rebalancing

Cost plus

Widespread take up of a cost plus unbundled dark fibre product could reduce BT's market power in the downstream active market, making it unfeasible for BT to maintain the steep tariff gradients it currently uses in order to limit demand for high bandwidth services.

To the extent that the current tariff gradient does not reflect customers' willingness to pay but rather profit maximisation by BT, this could allow end users, both corporate users and customers of networks which rely on BT infrastructure for backhaul, to benefit from increased bandwidth, potentially leading to an increase in allocative efficiency.

As a cost plus approach could use the same degree of geographic de-averaging as the active product (e.g. separate average costs for WECLA and non-WECLA) it would not lead to any rebalancing across geographical areas.

Active minus

The main aim of an active minus approach is to enable the tariff gradients to be maintained. There would appear to be little or no rebalancing effect from the introduction of an active minus passive remedy.

4.1.5 Investment incentives

As both active and passive prices would be set on a common costing base, CP's build or buy decisions between active and passive products should be undistorted in either a cost plus (after rebalancing of active prices) or an active minus approach.

Similarly as the underlying costing approach used to set BT's access prices would not have changed from the current regime, the cost relationship between building competing infrastructure and relying on regulated access products would not fundamentally change. As such there would be little expectation of stranded assets.

4.1.6 Conclusion

Simple dark fibre unbundling could bring benefits by allowing competition over more of the value chain and by allowing CPs to deliver services without BT providing redundant active equipment. A cost plus approach appears to result in significantly higher overall benefits than an active minus approach due to the far greater scope for product innovation. However the degree to which CPs could innovate would be restricted by the restrictions or the routing of the dark fibre, which would need to correspond to an existing access product.

Overall, a cost plus approach would appear to bring significant net benefits overall, driven by potential dynamic efficiency gains. Benefits from an active minus approach would be much smaller than this due to the limitations on CPs' ability to innovate. The much greater regulatory complexity of such an active minus approach suggests the net benefits of introducing an active minus approach would be much smaller than a cost plus approach.

4.2 Full unbundled dark fibre

4.2.1 Regulatory complexity

From an operational perspective, the introduction of full fibre unbundling would be likely to be more complex than a simple unbundling of fibre.

While the processes for ordering, provisioning and operation of simple unbundling can be adapted from those used for active products, the processes for full unbundled dark fibre would need to be developed largely from scratch.

Price regulation and a charge control[24] under a cost plus basis could be based on the existing costing approaches in BT's accounts, although potentially with some modification, for example if a uniform dark fibre price was to be used across all parts of the network.

In the short term the introduction of a dark fibre remedy would require significant additional regulatory resources to set up and operate. However, in the long term a dark fibre access regime could reduce the need to regulate fibre based active products, significantly reducing regulatory complexity.

4.2.2 Increased competition

Dark fibre access would allow competition over a greater part of the value chain compared to active products bringing benefits in terms of productive efficiency and quality of service.

Decoupling dark fibre from BT's network topology would also enable significant dynamic competition in additional areas where a simple unbundling of dark fibre would not be efficient (or not as efficient).

4.2.3 Innovation in services

A fully unbundled dark fibre service would allow innovation in network topology and technology in ways not possible with simple unbundling, while also enabling the types of innovation in active products that simple unbundling would offer. For example, dark fibre could be used to support innovative fixed and mobile access network solutions and as 'infill network' extending a CP's own network footprint.

4.2.4 Rebalancing

The introduction of a general dark fibre product on a cost plus basis could lead to three forms of rebalancing:

- flattening of tariff gradients by bandwidth, by reducing BT's market power in the active market;
- potential averaging of prices between different levels of the network hierarchy, to the degree that the unit fibre costs in BT's current RFS differ between fibre used in the access network and that used in the backhaul network ; and

[24] Under a cost plus basis, given that the lack of correspondence between individual fibre routes and active products would make an active minus approach infeasible.

- potentially de-averaging of prices by length of link, where BT's prices are currently distance independent (for example de-averaging by distance from the exchange in the access network).

The potential impact of flattening tariff gradients has been discussed in section 3.1. The risks of rebalancing by reducing tariff gradients are likely more than outweighed by the dynamic efficiency benefits of increased competition.

