



BT's response to Ofcom's consultation document

"Business Connectivity Market Review: preliminary consultation on passive remedies"

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NON CONFIDENTIAL VERSION

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1. Executive Summary

- 1.1. Business connectivity in relevant UK markets is a thriving marketplace – with high growth in demand, high degrees of technology innovation and rapidly reducing prices. Competition in retail markets, and increasingly in some wholesale markets, is intense. The current regulatory approach for business connectivity provides a level playing field supporting strong downstream competition based on active remedies being used by a variety of downstream providers.
- 1.2. Ofcom’s own figures¹ show that the current regulatory approach is effective in promoting competition, for example:
 - BT’s share of the AISBO market (which includes Ethernet services at and below 1G) inside the Western, Eastern and Central London Area (“WECLA”) has moved from 51% in 2011 to potentially as low as 36% in 2014 and from 74% in 2011 outside the WECLA to just over 50% in 2014.
 - In the MISBO market (which includes Optical services and above 1G Ethernet services), BT’s market shares have fallen to levels indicating it does not have Significant Market Power (“SMP”).
- 1.3. In such circumstances, Ofcom should be considering the opportunities for reducing regulation in business connectivity rather than introducing greater regulatory intervention. There is no evidence of any market failure which would justify Ofcom contemplating a more intrusive regulatory remedy such as mandated passive products. These would not be as effective in providing a platform for robust competition among all players downstream as the present well-proven active remedies. Moreover, by their very nature, passive remedies could not be effectively ring-fenced to prevent distorting competitive and prospectively competitive markets.
- 1.4. Passive remedies would create significant costs in terms of inefficient investment incentives, causing distortions to active product pricing and hence the pattern of common cost recovery. Further, the implementation costs and challenges would be significant. Against these costs the main benefit identified, of enabling more innovation, would be limited, with many of the alleged opportunities also being possible using active products.
- 1.5. Introducing passive remedies would represent a fundamental shift in the strategic approach to regulating business connectivity markets and be a hugely disruptive step. It would inevitably cause big changes to the competitive landscape for the industry: bigger players would be able to take more advantage of passive remedies than smaller and medium sized CPs, who in contrast would face active product price rises. This would damage the interest of consumers and businesses across the UK, undermining investment incentives for existing players.
- 1.6. In these circumstances (greater competition and BT’s market power declining or disappearing) introducing a more intrusive remedy alongside existing rigorous active product charge controls would also be contrary to the European Common Regulatory Framework and Ofcom’s duties under the Communications Act 2003 (“CA03”).

¹ See “Business Connectivity Market Review: consultation on data analysis”, published 8 October 2014, available at <http://stakeholders.ofcom.org.uk/consultations/bcmr-data-analysis/>.

- 1.7. Even in specific wholesale markets where BT may still have SMP, Ofcom cannot assume that it is starting from a blank slate. Ofcom would be obliged to demonstrate clearly why the existing regulation based on active products is not an appropriate remedy to any competition issues identified. For the reasons set out in this response we consider that existing active product based regulatory remedies continue to be most appropriate to address any competition concerns. To justify the introduction of passive remedies, Ofcom must also consider (and demonstrate) why a more intrusive regulation is the most appropriate and proportionate remedy which deals with any competition issues identified in its market power assessment **and** that the costs of such a change are outweighed by any benefits.
- 1.8. The Openreach portfolio of active “open access” products is continually reviewed. Openreach considers possible developments to the Ethernet and Optical portfolio, to meet evolving customer needs, through both technical and commercial developments. This development is partly achieved through the Statement of Requirements (“SOR”) process, as well as through regular commercial dialogue and engagement to ensure that the range of active products can continue to support and drive forward innovation and competition in business connectivity markets for the benefit of all CPs. Openreach continues to develop its plans for evolving the product roadmap to meet future customer needs through existing and future active products.
- 1.9. While this response focuses on the specific issues raised by Ofcom in this Consultation, we are also aware of wider issues on service and pricing being raised by CPs and other stakeholders. BT and Openreach will be responding on these broader issues as appropriate through the course of this review.
- 1.10. The potential adverse impacts of introducing passive remedies are significant.
- **Distortions to common cost recovery and higher active prices.** CPs would use new passive products where current prices of active products (based on averaged costs) exceeded the specific costs for individual circuits in a particular area for an active product using the passive input. This would lead to inefficient market entry and undermine existing active product pricing. More common costs would need to be recovered from other leased lines products, leading to average price rises across remaining active products of 27% on Ofcom’s own figures.²
 - **Increase in active product prices.** For the reasons set out above, Openreach would need to make substantial price changes to active products – essentially removing or reducing the effects of cost averaging. This would have significant adverse and highly disruptive distributional impacts (leading to prices increasing for smaller operators and their customers as well as those end customers who tend to purchase lower bandwidth circuits and/or outside of metropolitan hotspots) and reduce the efficiency benefits of current pricing flexibility.
 - **Distortions from regulating at multiple levels of supply chain.** Regulating the provision of both active and passive remedies would inevitably create issues and distortions; it would lead Ofcom into highly intrusive regulatory management of margins between different multiple levels of the supply chain.

² BT considers these average price rises would be even higher at around [X] %.

- **Difficulties in ring-fencing passives and cross market impacts.** Mandating passive remedies, and particularly dark fibre, given the difficulties of ring-fencing usage, would be likely to have disruptive effects on a range of other markets, undermining the regulatory measures currently in place in markets such as Wholesale Local Access.
 - **Jeopardising investments and innovation.** Passive remedies would jeopardise investment and innovation across business connectivity and other markets, undermining the incentives for infrastructure investment and jeopardising the recovery on recently made investments in Ethernet networks.
 - **Increased complexity.** Passive remedies would adversely affect service quality, making provision and fault fixing processes much more complex and costly, involving co-ordination between more parties, risking damage arising from multiple inexperienced parties intervening in the network, and impeding Openreach in the holistic monitoring and controlling of the network.
- 1.11. In combination with the significant challenges of implementing passive remedies, these costs need to be contrasted with the potential benefits. Ofcom identifies the main benefit of such an approach as enabling greater innovation (as opposed to being a way of reducing the prices faced by other CPs, which can be addressed through the existing charge control). These alleged benefits are limited and uncertain:
- no concrete examples have been provided of, even potential, innovations which would be enabled by passive remedies, which could not also be enabled through the existing active suite of products or developments to them: the key example set out in the Consultation of Cloud Radio Access Networks (“C-RAN”) may not require dark fibre and is only one of several potential future development paths for mobile networks;
 - in this respect, the introduction of passive remedies could risk lessening the market benefits of competition; even if a technology innovation was deployed by a CP over a new passive Openreach input product, the benefits are likely to be reserved only to that CP’s part of the downstream market, rather across the market as a whole via an Openreach equivalent wholesale product set;
 - as recognised by Ofcom, passive remedies are not required, or even necessarily the best way, to promote productive efficiency gains; and
 - expressing the potential for future deregulation of active products as a deregulatory benefit is misplaced: passive remedies would be more intrusive and are envisaged as existing as additional regulation alongside active remedies.
- 1.12. As identified in the Consultation the introduction of passive remedies would be extremely difficult and costly. There are substantive and substantial issues around the scope of any such products (including how they could be isolated only to markets where Openreach is found to have SMP as is required under the European Common Regulatory Framework and the CA03), their design and pricing. All of the options outlined in the Consultation on these issues would raise major challenges which would distract the industry and lead to competitive and investment incentive distortions for some years to come.
- 1.13. The costs of implementing passive products would also be significant and there would be major challenges in ensuring that the right protections and processes were in place, including developing a pricing scheme.

- 1.14. For these reasons the introduction of passive remedies would not be appropriate or proportionate, would harm rather than promote competition, and would put the UK's leading position in business connectivity, in terms of competition and investment, at risk.

2. Outline

Introduction

- 2.1. Ofcom's current regulatory approach to business connectivity is delivering choice, competition and falling prices. Introducing any form of passive remedy in business connectivity would mean taking a strategic choice to turn away from this approach. Indeed, Ofcom's BCMR Data Analysis consultation (8 October 2014) indicates that competition is so strong in some market segments that Ofcom should be seeking to take a less rather than a more intrusive approach. As Ofcom warns in the Consultation, introducing passives would also be a major practical undertaking that would require significant effort from BT and other CPs.
- 2.2. As we show in this response, the benefits claimed for passives can be achieved through the existing approach based on active remedies without risking the serious downsides that introducing passives would entail. In view of these factors, we believe that introducing passive remedies for business connectivity would be a fundamental mistake, with serious consequences for industry and its customers.
- 2.3. This section of our response provides an overview of BT's arguments and approach. The remainder of this document addresses the issues raised in the Consultation in more detail.
- 2.4. In summary:
 - the evidence shows existing active product based regulatory remedies have worked well and, to the extent any regulation is required, this type of regulatory approach should continue. There is no justification for fundamentally changing the basis of competition and the strategic approach to regulation;
 - an appropriate assessment framework is vital if Ofcom is to consider such a radical change to the regulatory approach;
 - neither Ofcom nor industry have identified significant innovative benefits from passives;
 - the likely adverse impacts of passive remedies are very significant; and
 - there needs to be a proper assessment of the pros and cons of specific options for passives before Ofcom considers its next steps on this issue.

The evidence shows that the level of regulation should be reduced rather than increased

- 2.5. The evidence shows that the current approach based on active remedies has been effective, to the extent that in many market segments regulation is no longer justified.
- 2.6. For example, Ofcom explained in its BCMR Data Analysis consultation (8 October 2014) that there were 17 fixed network operators whose data could have a material impact on its market analysis in the review. As we show in Section 4, this indicates there are far more scale operators in business connectivity in the UK than in other EU member states.
- 2.7. The preliminary service share estimates in the same document show that upstream and downstream competition is strong and has grown significantly since the last review:

Table 1: Ofcom’s most recent market share estimates

	BT share 2011	BT share 2014
AISBO in UK outside WECLA	74%	52%-57%
AISBO in WECLA	51%	36%-50%
MISBO in UK outside WECLA	57%	31%-34%
MISBO in WECLA	24%	BT share too low to be reported

- The BCMR Data Analysis consultation also reports increases since 2011 in the number of businesses within reach of competing networks. Of the business sites included in Ofcom’s analysis, 94% of those inside and 29% of those outside the WECLA are within reach of three or more competing networks.
- BT’s prices for key wholesale products have fallen: for example EAD 100M rental prices fell by 40% from £4,044 to £2,400 between 1 April 2011 and 1 April 2014, and the connection charge now includes an exemption on the first £2,800 of Excess Construction Charges. (Similarly, EAD 1G prices have also fallen by around 40% from £9,500 to £5,664 over the same period. Further falls in EAD 1G prices to £4,200 will also be implemented on 1 April 2015 meaning the overall percentage price fall for these products between 1 April 2011 and 1 April 2015 will be 56%.) The international benchmarking by WIK set out in Annex 7 and summarised in Section 4 indicates that Openreach’s prices for wholesale Ethernet prices compare well with those in other EU member states.
- Openreach has a track record of innovation in active business connectivity products, as we show in Annex 4 “Innovation in regulated access markets”.

2.8. The level of benefits delivered under the current approach has the following implications for Ofcom’s analysis of the case for any passive remedies in business connectivity:

- Ofcom’s preliminary service shares indicate that there are important geography- and bandwidth-delineated business connectivity markets where BT does not have SMP, for example very high bandwidth Ethernet and Optical services across the whole of the UK. Under the European Common Regulatory Framework and the CA03, no SMP remedies of any type can apply in such markets. However, if passive remedies were to be imposed in SMP markets, in practical terms it would be impossible to prevent CPs from using them everywhere, including in areas and at bandwidths where BT does not have SMP. This issue is addressed in Annex 2 on the applicable legal framework.
- There is no evidence of plausible innovation that cannot be addressed by active remedies. The potential innovation benefits of passives are uncertain and the additional flexibility which passive remedies might enable over and above what can already be achieved is likely to be small.
- Benefits would largely be restricted to CPs in a position to take advantage of price arbitrage opportunities from passives³, generally large CPs focused on providing high

³ For the purposes of this response, by arbitrage we are referring to the situation where a purchaser of passive access products is able to take advantage of differences in relative costs and prices to undercut a portion of the prices for active products (which are based on averaged costs) with no economically

bandwidth services in urban areas. Smaller CPs, customers outside densely populated areas and those using lower bandwidth circuits would face higher prices due to the requirement for BT to recover efficiently incurred common and fixed costs.

- The potential adverse impacts on allocative, dynamic and productive efficiency resulting from unsustainable competition and exploitation of artificially low prices would be significant.
 - Business customers would inevitably pay the bill for the significant implementation and transitional costs that industry would incur.
- 2.9. The current set of regulated active products and existing regime are supporting vibrant retail competition across all Ethernet markets. The market structure, with a wide range of different CPs, reflects the diverse range of different types and sizes of business customer. Retail competition is strong (see Section 6) and on the basis of international comparisons the UK market benchmarks well against other European comparators (see Section 4).
- 2.10. The Openreach portfolio of active Ethernet and Optical products is continually reviewed to ensure it keeps up with technical and commercial developments and continues to meet evolving customer needs. This evolution is partly achieved through the SOR process, as well as through regular commercial dialogue and engagement (e.g. via the Ethernet Product and Commercial Group⁴) to ensure that the range of active products can continue to support and drive forward innovation and competition in business connectivity markets for the benefit of all CPs. Openreach continues to develop its plans for evolving the product roadmap to meet future customer needs through existing and future active products. This type of industry dialogue in support of innovation could be disrupted and undermined by the introduction of passive remedies.
- 2.11. This evidence indicates there is no justification to move from the current active-based approach to a much more intrusive remedy in the form of passives. We also believe there has been no material change in the market since Ofcom's successful defence in the Colt Appeal⁵ of its decision not to impose passive remedies in the 2013 BCMR, and hence no change which would change Ofcom's decision not to impose passive remedies.

An appropriate assessment framework is vital (Section 3)

- 2.12. The framework set out in the Consultation lists a number of the key factors against which Ofcom will assess what remedies should be imposed in light of the nature of any competition problems that it identifies. We agree that the factors listed are relevant, but it is essential that Ofcom also incorporates the factors below into its framework:

efficient market expansion. We consider that the form of arbitrage discussed in the Consultation and in this response is harmful to overall economic efficiency and has negative impacts.

⁴ See <http://www.openreach.co.uk/orpg/home/products/industryforums/ethernetservices/ethernetservicesf ora.do>.

⁵ Colt Technology Services v Office of Communications, Case 1212/3/3/13, Judgment of 26 November 2013 (the "Colt Judgment").

- the need to have regard to the principles of good regulation, to promote regulatory consistency and to impose regulation only where there is no effective and sustainable competition;
- the need to keep regulation under review and to remove it when effective competition develops;
- the costs of regulation. In this case it would be particularly relevant to assess the costs of duplication of assets and network and any inefficient entry which would be likely. An assessment of this type was a significant factor in the 2010 Wholesale Local Access (“WLA”) Market Review which concluded that the principal form of regulatory intervention should be at the active rather than the passive layer⁶;
- the allocative efficiency impacts on active pricing of introducing passive products. This is not only an arbitrage issue leading to distributional impacts: the pricing of passives would also trigger price increases for active products which Ofcom has always considered important;⁷ and
- the knock-on impacts on other markets. These impacts go beyond the need, which Ofcom recognises, to recover common costs in other markets. For example, Ofcom would need to consider the feasibility of restricting the use of any passive remedies imposed in the BCMR to leased lines and the potential impact on other markets of reduced investment incentives.

2.13. As well as incorporating these factors into its analysis, Ofcom needs to:

- describe how it will balance all the factors it considers against each other;
- explain how it will assess whether passive remedies are the least intrusive way of achieving Ofcom’s regulatory aims; and
- set out a coherent long run view on the interaction between active remedies and any passive regulation it proposes.

Significant innovation benefits from passives have not been identified (Section 5)

- 2.14. The CPs advocating passive remedies have exaggerated their potential benefits. As discussed in more detail in Section 5 below (see also Annexes 1 and 4), the additional ability to innovate that passive products could provide to CPs over and above what can be achieved through active products is very limited. In our view, many CPs’ calls for passives essentially reflect pricing concerns which could be appropriately and proportionately addressed through charge controls on active products.
- 2.15. Ofcom states that it will give “*particular weight*” to uses of passives products which could improve efficiency or promote innovation. In our view, Ofcom should only give weight to such uses: no weight should be placed on uses which simply replace existing active wholesale products with passive ones, with no gains to efficiency or innovation.
- 2.16. Ofcom identifies as an additional potential benefit of passives that they could lead to deregulation further downstream in the long term. However, since not all CPs would be in a position to use passives, it is likely that passives and actives would co-exist indefinitely. Even

⁶ Wholesale Local Access consultation 23 March 2010, see paragraphs 7.132-7.141 and Annex 10.

⁷ See, for example, section 8, 18 and 20 of the last BCMR final statement, published 28 March 2013, available at <http://stakeholders.ofcom.org.uk/consultations/business-connectivity-mr/final-statement/>.

if it were plausible that active-based regulation would be withdrawn in the long term, Ofcom would still need to set against this uncertain benefit the cost of a significant and certain increase in regulation in the near term. Any deregulatory benefit is highly uncertain and negligible in the short to medium term. On the contrary, progress over the last 3 years suggests active product deregulation is now appropriate.

The adverse impacts of passive remedies are large (Section 6)

2.17. The introduction of passives would necessarily force BT to increase prices for active products in certain market segments to ensure common costs continued to be recovered fully once CPs had switched to passives in other segments. During the review, Ofcom must properly recognise the material risks of arbitrage from dark fibre in particular, especially for shorter length and higher bandwidth circuits. [§].⁸ Serious adverse impacts from passives would include the following:

- Passives would encourage inefficient entry and reduce the incentives for infrastructure providers to make further investments in their networks.
- Openreach would have to increase prices for its active products to ensure it could recover its common costs. Ofcom estimates these common costs at £330m and the potential increase in active product prices at 27% (as set out in Section 6, we believe the impact may be even greater). Most of Openreach's circa 300 CP customers and their end customers would suffer from this, whereas comparatively few CPs would be in a position to benefit.
- The existing bandwidth gradient would not be sustainable, as users of high bandwidth leased lines would migrate to passives. Again, this would force BT to increase prices for lower bandwidth services, with distributional impacts on business customers.
- Overall costs would be increased by the costs of implementing new systems and processes; the costs of changing the Openreach network, which is optimised for the provision of active products); and the costs of uncertainty during the transition period.

Assessment of the options for passives (Sections 7 to 9)

2.18. We believe the introduction of passive remedies would be neither proportionate nor justified as a response to any SMP finding in business connectivity markets. Notwithstanding this, our response comments on the relevant questions on the scope and design of such products that Ofcom states it would need to address if it imposed passive remedies.

2.19. A key decision in this respect would be the choice between duct access and dark fibre remedies. Ofcom approaches this issue in the Consultation in relation to which form of access would meet actual and likely demands from CPs. This is not the only factor that Ofcom would have to take into account: it would also need to assess the relative costs and risks associated with different products, as well the extent to which they would realistically allow innovation benefits to be achieved.

2.20. The scope of passive remedies – for which products and geographies they would be available – is of fundamental importance. The Consultation suggests that the adverse impacts of

⁸ [§]

passives could be limited through restrictions on their availability. This is an important point. Assuming Ofcom could demonstrate passives to be the least intrusive and most proportionate remedies to SMP related issues, it would be essential to ensure they were only used in those segments.

- 2.21. The ability to implement such restrictions may in itself be a factor in whether the risks and impacts of passive remedies could be properly contained. We have to date seen no evidence that CPs or Ofcom have found any ways to overcome the problems of this nature which were identified by respondents to the consultation prior to the 2013 BCMR.
- 2.22. Passive remedies could only be imposed in markets where BT had been found to have SMP. It would be essential to ensure that they did not spread into adjacent markets where Ofcom's market analysis had found that lower levels of regulation or no regulation were appropriate. As Ofcom itself recognises, it has no power to impose SMP conditions on markets where no operator has SMP.
- 2.23. The structure and level of passive product charges would significantly influence the continuing use and pricing of active products. For the reasons set out in Section 9 we consider that all potential approaches identified in the Consultation would entail serious risks of disrupting active product markets. Arbitrage opportunities would be likely to remain under any approach to pricing passives. This would have adverse impacts on efficiency and distort the pattern of Openreach's common cost recovery, especially due to the necessary consequent rebalancing of active prices. As set out in Section 9 and the accompanying DotEcon report at Annex 6, the bandwidth gradient is an efficient way to recover common costs, and such pricing flexibility has been provided under previous charge controls for good economic reasons. Introducing passives would also lead to unpredictable distributional impacts as a result of de-averaging of active product prices, for example across both bandwidth and distance dimensions.
- 2.24. Moreover, passive products could potentially undermine existing regulatory remedies and investment incentives in adjacent markets (such as those assessed in the WLA market review). These impacts would represent serious adverse regulatory distortions and be inconsistent with the requirements both of the European Common Regulatory Framework and the CA03. If Ofcom were to mandate any passive remedies, it would need to take care that they were proportionate and that the harmful impact on the benefits delivered under the active-based approach was minimised.

3. Ofcom's Framework for assessing passive remedies

Introduction

- 3.1. Section 3 of the Consultation sets out Ofcom's view of the framework for assessing the desirability or otherwise of introducing passive remedies. We agree Ofcom's approach lists some of the relevant factors but the proposed framework is not robust. This section of our response sets out our detailed comments on the framework.
- 3.2. The current regulatory regime supports vibrant downstream competition. It is therefore essential for Ofcom to start from the right perspective – the key question is whether there are any significant competition issues which are not, or could not, be adequately addressed with the current active regulatory regime rather than starting by asking whether passive remedies are per se a good approach as if starting with a clean slate (which is clearly not the case). We therefore urge Ofcom to first assess whether there is a strategic aim or significant current competition or policy problem which is not being addressed by the current set of regulatory remedies (or could not be addressed by developing existing products) before considering the benefits or otherwise of passive remedies.
- 3.3. Once this question has been properly considered, and should Ofcom still assess there is a potential need for passive remedies, there are a number of concerns that must be addressed to make the assessment framework fit for purpose, in particular:
 - Ofcom must not simply consider the extent to which passive remedies address the competition concerns identified. Ofcom must also evaluate the extent to which passive remedies are the most appropriate and proportionate way to address those concerns (which involves comparing them against alternative remedies).
 - Ofcom is also obliged to consider a number of essential additional factors currently missing from the assessment framework. These missing factors include (see paragraphs 3.19-3.21 below):
 - having due regard to the principles of good regulation;
 - an all-embracing consideration of the costs of competition;
 - a more comprehensive consideration of allocative efficiency impacts; and
 - a more complete assessment of the knock-on impacts on other markets.
 - Moreover, Ofcom must give more consideration to the long term effects of introducing passives. In particular, a long run mix of active and passive remedies would create uncertainty, damage investment incentives and maximise opportunities for arbitrage and cherry picking that would harm allocative efficiency. Ofcom has not considered these issues in the Consultation, which have to be a central part of any assessment of the appropriateness or otherwise of introducing passives.
- 3.4. Finally, Ofcom has not yet set out how it will conduct its assessment. In order that stakeholders have the opportunity to provide meaningful input into any final decision, Ofcom should outline in detail in its consultation in spring 2015, the precise approach it will take to reaching its decision, and in particular:
 - how it proposes to balance all of the competing relevant factors, including the factors currently missing from the assessment framework; and

- how it sees remedies at different levels of the supply chain working and provide a likely timetable for withdrawal of active product regulation.
- 3.5. We conclude that the framework in the Consultation is not sufficient. It fails to start from a need to identify what it is that requires a consideration of passive remedies; it fails to set out the criteria by which it will assess whether only passive access will do; and fails to identify how the costs and benefits will be balanced against each other. Nor does it include all of the relevant criteria. The framework in the Consultation only lists the factors which Ofcom will take into account when considering these issues rather than setting out any kind of structure for balancing the different impacts. Finally, as a framework it does not adequately deal with the balancing of short and long run issues or how Ofcom would assess the interaction between active and passive remedies.
- 3.6. Following sections of this response address our views on the costs and benefits of introducing passive remedies in more detail, but we consider that the use of an appropriate framework would ensure that the uncertain and low benefits were outweighed by the certain and significant costs.

The Consultation approaches the problem from the wrong perspective

- 3.7. Ofcom's statutory duties, the European Common Regulatory Framework and Ofcom's own regulatory principles all require that any assessment of remedies in business connectivity markets is done in a way which ensures that the least intrusive approach is taken to address any issues identified.
- 3.8. To justify the introduction of passive remedies it is not sufficient simply to show that there is a possibility that in the very long term the benefits of passives might outweigh the potential costs (or that the costs could be expected to be mitigated). Ofcom needs to show that, compared with alternatives and in light of its statutory obligations, this would represent the best strategic choice for the industry, and would be a proportionate and appropriate response to the particular issues identified as arising from SMP, as well as delivering benefits to Cps and their end customers. This is required under the relevant legal framework (see Annex 2 below) as well being the right policy and economic approach. The impact on competition, for example, needs to be considered in the round and take account of inefficient entry and pricing structures which may be created by passive remedies.
- 3.9. A significant problem with Ofcom's proposed approach is that it approaches the issue from the wrong perspective. The Consultation sets up the relevant question as being one of whether the benefits of passive remedies outweigh the potential adverse impacts and risks identified. The right starting point is whether there is a strategic aim or current competition or policy problem which is not being addressed by the current set of regulatory remedies (or could not be addressed by new remedies on the existing products). If such a justification for change is found, Ofcom should first consider how amending the existing active regulation would meet its objective and only consider more intrusive remedies if this is not a viable option.
- 3.10. As a minimum, an appropriate assessment framework for this decision should include:
- a clear identification of the nature of the competition issues arising in business connectivity markets;
 - an assessment of whether these issues can be addressed by maintaining the current regulatory status quo or through less intrusive changes to the existing regulatory regime such as amending existing active remedies;

- if the evidence indicates that the status quo, or amending the existing active remedies, does not address the competition issue then it would be right and proper to consider more intrusive alternatives which might include passives. An assessment of the appropriateness of passive remedies should include a clear justification of why nothing other than that passive remedy would suffice and why passive remedies would better address the competition issue over and above what can be achieved under the current active only regime; and
 - even if then there appears to be a case for the introduction of passive remedies, any proposal should be justified with a full cost benefit analysis or impact assessment. This would need to compare a range of suitable alternative options as compared to the existing regulatory regime to justify such a fundamental change.
- 3.11. It would be wholly unreasonable for Ofcom to proceed without adopting a framework in line with that outlined above.
- 3.12. Any assessment of costs and benefits should be undertaken in the context of whether the proposed remedy is the most proportionate and appropriate way to address the nature of any market failure identified through the SMP analysis. In comparing packages of remedies which include and do not include passive products, Ofcom must therefore compare net benefits of the more and less intrusive approaches.

The framework needs to assess whether passives appropriately address the problem identified

- 3.13. Introducing a requirement to provide passive products would represent a fundamental shift in the way Ofcom regulates and promotes competition in business connectivity markets. Ofcom sets out its overall approach in paragraph 3.2 of the Consultation, stating that the assessment of the “merits of passive remedies” will be carried out in accordance with the EU Common Regulatory Framework and subject to Ofcom’s statutory duties. Clearly this must be the case and the starting point should be the market assessment and identification of any SMP leading to a requirement for a regulatory ex ante remedy. Ofcom then states that “a key step” involves identifying “any competition problems” and “determining the extent to which any potential passive remedy would address those competition problems”. Paragraph 3.3 of the Consultation then identifies what Ofcom considers are the main factors to be taken into account in any such assessment.
- 3.14. The principle of proportionality requires Ofcom to consider whether the incremental benefits of passive remedies would out-weigh the costs of their introduction as compared to the status quo. This does not appear to be recognised in Ofcom’s framework as set out in section 3 of the Consultation. While commercial and regulatory consequences (including a consideration of “whether there is a less intrusive way of achieving the same or similar outcome”) are listed as one factor, this is presented as just one factor to balance against others rather than a necessary prior step to justify proportionality. Further, it is clearly the case that Ofcom’s approach to any introduction of passive remedies must use the appropriate legal framework: we set out the relevant legal considerations which must be taken into account in Annex 2.
- 3.15. Ofcom should consider the introduction of passive remedies as a fundamental strategic choice of whether and where to regulate within the supply chain rather than just another remedy. Because Ofcom does not recognise it is not starting with a blank sheet its assessment cannot comprehensively assess the most appropriate way to achieve its relevant regulatory aims. Article 8 of the Access Directive requires Ofcom to impose SMP remedies

which are based on the nature of the identified problem, proportionate and justified in light of the objectives set laid down in Article 8 of the Framework Directive.

- 3.16. While it is clear that remedies can only be applied where SMP is found, the Consultation fails to pay sufficient regard to the difficulties in “containing” any passive remedies such that they only apply to where SMP has been found e.g. how could BT restrict the use of passives for MISBO services in WECLA where BT does not have SMP. This issue is all the more important as Ofcom’s provisional market share analysis suggests further scope for a finding of non SMP in specific markets e.g. MISBO outside WECLA. [X]
- 3.17. Ofcom should not simply consider the extent to which passives address the competition concerns identified, but the extent to which passives are the best and most appropriate and proportionate way to address those concerns, which involves comparing them against alternative remedies. This is not simply an assessment of whether a particular form of remedy addresses the problems identified. It should also include an assessment of whether existing remedies sufficiently deal with competition problems and if not whether other approaches would better deal with the issue and would be the least intrusive way of doing so.
- 3.18. Ofcom identifies the need to assess the competitive impacts and the extent to which a particular remedy facilitates effective competition. Ofcom further notes that this includes the effect on competition at different points in the supply chain. However, Ofcom should be promoting efficient and sustainable competition, as well as ensuring that there is no distortion of competition, at the most appropriate point in the supply chain to achieve this in the long run.

The relevant factors in the framework

- 3.19. While the framework Ofcom sets out lists a number of the relevant factors which should be taken into account when assessing whether passive remedies are an appropriate means to address a particular identified competition problem, this list is not a sufficient framework in itself. Below we consider Ofcom’s list of factors, then turn to a number of factors that Ofcom appears to have omitted at present from its framework but which should be included. In addition, more detail is required on the approach which Ofcom proposes to take in weighing and balancing these factors against each other and how longer term issues are assessed.
- 3.20. In terms of the factors Ofcom has included, “Commercial and regulatory consequences” encompasses a wide range of different potential impacts and it would aid clarity for this to be considered at a greater degree of granularity going forward. As discussed further below in Section 8, these include the significant operational impacts representing a cost which would need to be assessed and taken into account.⁹ This heading also covers regulatory burden and whether the remedy is the least intrusive way of achieving the desired outcome (as noted in the Consultation and discussed further below in this section and in Annex 2). Any costs of regulatory uncertainty, for example arising from any disputes over specific

⁹ We would expect that Ofcom would need to undertake itself or commission a significant evaluation of the operational practicalities, what would be required and the costs of so doing. This would especially be required were the proposed remedy package to include any dark fibre element as this would be a completely novel regulatory remedy in the UK. We note that Ofcom commissioned work along these lines when considering PIA for the WLA market review in 2010. Wholesale Local Access consultation, 23 March 2010, see paragraphs 7.120-7.131 and Annex 10.

terms related to new passive remedies, also need to be taken into account. We expect that other consequences will also emerge under this heading if potential passive remedies are further defined and assessed.

- 3.21. While recognising the issue in general terms, the Consultation also contains no firm proposals for how it would be possible to ring fence any passive remedy so that it only impacts where the competition problem in leased lines has been identified and SMP found. In the Colt Appeal, Ofcom considered this impractical,¹⁰ but the Consultation does not set out what has changed to mean this is no longer the case.
- 3.22. However, the list in paragraph 3.3 of the Consultation appears to be provisional as it omits some important factors. While some of these are implicitly taken into account later in the document when Ofcom sets out potential costs and benefits, not all of them are. We consider that it would be clearer to include explicitly all of these factors, together with any approaches to balancing those factors, in any list of relevant considerations to aid transparency and enable stakeholders to meaningfully respond to Ofcom's proposals.
- 3.23. In particular Ofcom's assessment framework is deficient in not including analysis of knock-on impacts given that there is vibrant competition for business connectivity services under the existing regime. There are two types of potential knock-on impact which could result. In competitive markets, passive products could be used to undermine investment incentives and distort future investment. For example, it is not clear how Ofcom could stop multiple dark fibre circuits being strung together to create long distance backbone circuits in the highly competitive core network market. Dark fibre could also distort investment choices in regulated markets, for example diverting demand away from GEA which could distort the fibre investment business case. That is, introducing a dark fibre remedy in business connectivity could realistically undermine Ofcom's own previous conclusions (which were subject to significant analysis and consultation) that active remedies were the best foundation for promoting investment and competition in relation to superfast broadband.
- 3.24. Other significant factors that Ofcom must consider include:
 - the need to have regard to the principles of good regulation, promoting regulatory consistency, and the need to impose ex ante regulation only where there is no effective and sustainable competition (and relaxing or lifting such obligations as soon as there is such competition);
 - a consideration of the costs of competition, in terms of a quantitative assessment of the costs of duplication of assets and network and any inefficient entry which is likely (an assessment of this type was a significant factor in the 2010 WLA review which concluded that the principal form of regulatory intervention should be at the active, not passive, layer¹¹);
 - the allocative efficiency impacts on active pricing of introducing passive products: this is not only an arbitrage issue leading to distributional impacts but would also, in effect, put active prices in a straightjacket removing the pricing flexibility which Ofcom had previously considered important (which by the same logic would in itself reduce allocative efficiency); and

¹⁰ Colt Judgement, paragraph 161.

