BUSINESS CONNECTIVITY MARKET REVIEW

CALL FOR INPUTS RESPONSE BY COLT TECHNOLOGY SERVICES

NON-CONFIDENTIAL VERSION

CONTENTS

1 ABOUT COLT

Colt is Europe's information delivery platform, enabling its customers to embrace the changing landscape of IT and communications so they can deliver, share, process, and store all of their vital business information.

Colt aims to inspire customers to think differently about the way they tackle their core business and technology issues. Colt's information delivery platform combines high performance, end-to-end control of integrated compute and network solutions with an agile and responsive approach that delivers an integrated experience across Europe and beyond.

Today, Colt runs a 23 country, 46,000 km network that includes metropolitan area networks in 41 major European cities, with direct fibre connections into 19,800 buildings and 20 Colt data centres.

Colt enables its customers to deliver, share, process and store vital business information by bringing together 3 key elements:

- Pioneering European Ethernet and IP networks that seamlessly connect over 100 cities and achieves the industry's highest standards in performance, latency and security.
- Significant IT infrastructure and services across Europe, with 20 state-of-the-art data centres with tens of thousands of devices under management.
- Extensive expertise in creating integrated IT managed services, networking and communication solutions.

Colt is continuing to invest heavily in its ability to deliver integrated network and IT managed services. Colt is also helping to lead industry standards and certification for cloud services.

2 EXECUTIVE SUMMARY

Today's BCMR remedies are essentially traceable back to the first BCMR shortly after the implementation of the new EU regulatory framework for Electronic Communications. At the time, business connectivity entrants were primarily concerned with obtaining leased line terminating segments with the right specification and pricing to allow them to compete on level terms with the regulated entity. Coming so soon after the "dot-com bust", this was also a time of severe capital constraints.

More than a decade later, the world has moved on. The demands placed on networks have increased, business markets have become more diversified and fragmented, and they interact with residential markets in increasingly complex ways.

As Ofcom prepares for the BCMR, there are two key factors that, in Colt's view, should be feature prominently in its deliberations. These are as follows:

- The complexities of the interactions between different market segments are now such that they can no longer be managed by a regulator, or left to the mercy of a single player; and
- The needs of business customers are becoming too diverse and fragmented for all the relevant dimensions of their connectivity products (including pricing models) to be managed by a regulator or a single player.

Regulation is too blunt an instrument to manage these issues. Instead, they should be managed by the market and the overarching objective of the BCMR should be to create space for this to happen.

Regulation is one of the most fundamental drivers in the structure of the Electronic Communications industry and the nature of competition within it. Essentially, the regulator choses the entry point and specifies the products that must be provided at that entry point. The further down the supply chain competition enters, the more competition is effectively "managed" by the regulator and the regulated entity.

In the past decade there have been almost no significant new infrastructure deployments in the business connectivity market by any player other than BT. Consequently, outside London, competition is largely organised around BT's wholesale products. CPs compete with BT in largely the same markets with largely the same products, using largely the same pricing models.

This cannot be healthy. Statistics on market shares may give the impression of a vibrantly competitive market but as far as BT is concerned, it is the right kind of competition. Another way to look at it might be to describe it as a "Shallow-Remote" model of competition, as opposed to what the market really needs at this time, which is a more "Deep-Local" model.

As we argue in this submission, the solution is a set of remedies underpinned by passive infrastructure access. Passive infrastructure remedies would allow CPs to:

- configure their services at all layers (from the physical layer upwards);
- provide flexible and differentiated pricing models;
- internalise the option value of customer acquisition, thereby allowing past expansion to be used as a platform for future expansion;
- challenge existing market segmentation strategies;
- roll-out differentiated services to customers outside the very dense business districts (such as central London); and

- create competition to Openreach in terms of time-to-market, SLAs, and time to repair, potentially providing a market mechanism to address recent concerns about its quality of service.

In other words, passive infrastructure remedies would provide the market with precisely what it requires to allow it to move towards "Deep-Local" models of competition, where the economics permit. As well as serving business customers directly, "Deep-Local" competition would allow the market to serve the increasing demand for backhaul capacity driven by NGA broadband and LTE usage.

Other countries have shown that passive remedies work. They have enabled the roll-out of alternative infrastructure in many second-tier EU cities and have proven effective in unlocking local NGA broadband investment. Furthermore, the ancillary processes and pricing models have developed and matured over time.

As other countries have shown, active and passive remedies can peacefully co-exist and there is no basis for any concern about adverse effects on the incumbent's ability to recover its common costs or its ability to price downstream services in an efficient manner.

All the problems one might anticipate with passive remedies can be and have been solved.

In terms of implementation, Colt's experience of using passive remedies in other countries has allowed it to identify various elements of best (and worst) practice. On the basis of our experience, the suite of remedies should include the following provisions (should Ofcom decide to pursue this route). It should:

- include duct access, dark fibre access and open collocation inside the SMP operator's exchanges;
- allow deployment in all network segments. ("Access" and "Backhaul" segments are terms that are relative to an existing network architecture, and are not absolutes in any sense. The key point about passive remedies their ability to allow the market to break down distinctions across multiple dimensions, including network topology)
- include a business class SLA in terms of delivery and faults;
- incorporate state of the art provisioning systems and processes.

We would be happy to work with Ofcom to provide more detail on how the remedies have been implemented in practice.

In the remainder of this document:

- Section 3 sets out our general thoughts on how to approach this BCMR
- Section 4 sets out our answers to the specific questions raised in the CFI.

3 OVERALL APPROACH TO THE BCMR

The first BCMR (2003) in our view, provided broadly the correct answers to the questions prevailing at the time. In the ensuing decade, subsequent BCMRs have improved upon the remedies in a series of evolutionary steps. While there have been some step changes (examples being the creation of CELA/WECLA, Trunk Aggregation Nodes and basket based price controls), the set of remedies are clearly traceable back to the first BCMR over 10 years ago.

Today, we argue that the questions requiring an answer have materially changed and different answers are needed.

3.1 CURRENT STATE OF THE COMMUNICATIONS MARKET IN THE UK: MOSTLY DOING WELL BUT FIT FOR THE FUTURE?

As Colt has consistently argued in its response to the previous BCMR[1], through its responses to the FAMR[2] and presently in its response to this CFI, electronic communications markets are strongly linked. The linkages are not difficult to see and they are strengthening. They include, among others:

- Complementarities: EU Market 4 remedies (such as ULL and other forms of passive infrastructure access) being used as inputs to both EU Market 5 and Market 6 services; backhaul "leased lines" being used by mobile operators and residential internet service providers; data centre connectivity as an essential component of the online supply chain.
- Substitutabilities: superfast broadband now being seen more as a substitute for some EU Market 6 products than has previously been the case. Some customers in the lower to middling segments of the market regard FTTX based broadband services as substitutable to a degree. Examples are customers who need the downstream bandwidth but not the high-end features of leased lines.

Such are the linkages that some EU NRAs are starting to review Markets 4, 5 and 6 concurrently. In its response to the FAMR Colt described in detail the approach taken by ARCEP and argued that Ofcom should consider whether conditions warrant a similar approach (note, we are not suggesting that Ofcom delays the next BCMR to coincide with the next FAMR, but rather to take explicit account of the linkages between the markets). The current drafts of the EU consultation on relevant markets are more cognisant of the linkages between markets and are designed to allow NRAs to take more explicit account of them.

A related issue is that the term "leased line" is becoming an increasingly ill-defined term that is rarely used outside the regulatory lexicon. Arguably, the definition of EU Market 6 has led to "leased lines" becoming considered by NRAs as a category of service that is entirely separate and distinct from other forms of connectivity; and secondly, as homogeneous within that category. We consider both to be gross over-simplifications that, if unexamined, can lead to errors in thinking.

[1] http://stakeholders.ofcom.org.uk/binaries/consultations/business-connectivity/responses/COLT.pdf

[2] http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-reviews/responses/Colt.pdf

Because of the linkages between described above, any consideration as to the performance of the UK Electronic Communications industry relative to its European peers should focus not only on the performance of individual markets but also on whether adjacent markets are providing the platforms for future development.

The UK Communications Market evidently has much to commend it. The WIK report for ECTA[3] "Business Communications, Economic Growth and the Competitive Challenge" considered the availability of various categories of regulatory remedy needed to secure a competitive market in business communications. The UK did well on all metrics. Further, Ofcom's own "European Broadband Scorecard"[4] concluded that the UK is currently performing well by reference to EU comparators in Superfast Broadband speeds, price, availability and take-up.

Nevertheless, despite the overall rosy picture described above, from time to time the UK Communications sector has endured stinging criticism. For example:

- The Public Accounts Committee strongly criticised the Government's approach to the development of rural broadband, delivering a framework which in practice, led to BT winning all the contracts. This can only be described as a serious failing. Many of the advances in competition in the past 30 years have effectively been undone. If there are any aspects of market dynamics or regulatory policy that have contributed to this outcome, these need rigorous and critical examination. We argue that BT's choice of FTTC, the absence of any FTTH unbundling product, and the absence of any effective passive access product (particularly dark fibre and duct access) have allowed BT to operate a market segmentation strategy at retail and wholesale levels that effectively allow it to manage the pattern of competitive entry.
- Linked to the above, CPs have claimed the lack of a dark fibre offer from BT is one of the key reasons for the failure of local investment: BT inherently self-provides dark fibre and sells only active products to other CPs. It can, for example, increase rivals' costs by the denial of effective backhaul.
- By comparison with other EU countries, the UK has seen a notable lack of infrastructure investment – particularly in the business sector – by CPs other than BT. Indeed, there have been almost no large-scale deployments of business class infrastructure in the past 10 years.

These and comments like them, seem to be among the most common criticisms levied against the UK communications sector. It is relevant to ask: are they linked, i.e. is there any unifying theme? Colt argues that, yes, they are indeed linked and in order to understand why, it is necessary to explore perhaps the most penetrating criticism of all: the allegation that the current structure and operation of the UK Communications market lies at the mercy of BT. According to this view, BT is free to make decisions concerning market segmentation, products and pricing (both level and structure) such that the competition often amounts to little more than an overlay to BT. In our view, BT's ability to do control the market is seen everywhere, for example:

[3] http://www.ectaportal.com/en/REPORTS/WIK-Studies/WIK-Report-Business-Communications-Jan-2013/

[4] http://stakeholders.ofcom.org.uk/binaries/research/broadband-research/scorecard/European_Broadband_Scorecard_2014.pdf

- Its pricing model, particularly in backhaul services, has the potential to impact market entry decisions in access networks;
- Restrictions on usage (particularly distance limitations and distinctions depending on whether the end-use is considered by BT "access" or "backhaul"), has the potential to prevent services being used for another purpose, thereby maintaining the hierarchical structure of its network;
- Its control over all the upstream inputs allowing it to restrict competition to the variants of its leased line products that BT itself provides

Such practices allow BT to maintain a set of segmentation strategies that suit its business, each segmentation strategy reinforced by measures designed to prevent entry arising from an adjacent market. These criticisms are almost certainly related: the lack of infrastructure investment in business connectivity services denies other operators a platform on which they can subsequently build their own access and backhaul networks, which in turn prevents CPs from challenging the market segmentation and price discrimination practices operated by BT.

Although the interactions between related markets are complex, difficult to analyse and still more difficult to find hard data to corroborate any hypothesis, it seems difficult to avoid the overall impression that BT is in control. Furthermore, it exerts control in a way that is far more profound than would be indicated by any metric on market shares in any given segment of the market. Put another way, although many segments of the UK market are competitive (as indicated by market share), as far as BT is concerned it is the "right kind of competition". Competition fits neatly into the market segments organised by BT, not challenging the boundaries between them. Except in areas with significant alternative infrastructure deployments (such as Central London), there is very little product differentiation because products are constrained by the wholesale inputs provided by BT.

Given this, it is relevant to: is the UK Communications market genuinely fit for the future?