It is not clear the degree to which FAC unit costs for fibre cable differs within BT's regulatory cost accounting system depending on whether cable and duct is classified as access, backhaul or inner core. It is unlikely that any distinction that exists reflects either genuine (incremental) costs differences[25] or willingness to pay. As such it is unclear that moving to a uniform unit cost will have a material impact on efficiency.

De-averaging of prices by link length may result in two offsetting effects:

- by better reflecting incremental costs (as main link backhaul costs already do), prices which take into account distance may provide better pricing signals for investment and consumption; and
- willingness to pay is likely to be largely independent on the customer's distance from a point of presence, i.e. a customer who happens be located close to a point of presence is not likely to have a different willingness to pay than a similar customer located a number of kilometres from the exchange. A disproportionate recovery of the fixed costs of the duct network (which are not avoidable) from customers further from the exchange may not be efficient in a Ramsey sense.

The degree to which this second point is an issue is dependent on the degree to which variations in wholesale costs feed through into end user prices, for example downstream operators may choose to average prices despite variations in the cost of upstream inputs.

4.2.5 Investment incentives

As both active and passive prices would be set on a common costing base, CPs build or buy decisions between active and passive products should be undistorted.

4.2.6 Conclusion

Full unbundling of dark fibre would lead to significantly increased scope for service and technical innovation above and beyond simple fibre unbundling,

25 As the fibres used in the access and backhaul networks could presumably be on identical cables in the same duct for at least part of the route.

which may help meet the demand for significantly higher bandwidth from end users.

Enabling this increase in innovation would initially entail some additional regulatory costs and potentially some rebalancing of end user prices, although it is not clear that any such rebalancing would materially reduce efficiency.

4.3 Infrastructure access

4.3.1 Regulatory complexity

As noted above, the cost of duct and other infrastructure is essentially treated as a common cost in the RFS. Under a cost plus approach, an approach would need to be implemented to allocate duct network costs on a component by component basis. For example a simple national average approach could set a single price per km of duct across the UK or prices could be differentiated to take account of underlying costs either driven by geo-type (e.g. urban, suburban or rural) or by the 'thickness' of the route (i.e. fibre count of cables or number of duct bores). This would then need to be allocated to the users of the duct, i.e. BT or CPs, taking into account utilisation and the need to maintain spare capacity for future demand and/or redundancy[26].

One approach could be to allow BT to de-average duct prices subject to an overall cap on prices. This would allow BT to proxy duct access prices to the recovery of costs from downstream prices: either the current active services or dark fibre access. There would also need to be some non-discrimination requirements to ensure that BT did not set prices relatively high in areas where there was potential or actual entry using infrastructure access. Such a non-discrimination requirement, for example a margin squeeze test applied on a geographic basis, may in the end resemble a 'active minus' approach as discussed below but would entail significant regulatory complexity.

4.3.2 Increased competition

An approach which allows CPs to use components of BT's infrastructure to either extend their own infrastructure or to construct networks which do not reflect BT's network topology would lead to a deeper level of competition compared to dark fibre access.

26 The current PIA pricing appears to be based on a cost plus approach, but is only available for very limited use cases and there is little transparency on how the costing approach used fits with the cost accounting approach used for other regulated services.

Allowing access to BT's infrastructure could also increase the level of competition by allowing CPs to install their own cables and passive infrastructure.

4.3.3 Innovation in services

Allowing competition at deeper levels in the network would allow much greater scope for service innovation than either simple or full unbundling of dark fibre.

Competitors would not be constrained by availability of fibre from BT or tied to BT's current cable routing. This would enable competitors to roll out dense fibre networks if they believed that there was demand for such services.

4.3.4 Rebalancing

As set out in section 2.3, it is not feasible to determine infrastructure access pricing consistent with the current recovery of infrastructure costs in BT's regulatory costing system. Potential options are to allow BT the freedom to set prices in a way which proxies this cost recovery or to set uniform infrastucture access prices, accepting the inconsistency.