¹¹ Wholesale Local Access consultation 23 March 2010, see paragraphs 7.132-7.141 and Annex 10.

- a more comprehensive assessment of the knock-on impacts on other markets: while Ofcom's framework recognises the potential impact of common costs needing to be recovered in other markets, we consider the potential implications in other markets are wider than this.

The framework must be clearer on how factors are balanced

- 3.25. Ofcom's framework, as described in section 3 of the Consultation, notes that the various different factors which it does identify may conflict. We agree. A framework for assessing such factors therefore needs to set out the way in which such conflicts would be approached and what Ofcom would, or would not, consider important in weighting the different impacts on each of these factors. In this regard, the Consultation as a whole is vague. The main balancing of different effects to which reference is made in the Consultation is that greater weight will be placed on innovative outcomes as opposed to ones merely driving arbitrage. However, even here the Consultation also notes that "some" arbitrage may be acceptable. We note that costs and benefits should be quantified by Ofcom wherever possible.
- 3.26. We address the likely significant levels of arbitrage under any potential pricing scheme in Section 9. Here we merely note that we consider entry based on arbitrage (which merely replaces demand already being supplied in an alternative way and therefore does not increase welfare) should not be considered as a positive form of entry. On the contrary, such entry would be harmful to allocative efficiency.
- 3.27. A number of the potential benefits of passives identified in the Consultation are also highly uncertain such as most of the potential innovation benefits or the "benefit" of deregulation of active remedies. Ofcom should give significantly lower weight to benefits to the extent that they are uncertain or speculative, alongside higher weight to costs which are nearer term and more certain.
- 3.28. The uncertainties involved around such benefits in the longer term (beyond the current market review period) need to be fully taken into account and therefore it is likely that little weight can be placed on benefits that do not appear in the current market review period for the purposes of assessing whether passive products should be introduced. If any more weight is placed on such a benefit then it is clear that the packages of remedies under consideration should also include one where active product regulation is completely withdrawn were passive access to be introduced. Further weight can only be attached to such a benefit in the context of much greater clarity on the circumstances and conditions in which active regulation would be withdrawn. This is both to understand the likelihood of such benefits and also to include the costs of having a dual system of regulation (and the likely timeframes over which this will occur). Further, the overall benefits of such deregulation are not clear as while there may be future reductions in active product regulation, this would only occur after additional regulation had been introduced at the passive layer.

A more appropriate long run framework is required

- 3.29. As noted above, one of the factors which Ofcom lists in paragraph 3.3 of the Consultation is “*commercial and regulatory consequences*” which includes both the burden of regulation and whether there is a less intrusive way of achieving the same or a similar outcome. However, the approach to regulatory burdens in the Consultation beyond this mention is flawed. The Consultation further notes that “over the longer term” it “may not be desirable to regulate at multiple points in the value chain indefinitely” (§3.6). This morphs into a potential benefit in Section 4 of the Consultation as possibly leading to deregulation of active products.
- 3.30. This overall approach to considering the longer term impacts and the extent to which active and passive remedies could or should co-exist is effectively an omission from the framework set out in the Consultation. Ofcom needs to set out a coherent view of the long run approach to regulation (consistent with the EU regulatory framework). This should include some consideration of the circumstances in which active product deregulation would occur and when this would occur. This is an important aspect of considering whether passive remedies are desirable. The speed and nature of deregulation needs to be taken into account. Further, the conditional nature of many of these statements suggests that Ofcom considers that permanent long-run co-existence of active and passive regulation is feasible. Again, the circumstances which would warrant this need to be explained. BT considers that there would be no such circumstances. It is worth noting in this regard that PIA was introduced in the 2010 WLA market review to fill a clear gap, namely the perceived need to create incentives for investment in the “final third” and this justified the mix of active and passive remedies. No such policy gap exists in business connectivity.
- 3.31. There is also no justification for Ofcom not at least considering a “passives only” approach (i.e. phasing out any active regulation rapidly where passive remedies were successfully introduced). The reasons for ruling this out are not set out in the Consultation, which states Ofcom will only consider active only or mixed active and passive packages of remedies. A long run mix of active and passive remedies would create potential for regulatory confusion and uncertainty, damage investment incentives and maximise the chance for arbitrage and cherry picking to harm allocative efficiency. For all the reasons set out in this response, BT considers that a passive remedy approach would be inferior to the existing regulatory regime based on active remedies. However, were passive remedies to be introduced, this could only be done in the context of a clear framework and approach for switching from one regulatory strategy to the other.
- 3.32. Ofcom’s current approach in the Consultation is to treat deregulation as a potential benefit, but this turns a mixed set of remedies into a certain cost. Ofcom correctly recognises that the implementation of passive products has the potential to take some time. As such, there is significant uncertainty as to how any active deregulation could occur and this could also stretch into future market reviews. At that time the market assessment may have changed as competition evolves, however it is likely that the introduction of passive remedies would be irreversible.¹² With no clear policy objective or competition problem which passives are meant to “solve” it therefore becomes even less clear how any deregulatory benefit can be assessed for the purposes of any individual market review.

¹² See further discussion of this point in Section 6 below.

- 3.33. The Consultation also notes that the implications of the Civil Infrastructure Directive will need to be taken into account. Clearly this is a relevant factor and the approach taken to implementing this legislation into UK law will be relevant to the assessment of passive remedies in the BCMR. At the very least this will represent another factor which needs to be taken into account when assessing whether the existing regulatory arrangements are sufficient or whether there is a specific competition problem which requires additional regulation through the BCMR.

4. International benchmarking of business connectivity markets and the implications for the UK debate on passive remedies

Introduction

- 4.1. Before examining the specific potential benefits and certain costs of passive remedies in Sections 5 and 6 of our response, we compare the business connectivity markets in the UK with those in other European Union (“EU”) member states and assess what this means for Ofcom’s consideration of passive remedies. In summary:
- The UK business connectivity markets provide CPs and their customers with some of the lowest prices and most favourable standard terms in Europe. This provides evidence that current active remedies and Ofcom’s approach to regulating them has already provided a level playing field supporting strong downstream competition.
 - We have found no EU member state where dark fibre is mandated on a national basis for business connectivity services. The only member state we have identified where dark fibre is mandated for business connectivity is Austria, where this remedy applies only in a sub-national geographic market.
 - These findings support our contention that there is no market or regulatory failure that would justify imposing passive remedies in UK business connectivity markets.
- 4.2. We therefore conclude that that the UK business connectivity markets compare favourably against those in other EU member states, and this is due partly to Ofcom’s current regulatory approach. BT is already pricing Ethernet lower than comparator countries showing that active remedies are effective. This further supports the position that there is no justification for introducing passive remedies: in fact it would be perverse for such intrusive regulation to be imposed in the UK whilst it has not been found necessary in other countries where the markets and regulation are not working as effectively.

International benchmarking of Ethernet services

- 4.3. BT has commissioned WIK-Consult (“WIK”) to carry out a benchmarking exercise comparing the reference offers for Ethernet services published by SMP operators in a range of EU member states, with a focus on service levels and prices. The resulting report by WIK is attached to this response as Annex 7. The charts set out below are taken from this report.
- 4.4. WIK found that prices for typical regulated wholesale Ethernet service configurations are lower in the UK than in other EU member states, as the examples below demonstrate.

Chart 1

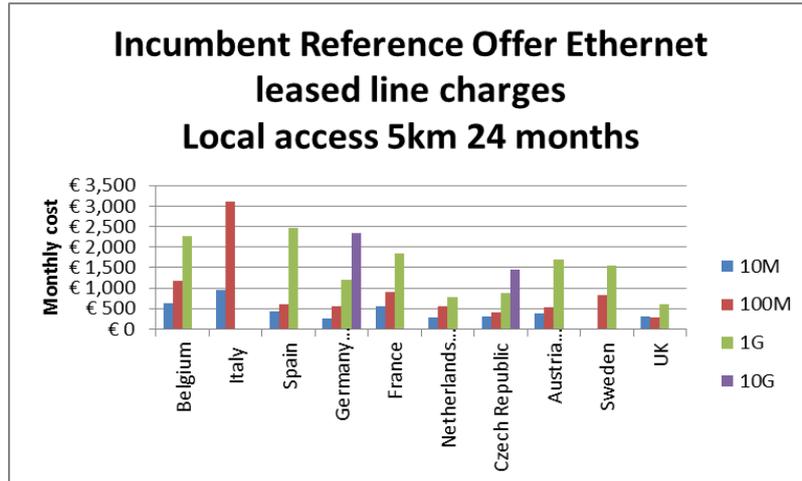
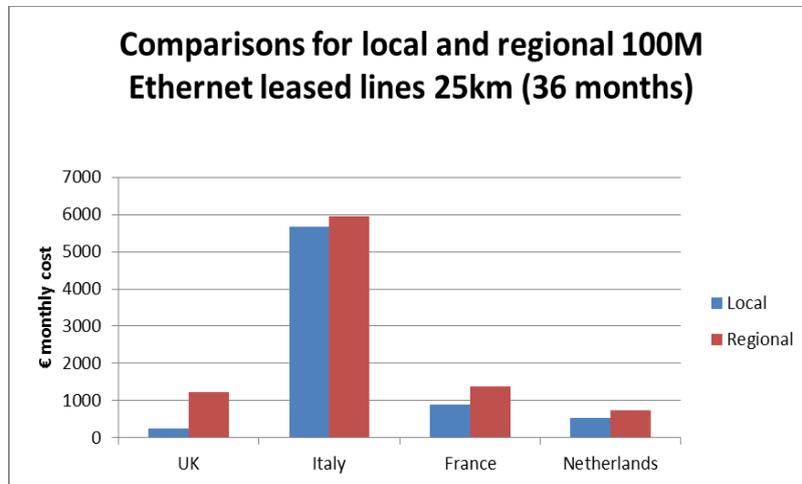


Chart 2



4.5. The benchmarking exercise found that the UK has the shortest regulated reference offer timescale for on-net provision of Ethernet of all the countries covered by the WIK benchmarking study, as well as the highest Service Level Guarantee payments for failure to meet committed dates: these findings are set out in the two charts below.

Chart 3

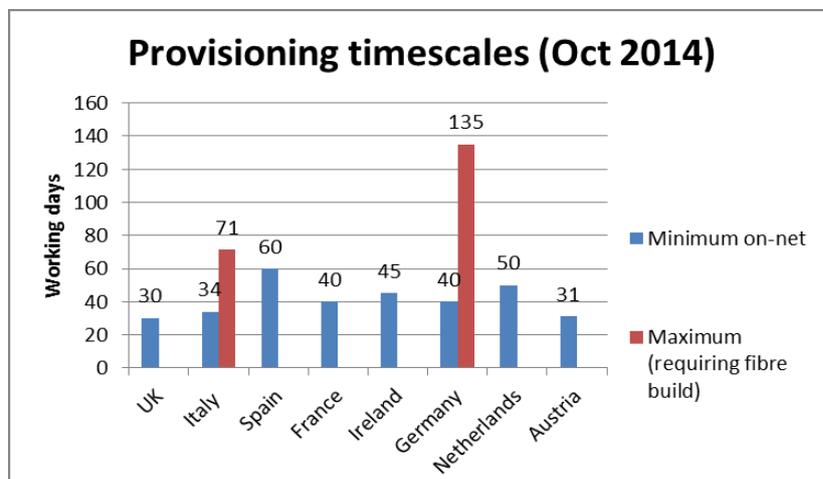
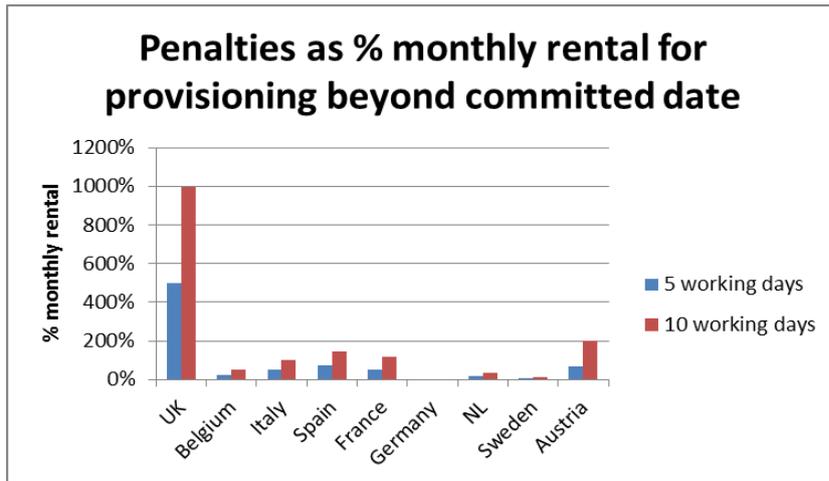


Chart 4



- 4.6. We note that WIK were unable to benchmark actual provision timescales due to a lack of publicly available information in other EU member states: in contrast, Openreach now publishes key performance indicators for Ethernet as well as copper service levels on its internet site each quarter.
- 4.7. Reference offer service levels and associated SLG payments for Ethernet repair in the UK were also found to compare favourably with those in other EU member states.

Chart 5

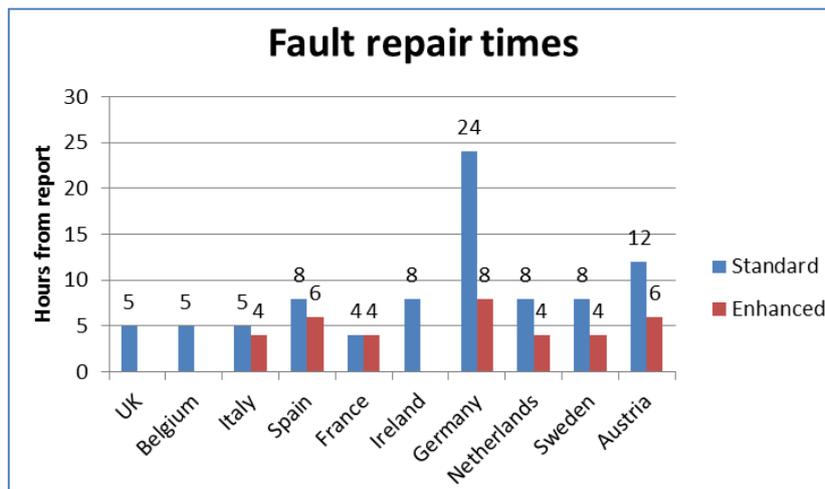
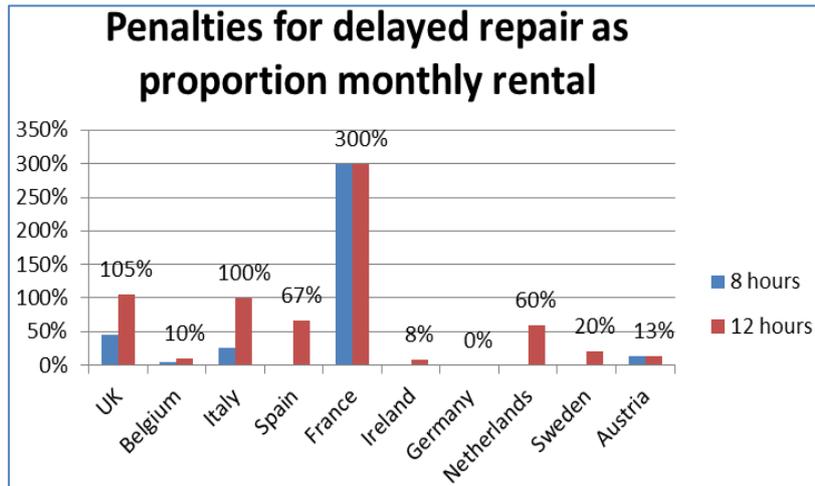


Chart 6



4.8. [X]

Chart 7

[X]

4.9. Finally, the WIK report compares the regulation of leased lines across EU member states. Whilst SMP remedies in business connectivity in the UK have a wide scope, in many other EU member states they are less broad and stringent. For example:

- **France.** Price regulation is limited to prohibitions against predatory and excessive pricing. In the UK, ‘CPI-minus’ charge controls apply to all wholesale Ethernet markets where BT has SMP except the WECLA.
- **Germany.** SMP only applies to circuits at bandwidths up to and including 155 Mbit/s. In the UK, BT has SMP nationally in Ethernet at bandwidths up to and including 1Gbit/s, and in Ethernet above 1Gbit/s and Optical services in the UK outside the WECLA.
- **Spain.** Regulated prices are set on a ‘retail minus’ basis.

4.10. Usage of active Ethernet products is high in the UK and it compares favourably with other jurisdictions in terms of price and SLAs. Competition, based on the existing active products regime, is effective. This further reinforces that there is no reason to disrupt the current market with a fundamental change in the approach to regulation.

Dark fibre in EU member states

4.11. CPs have frequently referred to the availability of dark fibre in other EU member states, and in Section 4 of the Consultation Ofcom invites views on experience of the benefits of passive remedies from use in other jurisdictions. In fact, our analysis set out below shows that dark fibre has only been mandated for business connectivity (i.e. as a remedy for SMP in Market 6 of the 2007 Recommendation on Relevant Markets) in one EU member state, Austria, and even then not on a national basis.

Table 2: Dark Fibre usage for business connectivity in other EU member states

EU member state	Dark fibre mandated for business connectivity?
Austria	Only outside 359 municipalities where Market 6 has been deregulated
Belgium	No
Czech Republic	No
Denmark	No
France	No
Germany	No
Hungary	No
Ireland	No
Italy	No
Luxembourg	No
Netherlands	No
Poland	No
Spain	No
Sweden	No

- 4.12. This indicates that where passive services are used in other countries, this will be the result of commercial negotiation and not SMP regulation. It is also possible that CPs may seek passive remedies on a commercial basis due to the difficulty of securing good active services in the absence of effective regulation of active services such as that which applies in the UK.

5. Benefits of passive remedies are limited

Introduction

- 5.1. In this section we set out why the existing active product set can support innovation and that passive remedies are not required to enable further innovation. We also address the other suggested benefits of passive remedies discussed in the Consultation. In particular:
- Limited potential innovation benefits. In this section we consider each of the identified innovation opportunities claimed for passive remedies and set out why these can also be achieved by developing the active products. The main opportunity cited in the Consultation is C-RAN, which our detailed analysis shows does not necessarily lead to a requirement for dark fibre as suggested in the Consultation.
 - Quality of service. We agree with Ofcom's initial view in the Consultation that passive remedies would not promote higher quality of service levels and urge Ofcom to recognise that, on the contrary, such an approach would create additional risks to service quality due to the lack of monitoring for dark fibre and increased complexity of duct access.
 - Productive efficiency. In our view any productive efficiency gains are highly uncertain. Openreach's network is currently planned, designed and dimensioned on the basis of providing active products and any introduction of passive products would create disruption and likely productive efficiency losses through less efficient utilisation of the network.
- 5.2. There are very limited potential innovation benefits from increased flexibility arising from use of passive products. Any such supposed benefits are highly uncertain and would not be significant relative to the costs involved (which are discussed in more detail in later sections of this response). Passive remedies represent an overly intrusive regulatory intervention. Introducing such a remedy would be disproportionate, especially since the potential benefits available from dark fibre for, example to handle 4G access services, could be more easily be addressed by development of the active portfolio.
- 5.3. Prior to examining these issues, we first address Ofcom's approach to the potential impacts on allocative efficiency and Ofcom's identification of the benefits which arise from the potential withdrawal or relaxation of some downstream regulation.

Allocative efficiency and downstream regulation

- 5.4. Ofcom is normally concerned about allocative, dynamic and productive efficiencies. Ofcom (§4.6) does not explicitly consider allocative efficiency in relation to passive remedies. Ofcom appears to couch this efficiency only in terms of the potential 'to withdraw or relax some downstream regulation'. In fact, it is likely that there would be serious allocative efficiency dis-benefits from passive remedies through the impact on the pattern of common cost recovery and consequent changes to active prices, which are addressed in more detail in Sections 6 and 9 of this response.
- 5.5. Ofcom does address issues of active product prices changing elsewhere in the Consultation such as in Section 2. Section 5 of the Consultation picks up on this (§5.8) addressing the possibility of price distortions leading to distortions to investment. Then, in Section 7 Ofcom also sets out options for pricing but does not explicitly make the link to the problems

identified earlier in the Consultation. We ask that Ofcom pulls together its proposals around pricing issues into a coherent framework to enable meaningful stakeholder comment.

- 5.6. This would need to address a range of issues, including, amongst other things:
- the problem of FRND implying a need to develop bespoke pricing;
 - the acknowledged impossibility of monitoring usage which would prevent passive services from being used for any downstream application at all;
 - the likelihood of a very high ‘retail minus’ price implying no industry demand; and
 - the regulatory requirements to recast the price control baskets.
- 5.7. The accompanying report by DotEcon examines these and further detailed comments are set out in Section 9 of this response.
- 5.8. In the context of recognising that pricing arbitrage might well occur, Ofcom (§2.21) simply addresses any concerns regarding the consequential pricing inefficiencies with the statement “*We need to consider what policy measures might be available to mitigate any potentially undesirable side-effects*”. It is not clear what sort of policy measures Ofcom currently has in mind (which must also be permitted under European and UK legislation) or whether in fact all that is envisaged are lighter SMP remedies. If Ofcom does proceed down this route, Ofcom must provide a concrete set of options to enable meaningful stakeholder input around such proposals.
- 5.9. Under the heading of “benefits” Ofcom does discuss the potential for passive remedies to mean withdrawal or relaxation of downstream regulation. BT agrees that the co-existence of regulation at multiple levels of the supply chain would create problems in itself.
- 5.10. First, downstream (active) regulation is a positive public good – its removal is therefore a harm unless an alternative is shown to be better and does not provide a duplicate remedy to the same SMP.
- 5.11. Second, such deregulation can only be considered as a benefit in the context of firm criteria on how and when such regulation would be withdrawn.
- 5.12. It seems clear that the level of regulatory intervention which might be needed to sustain competition based on passive remedies, or a mixture of passive and active remedies, would be, by its very nature, more intrusive and onerous than the current active remedies. In the meantime, co-existence of different remedies would create distortions. See also the discussion in Section 3 above on the need for an appropriate framework to consider these issues.

Limited innovation benefits from passive remedies

Specific examples of innovation cited by CPs and Ofcom

- 5.13. The question of where the major innovation opportunities lie in the business connectivity services supply chain is an important consideration as to whether passives could practically release such opportunities. As we set out in Section 3 above, there is a very important balance to be struck between theoretical benefits cited for passives and the practical possibilities of realising such benefits. Added to this there is the consequential negative impact on the active regulatory regime and its part in maintaining a dynamic and competitive framework.

- 5.14. The Consultation (§§4.11-4.14, 6.8) emphasises the possibility of dynamic innovation arising from product innovation, from network design and improvements in service quality. We first examine product innovation and network design issues and look at service quality separately below. Leased lines (especially Ethernet circuits which are likely to be the most relevant products when considering potential passive products substitution) are relatively simple connections between two points. The scope for product innovation in such leased lines (as opposed to in relation to other products and services provided around them, innovation in which can also be provided using active products) needs to bear this in mind.
- 5.15. Product innovation. Some CPs in their Call for Inputs (“CFI”) responses have argued that taking dark fibre will enable CPs to have control over the boxes which will permit upgrade and service reconfiguration. The example of C-RAN is referred to by Ofcom¹³.
- 5.16. It is important to appreciate the nature of the functionality provided over the boxes which BT has on the end of its leased lines. In its Ethernet portfolio BT is, in effect, providing the optical signal in a very basic packetized form but in a form which allows line monitoring.
- 5.17. We provide a fuller technical explanation of this in Annex 4 on innovation¹⁴ but it should be noted that:
- services in the layers above Ethernet can, and are, already reconfigured by the CP using Openreach Ethernet services; and
 - higher layers are almost all unaffected by lower layers of service.
- 5.18. We therefore consider that it is not accurate to describe service reconfiguration as a benefit of passive services – it exists today. We have set out our reasoning in detail in Annex 4.
- 5.19. Capacity upgrade. This is a minor issue. All other things being equal, it does not take Openreach any longer to upgrade an Ethernet circuit speed than it takes a CP.
- 5.20. New protocols. Looking to the future, the question arises as to whether there will be a serious possibility that new layer 1 processes or protocols, which are not in the Openreach portfolio, might arise such that dark fibre would be an attractive proposition for CPs.¹⁵ Such currently theoretical developments do not form a reliable basis to justify more intrusive regulatory intervention based on passive access. Whilst there are some ideas such as quantum key encryption these are highly speculative and probably many years away from commercialisation (beyond the time horizon for the current market review). It is extremely difficult to see how a separate economic market could be first defined for such services and then shown to pass the necessary conditions of the three criteria test to justify ex ante regulation.
- 5.21. Mobile network infrastructure. We provide at Annex 1, a more detailed analysis of the specific example of innovation cited in the Ofcom consultation (Figure 1) which is related to LTE/4G and LTE Advanced network design. Our view,¹⁶ is that there are potentially more efficient long term solutions based on active products which can be considered here. This is a new area of focus and direction for the UK mobile industry but Openreach is already in the

¹³ Ofcom (6.5) also refers to SDN. It was clearly established at the 2013 Appeal that passives have no bearing on SDN development.

¹⁴ See especially, Section V: paragraphs 126-151 and Table 6.

¹⁵ See Table 6 in Annex 4.

¹⁶ See <http://www.lightreading.com/roi-tco/altiostars-c-ran-steps-into-the-light-junks-dark-fiber/d/d-id/712169>. Further vendor details are also available.

process of assessing mobile network operator (“MNO”) needs and actively discussing potential development options with vendors with international experience in this area. In addition, we will continue to assess and develop our portfolio to address the multi-faceted needs of MNOs. There is no requirement for a standard such as CPRI or a network architecture such as C-RAN¹⁷ to be tied to passives provision from Openreach. Rather we believe that CPs considering C-RAN architectures will want access to appropriate solutions to meet their needs where alternatives such as microwave radio or existing leased line solutions are not considered suitable. This view is also supported by many equipment vendors and experts in the industry.¹⁸

- 5.22. As we set out in Annex 1, the reality is that MNOs already have a range of possible solutions to meet their LTE/4G backhaul capacity and coverage challenges, as well as maintaining existing voice, 2G and 3G services. Many of these needs are already being addressed by existing Ethernet and Optical options in the Openreach portfolio and by recent additions such as the small cells service Mobile infill infrastructure Solution (“MiiS”), as well as solutions supplied by other CPs. For these reasons it is important that the incorrect assumptions underpinning the CPRI/C-RAN linkage to passives are carefully examined. For clarity we summarise some of these assumptions below (covered in more detail in Annex 1):
- The incorrect suggestion that C-RAN will save costs - and only passive duct/dark fibre will enable such a cost saving. C-RAN, and any benefits arising from such a network architecture, could be achievable with active connectivity solutions: typically WDM technologies are seen as most likely to underpin such deployments (although Ethernet also remains a candidate¹⁹).
 - The incorrect suggestion that C-RAN is only possible with CPRI - and CPRI is only possible with a passive wholesale product (i.e. with dark fibre). C-RAN architectures can use different interface standards and it is possible for CPRI to be carried over an optical service, or even over Ethernet.²⁰
 - The incorrect suggestion that Only C-RAN will offer a technical solution of higher peak rates across a wider coverage area. C-RAN is a possible option to extend very high backhaul / fronthaul coverage but other technical options exist and all are subject to substantial industry review at the moment (See Annex 1).
- 5.23. In summary, the position is far more uncertain and complex than set out in Section 4 of the Consultation.
- 5.24. Resilience. The Consultation also raises the issue of resilient rings (§4.16). The underlying contention here is flawed in that ring networks are not the only way in which such resilience can be achieved.
- 5.25. We note that Ofcom (§4.18) acknowledges likely practical difficulties of using duct access for network build when BT already has a specific architecture which will likely not align with

¹⁷ The acronym C-RAN is used to refer to both ‘Cloud Radio Access Network’ and to ‘Centralised Radio Access Network’ which can infer slightly different network designs. The points we make in this response apply equally to both.

¹⁸ Please see <http://www.lightreading.com/roi-tco/altiostars-c-ran-steps-into-the-light-junks-dark-fiber/d/d-id/712169>.

¹⁹ See footnote 16.

²⁰ There are some technical issues here which are discussed in Annex 1.

how a CP would now choose to build a network (hub and spoke versus daisy chaining being the usual comparison).

- 5.26. The four claimed benefits of passives services set out by SPC Network²¹ on behalf of UKCTA do not demonstrate that active products are insufficient:
- Bespoke customer requirements. Ultra low latency is a highly niche application which can in fact be provided over Ethernet²² and we disagree that SyncE is a ‘good example of a product where there has been market demand for many years before it was made available by Openreach’; on the contrary the level of demand was not clear and Annex 4 shows that SyncE was developed in good time given the circumstances.
 - Ability to incorporate network performance monitoring. CPs had the possibility to acquire such functionality from the active service as set out in Annex 4 and their ability to acquire end to end visibility with dark fibre is at the downside of BT not having this capability with all the consequential service problems, which are not acknowledged by SPC Network.
 - Short term upgrades and capacity. This is addressed above at paragraph 5.17.
 - Higher SLAs such as installation and repair times. SPC assumes that SLAs for any passive product would be better than SLAs for the equivalent active product. It is not clear that this would be the case. Passive remedies would require more complex processes and interactions between Openreach and the purchasing CP, for example due to the lack of monitoring. It is entirely probable that services levels might worsen rather than improve. We address the impact of passive remedies on service levels further below.

Impact of passive remedies on quality of service

(i) We recognise the pivotal importance of Quality of Service (“QoS”)

- 5.27. BT agrees that good quality of service for communications service for the business market, both for CPs and their customers, is essential. Openreach is committed to evolving and improving Ethernet QoS, has invested in additional engineers and will be addressing the service challenge over the course of this market review process
- 5.28. Ofcom notes that CPs raised concerns in their responses to the BCMR CFI regarding the QoS provided by Openreach for its Ethernet portfolio. The main focus was on the timeliness of service provision and all parties seems to agree that passive services will not assist in any way regarding current service provisioning levels.
- 5.29. CPs also referenced a desire for faster repair and improved levels of customer service (§4.10). As we explain in Annex 4, a dark fibre or duct services would mean that BT is unable to monitor services which would likely lead to service level deterioration and raise a host of expensive practical problems.
- 5.30. We agree with Ofcom’s initial view that passives would not address the current concerns regarding service quality (§§4.20-4.22). There is little to suggest that passive remedies can lead to a material improvement in the customer experience for Ethernet services.

²¹ “Enabling innovation for enterprise customers” Report by SPC Network 25th November 2014 at page 32.

²² A more important issue than protocol is actually the routing of the fibre itself.

5.31. Further, Ofcom does not yet appear to have considered whether the introduction of passives actually presents *additional* risks to service quality. Section 5 of the Consultation, which is intended to cover the impacts of introducing passive remedies, completely omits any reference or analysis of the downside risks that passives would entail for service quality²³. Given the major process and systems changes required by all stakeholders to introduce passives, the lack of monitoring capability for passive services and the added complexity introduced into key provision and repair processes, we see the passive products representing a serious risk to service quality. [X]

(ii) QoS and Dark Fibre

- 5.32. Our concerns especially relate to the provision of a dark fibre service where there are two aspects of service quality to be addressed, which Openreach refer to as Lead to Cash (“L2C”) and Trouble to Resolve (“T2R”)²⁴. We cover these separately and in more detail below.
- 5.33. In our view, the magnitude of the change required to these processes is not given sufficient weight in the Consultation; rather Ofcom (§4.19) cites examples of control of service upgrade, reconfiguration of service, improved resilience and faster repair times as potential service improvements, none of which justify such a major reorganisation of the industry to achieve; these are all viable options for implementation through an Openreach active portfolio and fair incentive-based regulation.
- 5.34. Notwithstanding any particular view of the benefits of dark fibre, large scale changes would be required for all stakeholders as a basic requirement to address the new responsibilities for service quality and demarcation in the supply chain. [X]
- 5.35. Lead to Cash (L2C). The major factor impacting on the lead time to provide service is the non-availability of fibre at the customer location. This would not be improved by a dark fibre obligation. Either:
- fibre infrastructure is already present at the site or close nearby, or even provided at the site as an active service; or
 - infrastructure is not available (no fibre, fully utilised duct capacity etc.) and hence providing a fibre service will be more difficult.
- 5.36. In the latter case a dark fibre obligation offers nothing to solve the service provision problem, and for the civil engineering component there is no realistic opportunity of a service quality gain.
- 5.37. After the main fibre infrastructure has been provided, there are typically two final tasks – the connection from the T-node to the customer location and the provision of terminal electronics. Both of these tasks are currently carried out by Openreach but with a dark fibre product it would be possible for a CP to adopt responsibility for electronics provision. However, again there appears little opportunity for a significant service improvement; and given that the new process would introduce an additional external service hand-off between Openreach and the CP (or its contractor) for electronics installation, there is actually a further potential risk to service performance.
- 5.38. The scenario described above is also perhaps the most straightforward of the dark fibre requirements being discussed. In fact some CPs, although describing their requirements²⁵ as

²³ We have set these out previously in principle in our CFI response and in detail in Annex 4.