3.2 FIT FOR THE FUTURE?

As mentioned above, Colt believes the questions have changed and different answers are needed. Reform is needed if the sector and wider economy are to benefit to the fullest extent from the technological advancements on offer. These (collectively described here as "new-wave technologies") include:

- The growth of cloud computing and remote data services, in turn driven by demand for myriad online services including multimedia content, health, financial services etc. Many aspects of our lives are coming online. Storage capacity and bandwidth need to become scalable, secure and protective of personal privacy[5].
- The increasing dispersal of business sites requiring integrated connectivity. This is seen in the growth of pan-European businesses with sites in multiple jurisdictions, requiring

[5] Proposal for a Directive of the European Parliament and of the Council concerning measures to ensure a high common level of network and information security across the Union, Brussels 7.2.2013 (COM(2013) 48 final) and EU Data Protection Reform Package https://secure.edps.europa.eu/EDPSWEB/edps/site/mySite/Reform_package

seamless connectivity. It is also seen in the growth in home and mobile working, requiring high-quality access to remote data and applications.

- The growth in demand for data transmission capacity, driven by the increase in access bandwidths delivered by FttX and 4G. This is particularly acute in mobile backhaul. *"As a percentage of total mobile data traffic from all mobile-connected devices, mobile offload increases from 33 percent (429 petabytes/month) in 2012 to 46 percent (9.6 exabytes/month) in 2017. Without offload, Global mobile data traffic would grow at a CAGR of 74 percent instead of 66 percent."* (Cisco 2013).
- The growth in machine-to-machine (M2M) communications. We include in this category scenarios where remote machines are monitored or controlled by central servers, and White Label network services[6] allowing service providers to provide apps or connected devices to users (for example health monitoring apps available on portable devices feeding into a health service). According to Cisco, Western Europe will experience the highest CAGR of 97 percent from 2012 to 2017 with 112 petabytes per month of forecast M2M traffic in 2017.

Two things become apparent when reviewing these developments. **Firstly,** this is about business-to-business communications but it is not only about business-to-business communications. More precisely, these market trends illustrate what the business-to-business communications sector needs to deliver to the entire sector for the market to thrive.

Secondly, there can be no one-size-fits-all solution serving every requirement of all sub-sectors of all markets. One access regime, foisted on one infrastructure owner providing connectivity to all market participants, will not do the job. There is not merely one market for business connectivity. To the contrary, there are many markets, differing enormously in their requirements for quality of service (e.g. resilience, availability, latency, transparency, etc.).

How can the UK Communications sector deliver all of the above? We argue the single most important factor is new investment – not just any form of investment but rather, investment targeted at specific market niches, focused on the individual needs of customers involved in driving the changes described above.

In a market where the most important requirement is market entry and competition, a single entity with control spanning every market sector did not matter so much: so long as regulation dealt appropriately with the (relatively homogeneous set of) inputs required for competitive entry, competitors could enter and thrive. In a market where the most important requirement is differentiation and investment, it matters very much indeed.

3.3 THE WAY FORWARD?

We describe some of the more negative features of past BCMRs (which might not have mattered so much at the time, but increasingly will do going forward), before arguing more positively for how these issues need to be resolved.

[6] Trotter, P., Green J. (2012), Ovum, *Operator M2M Strategy Update 2012*, TE007-000626, August

The BCMR is not a static optimisation problem. In past BCMRs, Ofcom considered the problem as one of optimising the pattern of cost recovery across a relatively homogeneous, undifferentiated set of products called "leased lines". In this way, the character of the analysis is akin to utility economics under natural monopoly conditions. Today, we argue that the mind-set behind this approach is about as far removed from the reality of the market as it could possibly be.

Furthermore, Ofcom's justification for its approach has placed a great deal of faith in the coincidence between the incentives facing BT and the conditions required for optimum economic welfare. The conditions required for BT to have the right incentives to price in a Ramsey-optimal manner are in fact very strict and almost certainly do not apply in reality. In particular, it is required that the products sharing fixed costs face exactly the same degree of competition (in order for relative firm-specific demand elasticities to be in line with relative industry specific elasticities). Considered in the context of a market with a multitude of complex interactions, in which BT has incentives to maintain (and impose on the rest of the industry) its own market segmentation strategy, preventing any blurring between them and reducing the risk of entry from adjacent markets, the assumption becomes untenable.

Furthermore, in the light of BT's 2013 RFS restatement[7] in which it reported that for many years it had been wrongly allocating costs between different regulated markets (thus undermining the entire basis for the price controls that Ofcom has imposed in various market reviews) the degree of faith that has been placed in BT's ability to price in a welfare-optimal way, at best appears naïve and at worst, absurd.

A further factor relates to how unwieldy the BCMR remedies have become. Today, they are extremely complex and difficult for CPs to understand. The more elements, variants and parameters exist for each regulated product, the more difficult it is for BT to implement regulation in a way that matches the spirit as well as the letter, the harder it is for CPs to understand the products on offer and the more scope exists for gaming in terms of pricing, break points, operational detail, points of handover and restrictions on use. Thus, we argue (as we did in our reply to the 2012 BCMR consultation), that Ofcom should focus on a simpler and more generic set of inputs for this market.

Going forward, to devise a suitable framework for business connectivity for the future, we argue that Ofcom needs to introduce a regime that:

1. Provides a platform on which other operators can invest efficiently in infrastructure;
2. Provides a platform that allows other operators to differentiate their services (competing with BT at upstream and downstream levels on multiple levels including but not limited to: quality of service, SLAs, time to market, choice of technology, choice of technical features, choice of network architecture, etc.)
3. Allows the market (not regulation, or still worse, BT) to manage the multiple interactions between adjacent markets
4. Allows the market to challenge BT's choice of product/market segmentation

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7 http://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2013/CurrentCostFinancialStatements2013.pdf

The regime we advocate involves a combination of passive infrastructure access remedies with downstream wholesale remedies of a similar nature to those applying today.

As well as offering multiple benefits, which we describe below, passive infrastructure access has certain attractions in terms of the purity of the economic logic behind it. The fundamental source of market power that begat the need for regulation is, always was, and will remain, the civil engineering infrastructure. In a market with a plethora of downstream applications that are becoming ever more demanding, rapidly fragmenting and that interact in many complex ways, it makes sense for Ofcom to introduce a regime that allows the substitutabilities and complementarities to be managed by the market and not by regulation.

3.4 PASSIVE INFRASTRUCTURE ACCESS

Passive infrastructure access works. It has been implemented in multiple other countries and the processes and economic models underlying them are mature and well understood. True, in the UK PIA can hardly be described as a success, but the reason for this is almost certainly more attributable to the multiple restrictions on its usage than to any fundamental failing in the concept.

Passive infrastructure access can and does exist alongside active remedies in other EU countries and can be implemented in the UK in a similar manner. In France, passive infrastructure remedies have been applied and are now widely used in a way that has facilitated the rollout of the country's FTTH infrastructure. FTTH service providers make use of a competitive market in backhaul that has been created by passive infrastructure remedies in this segment of the market.

The fundamental benefit of passive infrastructure access is that it provides an efficient platform for market entry. Figure 1 contains a comparison between the actual digging cost and the duct access costs for four comparator countries. **[Confidential.**

Figure 1

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3.4.1 Addressing some of the criticisms of passive infrastructure access in the UK

Colt argues that Ofcom's views of the costs of implementing passive remedies have been overblown and the benefits have scarcely been considered at all.

- The "cost", in terms of the disruption to the price control itself depends on a view being taken on the virtues of the existing price control. To our knowledge, the putative benefits of the current price control remain unsubstantiated (except in a theoretical sense, where the applicability of such theory depends on a number of conditions applying that in fact, do not apply), and may well be over-stated. Any evidence that there may be that BT's pricing structure is efficient (and we have seen no serious attempt to establish such evidence) is counterbalanced by equally strong (if not stronger) evidence that BT's pricing structure is in fact not efficient. In other words, equally powerful arguments can be advanced that BT's pricing structure wants disrupting.
- The "cost", in terms of network duplication that Ofcom has previously used as a reason not to implement passive remedies, does not appear to take into account the potential reduction in the cost of network duplication that would result from a reduction in digging.

Whichever way we look at the issues, it is curious that two "costs" of such a doubtful nature and magnitude have been used as reasons to foreclose an entire platform for market entry. It is ironic to note that the most successful geographic segment of the UK business communications sector – Central London – is the segment that has seen the greatest extent of alternative infrastructure investment. 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[8], 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.

Although the network infrastructure in London has been implemented via digging rather than mandatory passive infrastructure access, the key point is this: if Ofcom's reasoning were correct, the very failings that have led Ofcom to decide against passive remedies should be in abundant evidence in London. Yet we see no such evidence at all.

LLU provides another example. LLU is a very specific form of (dark copper) passive access. BT heavily resisted its implementation in the 1990s with a series of apocalyptic warnings about its practicality and impact on network integrity. Oftel hesitated in mandating it until the EU Commission issued its Directive in 1999. BT conspired to break the product, which conspicuously failed until 2006, when a combination of regulatory reforms led it to take off. It was a humbling experience for the UK which, despite enjoying a 15 year head start on liberalisation, needed more newly liberalised markets to show that LLU could work. One suspects the real reason for BT's opposition to LLU was – just as with modern forms of passive access today – that it would allow CPs to offer better or different services to the ones BT itself had chosen to offer. The prospect of unmanaged, disruptive or chaotic competition is a frightening prospect for any monopoly.

Today, LLU is an unqualified success. It has led SMEs to enjoy truly business class "leased line" products in the form of Ethernet First Mile[9]. BT was not the innovator that brought this to the UK

[8] http://www.cyaninc.com/assets/docs/case_studies/Colt_case_study.pdf

[9] Ethernet First Mile: a business class Ethernet product provided using copper LLU.

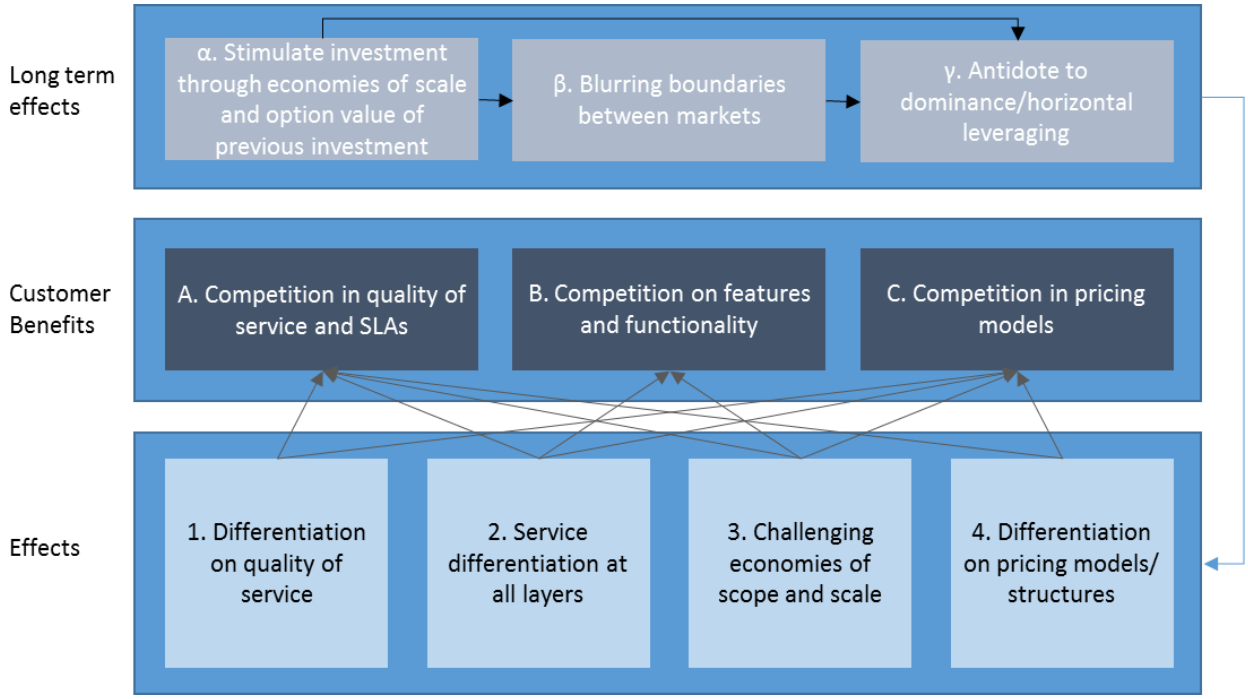
market. Despite the obvious parallels between LLU and modern forms of passive access, there has never been any concern about its disruptive effect on BT's ability to price efficiently or its ability to recover common costs. Even if there had been, it would be quite ridiculous to use such an arcane justification for the withdrawal of a product that now forms part of the staple diet of the UK electronic communications market.