Even with a complex regime which attempts to reflect the current recovery of the costs of infrastructure in the pricing of passive access to this infrastructure, there would be some inconsistencies between passive pricing and active cost recovery. As such, the potential for changes in downstream prices would be greater than that under dark fibre access (where the recovery of infrastructure costs is averaged out). The degree to which rebalancing would occur would depend on two factors:

- the degree to which the pricing of duct and other infrastructure could proxy the current recovery of these costs across active services; and
- the degree to which relatively high barriers to the use of infrastructure access would prevent simple substitution of downstream products using infrastructure access.

However, the likely implementation barriers for infrastructure access mean that a decision to invest using duct access is unlikely to be driven purely by differences in the cost of duct access versus other wholesale services. As such the degree of rebalancing may be constrained even where there is a mis-match between the prices of infrastructure access and the cost recovery of infrastructure in downstream products[27].

[27] As an example, the availability of duct access in other EU jurisdictions does not appear to have led to a high degree of rebalancing in these markets.

4.3.5 Investment incentives

If dark fibre access was available it is likely that that duct access would only be used in those cases where the existing BT fibre network was insufficient for the CP's purpose, either because it did not serve an area or because the volume of fibre available was not sufficient.

As a result investment enabled by infrastructure access is likely to be incremental to existing investments by BT and other CPs rather than simply substituting existing products, in order to serve demand that could not be met using the existing fibre network.

4.3.6 Conclusion

Error! Reference source not found. In certain situations, for example where the BT network did not provide sufficient fibre cable capacity on a given route, duct access could allow for service innovation which would not be possible with dark fibre access. In these circumstances, the benefits of infrastructure access over dark fibre access could be considerable.

Balancing this are the costs of implementation. There are also likely to be concerns, due the difficulty of setting an infrastructure access pricing regime that reflects the recovery of infrastructure costs in BT's regulatory costing system. These concerns may be mitigated by a flexible approach to pricing and the fact that operational barriers to infrastructure access will limit inappropriate use by CPs.

4.4 Conclusion

Table 1 below summarises the cost benefit analysis above.

Table 1. Summary of assessment

	Simple fibre unbundling	Full fibre unbundling	Infrastructure access
Regulatory complexity	Under a cost plus approach limited additional complexity in short run and scope for a reduction in overall regulation in the long run	Would require significant additional investment in processes but could build on existing costing methodologies with scope for a reduction in overall regulation in the long run	Would require significant additional investment in processes and regulatory intervention to ensure the relationship between infrastructure prices and downstream prices was appropriate
Increased competition	Increase in competition for the supply of active components	Would enable additional competition which would not be currently viable	Would promote competition deeper in the value chain
Innovation in services	Scope for service innovation	Significant additional innovation through alternative network topologies and technologies	Significant additional innovation by reducing dependence on BT's fibre network
Rebalancing	A cost plus approach would lead to a reduction in the bandwidth tariff gradient	Potentially would lead to some rebalancing between levels of the network hierarchy and some geographic de-averaging	Investment based on infrastructure access unlikely to be driven by difference in cost recovery
Investment incentives	Would provide appropriate build/buy signals compared to active services	Would provide appropriate build/buy signals and would prevent inefficient duplicate investment	Would allow incremental investment to serve demand that could not be met by BT's fibre network

Source: Frontier

This indicates that there are greater dynamic benefits from allowing competition at a deeper level in the network and removing restrictions on the use of passive remedies.

The evidence from previous regulatory interventions suggest that it is these dynamic effects which ultimately deliver most benefits to end users, often in ways which cannot be foreseen when the intervention was made.

It is also clear that providing access at deeper levels in the network raises additional converns. However, there is no evidence that any of these concerns outweigh the increasing benefits from increased innovation or cannot be mitigated through appropriate regulation.

This suggests that the long term benefits of passive remedies would be maximised though the implementation of both dark fibre and infrastructure access, rather than partial solutions such as simple fibre unbundling.

5 Annexe 1: Recovery of the cost of passive components in the current regime

To understand the impact of the introduction of passive remedies on the market, it is necessary to consider how the costs of these passive assets are currently recovered from regulated active products. The price regulation of active services has two elements:

1. the BT's regulatory costing system which underlies Ofcom's price regulation; and
2. the price regulation applied to Openreach services by Ofcom.