²⁴ Broadly L2C is the process for providing an order and T2R relates to the repair process.

similar to 'boxless' EAD, are actually seeking dark fibre provision throughout all of the BT network and with CP handover at any point in the network (i.e. not at a customer or exchange location). [REDACTED]

- 5.39. The impacts of the passives pricing regime would also be significant for the provision process. Given the commercial imperative to better align active and passive pricing with similar dimensions of costs if both types of remedy are to be provided, then charges are far more likely to require accurate route distance measurements (along with any other cost driver information). This in turn will impact on the current provisioning systems and processes, raising the uncertainty of charges faced by CPs and end-customers, and will impact both on the planning and delivery elements of the provisioning process.
 - 5.40. The extent of the operational impacts of such requirements are unknown at this stage, but are likely to affect:
 - [REDACTED]
 - 5.41. It is likely that there would be yet further resource required to handle problems that this pricing uncertainty would create in the marketplace. Specifically we discuss the need to change the ECC regime in Section 7 below, thereby losing the recent benefits gained through averaging.
 - 5.42. Trouble to Resolve (T2R). Major changes would be required to the T2R process to overcome the challenges associated with the diagnosis and repair of dark fibre. Such changes would be a significant driver of cost and resource both to implement and maintain. In principle, breaking the Openreach supply chain between the passive and active layer and passing responsibility to the CP for fault testing, diagnosis and call-off of Openreach engineering resource is clearly possible; but it is not achievable without a major investment in restructuring of systems, re-engineering of processes and a redefinition of responsibilities for all stakeholders. There would also be a need for Openreach to reconsider the requirements and priority of other 'active' systems developments in the light of scale of changes required to introduce passive services.
 - 5.43. This is particularly obvious when considering the industry structure that Openreach serves. Openreach currently sells active Ethernet services to hundreds of CPs. If even a small proportion of such CPs consume passive services, with multiple different electronic devices and network management systems, this becomes a highly complex systems scenario with significant risks to service quality. At a minimum, very tightly defined standards/interfaces would have to be specified and adopted by all CPs to feed measurements of the Openreach physical layer (such as an OTDR reading) from CP systems back into Openreach systems - essentially a reversal of the existing systems and processes as they operate today. Because an OTDR only indicates the fibre distance to a break and not its actual physical location, Openreach systems would also need to accurately correlate the external information with its plant and routing records to enable Openreach to dispatch an engineer to site.
 - 5.44. There would need to be unambiguous technical definitions of what constitutes various fault conditions (e.g. fibre bends, signal deterioration and not just a simple breakage scenario) as
-

well as significant developments associated with the more complex provision scenarios identified above. Where dark fibres do not terminate on clearly defined optical termination frames then the demarcation of the service boundary would be a major source of dispute in fault scenarios. Openreach would also need to run its 'active' diagnostic and repair processes and systems in parallel during the transitional period and on an ongoing basis for any CPs which did not have a test and diagnostics capability.

- 5.45. We view the removal of Openreach's integrated and standardised monitoring and diagnostic capability as inevitability causing:
- supplier boundary issues;
 - a lack of clarity in fault diagnosis; and
 - more engineer call-outs being required.
- 5.46. In fact, our current experience is that CPs often choose both channels to resolve faults (i.e. use of diagnostic capabilities and an Openreach engineering site visit) to ensure that end customers' faults are resolved with utmost speed and also because Openreach charges are typically lower than those of equivalently skilled third party organisations. This is even in circumstances where the fault has already been diagnosed as likely in the CP's domain (i.e. not in Openreach fibre or equipment)²⁶.
- 5.47. This behaviour clearly points to the high significance placed by CPs on service quality in the repair domain – an area where current performance is high - and where the risk of negative and unintended consequences from the introduction of passives could be very material.
- 5.48. Any change is against a backdrop of Openreach operating a repair service which is available 24 hours a day, 7 days a week (including public holidays), and responding within five hours of receipt of a fault report, unless agreed otherwise by the parties. The SLA target is to restore the service within five hours of a fault being reported, and a delayed repair will become eligible for compensation if the reported fault causes "total loss of service" (i.e. no transmission of signals in one or both directions) for more than five hours after it has been reported to Openreach. [X]
- 5.49. BT faces significant competition from other infrastructure based CPs such as Virgin Media and Colt, and having sufficient control of our T2R performance to meet and match the service quality required by CPs (and ultimately end-customers) is a key commercial attribute. To manage and guarantee its element of the service performance Openreach must ensure sufficient demarcation of its network and responsibilities. Therefore it is fundamental for there to be sufficient functionality in the service provided to allow clear demarcation between the Openreach service domain and that of the CP or end customer. Currently Openreach's control of the 'active' element of our service is the key enabler in being able to do this.
- 5.50. The identification and rectification of faults is a particularly difficult issue and our long experience has shown that absent appropriate monitoring equipment it is likely to be fraught with disputes and arguments. The purpose of monitoring is in part to remove this ambiguity and having a managed box at the end of our fibre allows us to confirm this in a manner that cannot be disputed even if a visit is required. The ability to quickly establish

²⁶ Non-Openreach faults constitute a large proportion of engineering visits ([X]) regardless of prior T&D classification as a non-Openreach fault (e.g. with a diagnostic accuracy of [X] in 2013/14).

responsibility is very important to address potential conflicts where issues of brand reputation may arise. It is therefore important to Openreach that there is not just an efficient overall end to end fault localisation process, but that Openreach can legally protect its brand from claims it cannot verify itself. We discuss the impact of passive services on industry structure and competition in Section 6.

5.51. [X]

(iii) QoS and Duct Access

5.52. On the one hand, duct access does not present the same difficulties as dark fibre in terms of a split of responsibility for the performance of the active service. In a duct access scenario a CP can have full control of the connectivity layer of both fibre and electronics and this would lessen some of the conflicts highlighted above.

5.53. However, on the other hand, there are other drivers of quality of service at the physical layer which are more complex such as:

- lack of availability of space;
- lack of continuous route availability;
- damage to plant by multiple CP interventions (e.g. breaking into and interconnecting duct networks);
- inability to identify and resolve problems and liability for damage; and
- multiple CP access required at major incidents for example.

There is also a high likelihood that demand for pinch points or hot spots in the network may develop, adding to service delays and requirements for new infrastructure build.

5.54. These would all be contributory risks to service quality and are more akin to the types of challenges faced by the dark fibre provision process with civil engineering tasks representing the major hurdles in terms of lead times. For T2R the majority of responsibilities would lie with the CP unless the replacement of Openreach infrastructure was required as part of the repair process.

Impacts of passive remedies on productive efficiency

5.55. The introduction of either dark fibre or duct access products could materially affect the efficiency with which BT can plan and run its networks. Arbitrage by itself would set up false investment incentives and indeed requirements on BT to expand capacity where costs may exceed benefits. It would also inevitably lead to poorer utilisation of our duct and fibre infrastructure.

5.56. We discuss below in Section 9 some of the pricing complexities that would arise from the introduction of passive remedies. The challenge to establish the linkage between efficient utilisation of our network and uptake of passive products is that it would depend to a great extent on the detail of the implementation and pricing approaches. Without any more concrete proposals the impacts cannot be set out in any more detail.

5.57. It is certainly the case that the current duct offer for NGA would not be appropriate for business connectivity example uses which currently seem likely. For existing infrastructure providers who wish to use duct piecemeal to add to their own networks, this would likely impinge on capacity in ducts which are already highly utilised and where additional capacity

would be required. The other current example would be MNO backhaul where it is possible, if not likely, that they would be the only users of some of the duct space.

- 5.58. Depending upon how pricing and uptake for duct access emerged, BT would have to consider how to amend its existing planning guidance to provide capacity which would be considered to meet a 'non-discriminatory' standard. Ofcom (§6.21-6.28) appears to acknowledge this with regard to new infrastructure but similar issues arise for the existing infrastructure.
- 5.59. As things stand, Openreach's access and backhaul networks are planned, designed and dimensioned on the basis of a need to provide 'active' business connectivity services on an open access and equivalent basis throughout the UK. These plans were driven by a known history of demand and anticipated capacity for future growth to meet well established and understood regulatory obligations (for example Ethernet access and backhaul services). The existing Openreach network has a specific topology which been configured and built to meet this need, in terms of availability and locations of duct and fibre routes and access nodes.
- 5.60. It is difficult to assess fully the exact impact on existing infrastructure of a passive obligation as this will depend on the outcome of this Consultation and the regulation which would be imposed as a result. [X].²⁷
- 5.61. To date, Openreach network planning and investment could not have anticipated all these possible variations of passive unbundling access and backhaul networks. The Openreach model both for WLA/WLR and BCMR services has to this point in time been one of conscious investment in an active and integrated fibre service layer to meet known demand, and with sufficient reserved capacity for future growth of such active services. Truly 'spare' capacity has not, and could not have been, built to allow for the possible duplication of CP networks using Openreach duct access or to account for different patterns of use of dark fibre use in selective and ad hoc sections of Openreach's network.
- 5.62. Incentives to improve productive efficiency are already built into the charge controls for active services and prices for active services have been reduced significantly under the current charge control. On the other hand, passive services will likely imply duplication of resources and additional costs which would have to be offset against highly uncertain benefits.
- 5.63. The outcomes of different potential passive remedies will of course vary depending on how they might be implemented. Broadly, and as Ofcom indicate, duct access has the potential to lead to more duplication of network build (§6.10) and inefficient use of scarce resource compared to active remedies. In our view, the impacts of dark fibre in terms of productive efficiency are likely to be more complex and variable. It could lead to stranding of Openreach assets depending on CP migration strategies and/or network architecture i.e. by CPs choosing to bypass existing Openreach plant which has been designed and dimensioned for active services. It could also create hot spots and under-provisioned points in the network as multiple CPs seek to lease separate dark fibre access to key nodes or on prime routes in the network. In these circumstances the ability of Openreach to provide an 'end-to-end' service on demand in these areas is also likely to be compromised unless planning and reservation rules provide sufficient protection for such circumstances.
- 5.64. We make further points on the provision of new capacity below in Section 7.

²⁷ [X]

6. Impacts and risks of passive remedies: the costs

Introduction

- 6.1. Overall, the retail and wholesale leased lines marketplace in the UK is functioning effectively, with the focus of any regulatory intervention being on active product remedies – generally at the wholesale level. This has supported and enabled:
- major investment by BT and many others (such as Virgin Media, Colt, Vodafone and others) in the UK's infrastructure;
 - the exponential growth of cutting edge technology services for consumers and businesses in the UK;
 - the most dynamic and innovative markets for both consumer and business services; and
 - the most competitive downstream consumer and business markets in the EU.
- 6.2. Against these certain and significant benefits of the active regime, any introduction of passive regulatory remedies would put all of this at risk.
- 6.3. It is imperative that Ofcom is comprehensive in its approach and gives due weight to the downside risks, especially since any introduction of passive remedies would be essentially irreversible. Also, as discussed in the previous section, any of the potential benefits suggested are highly uncertain and the sole specific issue identified by Ofcom (meeting the requirements of C-RAN) is more likely to be better addressed by the continued development of the current active products under the current regulatory approach.
- 6.4. Section 5 of the Consultation considers only two potential risks, namely the negative impact on BT's investment incentives and the disruption to the pattern of common cost recovery. Even here Ofcom underplays the size of the adverse impacts. In this section we set out why these two risks are more significant than Ofcom estimates.
- 6.5. After dealing with those issues, we lay out a more comprehensive set of adverse impacts that Ofcom must consider to adequately assess the cost of passives. In particular:
- stranded assets resulting in significant productive inefficiencies;
 - distorted investment incentives because BT is not able to make investments on the basis of a "fair bet";
 - inefficient entry and inefficient network duplication;
 - chilling effects which will undermine future investment in passive infrastructure; and
 - damaging arbitrage resulting in a significant loss of allocative efficiency and highly disruptive active price increases for active products – which will inevitably cause harm to those CPs (and their customers) who will tend to have least choice under any new passive remedy scenario.
- 6.6. Finally, we note a number of other potential costs and dis-benefits which would be incurred if passive remedies were to be introduced, and which are discussed elsewhere in this response, such as the direct costs of implementing any new passive product types.
- 6.7. In conclusion, we consider that there would be significant adverse impacts and risks which would arise from any introduction of passive remedies. We agree with those identified by

Ofcom but consider that these are greater and more serious than Ofcom currently indicates, and that there are further risks not explicitly identified in the Consultation. The impact on common cost recovery (through the introduction of arbitrage opportunities) is also not something which could be removed through the approach to pricing passive remedies (as also discussed in more detail in sections 7 and especially 9 of this response).

Markets are operating well under the current regulatory structure and this would be put at risk were passive remedies to be introduced

- 6.8. The introduction of passives would represent a major change from the strategic review framework established eight years ago when the Undertakings were introduced, which created clear boundaries between infrastructure and service layer investment, enabling large scale and long term business cases to be developed both by BT and other CPs to serve both business and consumer markets. The structure includes very strong obligations for open access placed on BT to enable scale and scope benefits to be shared by all purchasers of Openreach's active services, whether large or small. As acknowledged on numerous occasions by Ofcom (and European regulators) this has clearly been a major success story for the UK with very dynamic and innovative markets for both consumer and business services being established.²⁸
- 6.9. Any material change from the existing framework clearly has implications for this strategic role of Openreach and more generally on the incentives on Openreach to continue to invest in new active services and the effort and resource it allocates to current systems and processes. The position that Openreach plays in the industry cannot simply remain the same with the introduction of passive remedies. Such remedies would cause the boundary between CPs and Openreach investment to become extremely confused. [X]
- 6.10. The role that Openreach plays in taking the upfront investment risks and in working through the prioritisation and standardisation of requirements from CPs should also not be underestimated. CPs often have conflicting demands and objectives between themselves (not just with BT or Openreach). The open and transparent Openreach development process brings about a degree of alignment which allows the whole industry and to move forward and compete on a level basis.
- 6.11. Openreach has strong incentives not only to expand its customer base but also to encourage migration from old to new technologies to manage costs and to compete with other major infrastructure players in the UK. Take-up of services is required across a wide range of CPs and not just downstream BT. This is why it is in Openreach's commercial interests to have extensive and proactive engagement with CPs. This engagement leads to an almost constant stream of change and innovation on all products and services supplied; copper, NGA and business connectivity. We cite some further examples of innovation and future plans in Annex 4, but some notable examples would include a numbers of developments on the leading edge of technology, supporting new services demanded by CPs and end-customers – such as:

²⁸ For example, see “Impact of the Strategic Review of Telecoms” published 29 May 2009, which concluded at paragraph 1.40: “Given the substantial benefits the Undertakings have delivered to retail and wholesale customers to date, we continue to remain of the view that the Undertakings are an appropriate and comprehensive solution to the competition concerns that we set out in the [Telecoms Strategic Review].” (Available at <http://stakeholders.ofcom.org.uk/telecoms/policy/bt-undertakings/impact-strategic-review/>)

- the widely acknowledged success of superfast broadband in terms of availability, take-up and competitive framework in the UK;
 - the introduction of friendly ‘alien wavelength’ technologies into Openreach’s optical portfolio; and
 - the recent launch of Openreach’s mobile ‘small cells’ product.²⁹
- 6.12. In contrast to this, the claims that passives would lead to faster and/or greater levels of innovation by either CPs or Openreach are highly implausible. In reality, the inevitable fragmentation of the economies of scale and scope that Openreach is currently able to bring to product delivery, would risk chilling the ability of downstream CPs to innovate in the infrastructure and connectivity domains. Under a passives hypothesis, CPs would typically experience the investment risk directly, with a smaller addressable market over which to recover the costs of innovation. There is no evidence to suggest that time to market would be significantly reduced – and there would certainly be less confidence that active products would be developed for the wholesale market – which in turn would jeopardise the large proportion of smaller CPs currently in this marketplace. Retail customers would experience the dis-benefit of reduced competition in supply at this level. Key hurdles to overcome in the product development arena, such as standards development, equipment lead times and systems developments, are significant for all CPs no matter how large or small – and it is very likely that smaller CPs and their customers would suffer in this respect.
- 6.13. In summary, we believe that the framework establish for Openreach in 2005 continues to be appropriate, promotes competition, and allows CPs and their customers to benefit from the shared economies of scale and scope inherent in the design of the Openreach infrastructure. The framework has supported major investment by BT and others (such as Virgin) in the UK’s infrastructure and the rapidly increasing demand for high technology services from consumers and businesses in the UK. Passive remedies would put all of this at risk.

Impacts of passive remedies on industry structure and competition

- 6.14. It is accepted by Ofcom that most retail business connectivity markets are competitive and BT does not have SMP. This is especially the case for downstream AISBO retail markets, which are most likely to be impacted by use of passive access.
- 6.15. There is no case to introduce upstream passive remedies to address any competition issue in these downstream markets. [X]
- 6.16. We estimate that BT Business’s market share in providing Ethernet services to companies [X]. The overall market structure is also competitive (i.e. there is low market concentration in economic terms) with a range of other providers none of whom have a dominant market share. The existing regulatory approach which focuses remedies on active products, significantly reduces barriers to entry thereby facilitating this vibrant and competitive retail Ethernet market.
- 6.17. Indeed, the introduction of passive remedies would almost certainly cause irreversible damage to competition.
- 6.18. Smaller CPs, for example, are unlikely to have the economies of scale to be able to exploit dark fibre’s lack of a bandwidth gradient. Widespread use of dark fibre would therefore lead to smaller CPs being priced out the market and no longer able to provide the specialist

²⁹ Known as Mobile Infill Infrastructure Solution (MiiS).

services they currently do. The current diverse market structure meets the very diverse nature of business connectivity demand; a more consolidated industry would not be an improvement in competitive terms.

- 6.19. In this context it is also important to note that the introduction of passive remedies would effectively be an irreversible regulatory decision. Once CPs had integrated the use of passive remedies into their networks, their investment would have been sunk on the basis of using such passive products. Downstream market structures would then be predicated on their existence. As market structure and competition changes in this way it will become impossible to test the counterfactual of their withdrawal for the purposes of future market reviews. This will be even more the case to the extent that active regulation is withdrawn on the basis of passive product take up (an outcome which the Consultation identifies as a potential benefit) and further infrastructure investment-based competition has been disincentivised by the use of passive products. The market structure and basis of competition could therefore become dependent on passives as a regulatory remedy – with all the downside risks set out here becoming embedded for the longer term.

Switching supplier would be harder

- 6.20. As well as making the industry structure more consolidated and dependent on on-going regulation, passive remedies also have the potential for making it harder to switch in end markets. For example, it is reasonable to expect that passive remedies would be based on longer term arrangements and, especially where new infrastructure build is required; it is likely that the circuits provided to end users would be based on longer term upstream passive arrangements. Retail markets are thereby likely to migrate to longer term arrangements (or customers be incentivised to sign up for longer term deals).

Adverse impacts of passive remedies on existing investment

- 6.21. A full consideration of dynamic efficiency impacts of introducing passive products should take account of not only efficiency improvements from those purchasing such products but also the detrimental impacts on the incentives of infrastructure providers. The Consultation (especially §5.7 and 5.8) identifies two possible effects which need to be taken into account:
- the risk of passive remedies stranding investment made under the existing regime; and
 - the potential for passive remedies to generate inefficient investment.
- 6.22. While recognising these as risks, Ofcom's initial view appears to be that these risks can be controlled or minimised through setting appropriate passive prices. This initial view is overly optimistic and underestimates the adverse impact of these real dangers. Further, we consider that this characterisation fails to capture all of the potential impacts of passive access on infrastructure providers' investment and innovation incentives, which could harm dynamic efficiency. We address these issues below in more detail, before turning to Ofcom's initial view on the relevance of the "fair bet" principle.
- 6.23. The Consultation suggests that the potential for stranded assets occurs in relation to the introduction of any new access remedy, passive or otherwise, and therefore passive remedies are not in any sense special. The clear implication is that this is not seen as a reason for or against the introduction of passive products, but rather something which needs to be taken into account in how such a remedy was implemented. We disagree for the following reasons.

- 6.24. Ofcom approaches the issue as whether this is an aspect of passive remedies which could, if necessary, be mitigated away. However, as set out in Section 3 above, we believe that this is approaching the question in the wrong way. Rather Ofcom should be considering whether it makes sense to incur the additional costs of moving to passive remedies, given the successes of the existing active regulatory regime.
- 6.25. The Consultation also stresses that any such change would need to ensure that future investment incentives are not unduly distorted and Ofcom would need to take this into account in how it introduced passives (§5.7). We assume that this would include the consequent impact on active product regulation. In order to ensure that future investment decisions were not distorted the regulatory regime would need to allow all past efficiently incurred investments to be recovered.
- 6.26. While it is undoubtedly true that this is a relevant issue, the Consultation fails to recognise that, at both a practical and in-principle level, the issue is more complex in the case of introducing passive access.
- At a practical level, while some of the assets which are stranded may be relatively obvious, the introduction of, for example, a dark fibre product, could mean that Openreach would not historically have designed its network in the same way had it known that it was to be used for dark fibre. The current network structure is implicitly designed to provide active products efficiently. Identification of what costs are therefore stranded and need to be recovered through active and passive prices going forward will therefore be extremely complex. It will not simply be a case of identifying particular fibre strands or electronics boxes which are no longer required, as there could be fundamental issues of network design to consider. For example, if the introduction of passive remedies led to multiple CPs demanding duct and or dark fibre capacity in particular hot spots then this is likely to give rise to significant extra need for build of new network capacity in different parts of the network compared to under the current regulatory approach.
 - A more principled question is how a remedy could be designed to ensure that the stranded asset issue did not lead to significant adverse impacts on investment incentives. Introducing such a remedy would represent a fundamental shift in approach and would be subject to major uncertainties, not least in relation to demand for such products. Any consideration of stranded assets would therefore not only need to consider what pre-existing assets were made redundant, but also to what extent future investment, based on a view of potential future demand for passive products, was stranded when demand turns out to be different. This would interact with the prices set for passives, including relationships to any active product prices which may in turn be regulated, and would include an element of risk of regulatory forecasting failure.
- 6.27. We consider that properly taking stranded assets into account will be extremely complex and subject to significant risk. As such, this needs to be considered not only as a major potential implementation problem, but also as part of the overall potential cost of introducing these alternative forms of remedy. An example of the potential impacts can be seen if it is assumed that a mandated dark fibre product were introduced using an “active minus” pricing approach (such as, for example, the price of a 1G EAD minus the relevant incremental costs). In this situation:

- this price will become an effective floor for any active product, increasing the price for lower bandwidth products (reducing demand and stranding assets as a result); and/or
 - in relation to higher bandwidth circuits, CPs will rapidly switch to purchasing the dark fibre product – again leading to BT having a range of stranded or under-utilised assets.
- 6.28. Stranded assets costs are legitimate cost to be recovered from charge controlled active BCMR products. Such costs can be considered as part of the static inefficiencies which would inevitably arise from the introduction of passive remedies, the negative impact of which would be higher prices for CP customers of active products and hence higher prices for consumers. Such costs would be significant in size, and will be hard to predict with accuracy - any forecasting error would risk significant distortion to investment and innovation incentives.

The fair bet principle

- 6.29. We note that Ofcom (§5.9) expresses doubt that the fair bet principle would be violated on the basis that BT would be given opportunity to recover its efficiently incurred costs and that a CP using spare capacity would pay a price which would not undermine this principle.
- 6.30. At this stage it is difficult for us to articulate more precisely how potential risks of stranded investments might materialise, without knowing more detail about what proposals, if any, Ofcom would put forward around passive access. We have explained, however, that if CPs were able to migrate from active service to dark fibre then we would have significantly under-recovered the costs of equipment at the ends of the fibres at the moment. This appears not to have been taken into account by Ofcom in its estimates of common costs.³⁰
- 6.31. In expanding the opportunities for CPs to substitute, by migrating away from active services, Ofcom would inevitably be exposing BT to greater financial risk. CPs will be selective on which options they take and this will not be revenue-neutral to BT.
- 6.32. To the extent that Ofcom can make subsequent adjustments to prices – be they charge controlled or determined – it might be argued that BT would not be exposed to unreasonable risks of stranded assets or generic asymmetries. We are not at all convinced that this will be the case for a number of reasons.
- 6.33. First, the rules for setting prices of any potentially mandated new passive products are not known, and until it is clear who would be expected to pay for additional capacity for example, and whether that would be recovered immediately or amortized over a number of years, there will likely be asymmetric risks placed on BT.
- 6.34. Second, if it is found that BT is in fact not recovering costs in a fair bet manner, it is far from evident that Ofcom would have the power to retrospectively adjust for this. All market reviews and associated remedies have to be forward looking and it is quite possible that BT's position could be sufficiently undermined, depending on how Ofcom would address the regulation of products delivered to a declining customer base.
- 6.35. Ofcom appears to envisage giving CPs the opportunity to acquire real options. If, based on passive services, CPs were to have a change in plan or if their own designs prove to be sub-

³⁰ They are of course service specific rather than common but may in fact carry traffic relevant to a number of different downstream markets.

optimal, they can then demand active services from Openreach but relinquish passive services. On the other hand if their strategies prove successful, Ofcom implies that they would likely have permanent rights to the passive services. In this Consultation there exists implicitly a fundamental set of asymmetries which undermines any notion of genuine competition on the merits.

Passive remedies would incentivise inefficient entry; the costs of competition need to be assessed

- 6.36. We accept that the risks of inefficient entry need to be assessed in terms of balancing a number of different factors, and that whether investment signals are efficient or not will depend on the focus of the analysis and the detail of how remedies are specified and priced. Again, we would urge Ofcom not to be dismissive of the complex nature of these assessments and the inherent uncertainties which are involved in relation to passive access. For example, the Consultation suggests that setting passive prices “too low” would over-incentivise take up and lead to inefficient duplication of fixed assets. The implication being that a “correct” price for passives will mitigate if not eliminate such a risk. However, there are significant uncertainties such that setting the right passive price ex ante cannot be guaranteed and hence the dangers to dynamic efficiency cannot be eliminated here, if passive remedies are introduced.
- 6.37. This also interacts with arbitrage and cherry picking risks (discussed further below). As the Consultation recognises, it is likely that such forms of entry cannot be eliminated altogether in introducing passive access. Any assessment of the impact of passive access needs to include the extent to which additional costs are incurred, especially where customer demand is not increased but simply substituted from existing active to passive use.
- 6.38. The cost of competition is also something which Ofcom should consider and which needs to be assessed quantitatively. Such an assessment would need to include the extent to which assets would be duplicated (which could also impact on the likelihood and attractiveness of arbitrage opportunities) and the resulting impact on customers. When considering passive remedies in the WLA market reviews (assessing the benefits of introducing PIA there), Ofcom undertook such an analysis with some rigour. This analysed the average cost per user under different competitive assumptions.³¹ This was a key aspect of Ofcom’s decision to focus regulatory intervention on active products. It is therefore surprising that Ofcom makes no reference in the current consultation to any need to undertake a similar analysis were passive remedies to be considered in more detail.

Chilling effects on all infrastructure providers’ investment

- 6.39. As described in more detail in Annex 2, one of Ofcom’s basic regulatory principles has been to promote competition at the deepest level which is efficient and sustainable. There are a number of current CPs which own and operate their own basic infrastructure (most notably Openreach and Virgin Media) who therefore already compete at the deepest possible level of infrastructure. The introduction of passives would impact the business case for further infrastructure investment as the balance between customers supplied with passive and active products changed and relative margins changed as a result. The resulting adverse

³¹ See “Review of the wholesale local access market” Consultation published on 23 March 2010 at paragraph 7.80 and following as well as Annex 9. Available at <http://stakeholders.ofcom.org.uk/binaries/consultations/wla/summary/wlacondoc.pdf>.

impact on the case for future infrastructure investment must be taken into account by Ofcom and is also likely to have a significant adverse impact on dynamic efficiency.

- 6.40. Furthermore, Openreach and BT have a strong record of innovation.³² The introduction of passive remedies would also lead to reduced volumes of active products, which in turn will inevitably reduce the incentives of Openreach and other infrastructure providers to innovate with respect to their networks and active services. This will result in adverse impacts on customers (and end users) of such products. Continuing such innovation would be undermined by the introduction of passive remedies.
- 6.41. Ofcom not only fails to mention reduced incentives to invest and innovate but also takes a very BT-centric view without mentioning other infrastructure providers.
- Under the altered build/buy decision, CPs may be incentivised to purchase passive remedies and the additional investment to enable this would be largely duplicative.
 - Price arbitrage opportunities would remain (as discussed further in Section 9 below), regardless of price rebalancing, this will distort the pattern of investment with passive products being used for specific types of circuit (e.g. according to circuit length or bandwidth) or in specific geographies based on arbitrage rather than efficiency criteria.
- 6.42. As discussed further at Section 3, these effects could also spill over into other markets which could undermine investment incentives in other markets (such as for GEA).

Common cost recovery and arbitrage

- 6.43. Section 5 of the Consultation identifies, in our view correctly, that the impact of introducing passive remedies on what it terms the “pattern of common cost recovery” would be a significant and important issue. Section 3 of the Consultation also identifies distributional impacts on consumers as an important aspect which would be impacted by this. In principle we consider, that it is not appropriate or relevant to consider price rises which would occur if these common costs were spread more widely across other markets. Potential distortions to other markets arising from the introduction of passive remedies (discussed in Section 3 above) are relevant to a rounded assessment of the costs and benefits of passive remedies in the BCMR.
- 6.44. We welcome Ofcom’s recognition that the pattern of common cost recovery is an important issue in any assessment of the impact of introducing passive remedies, but consider that Ofcom has under-estimated:
- the size of the common costs involved;
 - the nature of the costs considered (i.e. in addition to fixed common costs, Ofcom should explicitly address the recovery of direct fixed costs that are at risk of being stranded);
 - the complexity in assessing the dynamic interactions between any active and passive products and pricing; and
 - the resulting size of the likely active product price increases required, especially for certain customer segments (given that the average price rises suggested in the Consultation could hide a wide variation).

³² See Annex 4.

- 6.45. Ofcom identifies a common cost pool of £330m and concludes the consequent price rises, which would be required to maintain efficient cost recovery across remaining active products, would be between 9%, in the low scenario, and 27%, in the high scenario.
- 6.46. Ofcom's assessment significantly understates the potential price increase for the following reasons.
- 6.47. First, a more appropriate approach would be to compare FAC and LRIC (rather than FAC and DLRIC as Ofcom does) and also include fixed and common costs of services which are not separately reported in the RFS. We consider that the overall pool of relevant common costs is more likely to be in the range [X] assessed using 2012/13 RFS or the 2013/14 RFS.³³
- 6.48. Second, Ofcom presents 9% and 27% as "maximum effects" but logically this must be wrong given the static nature of the analysis and the dynamic nature of the situation.
- The relevant revenue and returns are decreasing over time due to the charge control itself. Therefore, the required percentage price rises of the remaining active products will be greater in future years. For example, using 2013/14 figures³⁴ and Ofcom's approach active prices would need to increase up to [X]%. [X]
 - Not only will there be static substitution of active services by passive services but as time goes by, with reduced active volumes, the active price will need to continue to increase to recover the same level of fixed and common costs leading to more and more substitution by passives and even higher active prices.
- 6.49. Ofcom's approach seems to assume that once the size of the common cost recovery amount is estimated it would then be a straightforward mechanical exercise to set the right prices. This is unlikely to be the case and setting the right price would be a complex process involving a wide range of uncertainties.
- 6.50. Forecasting the appropriate volumes of active and passive products for charge control purposes would be inherently more complex and more uncertain given that the existence of passive access itself impacts demand for active services.
- 6.51. Were passives to be introduced it would be important to ensure that each relevant cost item was considered and the extent to which it would be recovered under a mixed active and passive set of regulations would need to be determined, to ensure that active price regulation remains appropriate and that BT would be able to recover all of its efficiently incurred costs.
- 6.52. Otherwise, there would be a substantial risk of under-recovery of fixed and common costs (with all the consequent damage to investment incentives) or a situation where active prices need to rise by even greater amounts.
- 6.53. Therefore it would be perfectly reasonable to assume that Ofcom's suggested "indicative" price increases of 9% and 27% are significantly understated. Notwithstanding that Ofcom's estimates are too low, these are substantial price rises in and of themselves which would

³³ Inclusion of items not considered by Ofcom such as Point of Handover and Regional Trunk could further increase this figure to around [X]. Clearly, to the extent that there is an impact on NGA markets the relevant common cost pool would be even greater.

³⁴ This is based on our understanding of the way Ofcom has derived these price increases is that all fixed and common costs are recovered through active products and that it is a static analysis based simply on substituting a certain proportion of active product volumes with passive ones.

have a significant impact on downstream competition and investment incentives across the supply chain. This would remain the case even if some of these fixed and common costs were to be recovered from passive prices.

- 6.54. We also consider that the approach set out in section 5 of the Consultation would need to be amended in a couple of important ways in order properly to reflect the likely common cost impacts.
- 6.55. First, Ofcom's "high impact" scenario would need significant refinement. [REDACTED]
[REDACTED]
- 6.56. At the very least, this makes Ofcom's current scenarios much too simplistic as a basis for properly assessing these impacts in a full cost benefit analysis of passive remedies. A considerably more detailed assessment would be required were this analysis to be taken further.
- 6.57. Second, by focusing solely on fixed and common costs there is a significant service specific fixed costs element missing in Ofcom's figures. Ofcom recognises this in Figure 2 of the Consultation but does not quantify this impact. It is less likely to be economically acceptable to recover such fixed costs elsewhere as they are 'caused' by business connectivity products. In order to maintain investment incentives for the active products these costs will still need to be recovered in the medium term over the relevant product base. Such costs are significant (over £[REDACTED] across AI and TI markets in the 2012/13 RFS) and therefore would lead to even larger percentage increase in active prices if recovered there.
- 6.58. Third, certain overhead costs (such as general management) comprise relatively low fixed and common costs. Whilst these fixed and common costs are included in Ofcom's analysis, the LRIC costs will not be. Yet the allocation of all of these costs (i.e. both LRIC and fixed and common costs) to service will be affected by the introduction of passive products. Were passives to be introduced, and the volume of active services reduced as a result, Ofcom's assessment would need to ensure that there would be fair recovery of such costs across all products. In this regard, Ofcom's assessment would need to be wider and not focus solely on fixed common costs.
- 6.59. Last, the expected average price increases stated by Ofcom are themselves likely to hide relatively wide differential price increases – i.e. the prices of some products and services would be likely to need to be increased by a much higher amount than the average. In order to assess the distributional impacts on consumers as well as the competitive impacts downstream a greater granularity of analysis would be required. To properly assess the impact, one would have to know the exact form of passive remedy, the pricing approach taken, and the resulting impact on the structure and level of active prices. In order to assess the importance of this we have considered the extent to which the [REDACTED]% price increase would be impacted if the remaining fixed and common costs were recovered only from AI services rather than being spread across all leased lines (on the basis that the AI services are those most at risk from being substituted to passive products). This would likely mean the price increases would be [REDACTED] higher than [REDACTED]% for that smaller sub set of services (and higher still once fixed direct common costs are taken into account).
- 6.60. All of these factors would influence the extent and incidence of arbitrage which occurs. Such arbitrage would need to be assessed in light of these more detailed and concrete scenarios across the various dimensions of geography, bandwidth, density and distance (see Section 9 of this response). This analysis would need to assess the specific "winners and losers" which arise. This would not only be a static snapshot analysis but would also need to take account

of dynamic impacts. The latter would include impacts on competition and investment by Openreach and other CPs. All of these factors would further complicate the forecasting of appropriate volumes and levels of migration between the various groups of products. This would also increase the bounds of uncertainty around the relevant unit costs.