Contrary to the allegations of its opponents, passive infrastructure access is not about arbitrage. It is about the ability to configure networks in differentiated and innovative ways. Instead of viewing passive infrastructure access in negative light – mostly in terms of its alleged incompatibility with the current set of remedies – we argue that Ofcom should focus more intensively on the positive benefits it could bring. In the next section, we outline a conceptual framework that could be used to analyse and evaluate the benefits allowed by passive infrastructure access.

3.4.2 Framework for assessing the benefits of passive infrastructure access in the UK

We have attempted to summarise some of the benefits that passive infrastructure could bring to the UK market in Figure 2.

Figure 2



Each element in this model is described below.

Effects. Starting with the areas in which passive infrastructure access would enable operators to behave differently, passive access would enable them to:

1. Differentiate on quality of service. CPs are able to offer better SLAs and perform better against their SLAs. For CPs besides BT, the SLA commitments for delivery, upgrades and repairs represent maximum lead-times. Customers also have the ability to request shorter lead-times by negotiating with their service provider, who have an incentive to meet their demands. In the case of Openreach, the SLA lead-times in practice too often represent

minima. Provisioning in less than the lead-time is relatively rare and customers have very little or no flexibility to negotiate a better service to meet immediate needs. Similar concerns to those surrounding Openreach's underperformance rarely occur with BT's competitors and in contrast to Openreach, such underperformance is typically isolated rather than systematic. Customers sometimes request SLA commitments from Colt that cannot be provided using BT's wholesale services. See answer to Question 16 for some specific examples.

2. Service differentiation at all layers. Using third party wholesale inputs, a CP is restricted to the technology and architectural choices of the third party. By constructing its own network, a competitor is able to configure its infrastructure and services to meet the needs of itself and its customers. Differentiation is possible from layer 1 upwards. Colt has constructed city rings in several EU cities using the pre-existing hub and spoke infrastructure. It is also able install its own WDM equipment, which may not be available using third party inputs. At Layer 2 and above, a CP is able to install technologies that BT has so far failed to incorporate in its own wholesale products, **[Confidential.**

]. It is well understood that several of the major innovations in the electronic market have not originated with incumbents. The Internet is one example of this. In the business services sector, Colt's pioneering role in introducing carrier-grade Ethernet in the City of London was undoubtedly one of the factors that led to the UK becoming a global leader in the wide-area Ethernet connectivity market. One would expect therefore a remedy that allows a CP to differentiate its services from those of the incumbent would lead to further technological innovations.

3. Challenging economies of scope, scale and density. Presently, BT gains an advantage due to its economies of scope between several market segments (for example between business and residential services) and economies of density between nearby customers. A CP building its own fibre ring would be able to use that deployment for multiple purposes. Examples include: wholesale services to a residential CP (if it is a business only CP); lower grade or "in between" services for less demanding business customers; cheaper connections for nearby customers (next door or on a different floor); the ability to re-use equipment following churn or move. A network connection also provides a node for incremental network expansion (either by the CP or another party); leading to the potential for further network expansion. Fibre rings are particularly well suited to this purpose. BT's wholesale inputs cannot be used in any of the ways described above. This allows BT to maintain its own market segmentations and limits competitive entry from one market to another, or the boundaries between them becoming blurred. It also prevents any CP from challenging its network topology and particularly, its distinction between "access" and "backhaul" – terms which are not absolute in any sense but which are only meaningful with reference to an existing network topology. Fibre rings on the other hand can be used as both access and backhaul for different customers. This tends to reinforce the entire UK business communications market as an overlay to BT.

4. Differentiation on pricing models/structures. By comprising such a high percentage of the final price to the end user, the price of BT's wholesale services set the floor on which CPs can offer services to their customers. Own infrastructure costs on the other hand, can be recovered in more flexible and innovative ways. Given that such infrastructure costs are generally shared between a larger number of customers across several categories of services and being capital costs, are amortised over a longer period of time, the pattern of cost

recovery can be more flexible. This might involve (for example), the bundling of access and services, usage based charging, etc. A CP buying active access will generally be cautious about charging a customer a price that (even temporarily) falls under the cost floor imposed by the monthly rental cost. On the other hand, own infrastructure costs are less direct in terms of their relationship with individual customers and over time. They therefore allow the CP to price in a welfare optimising way using various non-linear tariffs and bundling strategies.

These activities by suppliers would lead to the following benefits to the market:

A. More competition and choice in service quality and SLAs. Although we do not have data to support this contention, we believe that the market is more responsive than is Openreach, to customer requirements in terms of service delivery, upgrades, repairs, etc. **[Confidential.]** We would also expect more competition in service quality and SLAs to lead to a general improvement in the quality of service offered by Openreach where cost effective alternatives exist. In particular, we would expect the systematic failings in Openreach's quality of service to be a thing of the past.
B. More competition and choice in features and functionality. Different grades of service performance, technical features and SLAs can be introduced and live or die by the market. **[Confidential.**

] BT's wholesale inputs on the other hand are "one size fits all". These high-end products are only available on Colt's on infrastructure and can currently (in the main) only be enjoyed by customers in London.
C. Competition in pricing models. Existing infrastructure allows a great deal of flexibility in the pricing of incremental services. Upgrades can be processed cheaply and efficiently. Near-net customers can be served cheaply. Empty buildings (buildings with network but no service) can be priced flexibly. Different floors in a lit building can be priced flexibly. The ability for a given network segment to act as "access" in one capacity and "backhaul" in another, allows flexible pricing of both, as well as allowing economies of scope to be realised. Such flexible pricing could lead to welfare enhancements as the bundling of (for example) connectivity and service (eg cloud computing access or other managed service) could be priced in a way that allows customers with different tastes to find the full bundle of value, while also allowing the CP greater scope to defray the fixed costs of each component of the bundle. Similar economic logic that has been used to justify the bundling of pay-TV services also applies here.

In time, these benefits have the potential to facilitate the following structural changes in the market, including:

α. Further network investment on the back of options created by previous network investment

β. A blurring of the boundaries between market segments as CPs fill gaps in the market left by BT

γ. An antidote to horizontal leveraging as other CPs start to enjoy similar economies of scope currently enjoyed by BT

Some insight into how the dynamic benefits of passive infrastructure access might work in practice can be obtained by reference to

Annex A. **[Confidential.**

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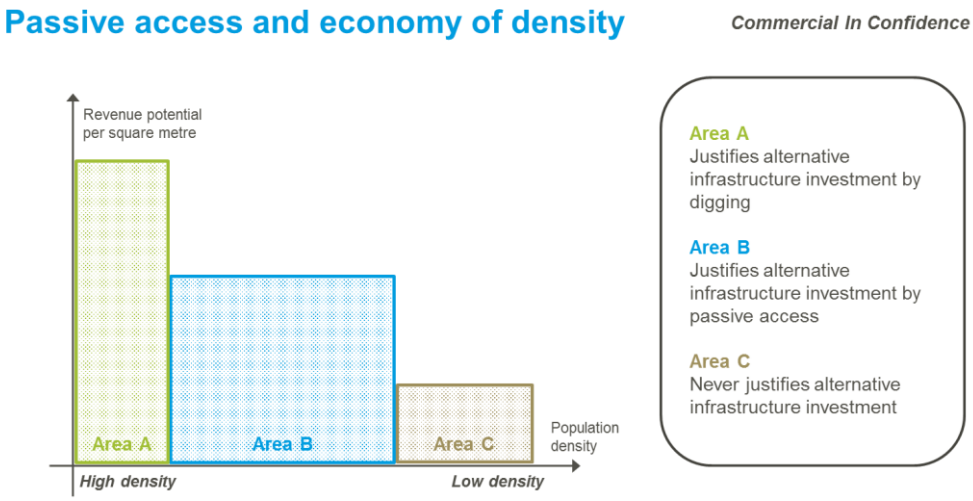
The interesting thing about this simulation is that it clearly shows the powerful potential of the option value created by previous investments. It does not, of course, consider all elements of the option value. It does not, for example, include any consideration of the option value of investment created by wholesale traffic (Colt's facilities providing a platform for investment for other CPs serving different markets). It also does not consider benefits arising from product differentiation.

Another way of looking at the issue can be seen by examining Figure 3 and Figure 4. Figure 3 represents how Colt views the case for alternative infrastructure investment in different types of geographic area across Europe. The interesting points here are twofold. Firstly, the transition from one area type to another is often not as continuous as one might expect. Cities in conforming to area type, include major cities (eg London, Paris, Rome, Berlin, Amsterdam etc). Central Manchester and central Birmingham would also fit into area type A. Area type B cities are typically smaller, provincial cities. Examples in the UK might be Bristol, Reading, Leeds, Newcastle, etc. In other countries, they might include Genoa, Bologna, Nantes, Basel, etc). There is relatively little in between area type A and B (the distinction is almost a binary one). Secondly, A-type regions will often justify alternative infrastructure roll-out via digging. B-type regions on the other hand, do not. However, they do justify alternative infrastructure roll-out where passive infrastructure access is available.

Figure 3



[Confidential.

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Figure 4

[Confidential.

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3.5 APPROACH TO THIS REVIEW

In this section, we set out our thoughts on how Ofcom should approach this review. Following the general comments in this section, we directly address Ofcom's questions in Section 4.

Our overall view is that Ofcom's approach creates scope for analysing all the benefits of passive remedies in a way that previous reviews have not. One general comment, however, is that Ofcom should resist the temptation to maintain the integrity of the price control at all costs. To do so would involve the unspoken assumption that the welfare properties that Ofcom attributes to its price control are more valuable than the benefits that passive remedies could bring.

In our view, there is nothing to indicate that passive remedies is incompatible with the type of price control that is currently in force. While (depending on implementation) passive remedies may cause BT's to reconsider pricing decisions within the price control, this is a decision for BT and not about the price control. Furthermore, if passive remedies were to force a departure from the pattern of pricing that some Ofcom economists may hope BT implements within the price control, it then becomes a question of assessing the costs versus the benefits: the costs (in terms of any loss of welfare resulting from sub-optimal pricing) versus the benefits (outlined in Section 3.4.2). As stated in Section 3.4.1, there are many reasons for doubting *a priori* that BT would price in an optimal way and there is some evidence *a postiori* that it in fact it does not.

In terms of cost recovery (as opposed to pricing structure), we do not believe there is <u>any</u> reason to believe that passive remedies would threaten this. Passive remedies would include a contribution to common costs (as it does in other countries). It might threaten BT's ability to recover costs on active equipment that it has purchased on the assumption that passive remedies would not be introduced and therefore demand for active services would remain high. However, we would argue that this falls under the category of regulatory risk and is a risk that BT, as well as all other CPs, must bear.

Our views on the ideal way to assess the role of passive remedies is summarised in the comparison between Figure 5 and Figure 6 below. Figure 5 describes an approach that is primarily about retrofitting passive remedies to an existing package of remedies and in particular, an existing pattern of prices that BT has chosen to implement within its price cap. Figure 6 is about defining the scenarios and comparing them. This approach implicitly allows the possibility that a scenario with passive remedies and a different form of price control (or pattern of pricing within the price control) may be better than a scenario with the existing remedies and pricing.