This annex considers these two aspects.

5.1 Overview of the existing regulatory costing approach with respect to passive assets

The current service costing methodology on which BT's regulatory costing system is based, uses a multistage process to allocate costs to services. This means that the linkage between a given asset and the final service costing may be indirect. In other words the costs of a given service may not be built up from the actual assets used (for example the cost of the particular duct and fibre along the route) but may instead reflect the costs of a given class of assets used by that product, for example the average cost of all access duct. In particular as certain costs may be pooled and allocated on the basis of drivers which may not proxy the incremental cost of the pooled costs[28], service costs may not closely reflect incremental costs. Costs are also pooled at a geographic market level such that service costs reflect geographic market averages (typically averages for the UK but in the case of some BCMR services averages for WECLA and non-WECLA).

5.1.1 Allocation of cable costs

The costs of various types of cable are identified:

- copper cable, used to provide LLU/WLR access;
- access fibre cable, used to provide fibre access to end users;
- GEA fibre cable used to connect MSANs in street cabinets to exchanges;

[28] For example costs may be allocated on the basis of other incremental costs.

- backhaul fibre used to provide Openreach services between network nodes; and
- inner core fibre used to provide non-Openreach services between network nodes

To the extent that different types of fibre cable may have different unit costs, for example due to differences in the number of fibres, the type of cable and the cost of installing and maintaining the cable, the unit cost (e.g. per fibre km) may differ.

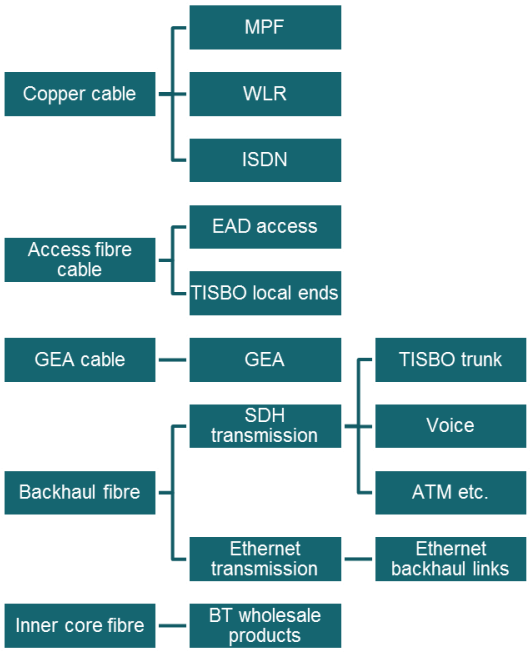
The allocation of these cable costs to services is dependent on a volume driver:

- for access copper and fibre, by the number of fibres/copper pairs used;
- for SDH[29] core and backhaul fibre, based on the length and capacity of circuits ('bearers') used by each type of service (voice, TISBO leased lines); and
- for Ethernet backhaul, based on the fibre kilometres.

[29] Synchronous Digital Hierarchy, a time division multiplexing transmission technology used to transport a wide range of legacy services.