- 6.61. As a result, the issues which arise from arbitrage would be greater than currently implied by Ofcom. We set out in Section 9 below the reasons why, regardless of the pricing approach taken, arbitrage opportunities are highly likely to remain and be significant. Combined with a greater level of common costs which would be impacted, this makes clear that the allocative inefficiencies which any passive remedy would thereby create would be highly material. Before turning to the distortions to competition this would also create, as discussed below, we address why we consider there is no reason to incur these substantial distortions given that the current marketplace (with regulatory intervention focusing only on active products) is working well.

Other costs and distortions which need to be taken into account

- 6.62. Although discussed to some extent elsewhere in the Consultation (and addressed, as indicated below, in other parts of this response as a result) there are other potential adverse impacts of any passive remedy which would need to be taken into account in any overall assessment of the costs and benefits of their introduction. These include:
- the costs and distortions which would arise from the difficulties in limiting passive remedies to specific product and geographic markets where SMP is found (see Section 7 below);
 - the costs and distortions arising from the interaction between active and passive remedies and their pricing (see especially Section 7 below, but the discussion in Section 9 is also relevant here); and
 - the costs of implementing passives (see Section 8 below).

7. Scope considerations

Introduction

- 7.1. Section 6 of the Consultation sets out a range of “key scope and design choices for passive remedies” which would have a significant influence on both the potential benefits and their adverse impacts (§6.1). We agree that these are significant issues and this section of our response addresses the potential scope of any passive products³⁵ and then subsequently the topics Ofcom sets out in the Consultation (§6.2), with the exception of implementation costs: these were partially addressed above in Section 5 of our response but are more fully developed in Section 8 below.
- 7.2. This section therefore sets out our views on the following.
- Primary applications of passives. Ofcom’s assessment focuses on potential applications for passive remedies. This risk of this approach is that Ofcom could end up picking winners and losers. Instead, Ofcom should carry out a wider assessment that looks at all the relevant factors.
 - Approaches to address common cost concerns. It is highly unlikely that passive remedies could be implemented in a way which would eliminate the risks of harmful arbitrage.
 - Appropriate product and geographic scope of passive remedies. We agree that passive services could not be mandated where BT does not have SMP, but this does not solve the problem of determining the precise circumstances where passives should be offered.
 - Arrangements for new construction. The initial views in the Consultation concerning any obligation to provide new infrastructure to meet a demand for a passive service considerably underestimate the complexities and potential for adverse impacts involved.
 - Form of non-discrimination obligation. We agree with Ofcom that it would be disproportionate to require BT to consume any mandated passive remedies on an Equivalence of Inputs (EOI) basis.
- 7.3. In conclusion, while it is important that passive remedies are only applied in response to an SMP finding, it is hard to see how this could be applied in practice or policed to ensure that other markets were not impacted. The complexities of leased lines markets means that it is unlikely to be feasible to remove arbitrage opportunities which lead to distortions. The introduction of any passive remedies would also make creating a fair and reasonable framework for new infrastructure extremely challenging: it would be important to ensure that CPs driving incremental investment and construction faced the costs of so doing. However, this would be difficult to achieve using existing approaches given that is likely that passive products would remove flexibility from Openreach in deciding how to provision new infrastructure.

³⁵ The severe challenges of passive product design are addressed in the next section of this response.

Potential applications for passive products

- 7.4. Ofcom should not try to 'pick winners' from the provision of passive services, as it appears to want to do in the Consultation. If it were possible to design a passive remedy so that there were no or very limited price arbitrage possibilities, then the only uses would be where there was a genuine innovation opportunity relative to what could be provided by active services. It does not seem likely that Ofcom will be in a good position to spot these opportunities.
- 7.5. There would inevitably be some form of arbitrage unless prices were set unrealistically high, in which case they would inevitably become subject to commercial and regulatory dispute. In broad terms, we would expect arbitrage to take place where there are combinations of higher than average proportion of high bandwidth circuits, where density of usage of fibre and duct are above average and where circuits are shorter in length.
- 7.6. Further the form of any passive remedy imposed should be based on a balanced consideration of all the relevant factors (see further the discussion in Section 3 above) and not simply driven by what passive products are being demanded.
- 7.7. We note that Ofcom does not consider here the impact on other markets. Depending upon the exact pricing of dark fibre, BT could find itself undercut in other markets in ways which were never envisaged as feasible or plausible when the original investments were made.

Impact of passives on common cost recovery

- 7.8. Ofcom (§6.12) identifies four ways to address the common cost recovery issues that would arise from passive remedies. These approaches are only set out in very general and high level terms in the Consultation, but the implication is that one or more of these measures could sufficiently limit or eliminate this adverse impact of passives. We believe this is not correct.
- 7.9. It is not clear in the Consultation whether the four mitigating approaches that Ofcom sets out would be cumulative or alternatives to each other. To the extent that the problems from arbitrage could be mitigated through the pricing of passive products, this will only be feasible if there was also greater wholesale pricing flexibility for active products. The problem of arbitrage arises from the relative prices and costs of active and passive products across a number of dimensions (as discussed further in Section 9 below). Therefore both the active and passive sides of the equation need to be addressed in order to reduce the danger to common cost recovery from passives. We address each of the potential approaches below.
- 7.10. Passive pricing approaches. For the reasons set out in Section 9 below, we doubt that an approach to pricing and regulating passive products could be developed which would sufficiently reduce the potential for arbitrage to undermine common cost recovery. In essence, this is due to the multiple dimensions on which such arbitrage is feasible and likely. Any pricing approach which could conceivably achieve such an outcome would likely be extremely complex and introduce distortions of its own, and would probably in itself reduce demand for passives, calling into question the justification for them in the first place.
- 7.11. Wholesale leased lines charge control flexibility. Linked to the above point, arbitrage opportunities would only be substantially reduced if there were significant changes to the levels and structure of pricing of active products. This would involve substantial price de-averaging, which would require greater flexibility in the existing set of price caps and sub-caps, and also increase the complexity of active pricing, introducing considerable costs in

itself. At least in some market segments this would inevitably mean reduced demand for active products, making it even harder to ensure recovery of all efficiently incurred fixed costs.

- 7.12. Product and geographic scope of the passive remedy. Ofcom suggests it would “consider restricting the scope of a passive remedy to particular wholesale markets” on the basis of their competition assessment. Ofcom does not explain why two similar areas might be treated differently and what rules or analysis would justify differential treatment. Further it would seem counter-intuitive to introduce such a more intrusive remedy except in markets where a substantial degree of completely entrenched SMP was found. Clearly, if this was to mean that the geographic or product markets where passives were available were limited, this would reduce the impact on common cost recovery. However, limiting the scope of passives would not limit all the costs of introducing them. In fact, implementation costs could be just as great if not higher under such an approach. We discuss this in Section 8 below, but note here that this also undermines the case for passives as it reduces the already limited benefits that they could deliver.
- 7.13. More widespread changes to the pattern of common cost recovery. The consultation also raises the possibility that this adverse impact could be reduced by spreading common costs in a different way across markets outside the scope of the BCMR. We have a number of concerns with this approach:
- it would not reduce the impact but merely dilute it across a wider product set;
 - there is a significant timing issue: unless Ofcom envisages interim market reviews or delays mandating passives until subsequent relevant reviews are concluded, there will be a period in which BT has to finance delayed recovery of common costs or could perhaps even never recover some of its efficiently incurred costs³⁶; and
 - the legal framework does not allow Ofcom to change remedies in one market review to address SMP issues identified in another.

Product and geographic scope of any passive remedies

- 7.14. Mandating passive remedies would make it very hard for Ofcom to carry out market reviews.³⁷ Since 2013 we have submitted a number of working papers to Ofcom on the methodologies adopted for market boundaries and in particular the issues of network topology (as it links to circuit counts and market delineations), the core network definitions and wider aspects pertaining to geographic boundaries. Considerable work is being undertaken by all CPs and Ofcom to address concerns on the data collection and analysis which will likely cut across all the market boundaries.
- 7.15. A particularly acute issue concerns high network reach and CP presence:
- dark fibre would be upstream of active services but cut across all bandwidth breaks;

³⁶ Consistency between charge controls and associated market reviews was an important consideration in the Vodafone and Verizon Appeal in 2013.

³⁷ To be clear we are not saying this is a definitive reason not to offer passive services but rather that Ofcom appears to imagine that the SMP assessments will be easy to do and that it might even restrict passive services to a sub-set of relevant products and geographies of something which is extremely difficult to establish in the first place.

- both duct access and dark fibre would cut across current product and protocol based distinctions, for example traditional and alternative interface categories; and
 - both duct access and dark fibre would be used for corporate access and fixed and mobile backhaul.
- 7.16. We believe that the current BCMR analysis which Ofcom is undertaking may well lead to some different assessments of competition, for example at higher bandwidths – it is precisely high bandwidth and the highest bandwidth services which CPs would be most likely to supply using passives.
- 7.17. It does not seem likely that BT or Ofcom would be able to monitor the impact of passive services to feed information into the current data collection processes to determine service shares in a coherent way. A dark fibre could be used for a 1Gb or 100Gb circuit. It would not be possible to monitor this. Whilst in theory CPs could monitor themselves this would still be fraught with difficulties. As product and geographic markets evolved over time along with different assessments of SMP (e.g. the scope of WECLA), we can only see that there would be continuous disputes and controversy.

Arrangements for new infrastructure

- 7.18. The analysis of the possible arrangements for the construction of new infrastructure set out by Ofcom in Section 6 of the Consultation is at a very high level only. Ofcom explicitly notes that these issues will require further consideration. Indeed, this issue requires substantial further analysis. The issue of the extent to which passive remedies would drive new infrastructure build and how the resulting costs are efficiently recovered is complex and highly dependent on the exact form and pricing of any passive product or products available. It is also likely that the approach for any individual form of passive product (e.g. dark fibre) would depend on what other passive products (e.g. duct access) were also available. Given the potential impact of passive remedies on infrastructure providers' investment incentives; this is clearly an important issue.
- 7.19. The initial view expressed in the Consultation (that the current arrangements for wholesale leased lines are appropriate for dark fibre and “provide a good starting point” for any duct access) does not reflect the complexities around the price and form of any individual passive product or the interaction with other passive products. Further, the current suggested approach, essentially based on the ECC regime, does not reflect the realities of operating parallel active and passive regulated remedies.
- 7.20. The implicit assumption is that the pricing *status quo* remains for pre-existing products and those patterns of fibre and duct usage are essentially the same in both active and passive cases. However, this would not be the case: changes to pricing would inevitably lead to a more de-averaged price structure that more accurately reflect localised build costs, and CPs have already indicated a desire to use only selective sections of the Openreach infrastructure, again indicating a need to move away from averaged pricing.
- 7.21. This would effectively mean Openreach's network build costs being driven by individual CPs' specific demands (distinct from the current customer-supplier relationship which drives demand today). This unbundling of the physical layer means that purchasers of regulated access to Openreach's passive infrastructure effectively become competitors to Openreach whilst also having influence over its capital expenditure decisions. This has potentially serious adverse implications for investment incentives and is likely to distort competition.

- 7.22. The basic principle should be that CPs driving incremental investment and construction by Openreach should face those costs, prospectively in any part of the network, and the associated risks of that investment. Typically costs will be driven by the network routing, the number and length of ducts bores, size and length of fibre cables and other infrastructure required such as jointing boxes or chambers. Under the current active-based regime, Openreach has flexibility to design, use and extend its capacity in the way it considers most effective overall. This enables it to plan and react to customer demand in the way it sees as most appropriate. For example, where capacity has been exhausted over a particular segment of a route, Openreach will make its own commercial choice of whether to accommodate additional demand through more circuitous routing or through new network build.
- 7.23. Many of the potential forms of passive product are likely to remove some, if not all, of Openreach's flexibility over the best way to provide additional capacity. In these scenarios the decision driving incremental investment in capacity or restoration, for example the removal of blockages, would move to the passive product purchaser. In these circumstances it would not be efficient, reasonable or appropriate to leave the risk and cost of such capacity increases with Openreach when it no longer has control over them. For this reason the distinction made in the Consultation between dealing with congestion and network extension would not be clear cut nor a feasible basis for distinguishing between how new infrastructure build is funded compared to existing infrastructure.
- 7.24. Given the unique needs of each individual CP, charges for new infrastructure would need to be reflective of costs on a case by case basis. In such circumstances CPs would face costs analogous to Openreach and they would be required to decide whether further duct build was required, which routes should be enhanced, and face the investment cost and associated risks of under or over provision. This undermines Ofcom's view that the wholesale leased lines arrangements are likely to provide a "good starting point" for the consideration of the arrangements appropriate for a duct access remedy.
- 7.25. Instead, we would expect the starting point here to be the arrangements already in place with respect to new duct build under the PIA remedy. The need to move quickly to a more de-averaged and disaggregated parallel pricing structure for the active portfolio will also have many impacts but one obvious area which will require consideration is ECC policy for Ethernet services. These have typically been charged for on an item by item basis as discussed above, but a recent innovation in summer 2014 changed the process³⁸ creating an average ECC allocation per order. This has been very effective in improving the order process, providing greater certainty to customers and reducing cancellations.
- 7.26. However, this averaging would not be appropriate for a duct access product or dark fibre given the opportunities that it would create to game the average cost structure where a CP like Colt could choose between self-build and dark fibre. To avoid arbitrage opportunities with active products, it is likely that ECCs would need to revert to a unit pricing basis for active products too. This would reverse the real benefits from averaged pricing that have been of great benefit to industry: [X]

³⁸ From 1 June 2014 EAD orders (excluding Resilient Option 1) have been subject to an additional £548 ECC Fixed Fee payable on connection, in conjunction with an exemption that covers the first £2,800 of variable ECC charges. See <http://www.openreach.co.uk/orpg/home/updates/briefings/ethernet-services-briefings/ethernet-service-briefings/articles/eth00314.do>

- 7.27. In conclusion, at this early stage, the issue of new infrastructure build for passive products can be considered under a number of possible scenarios, along with our initial views on what arrangements would need to be considered in each of these.
- Dark Fibre only. Current industry discussions suggest that CPs who wish for dark fibre are looking for access to a greater number of flexibility points in the network than would traditionally be available using EAD products. This would place additional investment demands on certain parts of the network than would be required if only active products were provided. It would also lead to stranded assets elsewhere in the network. The regime would need to ensure that these costs were appropriately faced by those purchasing passive products.
 - Dark fibre combined with a duct access remedy. If both forms of passive remedy were available, CPs requiring new fibre should be required to use duct access to provide it themselves. The existing arrangements for new duct in the PIA regime would be a suitable starting point for situations where new duct was required.
 - Duct only. Where new duct is required then CPs are free to commission or build such new duct themselves and there is no suggestion that Openreach has market power in relation to such civil engineering projects. By the same token Openreach should be free to offer to build new duct at commercial rates provided in a competitive market. Costs for unblocking/renewing duct should also be faced by the CP unless it forms part of an Openreach plan to enhance that particular duct route.

The form of non-discrimination obligation

- 7.28. Whilst we support the principle of non-discrimination, we have serious doubts as to how it can be applied in practice as pricing would increasingly need to be de-averaged or bespoke to reflect localised conditions. It would be difficult for BT to interpret a FRND condition, and it is not clear Ofcom would choose to interpret it under its dispute resolution powers. Such an approach would at the very least therefore create regulatory uncertainty.
- 7.29. Ofcom concludes that it would be disproportionate to require BT to consume passive remedies to provide existing wholesale leased line services on an EOI basis. However, we assume that Ofcom would not seek to prevent downstream divisions of BT from using future passive products in the same way as other CPs.
- 7.30. Ofcom has not discussed or mentioned margin squeeze explicitly either in Section 6 or in its consideration of FRND obligations in Section 7. We note that the former application of DataStream and IPStream margin squeeze models to Wholesale Broadband Access shows that network-based margin squeeze tests may become very complex and ultimately not serve their intended purpose.³⁹

³⁹ When Ofcom mandated PIA it took the view that margin squeeze tests should apply between PIA and any downstream products e.g. VULA, WLR and LLU. We believe the same should apply here.

8. Design considerations: Implementation of passive remedies

Introduction

- 8.1. Ofcom (§§6.34-6.38) comments briefly that it considers the implementation of passive remedies “would be a significant undertaking”. BT agrees. The costs involved in implementing any form of passive remedy would be considerable. While BT disagrees with the need to mandate passive remedies, if Ofcom were nevertheless to take this approach, BT should be entitled to full recovery of the costs it incurs.
- 8.2. This section sets out our initial view of the significant costs and practical difficulties in implementing any passive remedy with respect to:
 - how such remedies could be limited to the relevant SMP markets;
 - developing product specification and reference offers;
 - evolving the required systems and processes; and
 - developing a pricing system (the principles involved in doing so are addressed in Section 9 below, whereas this section addresses the practical issues involved); and
 - addressing a number of other additional factors such as migration costs, updating the SOR process and treatment of transition costs.
- 8.3. If Ofcom were to consider that passive remedies might be appropriate, a detailed assessment of the operational and implementation costs would need to be commissioned, as was done for PIA, to ensure that the resulting cost estimates were properly taken into account in the evaluation of options.
- 8.4. As well as the practical implementation costs, a change as fundamental as the introduction of passive remedies would create transitional costs given that BT’s current network is optimised for the provision of active products. Changing this would in itself create costs over a potentially significant period of time, during which infrastructure investment would need to be re-optimised to provide the new set of passive products whilst at the same time continuing to supply active products. This is discussed further in Section 6.
- 8.5. In conclusion, the costs and challenges associated with implementing passive remedies would be very significant. Ofcom would need to take such costs into account when assessing whether passive remedies were appropriate and proportionate in the first place. Further, such costs would need to be assessed in detail and mechanisms put in place to ensure that BT was able to recover its efficiently incurred costs.

Developing and implementing passive remedies in relevant SMP markets

- 8.6. The most fundamental implementation would be the limitation of passive remedies to the markets in which they mandated. Ofcom accepts that it does not have the power to require passive services where BT does not have SMP (§6.16). Therefore Ofcom would need to define a clear methodology for designating markets, whether geographic- or product-based, where the remedies applied and did not apply. There would also need to be an understanding of how remedies would change when SMP designations were removed in later market reviews: for example whether there would be a transition period during which passive obligations fell away, whether existing services already in place ceased immediately or whether ‘sunset clauses’ would be required.

- 8.7. It is not clear how Ofcom would propose to address these issues, but it is certain that limiting passive remedies to SMP markets would be a major issue requiring considerable thought and analysis. The practical and logistical problems would be immense.
- 8.8. BT and other stakeholders would also need greater clarity on how Ofcom would implement passive remedies in the BCMR in ways which did not enable leakage into adjoining markets such as the WLA , for example through deployment of dark fibre to street cabinets. A clear competition and regulatory framework already exists for NGA investments with well understood and defined remedies such as VULA, LLU, SLU and PIA. These are widely acknowledged to be working well and supporting ongoing large scale investment and competition for broadband services throughout the UK.

Product Specification and Reference Offers

- 8.9. We agree with Ofcom's preliminary assessment in Section 6 of the Consultation that implementing passive remedies would be a significant undertaking technically, operationally and financially. As Ofcom also notes, there would need to be a lengthy implementation period. Both Openreach and CPs would need to make significant investments in process and systems changes, particularly if high order volumes were anticipated.
- 8.10. At this stage of the market review process, given that no options have been definitively ruled out by Ofcom, it is not possible for us to present detailed proposals for passive remedy product specifications. Potential solutions may need to meet demand for duct access, dark fibre access or both together; with or without obligations to provide new build infrastructure; and with or without obligations to provide active services in parallel. [X]
- 8.11. Whilst in principle none of these options is physically impossible, there are very many significant questions which would need to be resolved. All of these would affect the costs of transition and ongoing costs in the future, as discussed above in Section 8. These include: active and passive pricing, and related charge controls; costs of implementation, which would have an impact on all parties; prioritisation of resources; and systems/process reengineering - all on a multi-CP basis. There is also the question of what an appropriate and plausible time-scale for implementation would be.
- 8.12. The complexities of implementation would also be driven by the specification of the remedy imposed. A single remedy (duct or dark fibre) would be costly and time consuming to implement and would be likely to require multiple systems releases. If both duct and dark fibre access were imposed then the degree of process/systems change required would be higher still.
- 8.13. We set out in Section 5 above that implementing a dark fibre remedy would require many new issues to be addressed, especially if CPs were to demand access points which did not have a parallel in current active services. Similar new issues would arise for duct access.
- 8.14. Ofcom (§6.36) notes the experience gained during the introduction of PIA. That process required extensive engagement by Ofcom, Openreach and CPs both before the remedy was introduced and after the SMP regulation was formalised. PIA was in many respects a fairly tightly defined remedy, and the reference offer was structured in a way which enabled CPs to take carry out deployments independently of Openreach.
- 8.15. BCMR passive remedies would be more complex and entail greater Openreach involvement, and this would require far more negotiation and much more detailed reference offers. In particular, the very detailed decisions that would need to be taken with regard to fault repair

systems and service quality measures would far more complex than those involved in the PIA process.

Systems and Processes

- 8.16. We do not agree with Ofcom's comment (§6.36) that the costs involved in implementing dark fibre 'would not require significant administrative effort' as there is no reason to suppose that demand for dark fibre would necessarily be equivalent to that for wholesale leased lines under the current framework: rather, CPs may request dark fibre which does not parallel our active services.
- 8.17. We have similarly explained above that the existing PIA remedy would not be suitable as a generic duct access obligation that could also apply in business connectivity markets. Ofcom itself indicates this might be the case in §6.37 of the Consultation.
- 8.18. This is clearly a key operational area to consider and a significant driver of cost and resource. The magnitude of the systems and process issues would depend on the specification of the remedies and anticipated volumes. In broad terms, it would be possible to break the supply chain between the passive and active layers and to pass responsibility to the CP for fault testing, diagnosis and calling-off of Openreach engineering resource. However, this would not be achievable without a major reinvestment to restructure systems, re-engineer processes and redefine responsibilities on both sides.
- 8.19. If multiple CPs consumed passive services with multiple different electronic devices and network management systems, the complexities would be even greater. At the minimum, very tightly defined standards/interfaces would have to be specified and adopted by all CPs to feed Openreach physical layer data from their systems back into Openreach systems - essentially a reversal of the existing systems and processes as they operate today.
- 8.20. The magnitude of this change cannot be overstated. In addition, Openreach would need to reconsider the requirements and priority of other 'active' systems developments in the light of the scale of the changes required to introduce passive services. Changes would also have to be made to quote, billing and inventory systems.

Pricing

- 8.21. Pricing of passive remedies would represent a major challenge. Openreach would be obliged to move from the current system of price variation across bandwidth and there would be adverse impacts from losing this flexibility as set out in Section 9 and the DotEcon report attached at Annex 6.
- 8.22. There are many other reasons why prices would need to be adjusted:
- De-averaged pricing. Openreach would not be able to maintain uniform Ethernet prices in the presence of either or both of duct access and dark fibre. The current portfolio is already highly averaged by geography, distance, and density, largely at the request of the many CPs who purchase Ethernet services.
 - Speed of adjustment. Openreach would have to move immediately to alternative pricing structures for active services which would increasingly involve individual circuits having bespoke features. Some new prices would also need to be introduced immediately (for example for chargeable surveys and cancellations) and recent averaged ECCs reversed.
 - Ease of adjustment. As noted above, the costs of adjustment both for Openreach and for CPs would be significant. Openreach has considerable equipment already in

its installed base which could be stranded if it were obliged to provide passive services and in particular dark fibre effectively on demand.

- 8.23. Any charge control (and/or other regulatory price constraints) would also need to be refined to take account of prospective and uncertain passive service volumes and pricing. This would apply to any change controls on both active and passive products. The degree of change required would depend on the nature of the remedies and how CPs intended to use them, but again the complexity would be greater the more layers of passive remedy were introduced. Ofcom has not yet provided any clear proposal on how multiple intervention points in duct, fibre and active layers could be adequately accounted for in the proposed Leased Lines Charges Control. As a simple example, any active charge control would need to be based on volume forecasts taking account of the introduction of passives, as discussed in Section 6.
- 8.24. The active charge control would also need to take account of the introduction of passive remedies to set appropriate incentives. Ofcom has assessed the level of common cost recovery that might be displaced in the event of a passive remedy as the difference between FAC and LRIC as the appropriate level of common cost. This makes the implicit assumption that the pricing level in a regulated market would equal FAC.
- 8.25. However this overlooks the impact that a CPI-X charge control has on cost reductions. In charge controls BT has the incentive to reduce costs on the expectation that any cost reductions over and above those anticipated by the charge control (or any growth in volumes over and above that anticipated) will lead to returns above the WACC during the control. Alternatively this could be expressed as prices being above FAC. In an incentive-based regulatory environment, there is a genuine expectation that this additional revenue (or fixed common cost recovery) will flow into the subsequent charge control and be increasingly shared with customers through the operation of a glide path.
- 8.26. BT is concerned that a move to passives might result in these efficiency gains being disrupted through the move to passives, unless an allowance was also made to include an element of the fixed and common cost recovery implicit in some of BT's prices being above FAC.

Additional factors

- 8.27. We have also identified the following additional issues which would need to be addressed as part of any implementation of passive remedies:
 - Migration. The introduction of passives (particularly dark fibre) would raise the issue of whether products were required to enable migrations both from actives to passives and from passives back to actives. Relevant scenarios would need to be identified and network solutions developed to allow movement between different fault reporting and management processes/systems, and for different jumpering and jointing scenarios to be developed and implemented.
 - SOR process. There would also be a need to restructure the SOR and industry engagement processes. CPs purchasing passive products would be competing with those continuing to use Openreach active products, and some degree of separation and confidentiality between the two groups of CPs would be necessary to avoid competitive distortions. Ofcom would need to ensure that revised processes were used fairly and appropriately.

- Transitional period. Openreach and CPs would need to understand how and when the regulation on Openreach active products was likely to be withdrawn. This would be particularly relevant to smaller CPs (the vast majority of Openreach's c.300 customers) who are unlikely to be able to consume passives in the same way and at the same scale as larger CPs.
 - Competition impacts. There is a need to better understand how competition might develop or otherwise be affected with large scale use of passives. There would certainly be a significant risk of 'first mover advantage' disrupting the multi-CP framework as it currently stands and again this may be disadvantageous for smaller and niche CPs.
 - Impact on competitive infrastructure investment. There would also be a risk that existing alternative CPs' network investments would be undermined by large scale use of Openreach passives and create a disincentive for true 'competition on the merits' from alternative networks such as Virgin and Colt. There would be a clear risk that future network investment by such CPs would be chilled.
- 8.28. It is difficult for BT to estimate the market impact of changing the current structure of prices, although we can speculate on some broad outcomes. Generally, we believe that the corporate access market would suffer relative to the two backhaul markets, where contracts are fixed and there are more lower bandwidth circuits. In the case of duct access alone, there would be a re-structuring of active prices reducing the bandwidth gradient and likely to require de-averaging by distance and possibly density and geography. Low bandwidth users, more likely to be smaller companies, would face much higher relative active product prices than those they pay now.
- 8.29. [X]
- 8.30. The aspects discussed above are all areas to which Openreach, CPs and Ofcom would need to devote significant resource for a considerable period of time. Before such a major reorganisation of the Openreach operating model with consequential costs and unknown impacts on CPs and customers were triggered, Ofcom would need to be confident that the claimed benefits had a realistic chance of being achieved.

9. Pricing issues

Introduction

- 9.1. The price set under any passive remedy would have a significant impact on the size of the adverse impacts of their introduction as well as influencing the incentives of both those purchasing and selling passive products. Section 7 of the Consultation, setting out the issues relating to the setting of such prices, is therefore of central importance to the assessment and analysis of introducing passive remedies.
- 9.2. The Consultation lists a number of possible approaches to pricing passive remedies. For the reasons set out below we consider that none of these approaches would sufficiently deal with the potential for arbitrage and, therefore, the adverse impacts of passive products. Each of the proposed pricing approaches has major implementation and conceptual problems associated with it.
- 9.3. We consider that the pricing issue is the most difficult one of all to address and such a fundamental shift in regulation would likely entail significant problems. Ofcom has not yet addressed any of these, although the Consultation document lists possible approaches, identifying some of the relevant issues. If Ofcom considers that it is justified in taking the consideration of passive remedies further, then we expect that significant further work and analysis will be required to derive feasible and appropriate pricing mechanisms – this is required even just to complete any proper assessment of the overall “costs and benefits” of any new passive remedies before any decision to do so.
- 9.4. As set out in previous sections, BT does not consider that any form of passive remedy is justified, proportionate or required. Against this backdrop, the remainder of this section provides our comments on the discussion of pricing any passive remedy in the Consultation. In particular:
 - the comparison with the existing active pricing structure would be a complex issue as the relevant prices would inevitably vary over time and cover a very wide range of different individual products;
 - the option of no pricing obligation at all needs to be kept under review once further detail on the scope and coverage of any potential remedy is more concrete;
 - a fair, reasonable and non-discriminatory pricing approach would likely effectively lead to a charge control on prices, either through guidance or dispute resolution;
 - any feasible form of cost based charge control would raise substantial arbitrage concerns and be very difficult to implement;
 - none of the currently identified benchmark active prices which could be used for a charge control based on an “active minus” approach would be appropriate and such an approach is likely to lead to very serious arbitrage concerns; and
 - the assessment in the Consultation of arbitrage does not yet reflect the real commercial complexity or the opportunities for such behaviour which would exist – or indeed the real damage to customers and industry players that would result.
- 9.5. Our conclusion is therefore that any of the potential pricing approaches for passive remedies outlined in the Consultation would be problematic and it would likely be extremely hard to remove realistic opportunities for arbitrage and the damage that would result.

Interaction with active pricing structure

- 9.6. Ofcom (§7.9) takes as its starting point ‘the current active pricing structure’ in order to consider the potential interactions between active and passive services. This is a deceptively simplistic phrase which does not convey the range of prices which might be relevant for the full scope of services supplied by passive services. At one end, it might be considered to represent the regulatory prices for AI and MISBO services and for example to exclude TI and linked services such as broadband. However, this presupposes that the use of passives could be limited in this way which seems highly unlikely.
- 9.7. Further, it is not clear what Ofcom means by ‘current’. Ethernet prices for different bandwidths (and hence the bandwidth gradient) have continued to evolve over time (and a similar picture is also relevant in the optical area). [X]

Chart 8: [X]

[X]

- 9.8. [X]
- [X]
 - 1Gb. In September 2012 the price of EAD 1Gbit/s was £9,500 (excluding main link charges), and from April 2014 was £5,664 – a 40% reduction in 18 months.
 - [X]
- 9.9. Different active prices are therefore changing over time and any of the options which Ofcom considers for passive prices would be against this backdrop of frequent changes in both the level and structure of active prices even if they themselves were regulated in a basket. Similarly, the electronics costs which would be avoided in the provision of dark fibre are also changing constantly and this would need to be taken into account to maintain the price of passive products: including increasing with new development and innovation capabilities, decreasing with improved supplier negotiations, volume of demand, and production technology progress.
- 9.10. Indeed Ofcom (§7.14) itself acknowledges that ‘it may still be necessary to allow for some rebalancing of active prices following the introduction of passive remedies’. But without the corresponding assumptions of how Ofcom would propose to regulate BT in its active portfolio, the detail of this analysis of how active and passive prices would interact cannot yet be undertaken, but should be an essential part of any assessment which justified the use of any passive remedy.

No pricing obligation at all

- 9.11. The Consultation dismisses the approach of having no regulatory obligation on passive pricing relatively briefly. Ofcom suggests that such an approach might limit the arbitrage opportunities but would give BT the incentive to price in such a way as to deter take up and this would create uncertainty for other CPs. BT considers that this option needs to remain one of those which is assessed – if Ofcom are to proceed further with consideration of passive remedies. This is because the supposed effects identified by Ofcom to dismiss it in principle will depend on the exact form, geographic and product scope and implementation of any remedy. We also note, as discussed in more detail below in relation to other potential pricing approaches, that the contention that pricing flexibility would suitably “limit” arbitrage opportunities is not likely to be true.