Figure 5

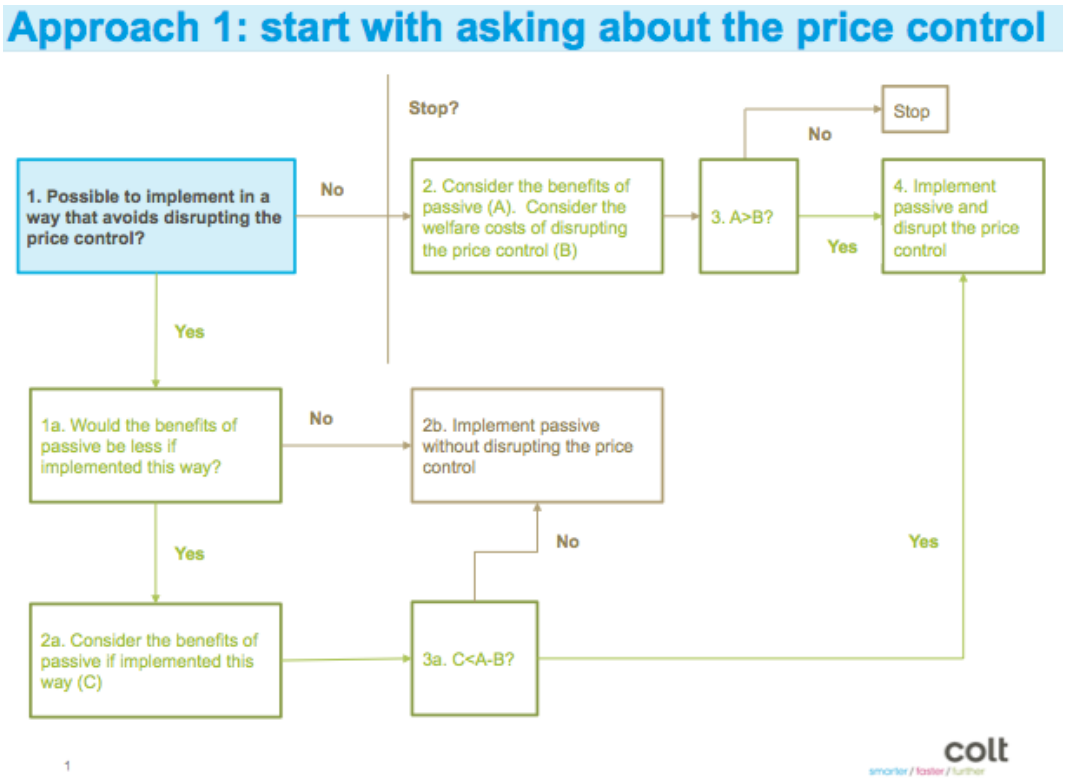
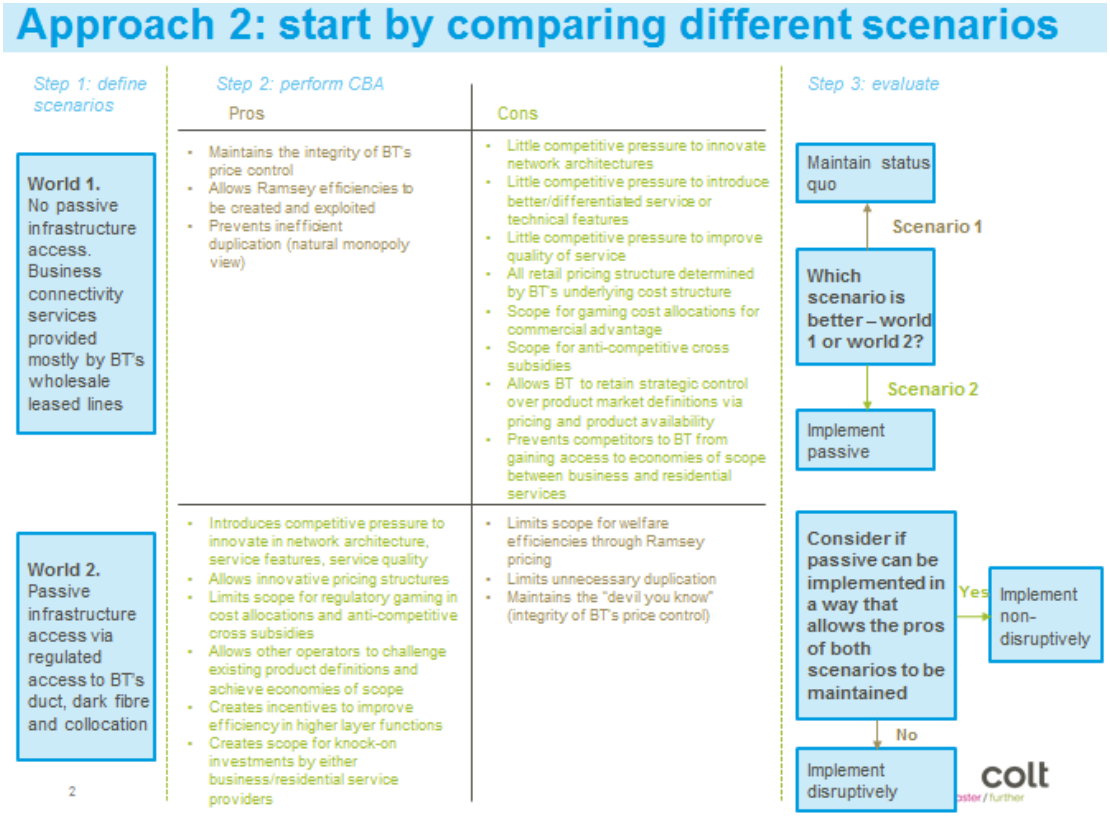


Figure 6



Even if we do accept (which we do not) that the current form of price control is unarguably the best, and BT's pricing within it is Ramsey-optimal (which again, we do not), the advantage of the approach described in Figure 6 is that – conceptually at least – it allows the costs and benefits of each scenario to be evaluated.

Our overall views, explained more fully in Section 4 below, are that (assuming the BCMR finds the relevant markets are similar to those applying today, and BT is found to hold SMP in broadly the same ones):

- Active remedies similar to those applying today should be retained, with various evolutionary improvements
- Passive remedies should be implemented that make no distinction between the end-use or the segment in BT's network topology that the relevant network facility resides
- Passive remedies should be priced at a level that allows a fair contribution to BT's common costs
- Passive remedies should be implemented via a clarification to the PIA obligation that it must not discriminate by end use and is equally allowable in any network segment. In addition, BT should be subject to an obligation to provide dark fibre and open-collocation allowing other CPs to install equipment in its exchanges
- The existing PIA obligation needs substantial work to remove the "deal killers" currently preventing its use. Colt has substantial experience of working with passive remedies in other EU countries and is able to work with Ofcom to understand the examples of best and worst practice

- Passive remedies are not incompatible with active remedies (as demonstrated in several other EU markets). As long as passive remedies involve the correct contribution to common costs, it is not incompatible with the form of price control currently applying to BT
- Assuming a uniform price, it would probably incompatible with the way BT currently prices within its price control, but we would not expect prices to unravel immediately, but rather, to adjust smoothly over time. There is no reason to believe *a priori* that a rebalancing of prices is a bad thing per se, and even if it was, the correct approach would involve a comparison of the costs and benefits
- Passive remedies could be priced in a way that depends on end use (for example, bandwidth, technology or type of customer), but in reality should not be. The reason for this is that doing so would jeopardise the effects, benefits and long-term effects described in Section 3.4.2.In particular, such a form of pricing would jeopardise effect 4, potentially effect 3, benefit C and long-term effects α, β and γ. Overall, it would reinforce the pattern of competition as an overlay to BT and reduce the strength of the virtuous circle of dynamic market entry, competition and innovation. It would also be highly complex to implement, monitor and enforce and could well end up being a deal-killer that prevents its practical use
- Passive remedy pricing could be subject to geographic variations in pricing, as is the case in some other countries (eg Italy)
- There is no incompatibility between passive remedies and Ofcom's legal duties or powers. Passive remedies do not per se threaten BT's ability to recover its legitimately incurred costs, so would not be vulnerable to challenge on those grounds. Duct access can be implemented by a removal of all limitations to the scope of the obligation that currently prevents its use in BCMR markets. Dark fibre can be implemented as an ancillary remedy to both BCMR and FAMR markets (as ARCEP for example has done – and this was accepted by the Article 7 task force). Open collocation can be implemented as an ancillary remedy in the BCMR, just as various ancillary remedies are imposed today (including various forms of collocation).

4 ANSWERS TO OFCOM QUESTIONS

4.1 MARKET QUESTIONNAIRE

Question 1: Is your organisation active in the provision of leased lines and related services? Would you be willing to help Ofcom with its analysis of the leased lines markets by completing a questionnaire?

Colt is very active in the provision of Leased Lines in the UK and especially in London, Birmingham and Manchester thanks to its Metropolitan Areas Networks. We would be delighted to help Ofcom with its analysis of leased line markets by completing a questionnaire.

4.2 PROPOSED APPROACH TO THE REVIEW

Question 2: Are there any developments since the last BCMR or prospective developments that may be material to our analysis of competition in this market? Please identify specific developments, explaining why they may be material.

Our comments to Ofcom's proposed approach to the review are described in Section 3 above. The main developments that Ofcom should take into account include:

- The growth of FTTX and LTE in the UK, which has the following broad implications:
  - Substitutability with "leased lines" in lower-end usage models
  - Growing demand for backhaul bandwidth, which increases demand for BCMR products
- The growing differentiation in customer demands resulting from the growth of cloud computing, cloud-based business models, distributed computing, the Internet of Things and the growing trend for business and daily life becoming online. This is leading to:
  - A growing fragmentation in connectivity solutions. The term "leased line" is ceasing to be a meaningful term in end-user markets
  - A growing demand for product differentiation in terms of performance, monitoring, flexibility, functionality, features and quality of service

4.3 QUALITY OF SERVICE

[Confidential.

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Those problems of Quality of Service can be divided into different types: provision, responsiveness, complexity and communication.

1. **Provision**. Overall the quality of provision is satisfactory. As a trend, the lead-time is met most of the time and most orders progress are fine. However, as soon as the order involves civil works and procedures the QoS is unsatisfactory. In the event that a dig and/or wayleave is needed, the delivery of the order becomes a very difficult experience.
2. **Responsiveness**. Business customers need to be kept informed at all stages of the order. This is not possible when dealing with Openreach and this has not improved over recent months. On the contrary, often, orders have to be escalated up to Level 5 to receive a response to a basic update query. Moreover, even though lead-times are generally on target, adhering to agreed dates with Openreach is quite difficult, these very often get pushed out.
3. **Communication.** As already shown by the above point, there is a lack of clear communication from Openreach to its wholesale customers. Another example of this is in case of faults and/or delivery, when Openreach needs to access the customer site: access is not always agreed with the customer before actually going to the site. This can obviously cause a number of issues.
4. **Complexity.** It is overall very difficult to deal with Openreach because each step of the process is complex and time consuming. An example of this can be shown by the difficulty involved trying to understand their SLAs. In order to know specifically what they are for a given product we need to go through at least three or four different documents that are not gathered in the same website page (i.e. where the product description can be found). This can be the case for each characteristic the CP is interested in. Nothing is clear and straightforward: just the opposite of user friendly. Colt never organises its SLAs in this way and neither, incidentally, does BT Wholesale.

Additionally, Colt does not believe the KPIs that BT publishes give CPs and the industry a sufficient visibility of Openreach's performance and most importantly Colt does not consider those KPIs reflect their true QoS. This is mainly due to the fact that Openreach's KPIs are based on the Contractual Delivery Date (CDD). Indeed, in most circumstances, CDDs are set with delays in the first place, therefore when CDDs are actually met, this does not reflect the real lead-time applied to a customer for a given order. Moreover, Openreach can indirectly manipulate its CDDs by choosing to place orders into the 'customer delay function'. Regularly, orders are placed falsely into that function in order for Openreach to push the CDD out.