Annexe 1: Recovery of the cost of passive components in the current regime

Figure 4. Overview of the allocation of cable costs in the RFS

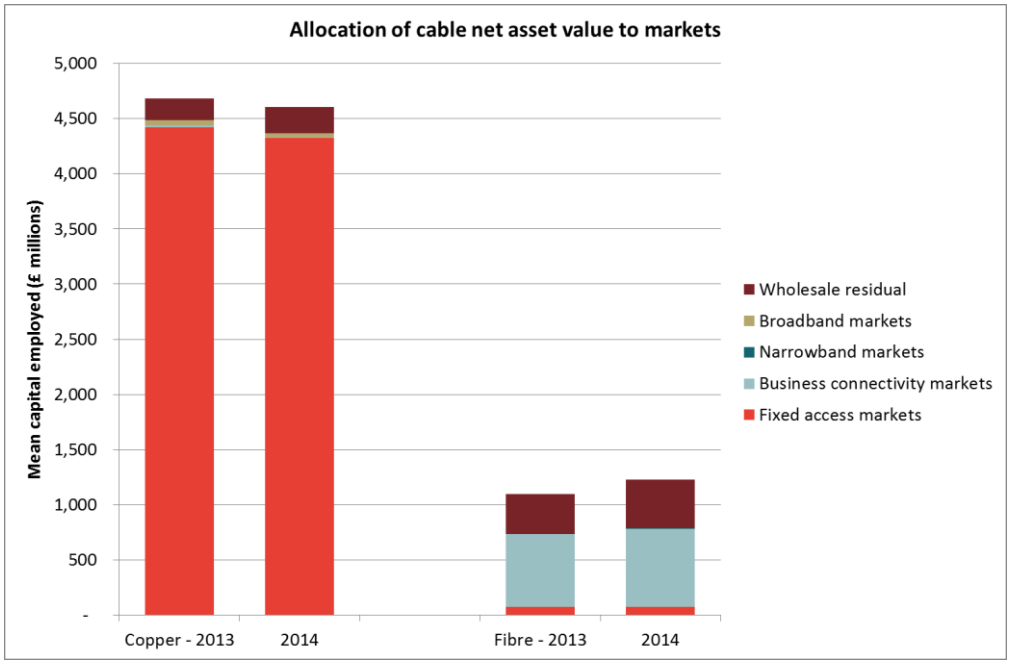


Source: Frontier

Figure 5 summarises the results of this allocation in terms of mean capital employed by market. The majority of the value of cable is still copper cable predominantly used to deliver mass market access services.

Annexe 1: Recovery of the cost of passive components in the current regime

Figure 5. Allocation of cable costs



Source: Frontier analysis of RFS

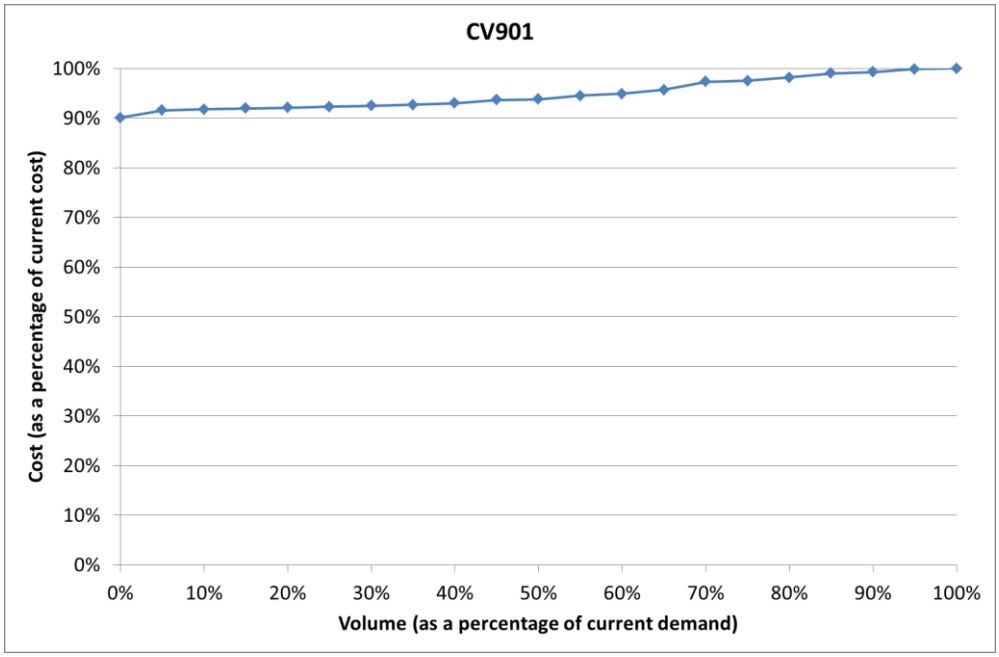
The majority of fibre cable value is allocated to services in the business connectivity markets with most of the remainder of the value apparently allocated to the 'inner core', i.e. services not delivered by Openreach.