Fair, reasonable and non-discriminatory pricing

- 9.12. In this case any non-discriminatory approach would need to address complex product sets co-existing at two levels of the same regulated value chain and for this reason it would be more challenging to set prices here on a FRND basis (compared to existing services controlled via a FRND approach). The challenge would be even greater should two variants of passives (e.g. dark fibre and duct) co-exist with the active products, meaning a FRND pricing regime would potentially have to cater for three levels of the same regulated value chain.
- 9.13. We consider that fair, reasonable and non-discriminatory (FRND) pricing would be difficult in practice and likely lead to commercial and regulatory dispute.⁴⁰ Even with Guidance that is 'well specified', as suggested in the Consultation, this would still be the case. Either the Guidance would need to be highly prescriptive such as the precise nature of passive pricing in terms of structure and level, or alternatively it would be less deterministic and leave more latitude to BT.
- 9.14. If the former, this would effectively turn any FRND pricing remedy into a much more restrictive form of pricing control. Ofcom would effectively need to set individual prices within bounds not normally associated with a FRND form of pricing regulation. FRND would usually include some element of assessment of effects as previously identified by Ofcom.⁴¹ If, on the other hand, the guidance was not as prescriptive but allowed BT some latitude on setting relative prices, the chances are BT will not be in a position to assess competitive effects as BT would likely have little, or even no, knowledge of precisely what the CP might wish to use the passive services for and hence no ability to accurately judge the usage and unit cost of various components.
- 9.15. In practice, any FRND based approach to controlling passive prices would likely lead to Ofcom having to take action to determine prices, and particularly relative price levels at different levels of the same value chain, either ex ante through detailed guidance or ex post through dispute resolution. Either way, we expect that FRND pricing would end up being a very complicated and challenging approach for setting efficient prices.

Charge control and cost based pricing

- 9.16. Whilst such an approach may be relatively simple conceptually, as Ofcom (§7.18) suggests, there is no suggestion that it would be economically appropriate as Ofcom (§7.21) also notes. BT considers that such a simplistic approach to pricing would not 'mean prices reflect the underlying costs of the passive infrastructure used' contrary to the suggestion in the Consultation (§7.18). We show below some evidence of the variation in fibre costs by density of utilisation in ducts. We explain below why distance is important and we provide additional evidence in the report from Analysys Mason provided at Annex 5, discussed further below.
- 9.17. Cost based pricing would be highly susceptible to pricing arbitrage: for example, around distance – a consideration Ofcom does not even consider in the Consultation. Ofcom states that a passive product would be primarily of benefit to mobile and fixed backhaul. This

⁴⁰ We note that this is consistent with the approach taken by Ofcom itself in the Colt Appeal. Colt Judgment, paragraph 159.

⁴¹ Undue discrimination by SMP providers. How Ofcom will investigate potential contraventions on competition grounds. Ofcom November 2005.

would tend to be longer, higher bandwidth circuits (for example the average length of a 10Gb circuit [X]). The average active product is more likely to be used for access, and be a shorter distance (for example the average EAD 100mb Standard circuit [X]). To avoid creating a significant pricing arbitrage from length (caused by the different uses of the products), the passive product (and the active product also) - would both need to be charged on a per meter basis.

- 9.18. Nor are density of utilisation and distance the only dimensions of cost variability. Given the variation in costs, any cost based approach would lead to substantial opportunities for arbitrage and all the consequent inefficiencies that would cause as discussed further below (as well as in Section 6 above).
- 9.19. Any cost based approach would not be simple to implement. First, depending on exactly how any passive remedy was implemented and where, it is not clear if cost data would even be available for such an assessment. Second, as volumes move between active and passive services Ofcom would have to continuously re-calibrate the common cost recovery needed for BT to continue to be able reasonably to recover efficiently incurred costs, including having a reasonable opportunity recover sunk investments made under regulatory obligations. Given that any demand for passive services is highly uncertain as is where it would arise or for what purposes, the complexity of this exercise would be extremely large and the regulatory forecasting problem of a different scale to existing charge controls.

Charge control and retail (active) minus approach

- 9.20. The Consultation identifies a number of potential approaches to setting an “active minus” price, based on using different benchmark active prices. We consider that each of the possible options either faces significant conceptual problems in whether it could be practically implemented or would create major arbitrage issues. Considering each of the options for the benchmark active price set out in the Consultation in turn:
- Each product individually. This would not be feasible as there would be no correspondence between individual products and use of passive services. Usage would often be multi-product against continuously changing active prices and at a more practical level it would be impossible to monitor which active product was the appropriate comparator.
 - Basket of active products. The Consultation suggest that “it is not clear” that this approach would deal with potential arbitrage issues. In fact, by averaging across different active prices as well as costs it is highly likely this would create arbitrage opportunities and this would totally undermine the basket definitions in any case.
 - Single reference point. No single reference point is likely to allow for efficient pricing. If the reference point chosen is low, this will create a major arbitrage opportunity. If the reference point is set at a sufficiently high level to ensure that common cost recovery is not disrupted, then it is likely this would mean passive remedies would not be attractive to purchasers, in which case significant cost and effort in making them available is wasted.
- 9.21. Ofcom needs to consider that BT’s active pricing is influenced by market as well as cost considerations. For example, were Ofcom to decide to select 10Gb as the reference product to set an active minus price, it is not at all clear which active product should be selected. Currently Openreach has a number of 10Gb products (WES, BES, EBD, OSA and OSEA) with EAD 10Gb in development. All of these products have different cost stacks which influence the pricing, regardless of the technology. The duct and fibre element of the cost stack is

influenced by distance and this varies depending on the product but the pricing also depends on Openreach commercial strategy.

- 9.22. [X] Selecting only one of these products will cause a distortion (and an arbitrage opportunity) because of these commercial pricing decisions. The same commercial strategies (and therefore arguments) also apply to the 1Gb products within the Openreach portfolio.
- 9.23. Any charge control based on an active minus approach would therefore also be subject to major practical difficulties for Ofcom. We do not see how Ofcom could easily set a charge control for the passive product, whilst also charge controlling the active product with any possibility of consistency for the reasons set out above – there are multiple services even at the same bandwidth. If the prices were initially set perfectly with no arbitrage, we would expect the active product to reduce in price over time as the charge control takes into account factors such as efficiency. Efficiency would undoubtedly be different for dark fibre and it seems likely that the two controls would be assessed to have different levels of 'X'. This would create a divergence between initially aligned active and passive pricing, further increasing the risk of arbitrage over time.
- 9.24. Another consideration for an active minus charge control is how sensitive the outcome is to the assumptions made regarding levels of volumes. Ofcom is proposing to set an active charge control to start in April 2016, which would be before the timeline for a reference offer for passive products (if required). This would be for a time period that would also cover the period of passive implementation. Given the calculation of X is sensitive to volumes, the active control could be set materially incorrectly.

Consideration of arbitrage in relation to duct and dark fibre

- 9.25. Whatever approach to pricing of any passive remedy is taken, it is likely that there will remain substantial opportunities for arbitrage. This would have severe adverse impacts on the pattern of cost recovery and ultimately on investment and competition. Costs vary along a number of different dimensions. Any practical pricing approach is therefore likely to leave BT open to being undercut on a particular sub-set of services and left only providing active products where they are less profitable (or not profitable), which will undermine BT's ability to recover its efficiently incurred costs and disrupt common cost recovery. We discuss the issue of arbitrage in the following paragraphs (see also the discussion in Section 6 above and in the accompanying DotEcon report at Annex 6). The discussion on different pricing approaches' impact on arbitrage and the extent to which it is different in relation to duct or dark fibre does not address all of the relevant issues. Ofcom has not considered distance with respect to dark fibre nor the question of stranded assets were active services be novated to dark fibre. We consider these to be very serious omissions from the Consultation and any further assessment of these issues would need to be far more comprehensive.
- 9.26. Further, on the issue of the bandwidth gradient, Ofcom (§4.25) notes the arguments from some CPs for a more 'efficient pricing structure'. Ofcom (§ 4.30) recognises that CPs are referring to the "bandwidth gradient" where higher prices are charged (relative to incremental cost) for higher bandwidth services. Passive remedies would allow CPs to exploit a pricing arbitrage here on higher bandwidth services, or alternatively they could potentially positively benefit from the rebalanced prices of active products that would be more closely linked to costs.
- 9.27. We discuss the issue of the bandwidth gradient in Section 6 above, and this issue is also discussed in Section 3.1 of DotEcon's report at Annex 6. We agree with Ofcom (§4.31) that if

this is the issue for resolution it could be remedied far more simply through a different form of active price control. The general benefits of charge controls could then be largely retained.

- 9.28. We also consider that there is significant potential for distance based arbitrage, which is analysed in more detail in the Analysys Mason report at Annex 5. As shown in Table 3 below extracted from the report and set out in detail in the report itself, there is significant potential for [redacted] arbitrage [redacted]

Table 3: [redacted]

[redacted]

- 9.29. We agree with Ofcom (§7.38) that there would be density based arbitrage for duct. However there is very considerable variation in dig costs of duct as well by geographic areas and we see a need to de-average here also. This would not address the issue of localised capacity problems on top of all the other issues identified.
- 9.30. We do not agree with Ofcom's statement (§7.39) that density arbitrage is less of a concern for dark fibre. CPs do not all follow the hub and spoke design of BT's network with single fibre strands used for each circuit and they have designs which are quite different. CPs may well be able to utilise a single fibre for multiple customers and in fact would be incentivised to do so if the charges for dark fibre vary by density. In other words, if BT de-averaged its fibre charge by the number of active fibres in the duct and charged more where a duct is very lightly loaded, this could encourage a second round of arbitrage further undermining our active services. This is an aspect of the density arbitrage that Ofcom does not seem to acknowledge.
- 9.31. Ofcom suggests (§7.39) that the corporate access market uses single fibres, and that as this would continue there would not be an arbitrage opportunity and there is no concern. However Ofcom constantly refers to the primary use of dark fibre being for mobile and fixed backhaul, and not the corporate access situation that Ofcom refers to here. Ofcom seem to acknowledge this in Footnote 42, nullifying its own point.
- 9.32. We show below in Table 4 an illustration of how the variation in fibre density and utilisation in different geographies can influence the fibre costs. [redacted]
- 9.33. [redacted]

Table 4: [redacted]

[redacted]

- 9.34. We consequently do not agree with Ofcom (§7.41) that arbitrage opportunities are less for dark fibre than duct. If anything we would argue the reverse, as Ofcom has not taken into account arbitrage based on bandwidth, length, and novation of the existing base and not fully reflected the scale of the density arbitrage. (We do not agree with Ofcom Footnote 42 either for similar reasons.)

10. Response to specific consultation questions

- 10.1. Our detailed comments on the issues arising are set out in the main body of this response above. This section sets out BT's response to the specific Consultation questions. We summarise our views on each of the consultation questions in the remainder of this section with appropriate references to the main body of the response.

Question 1: *Do you agree with our preliminary framework for considering the case for passive remedies?*

- 10.2. While this is a reasonable articulation of some of the relevant statutory duties Ofcom must consider, the framework set out in the Consultation does not provide a full framework for assessing these issues going forward.
- 10.3. We understand that this is a preliminary consultation, but Ofcom will need to set out a more robust approach to balancing the different factors in order to identify whether passive products are the appropriate and proportionate way of addressing any issues identified as arising from any SMP findings.
- 10.4. We also consider that there are a number of relevant factors which are not included in the framework set out in Section 3 of the Consultation including the need to have regard to the principles of good regulation, a consideration of the costs of competition and evaluation of the operational practicalities, and a comprehensive assessment of the knock on impacts on other markets. Further, in considering allocative efficiency impacts, Ofcom should also take account of the impact of price increases for active products as well as the arbitrage and cherry picking impacts.
- 10.5. Finally, going forward a proper assessment of these issues will require greater articulation and clarity around how and when active remedies would be withdrawn where passive access has been introduced. There are costs to intervening at multiple levels of the supply chain and the conditions which would need to be met to withdraw access pricing are therefore a key aspect of assessing the costs of passives remedies.
- 10.6. These issues are all discussed in more detail in Section 3 of this response and Annex 2 contains a more detailed overview of the relevant legal framework which Ofcom would need to comply with before it could mandate any passive remedies. .

Question 2: *Do you agree with our preliminary views on the potential benefits of passive remedies? Please provide evidence to support your view.*

- 10.7. BT does not agree with Ofcom's preliminary views on the potential benefits of passive remedies.
- 10.8. As Ofcom sets out in its analysis, the debate is very much centred on the possibility of 'potential benefits' arising from passive remedies, rather than any clear roadmap or direct linkage to such benefits. As we set out in response to Question 3 below and in Sections 3 and 6 above, we see a very high risk of a negative impact on CPs and customers from a move to passive remedies and away from an 'active' framework in the business connectivity market.
- 10.9. In terms of the dynamic efficiency benefits, the specific example set out in the Consultation of innovation relates to the provision of 4G mobile backhaul: for the reasons set out in Section 5 above (see also Annex 1) we consider that alternatives based on further

development of the active services are capable of delivering C-RAN solutions. Moreover, we do not agree that

- the particular form of C-RAN described in the Consultation is the only current option; or
- what the timing and size of demand for any products required for C-RAN would be.

10.10. As such the position is more uncertain and complex than Ofcom implies and it is far from clear that the C-RAN example makes a case for passive access. If this is the only identifiable example of potential innovation following the imposition of passive remedies then it is not sufficient justification for the imposition of such a remedy.

10.11. We also consider (discussed in Section 5 above) that there are no obvious productive efficiencies available from the introduction of passive access and a number of reasons for considering that, on the contrary, costs may increase:

- the existence of arbitrage would lead to less efficient utilisation of duct and fibre infrastructure;
- the planning, survey and implementation costs of allowing access in a greater number of variations would inevitably increase complexity and cost; and
- although this is highly sensitive to the exact form of any passive product, there is a significant risk that passive access would lead to network duplication, stranded assets and greater complexity in capacity management.

10.12. As set out in detail in Section 5 above (and to a significant extent recognised in the Consultation), the introduction of passive remedies would not have a positive impact on service. If anything the greater complexity in provision which would arise would make the situation worse and the removal of monitoring capability for Openreach would worsen fault repair.

10.13. At this stage, Ofcom has not provided any clarity on how and when downstream regulation might be removed as a result of introducing passive access. There would be significantly greater costs and complexity of operating two systems (i.e. passive and active products) together. Far greater clarity would be required on the conditions under which active regulation would be withdrawn, else regulatory uncertainty will increase. A detailed discussion of these issues is in Section 3 above.

Question 3: *Do you agree with our preliminary views on the impacts and risks of passive remedies? Please provide evidence to support your view.*

10.14. BT does not agree with Ofcom's preliminary views on the impacts and risks of passive remedies.

10.15. The Consultation recognises two of the most significant categories of potential risk, but under-estimates their importance and adverse impacts. As set out in Section 6 above:

- passive remedies would risk undermining infrastructure providers' investment incentives not only through the issue of stranded assets (which would be more complex to deal with through allowing recovery of costs in charge controls than the Consultation suggests) but also through changing the business case for future investments and network innovations; and
- the potential for arbitrage is wider and across more dimensions than Ofcom currently recognises and impacts a larger common cost pool than identified in the

Consultation (see also the response to question 4 below): therefore the arbitrage issue will be too complex to “fix” solely by setting the right price, even if that were possible (which for the reasons set out in Section 9 we do not consider to be the case).

- 10.16. There are also additional adverse impacts in terms of the productive efficiency, highly disruptive price rebalancing and knock-on impacts on other markets and distortion to competition in related markets which are not adequately recognised in the Consultation, as discussed in Section 6 above.

Question 4: *What are your views about the potential impact of passive remedies on the pattern of common cost recovery and the associated distributional impacts?*

- 10.17. Ofcom identifies a potential leased line common cost pool which would be impacted by the introduction of passive access of £330m. For the reasons set out in more detail in Section 6, we consider this to be a material under-estimate, and these costs are likely [X] (in both 2012/13 and 2013/14). This reflects including a number of un-published services excluded from Ofcom’s analysis.
- 10.18. Ofcom’s preliminary approach to then assessing the extent of this common cost at risk and the resulting impact on active prices misses a number of elements. Again, our detailed views are set out in Section 6 but in summary:
- The analysis is static in nature. But as time goes by, with reduced active volumes, the active price will need to continue to increase to recover the same level of fixed and common costs leading to more and more substitution by passives and even higher active prices.
 - It does not take account of the fact that by the start of the next BCMR period fixed and common costs will be a greater proportion of overall costs given on-going regulatory price reductions.
 - Ofcom does not yet recognise the complexity involved in relation to how common costs could be recovered across the active and passive product set that would exist in this scenario (relying currently on very broad brush calculations) and this level of detail will be important in assessing distributional and competitive impacts.
 - Ofcom does not recognise the impact on direct leased lines costs, which would not be immediately responsive to changes in leased line volumes and hence could lead to further cost under-recovery resulting from introducing passive product volumes, at least in the short to medium term.
- 10.19. In summary, BT agrees that the impact of passive access on the pattern of common cost recovery will be major and that Ofcom’s initial high level calculations on this topic significantly under-estimate the severity of this impact. Ofcom estimates that the price of active leased line products could increase by 27% under a reasonable scenario as a result of the introduction of passive products: using the same approach we consider that some prices may in fact need to increase by up to [X]% and for the reasons set out in Section 6 above, it is feasible the impact could be greater.
- 10.20. The impacts of this would be significant:
- while such substantial price rebalancing is occurring this is highly likely to open up greater arbitrage opportunities;

- even once price rebalancing has occurred there are still likely to be significant arbitrage opportunities remaining for the reasons set out in Section 9, which will create distributional and competitive distortions; and
- higher prices in relation to active prices would also reduce demand, further exacerbating these effects all coupled with seriously disruptive pricing adjustments which will disproportionately fall on low bandwidth users.

10.21. These price changes would therefore adversely impact a large group of customers reliant on active products and distort competition in the markets for supplying these customers. The overall volume supplied to customers across active and passive products would be heavily dependent on the detail of implementation, which amongst other things would impact the extent of the opportunities for arbitrage. Significant further analysis in the context of more concrete product scope and design would be required to understand the welfare impact of such an approach.

Question 5: *Do you agree with our initial view that mobile backhaul and fixed broadband backhaul are likely to be the primary applications with significant demand for passive remedies?*

10.22. We disagree with this initial view as there are many other areas of potential very high arbitrage possibilities in corporate access especially for circuits that are high bandwidth across comparatively low distances and where active circuits are currently in place. We note that Ofcom (§7.39) states that its primary focus 'is on the access part of the network' so if it were the case that the two backhaul applications were the primary applications then they are not in alignment with what Ofcom has stated it is most concerned.

10.23. We fully appreciate that MNOs and LLU operators will have increasing demands for bandwidth in the future and in the case of the MNOs, there are some complex technological issues which will affect network design. We do not consider that the situation of either of these groups of CPs justifies the provision of passive services. We have presented to Ofcom considerable evidence that these markets are largely competitive. The absence of SMP, and/or the prospectively competitive nature of these markets, strongly suggests there is no case for passive services anyway. We believe that our position is also supported by the latest market data in Ofcom's recent data analysis consultation.

10.24. We also note that Openreach has stated that it plans to assess further with its customers the development opportunities to meet specific business needs of individual groups of customers. This is looking to build sound cases to further enhance the Openreach portfolio and product roadmap to provide its customers with the service and product choices they require. LLU operators are further well served through regulatory measures introduced through the Fixed Access Market Review, which could (as discussed above) be undermined by the introduction of passive remedies. See further the discussion of these points in Sections 2, 7 and 9 (in relation to the wide scope for potential arbitrage).

Question 6: *What benefits might duct access offer over dark fibre and vice versa? Is there a case for having both remedies?*

10.25. We believe that there is no case for either remedy in that true innovation can be implemented downstream of the layer 1 active services in almost all circumstances. If, however, Ofcom was minded to offer only one passive service then duct access typically requires CPs to take more responsibility for the building and operation of their network, and is therefore likely to better align incentives for investment and innovation. CPs would need to be more certain of the real innovation benefits of their physical layer investment and

indeed prove that innovation was the primary motivator rather than using passives as an arbitrage opportunity. Therefore whilst we do not support the introduction of either passive remedy we do see some differences in the incentive properties. These are, to a large extent, dependent on the precise nature of the structure and level of relative prices at each layer. These issues are covered more in Sections 7 and 9 above. Given that BT considers neither remedy is appropriate or proportionate, we consider that even more strongly there is no case for both forms of passive remedy. This would increase the implementation challenges and potential for inconsistencies to arise between regulation of different levels of the supply chain.

Question 7: If passive remedies were restricted to particular product types or geographic areas how might this affect the usefulness and benefits of the passive remedy?

10.26. The impact of any restriction of passive remedies will completely depend on the exact form and scope of the restriction and the scope and design of the passive remedy being restricted.

10.27. A number of factors are relevant here:

- It is for CPs to assess how their own business models would be affected, but clearly the impact on volumes of active and passive circuits would be impacted which would result in many of the impacts discussed above changing consequently.
- There are significant practical difficulties, which it may not be possible to overcome in all circumstances, in restricting (and effectively policing those restrictions) use of a particular passive remedy to a particular use or geography: this will depend to a great extent on the nature of the relevant restriction.
- Where CPs purchased duct access, the geographic areas would not necessarily align with regulatory boundaries in any case as routes and ingress and egress will be determined by local conditions, which could also create practical difficulties in so restricting the geographic scope of the remedy.
- Geographic and product boundaries shift between market review periods, in line with changing competitive conditions, making obligations to supply and restrictions on usage extremely challenging to verify and enforce over time.
- It would also not be possible to mandate a more intrusive passive remedy in markets which are found to be competitive or prospectively competitive (such as markets within the WECLA).
- Notwithstanding the practical challenges, any remedy would need to be targeted at addressing a specific issue arising from SMP and therefore related to that market or set of products where the SMP issue arises. Therefore if a justification for introducing passive access in relation to a specific use or application only was identified, then it is important that an appropriate and robust form of ring fencing was implemented to limit passive use to that particular use or application. Such ring fencing would be important to ensure no wider adverse impacts through, for example, arbitrage in other segments. For the above reasons we currently expect that this will be extremely challenging.

10.28. One example of this complexity can be judged in the context of 4G Fronthaul/Backhaul. For example if an MNO was to use dark fibre for CPRI to implement Cloud RAN then they would need to build a set of hub sites where they would house the servers that carry out the processing for all the mobile station attached to them. CPRI has a range of no more than 20 km. So each major town would need a hub centre for all the base stations in the

surrounding region. The hub would co-ordinate the activities of all the base stations (big and small) attached to it.

10.29. These issues are also raised in Section 7 of this response above.

10.30. If dark fibre was only available in certain parts of the region covered by the hub, (such as rural locations where it might be thought that BT has SMP), then some hybrid of technologies would have to be used. Either they could use alternatives to dark fibre for CPRI, or use alternatives to CPRI itself. However, in terms of running a network it is generally preferable to use a single technology. This might imply a mixture of cloud RAN and current technology for processing, that is, some processing would be done in the base stations (as per Cloud RAN) and some at the hub site (as per today). There may be ways to make this work, but much of the cost savings of bringing all the processing to the hub site would be lost. So there is likely little point in using CPRI for a limited set of locations (see Annex 1).

Question 8: *What arrangements would be appropriate for the supply of new infrastructure for passive remedies?*

10.31. The Consultation sets out Ofcom's initial view that, in relation to arrangements for new infrastructure, the arrangements currently in place for wholesale leased lines would likely also be appropriate for dark fibre. Ofcom also suggests this would be a good starting point for considerations of the arrangements that would be appropriate for a duct access remedy. The Consultation also notes that passive remedies could enable network extensions from different network points (for example, footway boxes). Ofcom also notes that this is an area it plans to consider "further as we proceed with our analysis".

10.32. We consider that the interaction of passive remedies with new infrastructure build is more complicated than is presented in the Consultation. The basic principle which should be applied is that CPs driving incremental investment and construction by Openreach should face those costs. The exact form of the passive remedy will significantly impact the extent to which its purchase will so drive Openreach capital expenditure. Especially where a greater number of hand over locations are made available to purchasing CPs, the introduction of passive remedies is likely to reduce the flexibility and choice Openreach has on how to provide the products it provides. Where new network build is effectively determined by the purchasing CP then efficient incentives are only provided where that CP faces those costs. The initial view expressed in the Consultation will not achieve this.

10.33. We therefore believe that, for the reasons set out in more detail in Section 7 of this response, Ofcom would need to undertake significant further work on the appropriate arrangements required for new infrastructure build and that this will depend on the exact form and scope of any passive remedy.

Question 9: *Do you agree with our initial views about the non-discrimination arrangements for passive remedies?*

10.34. If Ofcom were to require Openreach to sell to itself on EOI terms it would require a fundamental re-structuring of the entire company which would effectively overturn the Undertakings given in 2005. In fact even there the problems would not end as in principle every dark fibre price would need to consume a duct service which would be an upstream input. Both could be considered to be inputs to active services. The re-organisation such an approach would imply creating new interfaces and systems across the value chain would also lead to greater costs and hence consumer prices.

- 10.35. Noting that we completely disagree with the provision of any passive services at all, we therefore agree with Ofcom that requiring downstream BT to purchase passive products on EOI terms is not feasible. However, we also consider that downstream divisions of BT should be free to consume whatever upstream passive services are available free of any additional regulatory requirements or restrictions.
- 10.36. These issues are discussed in more detail in Section 7 above.

Question 10: *In light of the trade-offs identified, which broad options on pricing do you consider would be most appropriate for passive remedies and why? Please also provide details if there is another pricing approach you consider would be appropriate in light of the considerations identified in this section.*

- 10.37. We set out in detail in Section 9 above, why none of the options that Ofcom has proposed would solve the multiple problems associated with pricing passive access. De-averaging of pricing would be essential for both passive services and Openreach would be forced to parallel these at the active layer in addition. There would be very significant costs to industry, and ultimately to consumers, with no incentives to any material innovation in downstream markets.
- 10.38. A cost based duct access service would not look like the current PIA offer which is essentially for a single CP wishing to do a complete network build and where capacity problems will likely not arise. Here the situation is quite different where it is likely that multiple CPs would be fighting for limited space in the same areas leading to disputes as to who should bear the cost of additional capacity in the duct network. Nobody has suggested that it is feasible to apply a 'retail minus' to duct access; this was effectively rejected at the Colt Appeal and nothing new has come to light since then to make this workable.
- 10.39. A solution based on FRND would solve nothing at all; it would be nothing more than a precursor for disputes and appeals in which alternative methodologies and options would have to be considered.
- 10.40. We have highlighted that Ofcom has failed to account either adequately or at all for a number of sources of arbitrage for dark fibre in particular including length, density and the existing active service base. Even if Openreach managed to re-balance its active portfolio for factors such as bandwidth and length and the problems of stranded assets from circuit novation were solved, we are quite certain that other sources of arbitrage would remain.
- 10.41. The prospect of a 'retail minus' solution for dark fibre is quite infeasible given the rapid developments in service offerings and costs of equipment. It is far from clear how this model could be run in conjunction with a charge control framework given that volumes could be highly unstable if the benchmark active service declined in importance over time in favour of another active service even at the same bandwidth. There would be a very serious risk that the 'fair bet' principle could not be adhered to and BT exposed to unreasonable risks on sunk assets. Setting the price at the highest possible level would be purposeless and lead to inevitable dispute in any case.
- 10.42. Even if this approach were adopted, and assuming that BT had SMP in the highest possible bandwidth service, it is not at all clear which active product should be selected. If Ofcom decided to select 10Gb as the reference product to set an active minus price, currently Openreach have a number of 10Gb products (WES, BES, EBD, OSA and OSEA) with EAD 10Gb in development. All of these products have different cost stacks which influence the pricing, regardless of the technology. The duct and fibre element of the cost stack is influenced by distance and [X].

- 10.43. Whichever active service were adopted, Ofcom would be setting a benchmark for an alternative against which Openreach itself would have to set its commercial strategies, and this would be a highly unstable solution.
- 10.44. Fundamentally with respect to all the pricing options which Ofcom has set out, it will not be possible for national averaging to be maintained for active services particularly if dark fibre is mandated. This would have major repercussions for CPs and businesses throughout the UK with customers in the least developed or competitive areas subject to very large price increases.
- 10.45. In summary our view is that no options are appropriate and the question itself is presumptive. Neither Ofcom nor any CP has provided resolution to the serious concerns raised previously by BT in relation to passive remedies and which Ofcom itself cited as reasons to reject passive services in the last BCMR.

Question 11: *If a value-based (active minus) approach to pricing dark fibre were adopted, what do you think would be an appropriate active wholesale product (or products) to reference?*

- 10.46. Using an 'average' bandwidth service or a typical or median service at 1Gb for example would inevitably invite arbitrage for higher bandwidth services necessitating Openreach to re-balance its prices. A basket of services would not solve the problem either. In any case, there are many different varieties of services at 1Gb and whichever is adopted will invite inefficient substitution to alternatives.
- 10.47. It needs to be appreciated that CPs do not make distinctions in their choice of services purchased from Openreach which Ofcom might assume correspond to one application or another or one economic market versus another market. There is no basis therefore to adopt one active service or another as reference point.
- 10.48. Any such approach would therefore be subject to major conceptual and practical problems as discussed in more detail in Section 9 above.

Question 12: *Do you have any other comments on the issues raised in the document or comments that might aid our consideration of the passive remedies as a whole?*

- 10.49. Our detailed views on the issues raised in the Consultation are set out in the main body of this response and an overview of these is provided in Section 2 of this response.

Annex 1: Meeting future demand for Fronthaul/Backhaul capacity for MNOs

Summary

1. Ofcom's preliminary consultation on passive remedies sets out a number of themes for consultation including general arguments related to innovation but also citing a specific example (§4.15 Figure 1) related to mobile networks. In the main body of our response and in Annexes 4 and 6 we set out our reasons why we see the potential benefits of passives in general as being very uncertain and the corresponding risks and costs arising from their introduction as being highly significant.
2. However, in this Annex we examine in more detail the specific example cited by Ofcom of Cloud Radio Access Networks (C-RANs⁴²) reviewing the technical and commercial background to understand whether such network options do strictly imply a linkage to passives provision from Openreach. Our assessment based on research to date is that this is most definitely not the case. The example cited by Ofcom of a C-RAN architecture utilising CPRI⁴³ on 'dark fibre' is one possible technical solution but other potential solutions certainly exist – and are in fact more likely to be required. In particular, C-RAN using CPRI does not scale well to 5G bandwidths⁴⁴, driving standards groups to explore more bandwidth efficient solutions for fronthaul.
3. There are many factors which will affect how MNOs choose to support greater mobile bandwidth capacity and coverage for their customers. They are very likely to differ by MNO in technology and over time with no single solution clearly defined at this stage. We recognise that MNOs considering C-RAN architectures will want to access appropriate fibre solutions to meet their needs where alternatives such as microwave radio or self-build are not considered suitable.
4. However, the prevailing view of many equipment vendors and experts in the industry⁴⁵ is that even if and when C-RAN solutions are adopted they may still continue to use protocols such as Ethernet⁴⁶ and/or other optical connectivity services such as 'active' or PON (Passive Optical Network) wavelength services. The availability of appropriate fibre solutions is key, but the conclusion that only a dark fibre or duct access product from Openreach can resolve such issues is vastly premature and likely to be incorrect.
5. The development of mobile C-RAN fronthaul solutions remains at an early stage in Europe and the UK, and current indications are that large scale investments in these technologies appear unlikely in the period of the forthcoming market review. However, this is undoubtedly a rapidly evolving and new area of focus for the UK telecoms industry and therefore Openreach has already begun the process of assessing MNO requirements and

⁴² The acronym C-RAN is used to refer to both 'Cloud Radio Access Network' and to 'Centralised Radio Access Network' and hence can infer slightly different network designs. The points we make in this Annex apply equally to both unless specified otherwise.

⁴³ CPRI refers to a specific electrical and/or fibre interface 'Common Public Radio Interface' standard
⁴⁴ Vendors have quoted estimates of 5G CPRI bandwidths of 600Gbps.

⁴⁵ See for example <http://www.transmode.com/en/about-transmode/news-and-media/press-release/3381-transmode-launches-mobile-fronthaul-solution-for-c-ran-rollouts>.

⁴⁶ Vendors do not currently offer CPRI over Ethernet but this is not a technical limitation – C-RAN fronthaul traffic can be carried over Ethernet. Please see <http://www.lightreading.com/roi-tco/altiostars-c-ran-steps-into-the-light-junks-dark-fiber/d/d-id/712169>.

actively discussing potential development options with major vendors with international experience in this area and which we discuss further in this Annex.

6. Should MNO investment plans mature 'over the next few years' as Ofcom expect, then Openreach is potentially well placed to support such developments both with its existing portfolio and with newly emerging connectivity solutions based on forms of WDM technologies for example, plus an operational capability to meet large scale deployments over the longer term if required.
7. In addition, Openreach intends to continue to review and develop its portfolio to address the wider needs of MNOs, not just for C-RAN options, but also to support complementary solutions as evidenced by the recent launch of its small cells (MiiS)⁴⁷ solution. Given the competitive pressures on Openreach to meet the challenges of new commercially viable mobile technologies and incentives to build on its existing portfolio we see no case for passives as the preferred or even likely Openreach solution to potential innovations required in the mobile infrastructure space.

Inaccurate assumptions linking C-RAN to dark fibre

8. As set out in this Annex there are a number of options for MNOs to consider when looking at future requirements. In our view, this complexity is not reflected in the consultation which seems to imply that Ofcom are making an assumption that C-RAN architectures are only possible with passive remedies. The reality is that MNOs will need to meet their LTE/4G backhaul capacity and coverage challenges, as well as maintaining existing voice, 2G and 3G services. Many of these needs are already being addressed by existing Ethernet and Optical options in the Openreach portfolio and by recent additions such as the small cells service (MiiS), as well as solutions supplied by other CPs such as Virgin Media. For these reasons it is important that the *incorrect assumptions* underpinning the CPRI/C-RAN linkage to passives are carefully examined. For clarity we summarise some of these arguments below:
 - It is incorrectly suggested that C-RAN will save costs - and only passive duct/dark fibre will enable such a cost saving.
 - Although the case here is largely unproven at present, initial evidence from case studies suggests that for some MNOs it may be possible to reduce costs using C-RAN type solutions in specific deployment scenarios. The potential economies and operational flexibility gained by centralising the Baseband Units (BBU) and/or 'virtualizing' these capabilities could still be achievable whether passives or an active connectivity solution (e.g. Ethernet, WDM-PON or active WDM) is used. Such 'active' services do not prevent C-RAN architectures from being implemented by MNOs and typically WDM technologies are seen as most likely to underpin such deployments (although Ethernet also remains a candidate⁴⁸).
 - It is incorrectly implied that C-RAN is only possible with CPRI - and CPRI is only possible with a passive wholesale product (i.e. with dark fibre).
 - C-RAN architectures can use different interface standards. CPRI is perhaps the most widely cited one⁴⁹, but again it is possible for that to be carried over an

⁴⁷ Also known as Mobile Infill Infrastructure Solution (MiiS).