As a result, Colt does not consider Openreach deliver a satisfactory QoS and does not believe this will improve unless more regulation is applied and more reflective KPIs are set. **[Confidential.**

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More generally, even if Colt believes more regulation is needed in order to specifically deal with Openreach's QoS, Colt believes that a market mechanism would deliver a better solution. A more

efficient solution is to give Openreach incentives to improve its service through facilitating competition at the infrastructure level.

4.4 BROADBAND SUBSTITUTION

Question 8: Can broadband, particularly NGA-based services be used effectively for the delivery of business connectivity? Has this changed over the last three years? How do you think this might change over the coming three years?

Colt does not consider business providers can effectively use NGA-based products to offer genuine business-class connectivity. Therefore Colt considers there are two separate segments of this market:

1. **A market for very high quality business access.** – A market comprising traditional interface leased lines and *"Carrier Grade Ethernet"* for example as defined in successive industry standards developed by the Metropolitan Ethernet Forum (MEF)[10]. From a demand side point of view, carrier-grade Ethernet offers intrinsic security and resilience characteristics that are not substitutable by residential Ethernet products. Considering supply side substitution, providers of residential Ethernet products and even less so providers of IP based products would not have the incentive or ability to switch to providing carrier grade Ethernet services instead, even in a time frame of 5 years (even less a time frame of once year, which is relevant from a market definition perspective). Carrier grade Ethernet availability remains limited to-date. Only the incumbent, where it provides wholesale carrier-grade Ethernet, offers national coverage of wholesale carrier grade Ethernet.

The security and resilience features of carrier grade Ethernet are qualitatively different from other service features which can be legitimately required by business customers, but which are not essential for all types of business customers or all of their sites. **[Confidential.**

] For this reason, carrier grade Ethernet is also particularly well suited to applications such as mobile backhaul, backhaul for the deployment of small cells, or the Internet of Things. **[Confidential.**

] In a world where cyber security is becoming increasingly important, natively secure networks are becoming an essential requirement for many of Colt's customers.

Typically, one would expect the market for carrier grade Ethernet leased lines to be national in scope except in the most dense business districts (such as Central London or La Défense in Paris) and perhaps with a bandwidth break for bandwidths in excess of 1 Gigabit per second. Typically the only supplier with a regional or national Carrier Grade footprint is the incumbent (in addition to niche providers such as Colt depending on geography). Annex C contains further information.

[10] http://metroethernetforum.org/carrier-ethernet/technical-specifications

2. A market for (regional) wholesale business access which is
    - Characterised by business SLA (for example 24/7 service response, 4-5 hour repair time, contractually defined maximum downtime)
    - Symmetric and asymmetric bandwidth, but with minimum 10 Mbit/s upstream bandwidth – whereas the required upstream bandwidth should be determined by upstream bandwidth requirements for certain cloud services demanded by business users.

Regarding the second market segment, there are two essential factors that must be considered in order to reply to this question: the obsolescence of LLU and the lack of any commercially viable replacement (SLU is technically viable as a replacement for LLU but the economics of rolling out SLU on a large scale are challenging).

Colt has noted and welcomes the efforts that Ofcom has taken to ensure VULA emulates LLU's characteristics/benefits such as:

- Service agnostic access enabling the product not to be confined to specific downstream services.
- Uncontended access emulating a dedicated capacity provided to the end user through a PR (ie Prioritisation rate introducing packets treated as "should not drop" which allow sensitive applications to have greater protection under congestion).
- Control of access permitting CPs to provide different types of services by varying QoS parameters. Indeed, BT offers three different types of profiles for its FttC-based GEA products implying a trade-off between line speed and line stability.

However, no method of emulation is perfect and while welcome, the initiatives described above essentially amount to retrofitting the functional characteristics of LLU to VULA. In many cases VULA and its underlying G.PON technology, is not designed to support them.

At the moment leased lines services can deliver "fully transparent" connectivity that satisfies both businesses at the retail level and operators at the wholesale level. Those services enable customers to enjoy full network features. However, it is true that some customers do not need and/or require all those features. If a customer wants to benefit from full network features to deliver connectivity between different sites, often that customer does not necessarily request all those features for all their facilities (especially for secondary facilities). **[Confidential.**

] Such services could eventually be delivered over BT's VULA. However, this does not allow Colt to serve all types of customer requirements that are possible with copper LLU. For example, a company requesting an EPN (Ethernet VPN) needs to benefit from full network features in order to structure its own internal network's architecture. Only offers with full transparency are able to meet such requirements (see Annex C).

Ofcom itself has acknowledged that the service features of copper LLU cannot be entirely replicated by VULA. **[Confidential.**

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In order for Colt to be able to serve business customers with the same range of services that it is able to do with copper LLU, we believe Ofcom should consider the following business customers' key requirements:

- **Time to Repair guarantee**. Currently the highest SLA offered by Openreach's FttC is six hours which is translated into a 7 hours from BT Wholesale. **[Confidential.**
  ]
- **Upstream speed guarantee**. We understand BT is offering a prioritisation rate up to 30Mbit/s for download speed. However, business customers require security on both upstream and downstream speeds. Moreover, even though symmetry is not always necessary, the difference between the two has to be reduced and guaranteed. The required upstream speed will evolve as the adoption of cloud services by SME customers evolves.
- **Basic VLAN control**. Frame length offered need to be long enough for VLANs to be controlled by the operator. Also, a functionality needs to be included enabling to add and control VLANs.
- **Time to market/provisioning time**. The regulatory framework should specify maximum provisioning times together with an expedite facility.

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.

The upshot of this is that in many ways, despite being "NGA", in some ways VULA provides an inferior level of performance to that available through LLU. This is a further reason why passive access should be permitted for leased lines (i.e. it would allow CPs to deploy a genuine alternative to LLU).

Question 9: Are new business customers that would traditionally have taken leased line products now opting for a broadband service? If yes, what type of broadband service are these business customers taking.

Question 10: Are existing business customers actively migrating from leased lines to broadband products? If yes:

- which types of business customer are migrating?
- which types of leased line product (interface and bandwidth) are they migrating from?
- which types of broadband service are they migrating to?
- does switching vary between different areas of the country (e.g. depending on NGA availability, the number of broadband providers present or other factors)?
- What are the barriers (if any) to switching from leased lines to broadband products?

[Confidential.

] there are several elements that Colt believes Ofcom should consider when undertaking that analysis.

4.4.1 Need for clearer and more accurate definitions of Leased Lines and NGA-based services

Colt understands Ofcom's definition of broadband services as a simple connection that is capable of providing high bandwidth. However, Colt never offers services that can be identified as only

providing a high bandwidth connection to its customers. Depending on the type of product, the high bandwidth feature can be offered alongside different levels of security, type of resilience, service performance managements, and options for interfaces amongst others. We believe all those different characteristics and also the possibility for our customers to adjust between those different options constitute criteria for distinguishing solutions used to provide business connectivity from business similar to NGA-based residential services.

Thus, Colt does not think that Ofcom's definition of Leased Lines as a 'dedicated symmetric transmission capacity to carry voice and/or data' adequately captures business connectivity services. We believe the distinction between the two is much more complex than characterised as symmetric and dedicated. In order to help Ofcom's understanding as to how business connectivity services are developed, we have provided our main product descriptions and respective SLAs to Ofcom as part of the information s135 data request. We would be happy to discuss these with Ofcom further. In Annex B, we include a table setting out a few service parameters and how they differ between typical business and residential offers.

Moreover, Colt finds it difficult to clearly identify how Ofcom defines NGA across its different market reviews. In the 2010 Wholesale Local Access market review Ofcom presented the NGA concept in the following way: "In this market review, a forward look is particularly relevant because the next few years will be the early roll-out period for NGA networks, which will enable the delivery of 'super-fast' broadband services. Super-fast broadband is generally taken to mean broadband products that provide a maximum download speed that is greater than 24 Mbit/s. This threshold is commonly considered to be the maximum speed that can be supported on current generation (copper-based) networks. Of course, the actual speed experienced by consumers depends on factors such as distance from the local exchanges. To achieve higher speeds than 24 Mbit/s, CPs would need to use alternative technology, based on providing a connection over optical fibre some or all of the way to the customer".

Another way for Ofcom to define NGA is in the Glossary provided in Annex 12 of the current present consultation:

- NGA: new or upgraded access networks that will allow substantial improvements in broadband speeds and quality of service compared to today's services.
- CGA: a copper-based access network that can support a maximum download speed of 24 Mbit/s.

Despite the lack of clarity of those definitions, Colt understands that for Ofcom, the key characteristics necessary for defining NGA networks are the following:

- A new or upgraded access network;
- Providing a fibre connection;
- Enabling delivery of 'super-fast' broadband services over 24 Mbit/s.

Looking now at Ofcom's definition of a Leased Line in the last BCMR statement: "A leased line is a service that provides dedicated symmetric transmission capacity to carry voice and/or data traffic. Dedicated in this context means uncontended, and symmetric means there are identical transmit and receive data rates. They are mainly used to provide enterprise networks to carry inter-site and inter-company traffic". Further in the statement, Ofcom presents some of the key characteristics of a leased line: availability, bandwidth, contention, latency, resilience, security, etc.

Comparing those two definitions, it is not clear whether Ofcom's definitions distinctly separate "NGA" and "Leased Lines". Indeed, it appears that "Leased Lines" belong to Ofcom's NGA definition. A leased line can and typically does use fibre, provide a bandwidths over 24 Mbit/s and be deployed in the access segment as a new or upgraded network significantly improving current broadband speeds and quality of service.

We understand the term of 'NGA' was introduced in the context of describing local loop fibre deployments, aimed at replacing historic copper loops. The term 'FttX' ('Fibre to the X') is often used to describe this phenomenon as well. Different sub categories of this term can be used such as: FttH (Fibre to the home), FttC (Fibre to the curb), FttO (Fibre to the office), FttLA (Fibre to the last amplifier).

4.4.2 Need for interactions between Leased Lines and NGA-based services to be considered

Rather than considering there to be a bright line distinction between residential NGA and leased lines, the range of services available and the factors that distinguish between them, are complex. Customer needs are diverse and manifold and the products required to serve them do not easily sort themselves into hard and fast categories. Certainly, the potential exists for the market to deliver a much wider array of customisable options than is available today.

Business customers only interested in high bandwidth, could have an incentive to migrate from Leased Lines services to NGA-based services. **[Confidential.**

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Nevertheless, we recognise that analysis is important for Ofcom to undertake for the following reasons:

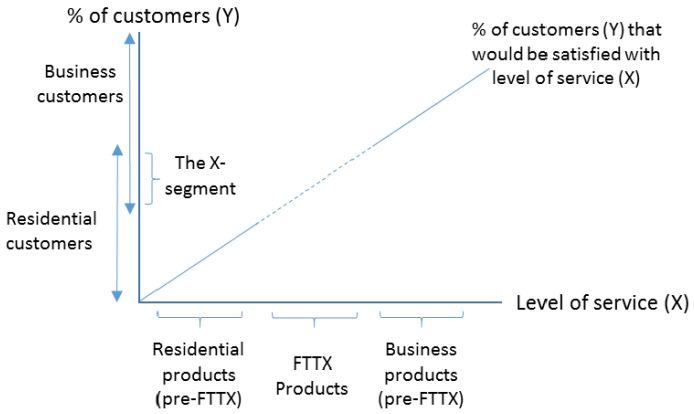
- It would allow Ofcom to quantify and qualify the competitive impact of NGA rollout on business customers' demand;
- It would give Ofcom a clearer view on where to reasonably draw the line between customers' demand for high quality business connectivity and demand (residential or business) that can be satisfied with NGA-based services;
- It would help Ofcom identify how, when and for what reasons substitution can effectively apply or not;
- It would, as result, support Ofcom in defining business connectivity and NGA-based services in a more accurate way;
- It would guide business and/or residential providers on how to adapt their offer in order to best serve their customers

Below is a description of how – conceptually speaking – Colt views the distinction between business and residential connectivity solutions, and the blurring between them. Figure 7 depicts a notional cumulative distribution of customers by their requirements in terms of level of service. I.e. the line depicts the proportion of customers (vertical axis) that would be satisfied by an equal or better level of service shown on the horizontal axis. "Level of service" is an amalgam of different service metrics, including QoS as traditionally understood, and bandwidth.