5.1.2 Allocation of duct costs

The cost of duct on a given route is largely a function of the terrain in which the duct is installed rather than the dimension of the duct, in terms of the cross sectional areas of the cables that it houses. For example BT estimates that the fixed cost of its duct network, i.e. the costs that would not be avoided if demand on each route fell towards zero, is approximately 90%, as shown in **Figure 6**.

Annexe 1: Recovery of the cost of passive components in the current regime

Figure 6. BT Duct CVR – "Variation in duct costs in response to growth in core and access network capacity"



Source: LRIC Model: Relationships & Parameters 2014

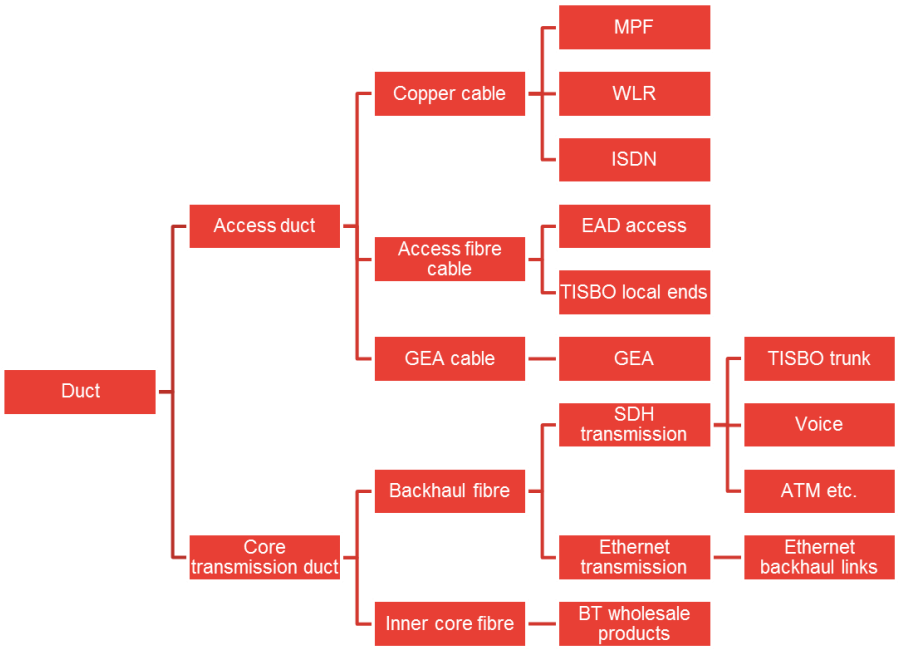
This means that the incremental costs of duct are of the order of 10% of the total costs of duct. In addition the causal relationship between active services and duct costs will be indirect, as the demand for active services will drive the demand for cables which will in turn drive the incremental cost of duct.

Given this weak and complex relationship between service volumes and duct costs, the BT RFS allocates duct costs indirectly on the basis of cable volumes and hence to services. This means that within a given type of cable, the allocation of duct costs is effectively through a mark-up on the allocated costs of cable.

Figure 7 summarises the allocation of duct costs to services.

Annexe 1: Recovery of the cost of passive components in the current regime

Figure 7. Overview of the allocation of duct costs in BT's RFS



Source: Frontier

There are three broad steps to the allocation:

- an allocation of duct costs to the level of the network (access, backhaul[30] and inner core[31]) depending on what part of the network the duct is used for (where the duct is used exclusively in one part of the network or another) or based on cable cross-section where a single duct route is used for a mixture of access, backhaul and core cables[32]:
- an allocation of duct costs to the type of cable within access and backhaul based on the cost of the cable:
  - between Ethernet and SDH transmission in the backhaul network;
  - between copper, access fibre and GEA fibre in the access network;

30 Backhaul Duct is the national network of underground bores and ducting between exchange nodes that are considered part of the Openreach division's assets and is used to house optical fibre and metallic communications transmission cables.

31 Inner Core Duct is the national network of underground bores and ducting between exchange nodes (excluding Openreach assets) and is used to house optical fibre and metallic communications transmission cables.

32 Albeit based on a survey of duct usage carried out on a sample of exchanges in 1996 (the Absolute Duct Survey), updated with data on capital expenditure on cable.