⁴⁸ See footnote 52.

⁴⁹ OBSAI is another standard often referenced.

optical service⁵⁰ as indicated above, or even over Ethernet. Transporting CPRI specified data in these ways may yet prove to be a preferential networking option as there are known limitations with CPRI – in respect of network monitoring for example.⁵¹ Initial indications from equipment vendors also suggest that new and more efficient standards may allow much lower fronthaul bandwidths to support C-RAN architectures.⁵²

- It is incorrectly suggested that only C-RAN will offer a technical solution of higher peak rates across a wider coverage area.
 - C-RAN is one possible option to extend very high backhaul/fronthaul coverage but other technical and design options do exist (including those discussed in this Annex) and all are subject to substantial industry review at the moment. In particular, the use of low cost small cell technology/architectures based on standard Ethernet interfaces may be an efficient and cost effective option in many deployment scenarios.

Potential Openreach options

9. Although this is a relatively recent and renewed area of focus for the UK mobile industry, Openreach is already in the process of assessing MNO needs and actively discussing potential development options with experienced vendors with international experience in this area. In addition, Openreach will continue to assess and develop its portfolio to address the multi-faceted needs of MNOs. As discussed further in this Annex, there are clearly a range of possible technical solutions for MNOs to consider, along with a range of other management and value added services that may be required to operate their networks which Openreach may also be able to offer⁵³. [X]
10. [X] Openreach is currently in the initial stage of trialling vendor equipment in this space as well as speaking to a range of potential suppliers. Openreach has also stated its intention to hold a mobile infrastructure focussed workshop with its customers in early 2015 to gather further information on what new portfolio options may be required.

The future capacity requirements of the MNOs

11. We set out below some further background information highlighting factors which will influence the industry to consider a broader range of design decisions other than the single C-RAN example cited in the consultation. Consideration of such factors will drive what are likely to be viable and efficient developments in mobile infrastructure.

⁵⁰ Other approaches use digital signalling processing electronics to carry CPRI with cheaper optical components, or to use electronics to provide a smart NTE which provides complementary management features for WAN whilst being transparent to CPRI.

⁵¹ CPRI was not designed with the normal features required by a WAN protocol (e.g. for fault location, resilience, performance and management). It is also an inefficient protocol for this type of application using a “brute force” approach to encoding the mobile signal therefore requiring a very large bandwidth. Future protocols which are more efficient and better suited to WAN connectivity and which recognise the digital nature of the mobile signal are currently being investigated by vendors.

⁵² See footnote 5. Also a number of external standards bodies are looking at redefining and optimising the radio to fibre interface such as the Small Cell Forum and 3rd Generation Partnership Project (3GPP).

⁵³ For example engineering services or project management – see <http://www.openreach.co.uk/orpg/home/solutions/solutions.do>.

12. It is accepted by all, that MNOs' customers are demanding greater bandwidth and greater network coverage. To meet these challenges of growing end-customer demands and coverage targets MNOs have several options including:
- Acquire access to additional spectrum - this is typically achieved via the auction of new spectrum ranges. Therefore individual MNOs cannot easily predict what spectrum allocation they will have in the long term. MNOs are also exploring use of unlicensed spectrum through LTE-U, but this provides a more variable quality of service.
 - Re-use the existing spectrum in more efficient ways - for example by reducing cell sizes. To achieve sufficient coverage and performance within cities and residential areas, MNOs can build more complex network structures with potentially large numbers of small cells complementing the main macro cell structure.
 - Additional Macro cells - the MNOs can build out new macro cells in rural locations for additional coverage. Potentially costs per site can be high and revenue generated per cell may be low.
 - Further develop infrastructure/network sharing arrangements - MNOs have already developed ways of increasing coverage by sharing the costs of base station infrastructure, and this could be further enhanced in the future.
13. The way in which MNOs utilise these options will have an impact on the design of their networks and demands for capacity. However in a number of areas they face a level of uncertainty:
- Spectrum allocations - different MNOs will win different quantities of spectrum in the up-coming auctions of spectrum in the 2.3 GHz and 3.4 GHz bands, which is expected to take place in late 2015 or early 2016. There is a large risk and uncertainty involved with this process for any individual MNO.
 - Mobile infrastructure sharing - depending upon which MNOs win spectrum at auction and how much, it may change the relative positions of the MNOs and the nature of commercial alliances between them. This can directly impact individual MNO base station construction plans.
 - Industry consolidation – recent developments regarding possible industry consolidation of mobile and fixed companies may also directly impact the nature and extent of mobile infrastructure build.
 - National UK roaming and other coverage options – technically calls from customers of different MNOs can be transmitted across another MNO's network to increase coverage and reduce costs. Although recent announcements⁵⁴ suggests that enforcing 'roaming' is no longer on the Government agenda in relation to partial not-spots⁵⁵, further policy measures may still be considered by the Government and Ofcom in relation to increases in total UK coverage.
 - Base Station Equipment - over time the cost of electronics typically decreases. However vendors may try to increase functionality to maintain price levels.

⁵⁴ Please see <http://www.bbc.co.uk/news/business-30528381>

⁵⁵ <https://www.gov.uk/government/consultations/tackling-partial-not-spots-in-mobile-phone-coverage>

- Network Costs - connectivity costs for a given bandwidth and line length are constantly falling. However if MNOs need to build to a wider set of locations for small cells then total network costs could still rise.
14. In the UK, most MNOs have upgraded their networks substantially over recent years, via a combination of the above methods, to address 3G and 4G requirements, so very large scale changes to existing architectures are unlikely for the next few years. However it is undoubtedly the case that MNOs will need to consider their longer term network evolution plans for the next 5-10 years from now.
15. Despite the various network strategies which can be deployed, it remains the case that in the longer term MNOs will need to increase the number and performance of cells in their networks, ranging from highly distributed networks of low cost small cells to tightly synchronised macro-cells with centralised processing. All these factors have implications for the potential requirements of fronthaul/backhaul networks and the range of different choices that individual MNOs may make in the future.

Technology assumptions are important

16. Assumptions on future technological trends are also important in understanding how mobile networks may develop to meet fronthaul/backhaul needs and whether dark fibre or other options are likely elements of the solution:
- Technological advances in base station technology – already some vendors are demonstrating miniaturised base stations,⁵⁶ which are much more compact, air cooled and with reduced running costs. Volume demand along with competition amongst vendors will exert considerable downward pressure on unit prices. This will lead to accommodation costs being reduced and reductions in power consumption. Such devices may be able to use Ethernet protocols (or other optical connectivity options) and therefore use already existing access products from suppliers including Openreach and Virgin Media. If however Ethernet with SyncE and 1588v2 are not sufficient then new standards-based protocols can be developed. This is in contrast to what appears to be a series of implicit and erroneous assumptions being made in the consultation text regarding dark fibre i.e. that base station technology will not evolve and cost components, size and power consumption will all remain largely unchanged; and that CPRI will remain a de-facto standard and more network efficient protocols will not be developed.⁵⁷
 - Technological advances in aggregation - it is likely that there will be innovation at the aggregation node. Functionality could be virtualised and will result in some further cost savings and improved operational performance. This is the main distinction between a 'centralised' RAN and a 'cloud' RAN design.
 - Network costs – Openreach is strongly incentivised to innovate and to continually improve cost efficiency over time – through a mixture of competitive and regulatory pressures. Openreach is regulated on all aspects of its portfolio where it is deemed to have significant market power and this leads to reduced prices over time. Where

⁵⁶ Atom Cell from Huawei is a miniature base station which uses either PON, Fast Ethernet or CPRI. See - <https://www.scribd.com/doc/234060853/Huawei-Small-Cell-Solution-Overview>.

⁵⁷ AirSynergy from Airspan is a miniature base station. See <http://www.airspan.com/products/airsynergy/>
Various network operators and vendors are already questioning whether a redefinition of CPRI is required to make it more compatible with fibre networks.

Openreach is unregulated Ofcom will have already identified the presence of competitive pressures from other providers such as Virgin Media which will constrain pricing and incentivise competitive pressures for new product developments. Virgin Media is now well established as a supplier to the mobile industry and is already working with major equipment vendors to increase its presence.⁵⁸ The assumption underpinning calls for dark fibre appears to assume that a passive solution will be a much cheaper option (and remain so) than an alternative regulated or competitively supplied service. However this does not take a realistic view of the underlying operational and capital costs of purchasing and building such services. As noted elsewhere in this response de-averaged passive pricing (for example of sparsely filled ducts in rural areas where the MNO may be the major user of the duct) may not lead to the types of savings assumed.

Commercial options may also support MNOs' capacity requirements

17. In addition to technological innovations there are other commercial approaches that MNOs could adopt to expand capacity:

- Access network aggregation - compared to an assumption of CPRI over dark fibre which requires dedicated fibre between the base station and the C-RAN node, considerable cost advantage may be achieved using other technologies by aggregation in the fronthaul/access section of the network (i.e. the link to the base station – as distinct from the backhaul link from the first network aggregation point back to the core network) hence reducing physical fibre count between cell-sites, other nodes and the C-RAN node. The cost gain is likely to increase with increasing density of cells. Such aggregation gains would likely be based on existing universal traffic protocols such as Ethernet, WDM, or WDM/OTN, whereas aggregation of CPRI based information could only aggregate base station traffic and would run 'parallel' to all other traffic in the access network.
- Base Station sharing - the infrastructure costs of accommodation, cooling and other operating expenses can be shared, reducing ongoing base station costs. MBNL and Cornerstone both use Multi-Operator Radio Access Network (MORAN) technologies to enable two operators' traffic and spectrum to operate via a common radio access network infrastructure.
- National roaming agreements - calls from customers of different MNOs can be transmitted across another each other's network. This could be an even more efficient way to share network infrastructure. Various MNO systems (e.g. billing) would need to be modified to cope with this type of interconnection, but it would arguably be a much cheaper and more effective method of increasing coverage than increasing network build.
- Small Cell Sharing - there are natural limitations to capacity in some geographic areas (e.g. individual streets) where there is potentially limited availability to attach transmission equipment. Again scarce resources such as this could be shared between MNOs.

⁵⁸ <http://www.transmode.com/en/about-transmode/news-and-media/press-release/279-virgin-media-business-awards-transmode-mobile-backhaul-contract?highlight=YToxOntpOjA7czo0OiJtYm5sljt9.>

- Third Party networks - There are also other possible solutions which combine various elements of the above, such as a shared backhaul/fronthaul network, provided in an open-access and non-discriminatory manner by a third party. This would avoid the need of MNOs to replicate each other's network, and may also be particularly suitable for reaching difficult locations for small cells and for remote rural locations where it is not financially viable for a single MNO to build out⁵⁹. This is in many ways the logical extension of base station sharing.
 - Under this type of scenario there is strong potential for scale and scope savings on existing and new fibre investment by Openreach to be shared with the whole industry and across both mobile and fixed services. The introduction of passive remedies undermines such forward looking investments, potentially restricting the wide-scale benefits of efficiencies in fibre deployment, and generating greater inefficiency and duplication of fibre infrastructure overall. However, we recognise that should a single approach be adopted across the industry then there may be commercial and regulatory issues that would need to be addressed in order for it to proceed.
18. Nevertheless, the key issue is that these types of solutions are arguably much simpler and more effective ways of increasing coverage and reducing costs for MNOs in both in rural areas and city centres, and they have not yet been fully assessed or exploited by the industry. In such circumstances it is essential that all technical and commercial options are explored by Ofcom before taking the radical, irreversible and potentially damaging step of introducing passive obligations on Openreach, arguably before the mobile industry has itself fully explored a multitude of opportunities which are already open to it.

Conclusions

19. There are many factors which will affect how MNOs choose to support greater mobile bandwidth capacity and coverage for their customers. They are very likely to differ by MNO in technology and over time with no single solution clearly defined at this stage. The structure of an individual MNO's network will depend upon many factors including how much spectrum they acquire and how tightly they need to control and reuse spectrum in their network designs.
20. Some of the biggest savings could come from future decisions on how MNOs decide to share infrastructure such as transmitter sites (small and macro) and whether initiatives such as national roaming are implemented. These decisions could substantially alter the amount of new infrastructure investment required by MNOs.
21. MNOs have carried out major upgrades of their networks in recent years and additional major network extensions are unlikely for a period. In that time, technological advances are likely to make base stations and other components for small cells much cheaper and more compact, and this has the potential to change the economics of the design decisions (e.g. for centralisation of equipment). Additionally, the whole mobile infrastructure area is now a major focus for research and it is likely that more efficient solutions than CPRI, requiring less bandwidth and carried by standard protocols such as Ethernet and/or optical services will be developed.

⁵⁹ Mobile Broadband Network Limited (MBNL) a joint venture between Three and EE already partially addresses this need as does Cornerstone (Vodafone/O2) although they adopt different commercial approaches.

22. At this stage there is no reason to presume that C-RAN provided by CPRI over dark fibre will be the optimal solution to develop a 4G/LTE network. Our assessment based on research to date is that this is most definitely not the case. To support MNOs Openreach intends to continue to review and develop its portfolio to address their wide needs, both for C-RAN options, and also to support complementary solutions such as small cells.
23. Given the competitive pressures on Openreach to meet the challenges of new commercially viable mobile technologies and incentives to build on its existing portfolio we see no case for passives as the preferred or even likely Openreach solution to potential innovations required in the mobile infrastructure space.

Annex 2: The applicable legal framework

A. Introduction

1. For Ofcom to properly assess the need for passive remedies, there are a number of initial matters that it must address to meet its stated objectives of maintaining “effective and sustainable competition, innovation, efficient investment and widespread availability of telecoms services”⁶⁰.
2. If Ofcom were to impose passive remedies without identifying a specific competition problem (or problems) in the business connectivity markets which properly justify additional regulatory obligations, BT considers that the introduction of passive remedies would fail to meet the legal test for the introduction of new network access conditions, set out in the European Common Regulatory Framework and the Communications Act 2003 (“CA03”).
3. This Annex sets out why BT considers that, on the basis of Ofcom’s proposed framework for analysis as set out in the Consultation: (i) Ofcom would have difficulty in establishing sufficient grounds to reach the jurisdictional threshold to include passive remedies in the Business Connectivity Market Review (“BCMR”) regulatory framework (by reference to section 87(3) “CA03”; and (ii) even if Ofcom were to reach the jurisdictional threshold, Ofcom’s exercise of that jurisdiction in proposing passive remedies would not be a proportionate way to address its regulatory objectives.
4. Further, BT considers that:
 - a. Ofcom’s powers to monitor and enforce existing active remedies (together with its competition law powers) are fully sufficient to address any concerns Ofcom may have as to the hypothetical possibility of competition problems in the business connectivity markets (where demand and downstream competition are well-established), where in fact competition has increased in many market segments since the last BCMR.
 - b. It is not clear what benefits the introduction of passive remedies would have over the current suite of active remedies, how this would better promote competition in the business connectivity markets and whether this is the appropriate level at which to intervene in the supply chain.
 - c. The case for passive remedies needs to be considered via a sufficient impact assessment which considers what competition problem(s) Ofcom would be trying to solve, whether passive remedies are the most appropriate way to address any problems identified and whether the incremental benefits arising would be outweighed by the significant costs and dis-benefits they would create. These costs include impacts on overall efficiency arising from cherry-picking and arbitrage, as well as harm to innovation and investment incentives and transitional and implementation costs.

⁶⁰ Ofcom, *Business Connectivity Market Review: Preliminary Consultation on Passive Remedies*; paragraph 1.7, page 3.

B. The relevant legal framework for Ofcom's consultation

5. The legal basis for imposing new network access conditions in relation to passive infrastructure is section 87(3) CA03. As per section 87(4)(d) CA03, one relevant factor in determining the most appropriate network access condition is “the need to secure effective competition in the long term”. This is therefore a relevant factor at the time of determining the *nature* of the condition, but not the sole criterion for deciding that a new network access condition is in and of itself appropriate.
6. SMP conditions are derogations from the general position laid down by Article 3(2) of the Authorisation Directive that only general conditions are to be imposed.
7. Article 8(4) of the Access Directive (“AD”) states that conditions imposed must be “based on the nature of the problem identified, proportionate and justified”, and Article 8(5)(f) of the Framework Directive (“FD”) provides that *ex ante* regulatory obligations should only be imposed “where there is no effective and sustainable competition” and that such obligations must be relaxed or lifted “as that condition [i.e. effective and sustainable competition] is fulfilled”.
8. Of further relevance are Ofcom's duties, as set out in sections 3 and 4 CA03. The principal duty is “(a) to further the interests of citizens in relation to communications matters and (b) to further the interests of consumers in relevant markets, where appropriate by promoting competition”. In addition, Ofcom must have regard in all cases to “(a) the principles under which regulatory activities should be transparent, accountable, proportionate, consistent and targeted only at cases in which action is needed; and (b) any other principles appearing to Ofcom to represent the best regulatory practice”.
9. In the Consultation, Ofcom states that the framework for analysis of appropriate remedies where there is a finding of SMP will be based on an assessment of “what remedies we should impose, whether passive, active or both, in light of the nature of the competition problems we identify in the relevant markets”⁶¹. However, BT considers that since the last BCMR, there have been no significant market developments warranting a shift in regulatory approach. It is therefore unclear what competition problems passive remedies would address. In this context, BT would caution Ofcom against determining that both passive and active remedies are required to remedy existing competition problems for which only active remedies were appropriate in the last BCMR.
10. In addition, Ofcom further states that passive remedies could have “potential applications and effects beyond the leased lines markets”⁶². This is not, however, the purpose of new network access conditions imposed in business connectivity markets. BT does not see how from a strict legal and regulatory perspective effects beyond specifically defined markets can properly justify the imposition of additional regulation in those markets.
11. The imposition of new specific network access conditions is therefore only appropriate in response to specific competition problems and only where that action would be, amongst other things, justifiable and proportionate. Prior to deciding that passive remedies are necessary, Ofcom must identify what additional risks are now present that could negatively impact competition in the business connectivity markets. It is not sufficient to rely upon a general need to secure effective competition.

⁶¹ *Ibid*, note 1, paragraph 1.10, page 4.

⁶² *Ibid*, note 1, paragraph 1.13, page 4.

12. Given the objective of deregulating where possible, regulatory remedies are not to be seen as the first step. This is recognised in Ofcom’s own regulatory principles and policy statements, namely:
 - a. Regulatory Principle 3: *“Ofcom will operate with a bias against intervention, but with a willingness to intervene firmly, promptly and effectively where required”*; and
 - b. the first paragraph of its guidance on how it will conduct impact assessments⁶³: *“The decisions which Ofcom makes can impose significant costs on our stakeholders and it is important for us to think very carefully before adding to the burden of regulation. One of our key regulatory principles is that we have a bias against intervention. This means that a high hurdle must be overcome before we regulate. If intervention is justified, we aim to choose the least intrusive means of achieving our objectives, recognising the potential for regulation to reduce competition.”*
13. This therefore sets out the legal background against which Ofcom will need to identify its regulatory objectives regarding passive infrastructure prior to making its proposals for full consultation.
14. Where Ofcom fails to meet the above requirements and, as a result, fails to reach the jurisdictional threshold for imposing new access conditions, there will be no legal basis on which to impose additional regulation by way of passive remedies.

C. Principle of proportionality

15. Even if the jurisdictional threshold for imposition of additional network access conditions were to be passed, Ofcom would still have to satisfy the principle of proportionality before it could impose such remedies, both as a matter of general law under the European Common Regulatory Framework and in light of the following specific provisions:
 - a. Article 8(4) AD and Article 8(1) FD and sections 3 and 4 CA03 all require that regulatory action by Ofcom should respect the principle of proportionality;
 - b. Section 87(4)(b) CA03 provides that Ofcom must consider “the feasibility of the provision of the proposed network access” when determining the conditions to impose; and
 - c. Section 87(4)(c) CA03 further imposes a positive requirement on Ofcom to take into account “the investment made by the person initially providing or making available the network or other facility in respect of which an entitlement to network access is proposed”.
16. In order to perform a proper analysis of whether passive remedies are required or whether the current status quo is sufficient to address competition problems in the business connectivity markets, Ofcom must place due weight upon the proportionality of remedies imposed in relation to any competition problems identified. Whilst BT does not dismiss their importance, Ofcom should not pay greater regard to the factors identified in the

⁶³ Better Policy Making: Ofcom’s approach to impact assessment; Ofcom’s approach deliberately reflects broader policy objectives of the UK Government to minimise regulation: *“The option of not intervening ... should always be seriously considered. Sometimes the fact that a market is working imperfectly is used to justify taking action. But no market ever works perfectly, while the effects of ... regulation and its unintended consequences, may be worse than the effects of the imperfect market”* Better Regulation Task Force (September 2003).

consultation document of “economic efficiency, including incentives to invest and innovate; effective competition among CPs; distributional effects on consumers; commercial and regulatory consequences; and the widespread availability of services throughout the United Kingdom”⁶⁴, if passive remedies would not categorically be a proportionate response to the identified competition problems.

D. The need for a sufficient impact assessment

17. A detailed, rigorous and careful impact assessment will need to form a vital part of Ofcom’s analysis of whether passive remedies are appropriate (or indeed, more appropriate than active remedies).
18. BT considers, therefore, that the case for passive remedies needs to be assessed in light of a balancing of the costs of any proposals against the benefits of applying them, particularly since individual elements such as innovation may involve both costs and benefits. Other relevant factors include: (i) the costs arising from the impact on overall efficiency as well as harm to innovation (via the loss of economies of scale resulting from an increase in diversity of products); (ii) investment incentives; and (iii) transitional and implementation costs.
19. Further, BT would emphasise the precise steps Ofcom would need to undertake to complete a sufficient impact assessment, as set out in the Department for Business, Innovation and Skills Impact Assessment Toolkit⁶⁵:
 - a. Identification of the problem;
 - b. Specification of the desired objectives;
 - c. Identification of viable options that will achieve those objectives;
 - d. Identification of impacts;
 - e. Valuation of costs and benefits, and selection of the best option.
20. Specifically in relation to the available options, impacts and cost-benefit analysis, BT submits that:
 - a. Competition based on active remedies remains appropriate and that passive-based competition would not enhance welfare through new products, better service or improved coverage;
 - b. Introducing regulatory requirements at different levels of the supply chain leads to a number of possible adverse impacts: loss of focus and clarity, greater regulatory uncertainty and harm to investment incentives; and
 - c. The current approach based on active remedies has delivered vigorous and effective competition at the retail level and increasingly at the wholesale level, such that less, rather than more, intrusive regulation is warranted.
21. Therefore, in its impact assessment, Ofcom must show that the regulatory status quo in terms of i) existing active remedies, ii) BT’s Equivalence of Inputs (EOI) obligations under its Undertakings accepted by Ofcom in 2005 and iii) and competition law are insufficient to address *specific* competition problems in the business connectivity markets and that,

⁶⁴ *Ibid*, note 1, paragraph 1.11, page 4.

⁶⁵ Section 2, *Better Regulation Framework Manual – Practical Guidance for UK Government Officials*, July 2013.

therefore, additional regulatory obligations are required. Even if, contrary to BT's view, those protections are inadequate to address Ofcom's concerns, then a sufficient impact assessment would require Ofcom to consider a range of options that could meet those concerns, prior to concluding that passive remedies would be the only (or preferred) solution.

E. The most appropriate framework for assessing the case for introducing passive remedies

22. In light of the above points, BT suggests that the most appropriate framework for assessment is as follows:
 - a. The first stage must be to identify what the underlying strategic justification for introducing passive remedies would be. This would involve identifying the specific competition problems to be addressed and overarching policy justification or market failure which needs to be solved by a change in the regulatory approach. In other words, a clear statement of the regulatory objective.
 - b. In the context of this identified objective, Ofcom should start by considering the extent to which this would be met by maintaining the status quo.
 - c. In the event that the regulatory objective could not be achieved by maintaining the status quo, Ofcom should then consider whether the objective could be met by amendment of the remedies that are applied to the existing active products, i.e., a consideration of all alternative options.
 - d. If passive remedies were to be considered, Ofcom should first be able to articulate why it is that active remedies would be unlikely to suffice to achieve the regulatory objectives and why nothing other than some form of passive remedy would suffice.
 - e. Ofcom could then assess different forms of passive remedy to assess whether they were able to address the policy need or market failure.
23. Ofcom should at that point ensure that a sufficient impact assessment was undertaken, testing a variety of possible solutions (not just its preferred solution) against the benchmark of the existing regulatory regime. This would enable Ofcom to determine if its proposals met the requirements of the European Common Regulatory Framework and the CA03. In particular, this would enable Ofcom to reassess whether, given the potential costs and benefits, the remedies proposed were the most apt and proportionate in all the circumstances.

Annex 3: A comparison with LLU or PIA is not relevant

1. This annex sets out BT's view that neither the introduction of LLU nor the subsequent launch of Physical Infrastructure Access (PIA) following the 2010 Wholesale Local Access (WLA) market review provide suitable analogies for why any form of passive remedy should be introduced for business connectivity. A number of the CFI responses drew a parallel between the introduction of dark fibre in business connectivity markets and introduction of LLU to support consumer broadband services. We do not consider that this is relevant as LLU was introduced in a nascent market to address a specific access bottleneck whereas passives remedies in a business connectivity sense would apply across a wide range of established markets. Ofcom introduced PIA in the WLA market specifically to address a particular public policy aim for which there is no equivalent identified in business connectivity. We therefore do not consider that either the introduction of LLU or the introduction of PIA to address SMP issues in relation to consumer broadband represent relevant precedents for introducing passive remedies in business connectivity markets.

PIA for Wholesale Local Access is not a relevant precedent for business connectivity

2. To the extent there is currently passive access to BT's infrastructure, this is implemented through the PIA product. This was introduced to address a clear policy need: creating the possibility for Next Generation Access (NGA) roll-out beyond the two thirds' of the country where it was considered commercially viable. The PIA product is designed with this wider goal in mind, enabling investment in areas where BT was at the time considered not likely to otherwise do so. This also aligns with both Government and wider European targets and policy goals to achieve widespread NGA availability and demand (as well as being consistent with Ofcom's statutory objective to ensure widespread access to and use of data services).
3. PIA is therefore clearly focused on achieving a socially important aim, which was considered not feasible only through other remedies, and which aligned with specific policy goals and Ofcom's statutory duties. There is no equivalent public policy challenge which could justify introducing passive access in relation to business connectivity. It is also worth noting that PIA was a complementary remedy and Ofcom's primary regulatory intervention in the Wholesale Local Access markets was through active remedies.

LLU also does not provide a relevant analogy for business connectivity passive remedies

4. A number of CFI responses argued by analogy that business connectivity dark fibre would have the same impacts as introducing LLU. This, largely unsubstantiated, assertion needs to be assessed with some care.
5. The Consultation makes two significant points with regard to this potential parallel. First, Ofcom notes that establishing LLU required significant time and investment for BT and the rest of the industry (§4.39). Second, the significant difference in circumstances between the two situations are pointed out (§4.40). We agree with both of these points.
6. At heart, this argument is suggesting there is a need for more competition which is assumed to solve the issues which some stakeholders have identified in business connectivity markets. Section 5 in the main body of this response deals with whether passive access would improve the specific issues identified (as compared with any improvements possible under the existing active regime), which BT disputes.

7. More fundamentally, LLU introduced competition with respect to an access bottleneck where the only alternative infrastructure provision was cable. As the Consultation recognises, the LLU situation was materially different, being introduced to support a relatively low base of consumer broadband services at the time. Ofcom also notes that in the business connectivity context active and passive remedies would need to co-exist in the longer term to support effective competition. This would create a fundamentally different situation to that which exists in relation to LLU. We would further emphasise the following points in relation to this comparison:
- LLU was promoting growth in a nascent broadband market rather than one where there was already well established supply and demand;
 - this related to a specific access bottleneck (as opposed to applying potentially across a number of markets, not only access, where there is no enduring bottleneck which is the situation with regard to current business connectivity services);
 - in relation to LLU there was a direct read through from the market analysis (undertaken at the exchange as a geographic unit) in a way which was measurable to the specific downstream market, while in relation to dark fibre there would be no such clarity in the analysis, measurement or outcome; and
 - LLU provided a complement to other network investment, in itself creating an investment incentive, whereas dark fibre could significantly substitute investment.
8. As such, the introduction of more widespread dark fibre provision would not create the same network based investment. In many areas of the country there are already alternative network based competitors providing business services. Rather than expanding infrastructure competition, dark fibre would shift investment incentives and could have effects reducing where operators are likely to roll out their own physical network. The overall impact would be to reduce the diversity of competition currently supplying a very diverse set of business markets. The overall net effect would largely be to shift returns between CPs, rather than the creation of sustainable additional competition promoting the interests of business orientated end customers. Active remedies already support a diverse range of providers supplying the diverse range of business end customers, which is a materially different situation to that which existed in relation to broadband provision prior to LLU's introduction.

Annex 4: Innovation in regulated access markets

I. Summary

Scope and conclusions of Paper

1. This Annex reviews the key allegations made by CPs in the BCMR Call for Inputs regarding the track record of innovation in Openreach and the assertions that passive remedies would alleviate some of these problems by permitting innovative services. To a degree these matters cross over into whether or not the SOR process meets the requirements of providing innovative services which are appropriate to the scope of Openreach itself as the provider of upstream access/backhaul bottleneck services.
2. The arguments made by some CPs in favour of passives are not restricted to purely technical features but also extend to commercial issues such as scalability of capacity and broader downstream commercial models. Colt has even alleged that the entire downstream industry has had to follow the technology and topology of BT's network and its own commercial market segmentation and that passives would help break free from this.
3. Although many of these arguments were extensively examined in the Colt Appeal in 2013, the same or similar points are now being made again. This annex provides our updated views in these points based on the published CP responses to the Call for Inputs. We also set out the innovation record of Openreach and explain why leased line monitoring plays such an important role, not only to ensure that faults can be identified as quickly as possible but also to ensure that BT's brand position is protected in both upstream and downstream markets.
4. CPs appear to consider that, in using passive products they would be in competition with Openreach in the provision of upstream active services including in a merchant market. Elsewhere in this response, BT sets out that, were either or both of Duct Access and/or Dark Fibre to be mandated, the pricing of active products would need to be significantly increased. The same applies to the incentives on Openreach to innovate and more generally on how to run the SOR process. This annex sets out important factors which would necessarily need to be reviewed consequent on passives being mandated.
5. There is no evidence that provision of passive access would result in any material innovative service downstream of Openreach which cannot be achieved by a form of active service.

Response to CP assertions on benefits of passives for innovation

6. In their CFI responses CPs claim that passive services would:
 - allow the supply of differentiated downstream service technical features such as Layer 1/2/3 decisions and other highly technical features of services;
 - permit better commercialisation of downstream services including tariff structures and differentiated commercial models allowing CPs to break free from the BT equivalents; and
 - improve Quality of Service (QoS) covering a broad range of issues including time-to-market, SLAs and time to repair.
7. Technical features of services. The active services which Openreach offers are deliberately designed to follow best engineering practice to allow a wide range of services downstream with very different technical features. We set out below what innovation should be

considered in the 'upstream' domain, what is in the 'downstream' domain, and the very small area of overlap for innovations which could be in either.

8. Any potential downstream service which may be hampered (if any) by the current range of Openreach Ethernet and optical services would be limited. If any such services exist, then they are: (a) for highly niche customer markets; and (b) at sites which would likely be located in competitive footprints in any case. There is therefore no likelihood in principle or any evidence to support any assertion of the technical inadequacy of Openreach services.⁶⁶
9. Commercialisation of business models. We accept that Passive services would have some advantages for CPs including ability to scale up capacity more quickly and without reliance on BT equipment. The benefit of greater speed of upgrade is in practice a minor benefit as CPs will typically plan upgrades in capacity and have excess capacity available at point in time. Removing their reliance on BT equipment also has adverse effects as it raises complex issues of monitoring and fault repair. Overall this will therefore not be a net benefit. Flexibility is possible, however, and the Openreach architectural approach for Alien Wavelengths discussed below, for example, may provide a suitable compromise for some uses although not appropriate for standard EAD services.
10. We can see no reason or evidence to substantiate the broader claim that CPs are bound to follow BT's network topology or commercial models. In any case, customers will be indifferent and likely totally unaware of the underlying topologies of their serving CPs whether hub and spoke or ring or hybrids of the two. Openreach does not double recover from 'unused capacity' and nor does it dictate the form of downstream commercial relationships either. Upstream inputs will likely form an important component in the overall cost stack, but will not form the majority of the total cost stack in any case.⁶⁷
11. Quality of service. While, this annex does not address all the issues on Quality of Service (QoS) in detail, it does look at a number of specific points. The first is that the process of provisioning the fibre itself would be unaffected were dark fibre mandated.⁶⁸ The second issue is that of fault repair and the associated matter of line monitoring. Introducing passive remedies would lead to a need for additional processes, given that Openreach would not be able to monitor the lines. Finally, we note that technical aspects of QoS such as contention, re-routing and protection, and latency are all aspects of QoS which are already under the control of the CPs with the current portfolio. Passive remedies would not add anything to the CPs' choices in this regard.