In a pre-FttX environment, the products are quite clearly defined as "business" or "residential". Customers sort themselves into each category – residential customers buy residential products and pay less, while business customers buy business products and pay more. FttX fills in the gap between business and residential products, blurring the distinction between them. Figure 7 is drawn

so that the requirements of some business customers and some residential customers overlap. The "X-Segment" is used to denote the segment of customers at the lower end of the business market and the upper end of the residential market, whose preferences lead them to buy the same products. FttX in the residential segment greatly increases the extent of this overlap. Products in this category may well bear some resemblance to "leased lines" but without strictly meeting Ofcom's definition of such.

Figure 7



Thus, Colt believes qualifying and quantifying the 'X-segment' would guide Ofcom in better defining services used to provide business connectivity and therefore would result in mandating more effective remedies for such interacted markets.

Colt would however urge Ofcom to consider technological evolutions, in particular the adoption of cloud services and the Internet of Things when it designs any questionnaires to business users, perhaps by including cloud solutions vendors in its field of inquiry. This is because it is likely that SMEs and SOHO (Small Office Home Office) customers will form those parts of the UK economy most likely to benefit from the opportunities for revenue enhancement and IT cost savings presented by innovative services provided from the cloud.

In terms of remedies, this way of looking at the market has the following implications:

- Active wholesale leased lines need to be maintained for the higher-end business connectivity needs
- An "in-between" VULA product needs to be introduced to satisfy the needs of the X-segment above. This would involve some business grade features and would be arguably based on the underlying residential NGA technology and architecture that forms part of the current VULA offer. Such an offer would potentially satisfy the definition of "high quality" wholesale broadband access considered in the EU Commission's revised definition of relevant markets
- Precisely because the interaction between business and residential grade products and how this is changing with the rollout of FTTC, passive remedies need to be introduced precisely in order to allow the boundary to be managed by the market. It should emphatically not be managed by the regulator or by a monopoly, which would inevitably do so in a way that reinforces its own product segmentation strategy

4.5 PASSIVES

Question 11: Do you have any comments about the scope of our planned work on passive remedies?

Colt welcomes Ofcom's attention to the question of passive remedies. As discussed in Section 3 we view passive remedies as:

- an elegant solution that focuses on the underlying source of market power and allows the market (and not the regulator or a monopoly) to manage the complex interactions between different downstream segments;
- allowing the market to offer the more differentiated connectivity options that the market requires
- exerting competitive pressure on Openreach to solve its quality of service problems
- creating a self-reinforcing virtuous circle of differentiation, investment, competition creating, through the exploitation of the option value from past investment, more differentiation, investment and competition

In short, we see passive infrastructure remedies as a potential game changer for the UK market.

Colt welcomes Ofcom's attention to:

- The different types of remedies that might be needed to consider and their potential applications,
- The benefits mandating of those remedies could have on the market overall and also by suggesting those benefits can be various,
- The potential impacts passive remedies could have on infrastructure competition and demand,
- How those remedies could be applied in practice both technically and economically.

Our views on how Ofcom should approach its assessment of these benefits are outlined in Sections 3.4 and 3.5. Our only real concern is whether Ofcom's approach is primarily about whether passive remedies can be retrofitted to the market that we see today. In particular, we are concerned that pricing passives depending on the value of the services provided is dangerous and would, while not removing all of the benefits of passive access, nonetheless remove some of them. Furthermore, such an approach can add complexity and eventually make the remedy unworkable.

Question 12: Which of the following types of passive remedy might be technically feasible and suitable for leased lines?

- Physical Infrastructure Access (i.e. duct and pole sharing);
- Dark fibre;
- Wavelength unbundling;
- Other passive remedies (please specify).

Question 13: For what applications could communications providers use each of the types of passive remedy listed in question 12 above?

Below paragraphs reply to both questions 12 and 13.

[Confidential.

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On the one hand, duct access is the right remedy for Colt to build local rings for the following reasons:

- Multiple (i.e. more than two) fibres are needed for rings to be built – and therefore used – effectively. Rings are intensively used and multiple fibres are needed to ensure the right capacity is delivered. Hence, access to some space such as a sub duct would enable operators to pull several fibres in a single deployment. Duct access offered as a space rental inside a duct is therefore optimal for building city rings.
- Duct access can give flexibility for CPs to choose the different routes they need their ring to follow. Indeed, with a workable duct access offer, operators can decide not to precisely follow BT's topology but to use one part BT's path via a given duct and then dig to join another duct and hence create very different topology. Duct access then gives the opportunity for communication providers to build their network in technically and economically efficient way.

On the other hand dark fibre can be the right remedy for Colt to **[Confidential.**

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Additionally, it is important for Ofcom to note that the method described above to work effectively, further technical points have to be considered. Since the approach we have presented involves CPs creating alternative network topologies, it is important for the offer not to be restricted in terms of network segments (relative to BT's network architecture) that are made available. Indeed the backhaul network segment for BT's type of architecture might not necessarily be the backhaul segment for another CP (i.e. BT) but instead it could be the access/local network segment part and vice versa. This point is described in more detail under question 16 below. As a result, if the duct access offer is, for example, restricted to be used only for the access parts of BT's network, this might not be compatible with the approach of building rings and may add complexity for the offer to be workable. An efficient offer would allow CPs to access BT's ducts from any point to any other point regardless of the provider's network architecture.

Furthermore, other technical aspects have to be considered in order for a duct access offer to work optimally such as:

- The implementation of well-defined and organised processes and tools when ordering and checking the availability of the product,
- The existence of SLAs in the reference offer regarding the delivery times and faults handling.
- The creation of an open colocation offer associated with the usage of duct access.

Those points are developed in detail when replying to question 18.

Regarding wavelength unbundling Colt would welcome any definitions on the potential product and ways in which it could be used in practise. This could help us to understand better how we might be able to use it and, thus, the advantages it could bring to the market in case a regulated offer is mandated. We can imagine possible uses: an alternative to dark fibre where there is no spare fibre available, or in the access network as a way to allow the creation of a logical point-to-point network

over a physical point-to-multipoint network. We note that line sharing in LLU is a form of wavelength unbundling, so there is precedent for this type of remedy.

Question 14: How might passive remedies extend the geographic reach of infrastructure competition?

[Confidential.

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Question 15: Would the presence of physical infrastructure belonging to other CPs affect usage of passive remedies? For example would you expect passive remedies to be used only or mainly in areas where only BT has passive infrastructure or would you also expect passive remedies to be used in areas where other CPs have passive infrastructure?

[Confidential.

] Moreover, Colt would not expect to use passive access from third parties where it has its own infrastructure. There might therefore be scope for a delineation in the geographic scope of passive remedies. The geographic scope should not necessarily be the same as the existing WECLA area: in our view, digging is too costly to justify Colt offering connectivity to the vast majority of off-net sites in West London, but the build/buy decision would undoubtedly be different if passive access were available.

Once some CPs deploy fibre using passive remedies, we expect more wholesale offers to become more available and as part of that process, dark fibre to be available more widely in the wholesale market. Moreover, sometimes using a commercial passive access offer from other CPs can be more advantageous for Colt because specific terms can be negotiated whereas regulated offers from the incumbent can be much more rigid.

This is in line with Colt's experiences in other European countries where passive access is available. **[Confidential.**

]

Question 16: What are the benefits that passive remedies might offer in comparison to active remedies? Please consider specifically:

- Service innovation benefits e.g. the ability to differentiate service features and functionality (such as fault finding, configuration options, etc.)

Business CPs' demand often varies from one customer to another, implying bespoke requirements that cannot be provided by buying an active service from BT. Also, business customers' demands are in a continual state of evolution. For example, a customer can require more capacity, a better QoS or a different technology on which its service is provided. 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 the above are can be varied when buying an active service from BT. BT offers specific SLAs, technologies, bandwidths and QoS, as well as an underlying cost structure that sets the floor for the downstream service. When customer demands change, CPs need either to ask BT for changes in the existing wholesale service provided and then bear the applicable set-up or change charges, as well as BT's provisioning lead-times. The process of responding to customers' changing demands relying on BT's underlying active inputs can be expensive and involve delays, preventing business providers from operating as flexibly as would be possible if they were to deploy network using their own infrastructure.

As stated above, on-net connectivity (through passive access) can provides benefits over and above off-net connectivity in that it allows greater control over several parameters including the choice of Layer 1, 2 and Layer 3 technologies, the bandwidth/capacity provided, the pricing structure and the QoS (including the prioritisation rate). These factors are important for business customers. Where a CP relies on an input from another supplier it is necessarily constrained in what it can offer to its customers by the underlying wholesale product. If the supplier is the only party able to make changes to a service but requires two weeks to make a change, the CP and its customer will have no option but to accept that.

With passive access CPs would have substantially more ability to develop and offer different service levels and combinations of features as part of their overall product offerings. They would only be constrained by BT's service offering to the extent of issues in relation to the passive elements purchased from BT, for example problems with the duct itself. Thus, CPs could compete by offering quicker changes to products or by scheduling maintenance downtime with regard to the specific needs of their customers. They would not be dependent on BT to put in place these customer benefits.

Similar considerations also apply to the commercial offering. The components of a commercial offering can be broadly categorised along the following lines:

- tariffing structures - how much is charged to whom and elements of price discrimination for different customer groups;
- contractual elements and terms of service, such as service level guarantees, payments for breach of service level commitments, minimum contract terms, rights of cancellation; and
- charging models - different methods of rating services (per transaction, by volume, hours of day, flat rate, fixed charge) and means of payment - in advance, in arrears, monthly, quarterly, annually.

A CP that is reliant on BT as a supplier for a particular element is constrained in what it can offer its customers by the terms BT offers to the CP. Thus, for example, if BT requires a minimum commitment of 12 months for any capacity that is ordered, the CP could not offer its customers a shorter period of commitment without running a risk of being out of pocket.

Having the ability to offer customers varying commercial terms and pricing structures is a point of competitive differentiation and passive access provides CPs with greater flexibility in this regard.

Regarding service innovation benefits for fault finding, that is the same logic, the more control a CP has, the better it will be able to identify what is the origin of the fault and the fastest it will communicate promptly that issue to his customer. The CP will also be in a better position to fix the issue as it can monitor it. Everything is possible to be achieved directly between the CP and the customer. However, when the service is delivered off-net, there is always a delay given the presence of an intermediary. When that type of issues occurs the timing is key to the customer.

Moreover, concerning faults it is not only the detection that is important but also the intervention in order to fix the issue. The associated SLAs dealing with that kind of issues are much better when delivered on-net that off-net. That is something we have described more in details in reply to question 17.

- Network innovation benefits e.g. the ability to configure the network in a different way to BT's network configuration.

A factor that must be taken into account in order to reply to that question is that the evolving market may require changes to the structure and architecture of backhaul networks. In constructing a backhaul network, a CP would do so for its own needs, with a structure and architecture that matches its own requirements. A CP would plan its routes, locations and breakout points strategically in order to optimise the availability of capacity in locations that it serves (both present actual and future potential). However, given that under the present framework, often the only realistic option open to a CP is to purchase a backhaul service from BT, a CP's ability to optimise its backhaul service in a way that meets its needs, is severely restricted.