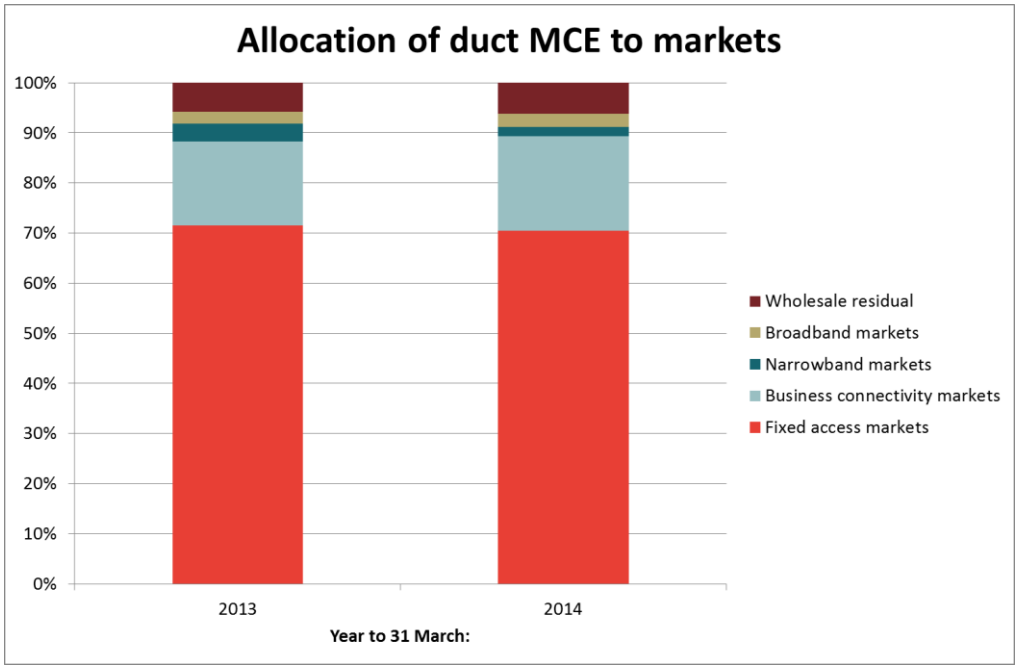
Annexe 1: Recovery of the cost of passive components in the current regime

- an allocation of the costs allocated to cable types to services dependent on the volume driver used for cables as above:
  - for access to copper and fibre, by the number of fibres/copper pairs used;
  - for SDH core and backhaul fibre, based on the length and capacity of circuits ('bearers') used by each type of service (voice, TISBO leased lines); and
  - for Ethernet backhaul, based on the number of transmission links (e.g. each 10, 100 or 1000 Mbit/s link) and their length.

The resulting unit costs (e.g. cost per fibre km) for different types of fibre cable would be expected to differ reflecting not only differences in the incremental costs of cable but also of the average cost and utilisation of ducts by this type of cable.

Figure 8 shows the overall results of this allocation approach. Unsurprisingly, the majority of costs are allocated to copper based access services, given that copper cable is the largest element of cable costs. Slightly less than 20% of the costs are allocated to services in the business connectivity markets, broadly reflecting the proportion of cable costs allocated to these markets.

Figure 8. Allocation of duct costs



Source: Frontier Analysis of BT RFS

5.2 Overview of existing pricing approaches

The key charge controls which apply wholesale services offered by Openreach are those for LLU/WLR and for leased lines (i.e. TISBO and AISBO).

Ofcom has explicitly determined the structure of pricing when setting price controls for LLU and WLR, for example linking the price of some services and setting the differential between rental services.

For the relevant services, the leased line charges controls are set using as RPI-X controls on baskets of services. The level of the charge control is set such that the forecast revenues from the basket of services should equal the forecast costs of the basket of services, on a FAC basis including a return on capital employed, at the end of the charge control.