Openreach track record on innovation and the SOR process

12. Openreach's track record on innovation has been good and kept pace with industry requirements. Where Openreach has not implemented certain services it has been because it was uneconomic to do so. While some solutions may have suited the particular requirements of an individual CP it is also important to take account of any significant costs which would stand to be recovered from the wider CP community.

⁶⁶ The CAT (paragraphs 133 and 178) noted that Colt itself had acknowledged that the UK has 'world class' business services.

⁶⁷ [X]

⁶⁸ With the important exception of the installed customer base of circuits where fibre would obviously be in place and then open to arbitrage opportunities.

13. Openreach has every incentive to provide innovative services through the EOI processes. These incentives arise from both regulatory obligations and also BT's position as a major downstream player competing throughout the UK.
14. The time taken to introduce SyncE was raised in a number of CP responses as an example of failure to innovate. In fact, SyncE was in effect 'gifted' by BT to the entire industry itself from BT research and it was provided without retaining Intellectual Property Rights⁶⁹. Subsequently, there was considerable dispute and uncertainty as to its commercial viability with strongly divided opinions and no consensus across industry. In this particular case there was a very high degree of uncertainty and Openreach was being asked to make a commitment which the MNOs themselves would likely not have done had they been in the position of having to self-supply. Openreach now offers SyncE as part of its EAD service. Other providers of backhaul services to the mobile industry also provide SyncE.
15. BT continues to innovate and, where appropriate, these developments are at the upstream level appropriate to Openreach. Many of the innovations which CPs discuss in their CFI responses are not relevant to the upstream market and should occur in the downstream markets. Openreach is continuing to offer higher bandwidths and new services such as the newly launched Alien Wavelength service, which is tailored to provide cost effective optical services extending beyond the current point to point topology.
16. BT is not aware of any parallel in the telecoms world anywhere which has anything like the degree of transparency and fairness which is now firmly established in the Openreach supply model through the SOR process. Openreach has several hundred CPs buying Ethernet services and the downstream end-user market is competitive. There are no material problems that need to be addressed through a fundamental shift in regulatory strategy from a new regime based on the introduction of passive remedies.
17. The SOR process inevitably involves a degree of consensus seeking which a fully integrated company might be able to circumvent. However, it is also the case that the development and investment timescales are typically not those of short term decisions of a few months but are generally of the nature where industry standards bodies themselves play a key role and these are typically in the period of a couple of years.

Passives raises many questions on future innovation by Openreach

18. Openreach would be put into a very different commercial position if it were to be placed in direct competition with CPs for the provision of active services. There is certainly no parallel to the situation of LLU and the consequent growth of consumer broadband and how the WBA markets became de-regulated.
19. The speed and strength of uptake of demand for passive products, if mandated, would be very difficult to predict. Much would depend on the precise obligations of provision as well as the level and structure of prices. It is also the case that technical progress itself could easily change the balance over time; fibre connectivity is not a homogenous "commodity" product and developments in electronic transmission could make it economic to use less rather than more fibres shifting the balance between duct access, dark fibre and active services.

⁶⁹ The use of Ethernet is in fact limited in one non-niche application case (for MNO base stations) which arises from the fact that it was not originally designed to provide synchronous services. This however is due to the basic core design of Ethernet, rather than due to any issue from Openreach and it was solved by BT in 2004 from the invention of SyncE.

20. Passive remedies would increase both the overall level of risk associated with innovation and fundamentally change the balance between different players which would be a radical shift from the current situation. We identify three potential impacts on Openreach itself.
21. First, it will be evident that where there is uncertainty of demand, Openreach would necessarily have to consider it less likely that certain services which are borderline for development would be less viable to be taken up.
22. Second, to the extent CPs take passive services and are active in a merchant market, the transparency in the current processes will be put under severe strain. Openreach cannot be put in the position of taking risks of development and service upgrade for CPs to be allowed the options to self-supply but if that fails, then to free-ride on the developments by then simply purchasing active services which will be paid for by others.
23. Third, [REDACTED]

II. Response to CP criticisms of Openreach

24. This Section deals directly with some of the claims and criticisms CPs have made regarding Openreach innovation record and the SOR process and how allegedly passive services would solve these. For ease of comprehension, we split up what may be considered to be the more technical aspects of service provision from commercial ones and then look at the operation of the SOR process and its relationship to some aspects of quality of service.

Whether active services prevent technical solutions for CPs

25. The two principal CP CFI responses which we deal with here are those of Colt (Pages 12-14, 31-36, Annex C) and TTG (2.4 Section 2.2.3 and 2.34) which make similar claims regarding the technical and commercial superiority of passive services compared with active services. References below are with respect to Colt but we believe these also address the substantive issues raised by TTG.
26. In general, Colt claims that the benefits of passives are wide ranging and pervasive. However, much of the discussion of these claims consists of broad assertions (and any supporting evidence appears to be redacted).
27. This Annex first deals with some specific claims made by Colt and then subsequently addresses the five main areas of technical/pricing specification of active products where it is claimed passive services would allow innovation.
28. With regard to specific claims and in response to the question of what benefits passive remedies might offer for service innovation (Question 16(a) of the CFI), Colt states:
“... For this reason it is important for CPs to be able to respond as flexibly and cheaply as possible offering a pricing structure that is responsive to the customer’s particular needs. Flexibility implies control over the:
 - SLA;
 - layer 1,2 and 3 technology decisions;
 - bandwidth/capacity provided (including factors such as symmetry, scalability and burstability);
 - pricing structure;
 - QoS.

None of these can be varied when buying an active service from BT.”

29. This is a very broad set of assertions which we consider to be wrong; in fact, all of these factors categorically can be varied to be “responsive to the customer’s particular needs ... when buying an active service from BT”.
30. Even an initial consideration (and a more detailed consideration of each point is given later in this annex) shows that this conclusion cannot be true. For example:
- The EAD input is only one factor which affects a retail SLA and even this may be decoupled by resilience and/or pre-provisioning for the EAD input.
 - Any aspect of the Colt retail SLA associated with the need of Openreach to provide new duct would be unaffected by passive access and similarly any aspect of the Colt retail SLA would be unaffected by dark fibre.
 - EAD is fully transparent to ‘Layer 2’ and ‘Layer 3’ and all innovation at these layers is unaffected by whether a passive access service is taken or not.
 - Passive access affects bandwidth/capacity only if the timescale at which a CP can change the bitrate/protocol with which a fibre is dimensioned using its own equipment, in comparison with the alternative of an access services and where Openreach undertakes a re-arrangement or upgrade.
 - As EAD is a permanent dedicated capacity, all flexibility associated with ‘burstability’ is downstream of EAD.
 - The pricing structure of the EAD input need have no bearing on the pricing structure of retail services. (See the next section of this annex on commercial models.)
31. Table 5 below summarises each of the claims made by Colt, summarised in paragraph 31 above, against four categories (these categories are also developed and discussed more fully in Section V below):
- (A) innovation downstream of current Openreach products;
 - (B) innovation downstream of dark fibre but upstream of the current products;
 - (C) innovation downstream of duct access but upstream of dark fibre; and
 - (D) innovation upstream of duct access.
32. In fact, all the areas in the first column can be varied under the current Openreach portfolio and these represent a large number of the important differentiators of retail services. In the last column are those areas where innovations must be undertaken by Openreach, even under passive access, as the innovation depends directly on the passive infrastructure still being provided by Openreach under passive access remedies.

Table 5: Categorisation of Areas of Innovation raised by Colt in Response to Ofcom Call for Inputs Question 16

	A CP innovation with EAD	B Additional CP innovation under dark fibre	C Additional CP innovation under duct access	D OR innovation under duct access
SLA	SLA aspects from own downstream elements SLA aspects mitigated by resilience and pre-provisioning structure	none	Ad-hoc use of cherry-picked bits of duct which happen to coincide with routing of desired access ring	All provisioning of new duct and repair of duct
Layer 1,2 and 3 technology decisions	All layer 2 and above including contention, switching, routing	Change process of layer 1 Choice of bit rate and layer 1 protocol not in OR portfolio or available under SOR	none	none
Bandwidth/ capacity provided	All end to end bandwidth, contention, traffic QoS, protection and restoration, time of day capacity management	The maximum capacity of the last mile.	Number of fibre strands preinstalled at a customer site. Type of fibre installed.	Installation of duct bore capacity
Pricing Structure	All pricing related to contention, resilience, routing and re-routing, time-based capacity reuse, etc.	Cost recovery options for their own NTE	Cost recovery options of cable installation (cable maintenance?)	Recovery of fixed costs or common costs of OR access infrastructure
QoS	All SLA parameters not directly associated with external access plant All traffic QoS, latency, resiliency/ availability, etc.	Cope with failures in EAD NTE when there is no OR proactive maintenance	New business processes where SLA parameters tied to routing of cable in ducts	All SLA parameters tied to duct routing and operations

33. This annex now turns to the wider claims in Colt's submission which includes four main areas where they say their ability to innovate is unduly restricted by Openreach's active products and passive access would, essentially, 'solve the problem'. These are as follows:
- Access rings: Colt's basic access network architecture is based on access rings which mean that every site served by Colt from their access rings has intrinsically resilient access. Colt claims that rings cannot be built using Openreach's active products but could be with passive access.
 - Process QoS and SLAs: Colt claims that the SLAs of Colt's retail services covering the operational process aspects of their service (for example, provisioning and repair processes) are tied to the corresponding SLAs of the Openreach input active services and Colt would have much greater freedom to offer higher level SLAs if Colt could use passive access.
 - Network Protocols and technical QoS: Colt claims that the protocols which Colt can use for its retail services are restricted by, even predefined by, Openreach's active products and passive access would give Colt freedom to choose its protocols at all layers. As a result, Colt suggests that the technical QoS aspects of the Colt's retail services including contention, protection, re-routing, latency, etc. are all restricted by, even pre-determined by, Openreach's active products and therefore Colt cannot control these aspects of its retail services. Passive would give Colt freedom control them.
 - Pricing: Colt claims that the pricing of Colt's retail services is restricted by, even pre-determined by, Openreach's active products and therefore Colt cannot offer appropriate pricing to its customers whereas passive would give Colt appropriate freedom in setting its retail prices.
34. Each of these four categories is here considered in turn; pricing, being a non-technical issue with wider considerations is examined separately below under commercial models.
35. Access Rings. This was a significant point in Colt's appeal and dealt with in detail in a number of the witness statements and cross examination. In the end there was reasonably common ground; for Colt to be able to build access rings in accordance with their access topology architecture they would need to be highly selective in the duct sections they use and they would have to interconnect their own duct build with the manholes/surface boxes on the ends of these sections.
36. Colt can never avoid own duct build altogether, and the interconnection between Colt's, and every other CP's duct infrastructure would occur at a very large number of essentially random points. We return to the costs of this scenario below.
37. Process QoS and SLAs. Colt claim that when using Openreach's active products, their SLAs, notably service provisioning time, is tied to that of the Openreach active product. They note that this contrasts poorly with the service they are able to offer 'on-net'. They imply that if they could have passive access, they could offer their customers 'on-net' levels of SLA.
38. The discussion however ignores the impact of pre-provisioning of the physical infrastructure. When Colt says a customer is 'on-net', this will normally mean that the Colt has prebuilt their own infrastructure to that customer site and it also likely to have done at least some pre-provisioning of equipment. In these circumstances, responding to customer requests is relatively easy, normally requiring no physical network operations at all or possibly adding a card to a prebuilt chassis.

39. However, by definition, when a customer is off-net, Colt has not prebuild infrastructure. But then there is no reason to suppose that Openreach has either. Even if duct already exists, it may be full. In many cases, either cable or both cable and duct need to be built to meet the order. In some cases, whilst both duct and fibre do exist at the customer, electronics may not be pre-built and installed.
40. In essence, Colt assume that they would be using passive access to pre-build infrastructure and therefore would not affect specific SLAs for services supplied once the infrastructure is built. But this is not a like for like comparison; it is comparison between pre-build and on-demand build. As such it does not provide a suitable comparison between active and passive supply from Openreach. Under a like for like comparison, the opportunity for difference between retail SLAs based on passive and active products is likely to be modest.
41. There are additional factors to bear in mind here:
- Colt is perfectly free to buy active products ahead of customer demand in order to effectively pre build their presence at the customer site and in this way they are able to treat the customer site as 'on-net' for the provisioning of all their retail services.
 - Even if Colt were to rely on passive products, where they choose to supply service to a site on-demand and without prebuild, then this will be subject to basically the same service provisioning processes and timescales as the active products, especially where duct build is needed.
42. In summary, Colt are making a comparison between service delivery SLAs achievable with pre-provisioning of access with the service delivery SLAs achievable when the access is provided on demand. This is not the different between active and passive supply from Openreach.
43. Network Protocols and Technical QoS. Colt and TTG claim that active products limit their choice of layer 1, 2, and 3 protocols. However in neither case is there an explanation or any discussion as to whether the limitations are different at the different layers. For example, it would appear that it is this asserted limitation on choice of protocol which is behind Colt's following statement:
44. [On the basis of competitive physical infrastructure] "London's business customers have access to certain services that are not available in other parts of the UK. These include ultra-low latency connections, innovative technologies (such as MSP Ethernet interfaces, software defined networking and performance monitoring systems) and differentiated SLAs. These are widely available on the market (via alternatives to BT) but not available through BT's wholesale products (further details are included in our answers to the consultation questions). Passive infrastructure access would allow such services to spread to other regions of the UK."⁷⁰
45. The basic principle is that choice at one layer does not affect the choice at other layers. Openreach's active products affect only layer 1 and CPs are therefore free to choose their protocols at layer 2 and layer 3. We discuss some of these more technical issues at Appendix 2 to this Annex.
46. BT can understand no technical reason why these services (insofar as they can be discerned from the information available in the public responses) cannot be fully supported by

⁷⁰ See Colt's response to the CFI (non-confidential version) section 3.4.1, page 11, third paragraph.

Openreach's active products. For example, BT Global Services is active in this market and uses Openreach's active products as its inputs.

47. It is the choice of these layer 2 and layer 3 protocols which determine all the technical aspects of QoS of the downstream retail service. Therefore all aspects of service such as contention, traffic prioritisation, time of day services, re-routing and protection, latency, are already fully under the control of the CP with the current products.⁷¹ Appendix 2 provides further discussion on these issues.
48. In summary, first Colt suggests that there are a number of key innovations which cannot be supported by Openreach's active products but can be supported by passive products. Based on the information in Colt's public response, BT disagrees. The services as described can be supported on BT's active products. Second, many of these innovations are only available to Colt because BT and others have developed the technologies and made intellectual property openly available.

Whether active services prevent differentiated commercial models

49. Some CPs have claimed in their CFI responses that the freedom to set prices for their retail services is unduly constrained by the pricing of Openreach's active products and that were passive remedies available, they would be able to offer more innovative pricing solutions to their retail customers.
50. Common input pricing through EOI. If every CP shares the same basic input costs, then competitive pricing innovation is properly based on the added value of the CP between the upstream input service and the downstream retail service. The relevant question is whether or not productive efficiency is incentivised from the scope of the service coming out of Openreach and if this was extended or reduced. However, this is not a matter of pricing innovation as such, it is really part of an underlying trade-off between encouraging infrastructure-light CPs and potentially more competition at the retail level versus encouraging infrastructure build and where there may be a conflict between facilitating size of competitors versus number of competitors (see also Section V below).
51. Units of measurement. A more direct issue arises in pricing structures where it is evident that different layers of production might be priced in different units of measurement: duct access from available capacity in the duct and length/location of duct; dark fibre by length but likely not intensity of usage of the duct; and finally active services which will be by bandwidth (determined by electronics and not fibre or duct capacity) but probably neither length nor any indicator of usage of capacity.
52. As a result there are necessary differences in the pricing structure at the different level of EAD/OSA/OSEA versus dark fibre versus duct access. In practice, a level of averaging of the utilisation is necessary both practically and economically. However, inherent in most of the CPs proposals is that these differences equate to 'pricing innovation' when in fact they only amount to arbitraging against this averaging (discussed further in Sections 7 and 9 above).
53. Contracting for risk. Finally, the way in which risk is contracted, priced, and shared between upstream and downstream needs to be taken into account. In general, upstream investments

⁷¹ Parameters which depend on the physical routing such as separated physical routing and speed of light latency depend on the duct routing and are unchanged under passive access other than in the Colt proposed narrow context of duct access for access rings discussed above.

are made well ahead of possible downstream revenue earnings and as such there is considerable investment risk in terms of the timing, likelihood and level of any future income.

54. Ultimately, if upstream investment is to be profitable over the long term, this has to be borne by downstream CPs and ultimately end-users. With a short term contract, the downstream party absorbs little or no risk but pays for the risk, with a long term contract, downstream absorbs much of the risk assuming there are penalties for contract cessation and the discount compared to the short term contract is the price of the risk that downstream is now absorbing. It will also need to reflect downstream CPs' additional sunk assets more general considerations of technical progress devaluing both the upstream and downstream assets.
55. Some of the CFI responses appear to assume that the current active products are only available on a short term contract basis while passives would only be available on a long term contract basis. Passives would then enable CPs to undermine the BT commercial framework in general. The suggestion is that passive services allowing downstream pricing innovation is actually about being able to offer different retail contracts based on different risk sharing models with their own customers. This interpretation has a parallel with claims about innovation in SLAs when in fact it is actually about pre-provisioning of capacity.
56. The following points are therefore relevant:
 - There are a range of CPs with requirements and current Openreach products are typical term lengths which many CPs want to minimise their own commitments.
 - CPs could internalise long term risks with their own customers by reflecting this in tariff structures.⁷²
 - Future customer demand would be expected to cause Openreach to seek to extend the current range of discounts to include term and circuit volume across multiple services, and this would provide CPs with more options at the retail level.⁷³
57. Vodafone (Page 4 section 2 of their CFI response) have made a very specific assertion that the structure of the EAD tariff is reducing innovation.
58. "In contrast to PPCs, Ethernet technology limited the service to shorter distance circuits. Competition over traditional leased lines was facilitated by few points of handover as PPCs required interconnection at 69 handover locations in order to purchase only terminating ends. Whereas BTW offers (EAD) LA from 1223 locations. For a CP to use (WES/EAD) LA significant investment was required to establish new space at local exchange sites (co-location space – PPC POH are not in CP dedicated exchange areas) and the construction / purchase of backhaul. For an extensive period of time only BTW had the necessary scale to purchase LA services meaning other CPs relied upon WES22 or, increasingly, purchased directly from BTW. A combination of these issues resulted in the collapse of the wholesale competition and the loss of dynamic innovation."
59. There are a number of issues here which require careful consideration including the regulatory origins of the current tariff structures for PPCs and secondly the potential link to innovation.

⁷² This is seen for example in the energy sector where it is possible for end-users to have fixed term contracts over several years.

⁷³ We do however see scope for further more innovative pricing solutions here which span across different services themselves.

60. [X]
61. [X]
62. [X]
63. In summary, we can see nothing from the Vodafone assertions to justify the argument that competition and innovation were in any way limited from PPCs.

The SOR process

64. Some of the CFI responses also claimed that the SOR process was not working. We disagree. The purpose of the SOR process is for it to be open to all CPs to trigger further developments of the Openreach active portfolio to meet their needs on a non-discriminatory basis encompassing both issues of service and product developments.
65. The SOR process is a regulatory requirement on Openreach and is heavily scrutinized by CPs, regulators and internal auditors; passive remedies will not offer benefits here above and beyond current arrangements. CPs can utilise the SOR framework in a very wide number of ways including to drive new product requirements, to change SLA/SLG arrangements and/or trigger Ofcom or OTA intervention.
66. In our view, the SOR process has been used extensively to bring about product changes, it remains appropriate for the business connectivity market and is emphatically a positive structure which does not merit the criticisms levelled at it by some CPs. It achieves a fair balance in that requests are assessed on whether they are commercially viable for Openreach and technically feasible, but also by whether they align with Ofcom's regulatory framework and policy. This means a focus on equivalent and industry wide changes in scale and scope of products at the appropriate layer of the value chain where some key investment decisions are made.
67. We consider that it is in Openreach's commercial interest to develop and promote products which can be successful in the marketplace for all CPs (and ultimately for end-customers) and where Openreach is already in competition with other CPs such as Virgin Media and Colt. Openreach is keen to continue to work closely with CPs through the Industry agreed forums, and where needed with the Office of Telecommunications Adjudicator (OTA) and/or Equality of Access Office (EAO).
68. The issues which typically cause differences of opinion between Openreach and CPs relate to the commercial viability and/or technical feasibility of the access request. Differing views are to be expected on such issues and we note that much of the upfront investment risk is taken by Openreach. We believe that the existing SOR process (in tandem with other obligations in BT's Undertakings such as EOI and information sharing rules) has worked well and already mitigates strongly against the risk of Openreach discriminating in favour of downstream BT businesses.
69. Openreach's transparency in dealing with SOR requests can be seen in the following processes:
 - Openreach hold a monthly review of SORs and provide any reasons for rejection in order to validate them, with participation by representatives from OTA2 and the EAO. All SOR changes (rejected, in development etc.) are reviewed as part of this meeting to ensure an agreed set of data on which discussions are held.
 - A monthly report is issued based on updated SORs to Industry chairs, OTA2 and the EAO.

- Any amendments made on the SOR tool are transparent and accessible by all CPs via the Openreach portal.
 - Any issues concerning SOR response times (or any other concerns) are also open for review in a monthly review held with OTA2, the EAO and Ofcom.
 - All meetings and discussions are recorded and the Minutes are issued to the EAO, OTA2 and Ofcom.
70. In addition to all of this, Openreach have recently implemented (with the Copper and Ethernet Forums) the use of a programme plan view which provides a clear overall view of all CP and shared Openreach SOR status positions which has been well received by industry.
71. In summary, BT believes that the Openreach SOR process is generally working well with most of industry and is not directly linked to current concerns such as provisioning times.

III. Innovation and leased line monitoring

72. Openreach has generally kept pace with innovation relevant to its position in the value chain and BT more generally invests in R&D which is to the benefit of the wider industry. The alleged examples of failure to innovate (for example, described by Frontier Economics in a report accompanying Vodafone's CFI response) are more complex than they acknowledge including in particular the example of SyncE.
73. Openreach and BT itself have particular concerns regarding fault monitoring and we set out why this is an absolute requirement not only for the efficient provision of Openreach active services but also to ensure that BT does not unfairly suffer reputational damage.

Historic record on innovation from Openreach

74. BT is rated as the second largest fixed line telecoms operator in terms of R&D investment in the world and the third largest investor in the UK both over the last five years⁷⁴. Recent examples of BT innovation activity include:
- Superfast connections Easter 2013. BT ran the World's first 800Gbps super channel and the first Terabit/s link.⁷⁵ The latter could be switched in real time and was over a real network from Adastral Park Ipswich to BT Tower.
 - Alien Wave Lengths September 2014. [X]
 - Quantum Key Cryptography. Since Alien wavelength can pass through all carrier equipment without regeneration, it is possible that these could be used to carry Quantum Encryption Keys so Quantum Cryptography could be used across a carrier's network. Unlike current encryption techniques, this is not vulnerable to future advances in Computing, Mathematics or engineering (based on current understanding of fundamental physics). [X]
75. Frontier (paragraph 54 Table 1) lists three examples of potential innovations which they claim would have brought benefits to consumers. As we show below, only Ethernet NID was deemed not viable (SyncE has now been launched) and which suggests that the large number of smaller innovations which Frontier imagines are even less likely to be relevant. This includes the example of TILLAP discussed below.

⁷⁴ Source: EU Industrial R&D Investor Scoreboard 2008-2012.

⁷⁵ <http://www.pcpro.co.uk/news/broadband/386668/want-faster-broadband-bt-trial-tops-1-4tbit-sec>.

76. TILLAP. The replacement service for WES155 and WES622, where £[3<] of systems development cost was cited as the barrier to progress, despite the hardware to be used already being in production for the WES2500 service, requiring a software selection step for new lower speeds requested.
77. TILLAP was a requirement from a single CP, seeking replacement of a previously used service type, to serve a very specific market sector. Consequently Openreach had initial concerns as the business case was difficult given low expected demand compared to high expected development costs. There was much discussion with Vodafone to establish a clear customer demand.
78. Following extensive discussions with Vodafone on expected demand, Openreach progressed this and did extensive development to build a replacement TDM access service. It also required extensive work on the software which took significant time to develop. Concerns around low customer demand have to date been borne out.
79. Ethernet NID access. This was to allow CPs remote access to Openreach EAD electronics for fault monitoring. Openreach received an SOR and completed a feasibility study. Subsequently CPs were invited to a Proof of Concept demonstration to clarify requirements, use cases and assess the potential demand for developing standards based on 802.1ag and Y.1731 support features.
80. Although supporting enhanced OAM on the Openreach access product would support CP E2E service diagnostics and performance monitoring, there is no clear documented evidence on how this functionality could reduce the volume of reported faults that end up being ‘Fault-Not-Found’.
81. As has been noted, supporting this capability requires new hardware/NTEs and other components that carry a cost premium. So in the absence of clear indications of volumes this SOR was closed. Openreach considers that the existing Portal diagnostics capability could be used prior to reporting a fault, significantly to reduce the numbers of ‘Fault-Not-Found’.
82. Synchronous Ethernet. The development of this product has a long history which we set out in Appendix 1. Openreach did not reject SyncE: in fact BT invented the underlying technology and spent many years establishing it as an industry standard. Openreach launched its SyncE service in 2014.
83. The SOR process is described in certain CFI responses as dysfunctional and slow. SyncE is cited as an example of how the process failed to deliver CPs’ needs. We do not believe that SyncE’s development is typical of the general SOR process; rather it was an extreme example where there were conflicting messages and incentives amongst many parties in the value chain:
 - Openreach was looking to the downstream MNOs to commit to orders for SyncE in advance of the product development.
 - The MNOs felt it was unreasonable to commit until they knew what would be the best technological choice but once the decision was made they would then want the network to be available quickly and ready to operate with that choice of technology.
84. There was however no consensus on the most appropriate technology and rival standards were perceived as substitutes and complements simultaneously. It was not possible therefore to find a commercial solution. It is not clear why internalisation of the inherent risks through the use of passive products would have made any difference in this case.
85. This is because networks, whether operated by an MNO or by Openreach, take a long time to apply new technologies and to re-engineer, upgrade and test their provenance. The network is

a vital resource and there are only certain times it can be taken down and modified to a planning schedule set well in advance. Management systems and processes also need to be modified and tested.

86. Both networks and systems are complex and costly to modify and inevitably it is a slow process, often taking months or even years depending on the scale of change. Large investments are made and need to be justified in terms of future demand. The introduction of any passive product would not change these realities.
87. SyncE is now available from Openreach and alternative solutions are already available with further technological solutions being discussed. This will be further impacted when the next round of spectrum auctions take place where individual MNOs may win different mixes of FDD and TDD spectrum (which could impact on their requirements as operating TDD spectrum has a requirement for more accurate timing) . Once the outcome of these auctions is known then the MNOs will again make decisions on their need for SyncE or otherwise. Clearly there will be a commercial imperative for any SyncE product to be operating as quickly as possible to make use of any new spectrum. Auction outcomes can therefore radically alter technological requirements of individual MNOs. Openreach however cannot predict who will acquire what spectrum or be certain that the product will ever be used; it has had to take a financial risk on this product with an uncertain outcome.
88. This is reflected in the demands of some MNOs that it is in the best interests of the industry that Openreach should be forced to build the technology they want. In practice this will only shift the technology risk from the MNOs to Openreach.
89. If MNOs use passives then the investment in active electronics must be undertaken by themselves rather than Openreach. Each MNO is likely to have a smaller addressable market within which to spread their risks with potentially less incentive to build out and passives may in fact hinder innovation and deployment.

Openreach incentives to innovate

90. TTG (2.34) claims that 'Openreach dictates any innovation (or lack of it) in the electronic layer of active products.' We have addressed the generic claims that downstream technical features are constrained by Ethernet above.
91. TTG (2.37 and 6.5) also implies that self-innovation using passives would create better incentives than the current regime. First, we note that there is nothing stopping CPs from self-innovating at the moment for the business market, and some access infrastructure operators already do.
92. Any major innovations are inevitably likely to involve industry co-ordination. In reality we expect CPs will likely continue to wish to take advantage of developments made in the regulated open access Openreach portfolio – which may of course be driven by requirements of other network operators, who variously support international standards work with different levels of resource and priority.
93. With regard to the multiple reasons which TTG cites where Openreach may reject an innovation that is in consumer interests:
 - Evidence. TTG does not provide concrete example of where such an innovation has (not) occurred.
 - Business case. TTG fails to recognise Openreach's legitimate requirement to develop a business case which allows innovations to be funded properly.

- Arguments on innovations that fail to meet criteria. These include existing processes, systems, operational practices and capacity constraints. Openreach like any normal business has to take these into account just as would any CP using passive products or their own infrastructure. We do not believe that any material innovations have been adversely impacted by any of these factors.
 - Risk averse. There is no evidence that Openreach has been risk averse and has developed products for CPs who then subsequently fail to meet the demand previously stated as the basis of the investment. CPs have the opportunity to collaborate with Openreach in any case to guarantee funding for investments.
94. Openreach can sponsor work in BT TSO (BT's research arm); however beyond basic commercial viability, it has to balance how it innovates on two factors – its position in the value chain and the technical viability of the innovations themselves. Openreach innovates within the scope that is of an upstream and 'neutral' access supplier in which it must treat all downstream CPs on a non-discriminatory basis. It provides connectivity and needs to supply products that can be managed, so terminating electronics are generally needed at each end of circuit. These devices need to have standard interfaces (agreed by industry and standards bodies) which have to be safe and fully tested.
95. So innovation in this area is typically to develop one or more of the following:
- Connectivity to reach more and more remote places.
 - End electronics to reduce power, dimensions and location of end devices. To make sure they are still safety and performance tested. They may need to be ruggedized (water proof, temperature) for certain locations.
 - To achieve greater speeds.
 - To enlarge the range of standard interfaces or protocols. Whilst most customers want Ethernet, there are a few other interfaces which are wanted such as Fibre Channel.
 - Management and monitoring to internally manage the network. This includes identification of faults and improved processes and systems such as communicating information to customers via for example a Web portal.
96. Openreach has not sought to innovate further down the value chain: technologies such as VLANs for Ethernet, MPLS, routing, non-standard interfaces and applications are areas where customers downstream of Openreach will innovate themselves.
97. Although BT has a large portfolio of 4,300 patents, it has recognised that today it is often better not to patent, but to openly share information. This was demonstrated with SyncE. Rather than patent it in 2004, BT decided to share this idea and spent years getting it through the standards bodies. This in turn encouraged the hardware vendors to build suitable electronics. BT is no longer in the business of building hardware; instead it has to work with vendors across the world to help get new technology to market.

The role of monitoring for fault diagnosis

98. Openreach requires sufficient functionality to maintain the operational integrity of the network with clear demarcation between the Openreach service domain and that of the CP or customer. In practice this means having boxes of some description at both ends of fibre to monitor the state of the line. Any change to this framework would cause significant disruption

to operational processes, with consequential adverse impacts for end to end costs, and for quality of service provided to the customer.

99. The identification and rectification of faults is a particularly difficult issue and our long experience has shown that, absent appropriate monitoring equipment, this process leads to disputes. Currently the majority of EAD repair visits are not in fact driven by Openreach related problems and this is even the case with equipment in place that allows remote monitoring. A significant purpose of this monitoring function is to be able clearly to demonstrate when the circuit itself is not at fault. Having a managed box at the end of the Openreach fibre also allows Openreach to confirm this in a manner that cannot be disputed even if a visit is required. It also allows Openreach to identify the location of any circuit fault accurately and ensure that a technician with the appropriate skills is despatched to the right location.
100. This gives the CP service fault diagnosis by process of elimination. Without managed NTEs at both ends of a fibre, Openreach would be 'blind' and totally reliant on CPs to provide with correct information. Current CP fault-reporting practice even with the NTE equipment in place at the moment, indicates that there is huge potential for errors in reporting and high costs for fault resolution.
101. The Openreach equipment is not solely for the benefit of Openreach; the NTEs also can be configured to act as 'test probes' for the CP VLAN and IP services delivered over EAD and this is something that could also allow CPs E2E diagnostics directly from their OSS systems rather than a need to interrogate the Openreach portal.
102. It is relevant to recognise that MPF is not the equivalent of dark fibre in respect of line fault monitoring, as Openreach maintains monitoring equipment and carries out regular line tests on MPF. Openreach monitors and tests all types of lines in all of its products. This even applies to our new Alien Wavelength optical service as discussed above, which is an innovation designed expressly to reduce equipment costs and potential for duplication.⁷⁶ For this service there is Openreach equipment at both ends. This allows Openreach to monitor the up-stream and down-stream optical power levels, and to determine (at a basic level) if the OSEA circuit is operating correctly.
103. The ability to quickly establish responsibility is very important to address potential conflicts where issues of brand reputation as well as SLG payments may arise. It is important to Openreach (and therefore indirectly to BT) that there is not just for an efficient overall end to end fault localisation process, but that Openreach can protect its brand and legally protect itself from SLA claims which Openreach itself cannot verify.
104. More generally we believe that this issue is of particular importance in the UK which has a very vibrant downstream retail market for BCMR services and is untypical in the range and depth of competitors to BT and the downstream BT divisions have market shares lower than typical incumbents. EAD is an upstream product which allows much greater value add by CPs compared to the situation in many countries where the wholesale Ethernet service could include aggregation and switching.

⁷⁶ Friendly aliens are allowed only across Ciena 6500 compatible CP core networks. There other vendor ROADM networks but we do not know exactly what would happen to the wavelengths under fault conditions or if our waves would affect the CP's core network.