Put another way, CPs seek to construct their networks such that the routing and architecture allows economies of scope to be exploited between adjacent access zones. This may involve some ambiguity in the classification of a given network segment (i.e. it may perform as "access" for one zone, while the same segment performs the function of "backhaul" for another zone).

Colt's preferred ring architecture allows networks to be constructed very efficiently. Unlike BT, Colt deploys rings instead of hub-and-spoke networks when accessing customers' premises. We believe that this is superior to BT's hub and spoke network architecture both in terms of efficiency (because it allows more customers to be accessed from any given trench or cable length) and in terms of resilience. An added efficiency benefit of the ring architecture is that it allows a CP to build rings upon rings. In other words, it allows the easy extension or expansion into an adjacent zone, simply by deploying a second ring that interlocks with the first. Following this, a third can be added, then a fourth, and so on. It should be clear that this type of architecture results in a breakdown in the distinction between access and backhaul. A ring that is "access" for one customer may be "backhaul" for another. It would also result in the locations of such backhaul having no geographic relationship to the backhaul parts of BT's network.

Colt views the ring architecture as the only true "NGA" configuration. BT's version of NGA is constrained by its legacy hub-and-spoke structure that was optimised primarily around the distance

and bandwidth limitations of copper. We further believe that, in basing its SMP obligations around a distinction between the "access segment" and the "backhaul segment" (where such terms are defined according to the structure of BT's legacy network), and further by not having access to a form of business passive access, CPs are forced to deploy their networks in a way that matches BT's legacy architecture. This prevents any real innovation in network architectures and the concomitant benefits thereof, which include (inter-alia) improvements in efficiency, quality of service and the economics of incremental network rollout. It also strengthens BT's position as wholesale provider of last resort – a position that we believe Ofcom should seek to discourage.

Instead, if CPs had access to passive infrastructure for deploying Leased Lines, it would definitely change the way networks are deployed. **[Confidential.**

]

- Technology innovation benefits e.g. the ability to adopt new technologies, or introduce new technologies earlier than they might otherwise have been introduced.

Passive access allows for the CP using passive access to develop, trial and use new technologies **[Confidential.**

] 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.

In addition, there is a long history of business-only CPs providing the infrastructure platform over which residential service providers are able to provide new and disruptive services. Freeserve, for example, was a disruptive entrant that launched a revolution in the dial-up Internet business model. Its backbone infrastructure was provided by Energis. Likewise, AOL was a pioneer in bringing the Internet to UK homes. Its backbone was provided by MCI WorldCom. UK Online was the residential arm of Easynet, which was later acquired by Sky. There is no reason to expect that this would not continue in an NGA world.

- Avoiding duplication e.g. the ability to avoid the duplication of network elements for network monitoring purposes.

The risk of duplication of investment is a reality when mandating access to civil engineering infrastructure (and with competition in general). However, if one considers that 60%-80% percent of the cost of deployment of fibre infrastructure is the cost of civil engineering then perhaps the risk is more the reverse: how not introducing passive access prevents competition in a market – once the

hurdle of civil engineering is surmounted – no longer exhibits natural monopoly characteristics. This is particularly likely to be the case in geographic areas where customer density is such that demand for connectivity would match supply absent the "hump of digging".

In addition, Colt does not consider that "returns to digging" are returns to innovation hence there are no dynamic efficiency losses to be expected from introducing SMP remedies in the form of access to passive infrastructure.

1. The risk is overestimated given the current status of infrastructure-based competition in the UK market,

As presented under the current consultation, the only CPs committing substantial investments in NGA (as Ofcom understands the term) are BT and Virgin Media. Other important residential CPs such as TalkTalk and BskyB rely on BT's infrastructure. Therefore, when considering the NGA market (as Ofcom understands it), the UK market is close to a duopoly (and indeed is a monopoly in some areas). It is unlikely this duplication of investment reaches such a level where the inefficiencies imply a substantial additional cost for the industry, such that it undermines the benefits of infrastructure competition. Moreover, it is unclear why Ofcom referred to this risk under the BCMR when it does not appear to be a material factor in the FAMR. There is no obvious reason why, if it is a concern in the BCMR, it is not so in the FAMR.

2. Infrastructure based-competition cannot occur without a risk of investment duplication but the risk can but mitigated,

In the FAMR, with the simultaneous availability of an NGA active remedy (VULA) and passive remedies (PIA and SLU), it is clear that Ofcom recognises the benefits of competition at deeper levels of access but nonetheless, also recognises the benefits of maintaining a less capital intensive entry route by means of VULA. We wholeheartedly agree. But it is also clear that this being so, Ofcom is willing to tolerate a degree of duplication of electronic equipment and (in the case of duct access) dark fibre or copper in return for a deeper level of competition.

The counterfactual to that is where either of the two scenarios below hold:

a) There is no competition and product differentiation in relation to active business connectivity products, BT being the only provider; and
b) There is competition and real duplication as in Central London, because demand and supply are such that the market supports it.

Scenario b) is where the market supports duplication and nobody would ever argue that to be inefficient and that it should be stopped.

Scenario a) can again be split in two sub-scenarios:

i. Where passive access would enable the market to deliver competition as in Central London but on the back of access to ducts and dark fibre
ii. Where passive access would not make such a difference and access to active services would still be required to enable business customers to benefit from multiple suppliers of Carrier Grade Ethernet.

Essentially, the risk of duplication would only apply in scenario a)i. If scenario b) is considered to be efficient then it cannot be simultaneously argued that scenario a(i) is not.

It should not be forgotten that passive forms of access may even reduce duplication where for example, a CP deploys fibre where otherwise it would have to dig. Given that digging is more common in the leased lines market, the potential for passive access is arguably greater than with residential NGA. This would particularly apply in areas such as West London where there is still a significant difference in economics of density compared to Central London, for example.

If duplication is still considered to be a risk, a regulatory framework designed to mitigate the risk could be considered. For example, in France, in the last market 4 review conducted in 2011, ARCEP mandated Orange to implement engineering rules aiming at two objectives:

- Minimise constraints for the deployment of shared fibre networks (i.e. In France, for FttH networks, there is a part of the network which is shared between operators (symmetrical regulation). This part is between the 'mutualisation point' (i.e. concentration point covering 12 dwellings in dense areas) and the end-user point).
- Distinguish other types of deployments (connection of mutualisation points and connection of business customers or network elements) by implementing additional constraints to ensure those deployments do not pre-empt FttH deployments.

To implement those objectives ARCEP brokered multilateral discussions between CPs. This resulted into different rules depending on the type of deployment. E.g.:

- Deployments of shared networks between the mutualisation point and the customer: The operator does not need to leave an available space equivalent to the size of its own occupied space ("1+0" rule),
- Deployments between the optical MDF and the mutualisation point: The operator needs to leave an available space equivalent to the size of its own occupied space ("1+1" rule),
- Deployments to connect business customers and network elements: "1+1" rule,
- Deployments using overhead infrastructures: The operator needs to leave an available space equivalent to twice the size of its own occupied space ("1+2" rule).

Those rules are removed once a first FttH network is deployed.

- Other benefits (please specify)

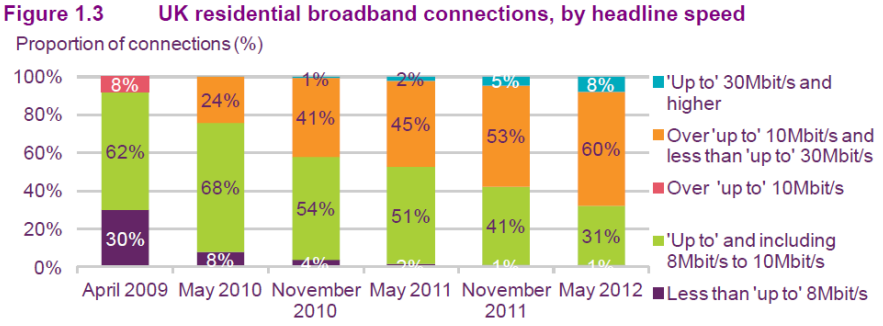
Mandating passive remedies in the BCMR would enable more competition in the backhaul market and therefore possibly unlock NGA investment.

CPs need an efficient market in backhaul in order to provide the products they wish to sell. Price, quality, bandwidth and location are among the important dimensions of the backhaul market that are important to CPs. Indeed, with the explosion in access bandwidths we are seeing today (e.g. FttC and 4G), an efficient market in backhaul is arguably more important than it has ever previously been, to secure the right incentives to develop the right products. Such backhaul is clearly complementary to access and therefore an example of the type of complementarity discussed elsewhere.

As described in the 2013 BCMR statement: "The demand for leased lines bandwidth has increased steadily in the last few years, driven by sustained increases in both the penetration and the speed of business and consumer data services. Adoption of remotely hosted computing applications (often known as 'cloud computing'), growing consumption of video content, and the rapid growth of e-commerce and of internet applications have all added to businesses' bandwidth demands. At the same time, providers of consumer broadband services, both fixed and mobile, have required steadily increasing bandwidth to support the growth in traffic from their end-users."

The need for consumer providers to be supported by backhaul capacity can also be shown more by the growth in higher-speed connections provided. Figure 8 taken from Ofcom's review of UK fixed-line broadband performance in May 2013, illustrates this.

Figure 8



Source: Ofcom, based on data provided by the UK's largest ISPs by retail market share (representing over 90% of the total market)

A further factor that must be taken into account is that the evolving market may require changes to the structure and architecture of backhaul networks. In constructing a backhaul network, a CP would do so for its own needs, with a structure and architecture that matches its own requirements. A CP would plan its routes, locations and breakout points strategically in order to optimise the availability of capacity in locations that it serves (both present actual and future potential). However, given that under the present framework, often the only realistic option open to a CP is to purchase a backhaul service from BT, a CP's ability to optimise its backhaul service in a way that meets its needs, is severely restricted.

ARCEP Approach

In other European countries in which Colt operates, the situation is quite different. For example, ARCEP stated that although the European Commission has not referenced the backhaul segment in its definition of relevant markets, since 2005 ARCEP has explicitly addressed this segment as being an essential factor contributing to the extension of the unbundling coverage and therefore mandated ancillary remedies in the backhaul segment.

In consideration of the linkages between access and backhaul, ARCEP mandated Orange to provide a dark fibre offer for backhaul purposes (through the "LFO" offer, i.e. Lien Fibre Optique). Moreover, Orange is also required to provide civil engineering infrastructure in the backhaul segment when the MDF is not connected with fibre and Orange cannot set its existing LFO fibre free. Precisely in order to encourage CPs to construct their networks according to their own specific needs, ARCEP has chosen not to mandate access to active services for backhaul purposes. Nevertheless, this does not prevent competitive wholesale offers being available. Indeed, the availability of primary inputs seems to have been a spur to a vibrantly competitive market for wholesale services in this segment. Several players now have commercial wholesale offers in this segment, including Orange.

In France, residential NGA networks (i.e. FttH or as ARCEP calls them: Shared Local Loops, as opposed to FttO being Dedicated Local Loops), are being deployed by five different operators (SFR and Bouygues Telecom together, and Orange, Free and Numericable (FttLA)) and even more if we consider FttO. As shown by Figure 11 and 13 of Wik Consult's "NGA progress report" and Figure 1 of Cullen International's study "Build, Buy or Share: regulatory options for broadband network

deployments" (see relevant charts paragraph 3.3), France seems to be a leading country in terms of NGA deployments.

In the UK by contrast, CPs' options for backhaul are relatively limited. In principle the following options could exist. CPs could:

1. Deploy their own backhaul network by:
   a. Digging and installing their own ducts
   b. Using duct access from BT or other suppliers
2. Buy active services from BT or other suppliers
3. Buy passive links such as dark fibre from BT or other suppliers.

Yet in most cases the only practical option is to buy active services from BT. The very limited range of regulated products and services available from BT means that CPs are highly restricted in the structures, architectures and locations that are available to them.