Within the baskets, BT has freedom to set prices, subject to sub-caps. This means that there is no requirement for the level of individual prices to align with FAC (although if total basket revenues equal total basket costs on a FAC basis, prices above FAC must be balanced by prices below FAC). Ofcom often imposes some restrictions on the structure of prices within price control baskets:

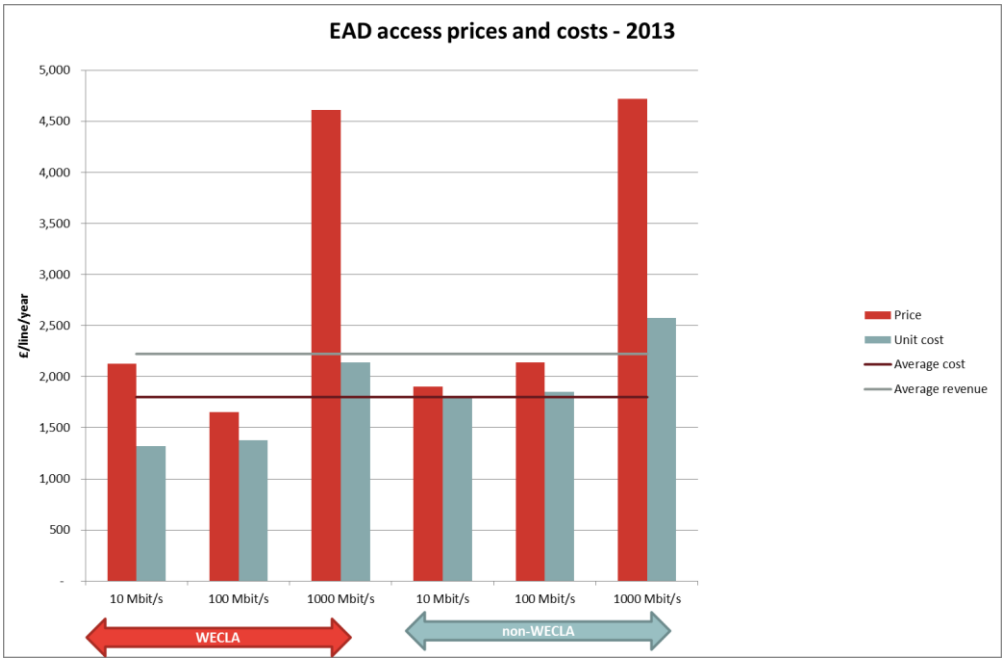
- previously a 'basis of charges' obligation was imposed on BT in addition to the charge control, which effectively set floors and ceilings for individual charges; and
- there are currently sub-controls which limit the rate of increase of prices for the leased line charge controls.

In theory, this flexibility allows BT to differentiate prices to reflect end users' willingness to pay in downstream markets. This could improve allocative efficiency by maximising the total demand for services. This would be the case if BT were a monopoly provider in those downstream markets, where BT's incentive to maximise revenues under an overall price cap would be aligned with maximising demand in that downstream market. However, in practice as BT is not a monopoly supplier to end users, but a supplier with market power in upstream markets competing with wholesale customers in downstream markets. As such BT's profit maximising behaviour may take into account margins and market share in the downstream markets when setting prices for the wholesale markets subject to price caps. Similarly BT will take into account the impact of pricing for regulated services on profits for non-price regulated services which are partial substitutes, for example VULA services or certain MISBO services.

Annexe 1: Recovery of the cost of passive components in the current regime

While the additional controls have limited the extent to which BT can price discriminate, prices generally do not fully reflect the underlying FAC costs within each basket as illustrated in **Figure 9** below[33].

Figure 9. Comparison of costs and prices for EAD



Source: Frontier analysis of the RFS

This shows that, on average, prices are above FAC costs, despite the RPI-X charge control. However the difference between FAC costs and prices is much higher for high bandwidth services than low bandwidth services.

This pattern continues for higher bandwidth services, for example 10 Gigabit services, which show a further steep increase in prices.

33 The FAC differentials are themselves likely to significantly over-estimate the true LRIC difference in the costs of individual services.

FRONTIER ECONOMICS EUROPE
BRUSSELS | COLOGNE | LONDON | MADRID

Frontier Economics Ltd 71 High Holborn London WC1V 6DA
Tel. +44 (0)20 7031 7000 Fax. +44 (0)20 7031 7001 www.frontier-economics.com