105. There would also be significant complexities in identifying and resolving challenges such as ingress points and damage, which could lead to multiple disputes. This will especially be the case if CPs take just small sections of Openreach duct coming in and going out on a highly localised basis.

IV. Potential implications of passive remedies

106. If passive services were to be mandated, this would raise challenges to maintaining the current non-discriminatory approach. Some CPs have explicitly said that they would position themselves directly in competition with Openreach and we assume this will extend into a merchant market.
107. One of the important factors concerns simultaneous launch of upstream active services and whether this should be maintained. More generally we have concerns regarding Openreach incentives to take on risky projects were passives to be offered and the interaction with the SOR process, where CPs will be consuming both passive and active products and therefore have mixed incentives.

Simultaneity of launch and first mover advantage

108. Some CPs raise the issue of First Mover Advantage (FMA) and governance processes when new services are introduced by Openreach. It has been suggested that: (a) the inability of downstream CPs to acquire FMA is a disadvantage to CPs; and (b) that the general SOR process leads to a form of 'lowest common denominator' in terms of what is supplied (see also the discussion in Section II of this annex, but this section deals with FMA in more detail).
109. The justification of absence of FMA for the sorts of services and innovations provided by Openreach is contained in the Oftel April 1998 Statement Interconnection and Operability of Services over Telephony networks.⁷⁷ This set out the rules of requirements to launch simultaneously where there is an upstream economic bottleneck but not for enhanced services or where there are non-cooperative network services. The requirement for 15 month interface notification also fits in well with Openreach general timescales for industry standards currently.
110. EE and TTG argue that the current Openreach obligations of EOI in which it makes developments simultaneously available to downstream operators, limits scope for differentiation and innovation and EE argues that the current model prioritises allocative efficiency against competition and dynamic efficiency.
111. As the Consultation notes, there are often trade-offs between different forms of economic efficiency which need to be balanced. The problem however is to distinguish the circumstances in which Openreach (BT being the relevant legal entity) could reasonably and lawfully consider entering into an agreement which in fact explicitly allowed FMA.
112. In general, if it was the case that only one CP wished to have a specific innovation, it is unlikely that this would be a major service as the industry itself would likely have adopted such a standard. Despite this, Openreach has in fact undertaken development work for TILLAP with the outcome of a single CP purchasing the product.
113. Openreach is introducing services where there are common industry standards such as for Ethernet and it was Oftel's assessment that simultaneous launch in the context of an

⁷⁷ http://www.ofcom.org.uk/static/archive/oftel/publications/1995_98/pricing/ii498.htm

upstream bottleneck would be an appropriate regulatory standard to adopt. Enhanced services are those which are very largely located downstream of Openreach. For example, SDN is not a co-operative network service and other CPs can offer this on their own networks independently as to whether they take passive or active services.

114. [X] Common provision to downstream CPs on a non-discriminatory basis underlies the Undertakings and prevents disputes.
115. Any SOR arrangements existing alongside passive remedies would also need to ensure that Openreach is not “cherry-picked” on innovations and developments, with cost recovery slanted in favour of those who take passive services but also having an option through the SOR process to purchase active services should their own innovations or development processes fail. If this occurred it would reduce Openreach’s innovation incentives. Changing the incentives to invest and raising industry risk would have adverse impacts on overall welfare.

Openreach innovations put into doubt consequent on passives

116. If CPs take passive services as direct substitutes for active services this will effectively be arbitrage and not market expanding. In such circumstances this will make Openreach’s volume of active product sales more uncertain and lower. As a result, where a service is borderline for development it would be less viable. [X]
117. There are however more important long-term innovations which would more likely become questionable and in particular the somewhat specialised set of circumstances 4G rollout discussed in more detail in Annex 1.

The SOR process under competition

118. Mandating passive remedies would create a tension which does not exist at present in the SOR process. Regulated access to Openreach's passive infrastructure would effectively mean that purchasers of Openreach services become competitors to Openreach.
119. This represents a major change from the strategic review framework which created clear boundaries between infrastructure and service layer investment, enabling large scale and long term business cases to be developed both by BT and other CPs to serve both business and consumers markets. The structure includes very strong obligations for open access placed on BT to enable scale and scope benefits to be shared by all purchasers of Openreach's active services. As acknowledged on numerous occasions by Ofcom, UK and European regulators this has been a major success story for the UK and its consumers.
120. Any material change from the existing framework clearly has implications for: the SOR process; the strategic role for Openreach; and more generally on the incentives on Openreach to invest in new services and the effort and resource it allocates to the current systems and processes. The position that Openreach plays in the industry would likely be altered under competition from passive remedies.
121. Openreach's default position at this time is to share information extensively and in an equivalent manner with all CPs, as well as to provide open access to all product development trials and pilots to all CPs. With passive remedies, Openreach would need to consider carefully which information it could share and with whom and in what timeframe. Passive remedies would cause the boundary between CPs and Openreach to become blurred. New technical or commercial innovations proposed or developed by Openreach would become 'business secrets' and potential competitor CPs excluded from the process.

122. The role that Openreach plays in taking the upfront investment risks and in working through the prioritisation and standardisation of requirements from CPs is important. CPs often have conflicting demands and objectives between themselves (not just with BT or Openreach) and the open and transparent Openreach development process does bring about a degree of alignment. This enables competition.
123. Claims that passives would lead to faster and/or greater levels of innovation by either CPs or Openreach are highly implausible. Passive products would reduce economies of scale and scope, that Openreach is currently able to bring to product delivery, and risks chilling downstream CPs innovation incentives in the infrastructure and connectivity domains. Under a passive regime, CPs would face a smaller addressable market over which to recover the costs of innovation, and there is no evidence to suggest that time to market would be significantly reduced. Key hurdles such as standards development, equipment lead times and systems developments would remain.
124. Openreach has strong incentives not only to grow new incremental volumes but also to encourage migration from old to new technologies. Take-up of services is required across a wide range of CPs and not just downstream BT. This explains why there are commercial interests underpinning Openreach's extensive and proactive engagement with CPs.
125. In summary, we believe that the framework for Openreach since 2006 continues to be appropriate, promotes competition, and allows CPs and their customers to benefit from the 'shared' economies of scale and scope inherent in the design of the Openreach infrastructure. It has supported major investment by BT and others (such as Virgin) in the UK's infrastructure and the rapidly increasing demand high technology services from consumers and businesses in the UK. Passive remedies put all of this at risk.

V. The absence of any evidence of innovation from passives

126. Several responses to the CFI suggest that copper MPF can show by analogy what passive remedies could achieve in business connectivity. We agree with Ofcom that such a comparison does not exist for the reasons set out in Annex 3. The remainder of this section provides a general framework of where innovation is possible in the passive layers which are open to examination and assesses the innovation arguments made in the CFI responses in this context.

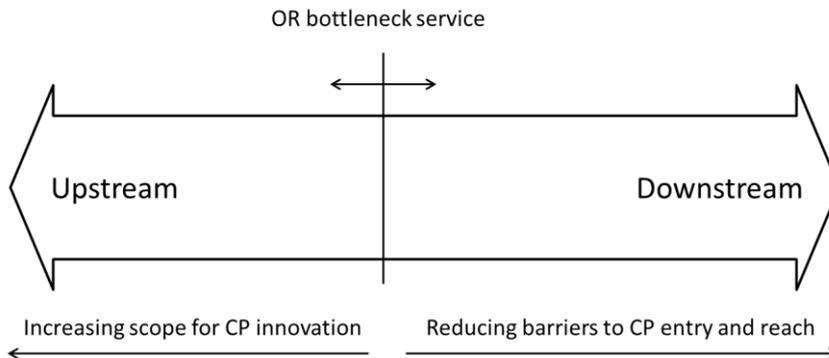
A model of where innovation should occur in the value chain

127. It is not in dispute that where BT is found with SMP, an appropriate remedy is required to allow other CPs to achieve connectivity to the sites to serve businesses and ensure backhaul. Remedies will have both short term and long term effects and policy objectives here include the following:
- A comprehensive solution which covers the full range of SMP sites.
 - Promotes competition, treating large and small CPs fairly.
 - Promotes investment from both CPs and the SMP operator at the appropriate levels in the value chain and thereby does not disincentivise service innovation.
 - Avoids cherry-picking and/or arbitrage based solely on the pricing and options of the regulated remedy.
128. These objectives may conflict with each other; in particular, any solution which promotes new entry is likely to require the CP to make minimal investment to enter the market to avoid sunk

costs. A remedy designed to promote such entry could well create an active disincentive to any CP seeking to invest further upstream or geographically.

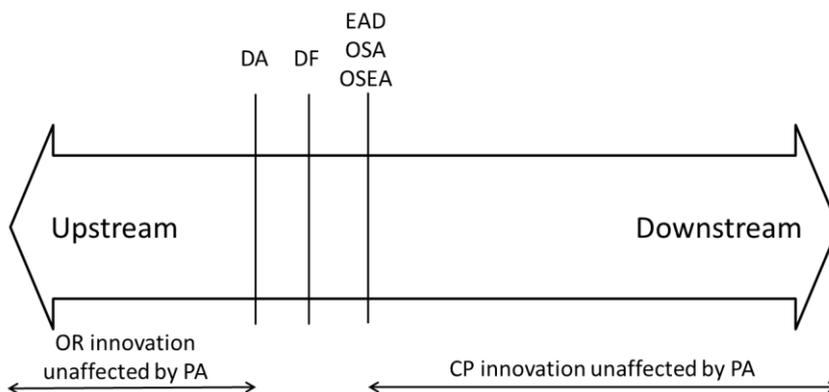
129. There is a similar trade-off in service innovation. The technical mechanisms which enable service differentiation and innovation can occur at different parts of the production chain. Broadly, the higher up the production chain the mandatory service is placed, the more technical features are open to CP innovation. At the same time, the higher up the production chain the remedy is placed, the greater the level of any investment a CP must make in order to enter the market. Therefore, as illustrated in Figure 1, the defined remedy must strike the right trade-off between these objectives.

Figure 1: Generic model of innovation trade-offs



130. The scope for true upstream innovation is largely driven by equipment vendors who work on a global scale in which Asia is the primary growth market.
131. The challenge is therefore to select the right point in the production chain to give the optimal trade-off between facilitating CP service innovation and facilitating CP service entry and reach. In the context of the consultation, the relevant question is whether dark fibre or Duct Access would lead to a better trade-off than EAD.
132. Irrespective of the impact that Passive Access (PA), whether dark fibre or duct access, might have on CP entry and reach, Figure 2 illustrates the innovation that might be impacted if the trade-off were moved upstream to these points in the production chain.

Figure 2 Position of Openreach services in value chain



133. The framework allows innovations to be divided into four categories.
- A. Innovations which may be developed by CPs are downstream of EAD and are therefore unaffected by dark fibre or duct access.
 - B. Innovations which are open to the CPs under dark fibre but not with EAD/OSA/OSEA.

- C. Innovations which are open to CPs under duct access but not under dark fibre.
 - D. Innovations which must be undertaken by Openreach even under duct access.
134. In general, new entrants would likely find innovations in the B or C categories too expensive whilst established CPs might innovate here but only in a niche way.
135. Table 2 summarises our position with respect to the scope and downsides of innovation within the relevant domain of Openreach and CPs taking passive services. This is presented as a matrix of the four areas of potential innovation developed in Section II against the four categories for innovation in the production chain set out in this framework. Our position is that under current arrangements, the trade-off is highly successful. That is, the current framework is achieving the right balance of the various objectives. EAD, and increasingly the optical services, are sold in high volumes to CPs.
136. Based on the CP responses to the CFI, the areas of innovation which are actually at stake between Openreach's active products and possible passive remedies are those in the middle columns:
- Dark fibre would give the potential to speeding up the time it would take to change the ultimate bearer bit rate of the fibre 'last mile'⁷⁸.
 - However, this would remove the mechanism by which Openreach can determine the operational state of the Openreach service remotely and which would raise other difficulties.
 - Duct access cannot provide any simple solution which allows a CP to build access fibre rings, as the basic duct structure of the Openreach network is already in the form of hub and spoke and the only solution would be a scheme where an individual CP cherry picks random short sections of Openreach duct and interconnects this with short random sections of their own build.
 - Such a duct access solution would only be relevant to a very small number of large business customer sites and would be irrelevant to the competitive supply of service to the vast majority of business customer sites.
137. In terms of the trade-off between CP innovation and CP barriers to entry and reach:
- Dark fibre:
 - Innovation – a possible increase in the opportunity for innovation in only a very narrow area which is normally irrelevant to the retail service.
 - Impact of entry and range - from a technical viewpoint the market reach of dark fibre is essentially the same as the current active portfolio.
 - Duct access:
 - Innovation – can only play a small part in a CP's choice in access topology (e.g. ring versus hub and spoke) and the CP would still need to carry out substantial own build.

⁷⁸ In most cases, this is not the actual end-to-end retail bandwidth which is controlled by the CP's own downstream aggregation and core network functionality and would be quite different to this access bearer bandwidth.

- Impact on entry and range – if duct access were to be the only bottleneck service, this would dramatically increase the barriers to competitive entry and greatly reduce the number of business sites with competitive service offers.
138. In addition, it would seem likely that the introduction of passive remedies would not just remove Openreach’s incentives to innovate and invest in the areas covered by the middle columns B and C, it would also adversely impact Openreach’s incentives to innovate and invest in areas in the last column, D. Aspects of innovation which were previously self-contained to Openreach may now require industry agreements as they would directly impact the passive service, thus increasing costs and risks.
139. Changing the balance would in fact create adverse impacts on Openreach investment incentives raising its risk profile and have little or negative impacts on barriers to entry and expansion for CPs. The countervailing benefits on increasing scope for CP innovation are limited.

Table 6: Categorisation of Areas of Innovation

	A CP innovation with EAD	B Additional CP innovation under dark fibre	C Additional CP innovation under duct access	D OR innovation under duct access
Resilient services using access rings	Resilience strategies based on choice of single or dual parenting	none	Ad-hoc use of cherry-picked bits of duct which happen to coincide with routing of desired access ring	All underlying duct and cable structure (i.e. the hub and spoke structure)
Process SLAs and QoS	Choice of pre-provided versus on-demand access Choice of resilience versus non resilient access Retail SLAs based on above choices	Repair process of NTE (note 1)	Some repair aspects of fibre cable (note 1)	All duct repair processes Some aspects of cable repair processes.
Protocol Choice and Technical QoS	Choice of layer 2, layer 3, and above All end to end bandwidth, contention, traffic QoS, protection and restoration, time of day capacity management, etc.	Change process of layer 1 Choice of bit rate and layer 1 protocol not in OR portfolio or available under SOR	none	none
Downstream pricing	All pricing related to contention, resilience, routing and re- routing, time-based capacity reuse, etc.	Cost recovery options for NTE	Cost recovery options of cable installation Cost recovery options for some aspects of cable maintenance	General recovery of fixed costs or common costs of OR access infrastructure

Note 1: At the same time, dark fibre and duct access remove the capability of Openreach to monitor the status of its own service and to remotely localise failures.

The lack of evidence from CPs on the benefits of passives

140. The likely beneficial impact on the overall business connectivity market of passive remedies would be limited.
141. The framework which Ofcom previously adopted with regard to passives was in two stages in which the magnitude of use of passives was a material factor but not the only relevant factor. The extent to which passive products are used to promote innovation rather than simply representing arbitrage is also important. The Consultation also takes this approach.⁷⁹
142. We do not consider that the CFI responses identify any material innovation opportunities which could only be enabled through the introduction of passive products.
143. First, the technical basis of differentiation in service is simply unfounded with a few possible very narrow exceptions. This in particular appears to be the case for Colt and for example, the absence of provision of very low latency circuits outside London is a function of the location of the relevant customer sites.
144. Frontier Economics (paragraph 21) asserts that there can be innovation in LLU backhaul but does not explain how this can occur. Backhaul is a very standard point to point service with no switching. Indeed Frontier (paragraph 56) then suggests that Openreach could undertake a 'self-install' service i.e. provide both the fibre and of boxes for CPs; this is precisely what Openreach does at the moment with its active service albeit the relevant boxes are those of Openreach and not the CP.
145. Second, to the extent that passives were not pure arbitrage, it appears that their likely scope will be limited geographically and/or to highly selected customers. As discussed above in Section 9 this needs to be contrasted with significant arbitrage opportunities with substantial numbers of existing circuits likely to be subject to arbitrage.
146. Third, it is possible that in the future there may be some niche areas where new services will need to be provided such as is discussed in Annex 1. There is still uncertainty in these cases about future technology adoption and active solutions could well be feasible or suitable.
147. Whatever final technical solution may emerge for 4G backhaul, this is highly specific to this particular market sector and there is no suggestion from any CP that these technical issues have any material relevance to fixed access to business customer sites or LLU backhaul.
148. The SOR process may have its limitations in terms of speed and not allowing First Mover Advantage. However, there are inevitable tensions here not only between CPs and Openreach as to who should bear development risk but also between CPs themselves some of whom may not want Openreach to develop something which will help their rivals. The creation of Openreach and EOI in 2005 set out clear rules which have been successful.
149. Passives increase the potential for disputes in three ways. First, they put Openreach in direct competition with CPs who will arbitrage where commercially incentivised to do so. For the reasons set out in Sections 7 and 9 above it will not be possible to remove such opportunities through changing active prices. Second, any loss of ability of Openreach to monitor where faults are occurring will potentially lead to litigation and disputes. Third, the SOR process itself will come under severe strain.

⁷⁹ See paragraph 1.14 of the Consultation for example.

Appendix 1: The history of SyncE
Synchronisation in mobile networks

1. For a mobile radio network to operate the hand sets and the base stations need to be synchronised. Also the base stations themselves need to be synchronised with each other. We are concerned here with the synchronisation between base stations. There are three types of synchronisation: frequency, time and phase synchronisation.
 - Frequency synchronisation is needed so that all base stations keep in step with each other. There are various ways for base stations to get their frequency synchronised. One way is to use SyncE over an Ethernet link to the base station.
 - Phase and time synchronisation is needed to ensure the time slots from different base stations do not overlap (this is called just phase sync from now on). There are various ways for base stations to get phase sync. One way is to use a hybrid of SyncE and 1588 over an Ethernet link to the base station.
2. Both 3G GSM and 4G networks need frequency synchronisation. However some features of 4G networks will also need accurate phase and time synchronisation, especially for LTE TDD, or Co-ordinated Multi-Point transmission (CoMP).

The early history of SyncE

3. In the late 1990s core carrier networks were migrating from SDH to Ethernet. However Ethernet is basically an asynchronous technology and therefore was not suited for carrying synchronisation signals that were needed for traditional leased lines.
4. BT labs came up with a simple way of carrying synchronisation information in the lower layers of the protocol stack in 2004/2005. This would allow a migration path from SDH to Ethernet within the core of these networks. It was also realised that this technology could be used for frequency synchronisation for mobile base stations.
5. It was decided within BT not to patent this technology, but to share it with the rest of industry with the initial ideas provided to ITU-T SG15 in Nov 2004. A number of key contributions provided to ITU-T SG15 in May 2005 are listed in Table 1 which provided the first written input on SyncE.

Table A1: Key technical contributions to SyncE

Reference	Date	Title
COM 15-D197	16-27 May 2005	Transporting Synchronisation Over Ethernet
COM 15-D264	16-27 May 2005	SSM Support in Ethernet PHY links
COM 15-D278	16-27 May 2005	Next Generation Synchronisation Architecture
COM 15-D279	16-27 May 2005	Generic Physical Layer Element Clock Function
COM 15-D647	6-17 February 2006	Draft Liaison Statement for Synchronous Ethernet
COM15-C1391	February 2011	Synchronisation Budget

6. A timeline involving industry is set out below.

Table A2: Outline history of SyncE

Date	Activity
2004	Invented in BT
2008	ITU standards produced.
2010	Vendors have SyncE Ethernet cards ready.
11/10	Statement of Requirements (SOR) for SyncE submitted by BT Wholesale
05/11	After technical discussions with the vendor it was confirmed that SOR will proceed
07/10	Industry call held to walk through the proposal
08/12	Industry advised of planning and development and launch plans
1/12	Call for industry to review their demand for SyncE. Planned launch Jan-2013
1/13	Industry advised on hold as lack of demand
02/13	Discussions on going with CPs
05/13	Indication of interest from Vodafone but no volumes or timescales given.
06/13	CP briefing issued stating SyncE would be included in EST restart.
03/14	Launch of EST restart, SyncE included.
2014	Problems in EST management code identified and delayed deployment
2014	SyncE widely available but low demand
2014	New solutions for small cells using 1588 being developed.

- Getting SyncE through standardisation was a lengthy process and took 4 years; however it was ready by 2008. Once SyncE was a recognised standard the equipment vendors were prepared to commit to building this technology. Various vendors began developing new Ethernet cards that had internal clocks of the required accuracy. By 2010 a number of vendors had suitable cards. Also during this time the standards were extended to include PONs and VDSL.

MNOs requirements for frequency synchronisation

- Originally base stations used multiple traditional 2Mbps leased lines (called E1s) to connect their base stations in their core networks. For 3G networks there were much higher demands for bandwidth and Ethernet circuits were deployed. Both Virgin Media and BT Wholesale have SyncE products.
- BT Wholesale offers MEAS (Managed Ethernet Access Service) to MNOs for interconnecting their base stations to the core networks. The original BT wholesale MEAS used an EAD circuit and a traditional E1 leased line. The EAD circuit carried the voice and data traffic back to the MNO’s core network. The E1 circuit was used to supply clocking for frequency synchronisation to the MNO’s base station.
- More recently BT Wholesale and some of the MNOs requested the use of SyncE for base station interconnect from Openreach as part of the SOR process. This would mean that the E1 link would no longer be needed and would reduce the cost of base station equipment. However, this required that Openreach deployed new Ethernet cards on all EAD links that were going to support SyncE.

Timeline of SyncE in BT and Openreach

- The development of SyncE was a complex and costly activity for Openreach. It required new Ethernet cards, new provisioning LTC processes around timing sources, and modifications to the processes on how circuits are delivered or maintained, and to refine all existing processes and repair sources. This came at a cost of c. £[X] to Openreach.
- The MNOs have argued that the SOR process has delayed the introduction of SyncE into the market and limited growth. However during this period the MNOs have greatly expanded

their networks and have been buying MEAS. MNOs have found alternative ways of obtaining synchronisation and even if there was a delay, then it has not stifled innovation.

13. In fact Andy Sutton, Principal Network Architect, of EE described their backhaul at the World LTE summit (24th-26th June 2013) and in particular how they used BT's Wholesales MEAS in an innovative way to aggregate their 2G, 3G and 4G traffic onto one backhaul connection:

"It allows us to realize synergies and makes for a more efficient network design. It helps as we only have to connect to a particular location once and then we can actually use that capacity effectively to support multiple radio access technologies. As we move towards Single RAN, ultimately we have a single interface. It's much more efficient, much slicker, more reliable and easier to manage." LTE speaker interview, Amsterdam, <http://ws.lteconference.com/ee/>

14. Now that SyncE is available then it is likely that MNOs will consider the option to purchase the product when they upgrade sites or commission new ones. The new product will require fewer devices at a site and so free up rack space and reduce power consumption. These are advantages but they are not crucial.

Technologies for supplying Phase synchronisation.

15. The introduction of 4G LTE TDD spectrum requires accurate phase synchronisation. There are a number of ways this can be done. One way is to use the 1588v2 protocol, which is a higher layer protocol (carried over Ethernet) which can be used to carry timing information. Unfortunately this protocol loses accuracy when used over multiple hops or on asymmetric routing and can be affected by traffic and network routing. It seems that the best way to use 1588v2 is using a hybrid of the 1588v2 protocol and SyncE. The technology is however still developing and there is not yet a definitive best solution and Openreach is currently investigating these technologies.
16. There are many alternatives one of which is to use GPS, in which case, there would be no need for a service from Openreach. Another option is to use signals from the MNOs own macro cells to synchronise smaller cells.

MNOs Phase Synchronisation requirements

17. Phase synchronisation will be required when MNOs have sufficient 4G LTE TDD spectrum. MNOs already use 4G LTE TDD, however there is limited operational experience yet and the MNOs requirements keep changing as their experience grows.
18. Accurate phase synchronisation can allow an MNO to use their TDD spectrum more efficiently. So depending which specific MNO's win in the next round of auctions, they will require phase synchronisation. Depending upon the auction, it would be advantageous for some MNOs to get the phase sync quickly, while for others it would be best if the service was delayed (and so delay their rivals).
19. As such, requirements for phase Sync are changing and vary by MNO. Also they are undecided as to which technology they wish to use. However, if they do decide to use a product from Openreach, then they will want it quickly. Openreach would need to start preparing the network now to meet this demand; however CPs are not necessarily willing to commit to volumes.
20. Phase synch could have features of the SyncE history:

- MNOs give mixed messages as to what they want and are not prepared to commit. This partly because technology is changing and it is unclear what spectrum each MNO will win.
- Equally, it would be a huge risk for Openreach to commit to the expensive development of phase sync until the MNOs give a firm commitment.

Conclusions

21. BT research arm invented SyncE but rather than patent this idea it was made generally available and BT invested to the time to make it an ITU standard. The changing and unclear market demands delayed its deployment.
22. The SOR Process is sometimes blamed for the delay of SyncE into the market. However this is not an issue that is specific to Openreach and the MNOs as such. This is true of any two organisations when a new technology is being implemented. Networks take a long time to re-engineer and this true no matter who runs the network. However what is the best end technology may not become clear for some time. As soon as it is clear, then a business will want to deploy it as fast as possible to gain advantage.
23. [X]

Appendix 2: Response to certain technical issues raised by Colt

1. Colt claims that a number of service features are only available in London and we set out our response to these below.
2. Ultra-low latency connections. Ultra-low latency services are a highly specialised requirement for the electronic trading sector of the finance industry which tends to be very concentrated in specific geographic locations, for example, City of London, New York, Amsterdam, Frankfurt, etc. So while it is true that ultra-low latency networks are not available throughout the UK, this is because of the location of the customers themselves itself. If other financial centres of comparable size were to arise in the UK, then the networks and CPs would serve them with dedicated build.
3. Where these services are supplied using Openreach inputs, the delay arising from the Openreach NTE is generally insignificant in the overall end to end latency; the end to end latency will depend on the length of the fibre routing and delays through switches, in addition to any delay from the NTEs.
4. The delay though current EAD NTEs can depend on EAD bit rate, the packet length, and may vary a little bit by NTE manufacturer. For example, the delay though a 1Gbit/s EAD NTE is between approximately 3µs and 15µs depending on the packet size. To put this into context, the delay through every 1km of fibre is roughly 5µs. It is possible therefore that over very short distances, this NTE delay might be significant; however, as soon as Inter-city connectivity is concerned, this delay is not relevant. Moreover, most switching and routers have delays more of the order to 1000s of µs, although we do note that there is a specialist market for ultra-low latency switches which are often used in these networks.
5. If the delay is still really important, the NTEs of 10Gbit/s and OSA products have even lower delays than the 1Gbit/s cited above, and of course, the CP is free to dig their own duct and by definition of the delay being significant, the distances must be short. This latter option should be especially relevant because the duct routing controlling the length of fibre is, by definition, highly significant, and own duct build is the only way the CP can control the latency from the length of the fibre.
6. As a final note, if ultimate latency is really an issue, the transmission delay of microwave radio is over 30% less than standard optical fibre, and can also normally be made to get much closer to the minimum radial distance.
7. MSP Ethernet interface. MSP is not a standard term and we assume it means “Multi Service Platform”. However this is rather vague and ambiguous. Openreach’s OSEA product has a range of interfaces, as well as Ethernet and if this is what is meant by “MSP” then Openreach also offers this.
8. Based on the reference Cyan paper, ‘MSP Ethernet’ would in fact appear to be the name of an internal Colt project rather than an innovative technology. Indeed, according the referenced material, MSP is primarily a programme of providing integrated access for Colt’s layer 2 and layer 3 services which many CPs have been doing for years.
9. Software Defined Networks. This is a generic term and there is no agreement about what this means precisely. SDN are currently mostly realised in Data Centres while the standards for potential products are still being discussed in the standards bodies. BT is active in these forums and helping to develop these standards whilst we are not aware of Colt being active in this area. If Colt has developed some form of SDN then this would typically operate at the higher layer protocols and could be run over Openreach EAD circuits.

10. The reference to SDN would also appear to be based on the Cyan network management and orchestration system. However, the Cyan systems are particularly well suited to managing the multi-layer, heterogeneous environment of third party active access input services. BT sees no technical barrier to Colt offering their new services over Openreach's active products⁸⁰.
11. Performance Monitoring Systems. All well designed networks have performance monitoring systems (including BT) and we are unclear what is being discussed here.
12. NGA and Carrier Grade QoS. Colt notes that NGA is for broadband and is not therefore to the quality of Carrier Grade Ethernet. NGA was not intended to be this standard as it is a service designed for residential users and small businesses. However it could still be used as a substitute for carrier Grade Ethernet where the business can make do with a lower capacity service. While it is true that NGA may not be appropriate for every business assess requirement, it does not follow that it is not without any application at all.
13. EAD is carrier grade so all the protocols discussed in the document and the Colt Annex can be carrier over EAD. The maximum frame size is such that Double tagging can be carried over EAD circuits (max is 2000 bytes).
14. Additional observations to make on the Colt parallel to NGA. First it should be stressed that the scenario they are envisaging bears no practical resemblance to the current PIA offer for NGA. The general context of the current PIA offer is for a contract with a single CP to supply complete duct routing for NGA systems with little or no interconnection to competitive duct and which would follow exactly the same basic topology and system architecture as Openreach itself would use for NGA.
15. The proposal of Colt is potentially hugely more complex involving: multiple CPs; ad hoc short sections of duct; large scale duct interconnection; and the installation of systems to a completely different topology and system architecture to that which Openreach would use for itself (indeed this is Colt's apparent objective).
16. The differences are so different to the current PIA offer, that such a solution could in no practical way be considered a simple extension of the current PIA beyond NGA to business services. It would be a completely new offer and would require a complete new set of operational processes and reference offer.
17. Second, this solution can only realistically address a small proportion of the overall business connectivity market. Colt and other CPs are already free to build their own duct to any customer with all the advantages of full vertical integration. This solution is only relevant to those sites where Colt, and other CPs, have currently decided it is uneconomic to build their own duct. But it does not replace the need for the CP to build, it only gives a marginal reduction in the amount of build that would be needed.

⁸⁰ For the sake of completeness, the substantial discussion in Colt's submission Annex C on packet formats and packet lengths is not relevant to the EAD/OSA/OSEA which support packet length of 2000 bytes and therefore have ample 'headroom' to support QinQ and MACinMAC headers. Moreover, unlike NGA, as these products do not network at layer 2 and so there is no reason why these products, in of themselves generate the need for such encapsulations. The Cyan paper also makes reference to Network Functions Virtualisation (NFV) alongside SDN. BT has been one of the primary driving forces behind this innovation. However, as BT decided to set up an international collaboration for this technology, it also happens that as a result, Colt is essentially benefiting from the significant innovation and investments from BT and other major carriers.

18. Colt does not suggest that this would extend the footprint of economic build by anything other than a modest amount when set in the context of all business sites currently service by Openreach's active products. The solution is sandwiched between the value of vertically integrated own build and the poor economics of any build at all in less dense areas.
19. Third, this modest possible increase in competitive reach would come at the heavy price of a large increase in the operational costs of the duct network with greatly increased complexities, and hence associated costs, in record keeping, planning, rights of access, responsibility of damage and repair, etc., added to the Openreach access infrastructure in perpetuity. This is in the part of the network where operations and record keeping are already very challenging.
20. Other statements. We set out below a response to further statements made by Colt we consider to be inaccurate and which is not an exhaustive list.
21. Page 25, section 4.4 "Broadcast substitution" ref [5]

"A last point to consider is that GPON broadcasts all packets to all terminals, which are filtered out and distributed to the relevant address. For many business customers, this is unacceptable for security reasons and furthermore, significantly increases the scope for congestion to affect network performance."
22. It is true that packets are broadcast to all terminals. Many years ago the US air force originally objected to this and the standards were changed. Powerful encryption was used to ensure that these broadcast packets could only be read by the correct user. However, any company today that wishes to keep their data secure will use strong encryption on their own end equipment for transmission across the network. Very few companies would ever rely on encryption of just one part of a connection across the internet. The broadcasts are done in a time division multiplexed way that would not increase congestion in any way.
23. Page 25, section 4.4 "Broadcast substitution" ref [5]

"This type of innovation is essential if innovation by infrastructure providers such as telecommunications companies and Over-the-Top (OTT) suppliers can continue to evolve organically as complementary forms of innovation required to deliver new services to users. Innovative providers of Software as a Service – SaaS – offered from the cloud, from office automation to talking fridges or health monitoring systems are not going to be possible to be delivered if the right kind of connectivity is not available in an efficient and scalable way. Active access as such limits innovation to the monopoly provider of telecommunications services in collaboration with regulatory and policy makers, on the one hand, and the OTT service providers, on the other."
24. The communication requirements of various technologies discussed here (if we make reasonable assumptions) should not be excessive and so they should easily be able to communicate over the existing networks available today. It is hard to see how passives would make any difference and how active products limit them in any way.
25. Active access does not limit innovation in this area to BTW or Openreach. BT and many other companies offer cloud services at the moment. In some flavours of these products high speed links would be needed, but they can be provided by the existing upstream wholesale services.

Annex 5: [REDACTED] report [REDACTED]

Annex 6: Business Connectivity Market Review: passive remedies, report by DotEcon

Report from DotEcon on the appropriate economic framework for passive remedies, attached to this response as a separate document.

Annex 7: WIK-Consult report “Ethernet leased lines: A European benchmark”

Report from WIK-Consult which benchmarks reference offers for Ethernet services by SMP operators in a number of EU member states, attached to this response as a separate document.