The lack of choice regarding backhaul options may indeed be a factor limiting CPs' incentives to deploy NGA networks. For example, only BT and Virgin Media have deployed NGA on any significant scale (see paragraph 11.6 of Fixed Access Market Review consultation: "the retail breakdown of superfast broadband subscribers is: 63% Virgin, 33% BT Retail and 5% others" and Table 11.1: BT and Virgin net superfast broadband subscribers).

Question 17: How valuable would the innovation benefits of passive remedies be? Would they be sufficient for you to choose passive remedies if there was no overall cost advantage compared with active remedies (i.e. if the price of the passive remedy was exactly equal to the price of the active remedy less the cost of the network components that you would need to provide)?

Colt and other CPs may use duct access in some cases even if there was no overall cost advantage compared to passive remedies. However, such a "wholesale minus" approach would not confer on the provider using passive access the ability or incentives to do so as:

- A stepping stone for incrementally increasing its network reach (loss of option value)
- A basis for using passive access on scale that would really enable it to invest in substantially incrementing its R&D in innovative products and solutions

Colt would consider using duct access if costs were the same as using active products in the following situations:

1. **Customers require the service to be delivered on-net and cannot get the same combination of price and service from BT**. They can require that directly by requiring diversity in terms of connections and indirectly by requesting some of Colt's product specificities that are only possible to be delivered on-net.

   Directly. Business customers often require a diverse connection in order to ensure maximum availability. Typically, this requires a separate connection and not (for example) two links provided by the same service provider. Currently, BT is often the provider of last resort.

   Indirectly. Some customers require some of Colt's products specificities/options which are only available if Colt delivers the service on-net. **[Confidential.**

Figure 9

]

2. **The gap between off-net SLAs and on-net SLAs is too important creating a significant risk for our customers.**

   When delivering a service off-net, Colt sometimes takes a commercial risk by having to pay service credits for SLAs we are not able to provide. Colt cannot provide those SLAs because it does not have control over the delivery or process to repair in case of faults and also because other CPs' SLAs are not good enough to meet our customers' requirements. **[Confidential.**

Figure 10

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In case Colt faces one of the two above situations and has no network in areas where the customer needs to be delivered, instead of being delivered through active off-net we would expect our customers to prefer their service to be delivered through duct access or dark fibre if that solution was available. Of course in many circumstances price would be a factor, hence it is difficult to say, hypothetically, whether a wholesale minus type price would or would not work. This is also likely to depend on how this price is defined in practice.

[Confidential.

Figure 11

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Question 18: What are technical and operational challenges associated with deploying and using passive remedies and how might these be addressed?

By undertaking a detailed benchmarking exercise across four European countries, Colt has been able to identify criteria necessary to create an efficient passive access offer. The offer needs to:

- Allow deployment in all network segments.

Since Colt seeks to deploy a very different network architecture than BT's, it is important for the offer not to be restricted based on BT's definition of 'backhaul' vs 'access'. That definition is specific to BT. Instead, in order for the offer to work efficiently CPs will need to be allowed to connect a point A to a point B regardless of BT's defined network segments. Ideally CPs will have the possibility to deploy fibre from any BT chamber to any other. The less restricted the offer is, the more network innovations can be expected. Indeed, that way the more different type of network segments are available the more they can be used differently by CPs. **[Confidential.**

]

- Include a business class SLA in terms of delivery and faults.

As already described in replies to questions 16 and 17, timing and responsiveness are important characteristics business customers value and require. In order for customers to benefit as much as possible of advantages brought when a CP delivers on-net, it is important that some business grade SLAs are included in the offer both regarding the delivery and faults.

Regarding faults a business grade SLA would be a 4 hours' time to repair. If SLAs are not possible to be provided by BT, another option could be for CPs to have the right to intervene themselves to fix the fault.

Regarding delivery, a business grade SLA would be a 35 days delivery lead time that should take into account each different step of the process (from ordering to activation by the CP). Each step of the step of the delivery should be associated with an SLA. For example, concerning duct access the SLA should include a committed process in terms of ordering, availability checks and potential alternative routes suggested, deployment and recording.

- Incorporate state of the art provisioning systems and processes.
  It is important for the offer to implement a well-defined and organised process for each step in the provisioning process. Colt has identified the following steps:

  - The initial request to order

  This step consists of ordering the product by specifying the area the CP would like to use the product for. This can be easily dealt with thanks to an ordering platform. Once the order has been done, a network map of the area can be sent to the CP specifying potential availabilities.

  - The availability check

  This is the most important step of the process. The lack of a fit-for-purpose process can negatively affect the delivery process and therefore, demand. The best way to manage that

step is if the provider implements an interactive tool in order for CPs to check each route's availability and also suggests alternative routes in case the first chosen is not.
At first such a tool may not be available in case not already implemented by the provider for internal use and even so, that tool would need to be adapted for commercial use. However, such tool can be built as the offer matures. For example at the start of the implementation process, surveys might be needed in order to check the availability of each route and proof of availability could be sent by the CP to the provider in order for the tool to be updated. As a result, after some time, work could eventually be based only on the tool managed by the provider without any surveys needed.

- The Deployment (for duct access only)

Depending on the offer, either a sub-duct or a cable is deployed. A sub-duct enables protection and better organised deployments. However in case that is the chosen option, those would have to be provided by the access provider in order to standardise deployments and avoid too much space being taken. Either way, it is for the CP to be in charge of the deployment.

- Order record

Once the deployment is made (or the order is available for dark fibre), this has to be communicated to the provider in order for the tool to be properly updated.

- Be associated with a collocation offer.
  Since the offer is for passive access, CPs will need to activate the circuit themselves. In order to do so it is important for the passive offer to be associated with a collocation offer that enables:
  - The installation of any equipment related to usage of duct access i.e. DWDM, switching/rerouting equipment
  - To have a fibre cable out, from the colocation to an external junction box where we can interconnect fibres with any CP.

As a result of the above points, Colt has determined the key characteristics of a workable duct access offer. In our experience, there are four:

1. The fewer restrictions we have (e.g. availability for all parts of the network), the more useable is the offer and the higher the level of demand;
2. The greater the involvement of the access provider in identifying suitable routes and installing the fibre, the more usable is the product and the greater is the level of demand;
3. The existence of an accurate online tool showing maps of the access provider's network, facilitates take-up and increases demand.
4. The inclusion of a SLA in the offer, or at least a committed process in terms of delivery and faults is a driver of demand.

[Confidential.

Figure 12

Figure 13

Figure 14

] Even if the benchmark focused on duct access instead of dark fibre, we expect the requirements to be quite similar for dark fibre especially regarding SLAs, collocation, and tools to order and check the availability of the service.

Question 19: What are the strengths and weaknesses of different pricing structures that might be adopted for passive remedies, in particular:

- uniform prices that do not vary either by geographic area or the use to which the passive remedy is put (e.g. residential NGA versus leased lines); and
- prices that do vary according to geographic area or the use to which the passive remedy is put, and which reflect the value of the services provided or geographic differences in the intensity of passive infrastructure usage, more like the way BT's prices active products now?

In practice Colt believes different prices for passive can be applied, though with certain reservations depending on how the distinction is applied and on dimension it is applied. Our chief concern relates to Ofcom's choice of wording: 'like the way BT's prices active products now'. Our concern is that, while not completely undermining the efficacy of passive remedies, it would partially move passive remedies to becoming merely another agent in the "overlay to BT" competitive model that exists in the UK. We are also concerned that it would add too much complexity to the product which could result in making the product unworkable.

We are concerned about a price distinguishing NGA demand and Leased Lines demand. If we take Ofcom's perspective, it is indeed possible to distinguish the usage of PIA for deploying NGA from its usage for deploying Leased Lines. Technically, Ofcom could keep the FAMR PIA remedies as they are and devise a new remedies for the BCMR. That way, products could be designed (both technically and in terms of pricing) to satisfy one usage model or another and attract different prices. However,

the problem arises when (for efficiency reasons), a passive infrastructure offer involves both residential and business uses. Colt believes that a better solution would be to create a single PIA remedy at a single price that is invariant to the end use. If Ofcom is concerned that this would jeopardise the efficacy of PIA use in residential markets, we argue that, to the contrary, it would promote it. It would encourage (for example) the deployment of backhaul "leased lines" in areas serving residential markets, thus promoting investment in local access.

Nonetheless, we do not preclude the possibility of developing several offers with different pricing, where each variant of the product is inherently more applicable to one type of use rather than another. The product should by no means limit the deployment to one usage model rather than another, but we see no reason why different forms of use should not self-select. There is some precedent for this in other EU countries. In France for example, there is a unique regulated offer from Orange, GC (Genie civil), which gives access to ducts under the same principles (access to available ducts), the same cost basis and the same geographical scope. However, three different subsets of the offer are designed specifically to satisfy three different types of requirements:

- GC FTTx: designed to enable residential operators to cover a whole municipality in a single deployment. ARCEP has recently decided to introduce a national average on duct access prices for this offer in order to foster NGA deployment in less dense areas (ie there is a higher length per line in suburbs than downtown but the rental price for duct access is the same). In that case operators do not pay for the space occupied in the duct but for a number of accesses.

- GC RCA: designed for on-demand point-to-point deployments to connect businesses with a dedicated fibre network. Especially, it is possible to use this offer without a Machine-to-Machine API interface (almost no IT CAPEX) unlike GC FTTx. In that case operators pay for the space taken by the cable inside the duct.

- GC REDR: designed to enable mobile operators to connect their base stations. From a process point of view, this offer is close to GC RCA, and operators pay for the space taken by the cable inside the duct.

[Confidential.

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The different approaches above are of course country specific but we believe a similar logic can be found in order to price passive access differently in the UK.

An approach that Colt does not believe would work, would be to allow BT to discriminate its prices according to the particular form of use applying within the "Leased Lines" category. Indeed we do

not believe BT would be able to set up a process that distinguishes the difference in value of each leased line type as defined in the BCMR ie AISBO, TISBO, MISBO and their various bandwidth. For example, passive access could be used to deliver the following very different type of services: high-speed business broadband, different types of business connectivity services varying in bandwidth and interfaces. Identifying what type of service is delivered through passives and especially identifying interfaces and bandwidth is not possible. It would add complexity to the product and give the incentive for CPs to advise BT wrongly on the nature of their deployments.

Finally, if Ofcom's over-riding concern is compatibility with BT's existing services and prices, and avoiding a disruption in BT's pricing pattern within its charge control, Colt's last and most important concern would be that Ofcom's starting point/approach to look at passive remedies might not be optimal (see Section 3.5 for further details).

4.6 RETAIL REMEDIES FOR VERY LOW BANDWIDTH TI SERVICES

Question 20: Do you think we should continue to regulate BT's retail analogue and Kilostream services after March 2016? Please provide reasons to support your views.

We have no comments on this question.

Question 21: Are BT's retail analogue and Kilostream services used for any other critical applications that might have difficulty migrating to alternative services?

We have no comments on this question.

4.7 CHARGE CONTROL REMEDY

Question 22: How effective do you consider the current leased line charge control has been in balancing Ofcom's objectives? Please provide evidence or give reasons/examples for your views.

Ofcom's objectives are the following:

1. to prevent BT setting excessive charges for specific leased line services where it has SMP, while providing appropriate incentives for it to increase its efficiency;
2. to promote efficient and sustainable competition in the delivery of specific leased line services;
3. to confer the greatest possible benefits on the end-users of public electronic communications services;
4. to take account of the extent of BT's investment in the matters covered by the charge controls;
5. to ensure prices are subject to appropriate controls, for example in allowing BT to retain sufficient flexibility in the way it sets its prices;
6. to provide regulatory certainty for BT and its customers and to avoid undue disruption;
7. to encourage investment and innovation in the relevant markets; and
8. to ensure that the delivery of the regulated services is sustainable, in that the prevailing prices provide BT with the opportunity to recover all of its relevant costs (where efficiently incurred), including the cost of capital.

Colt considers the current charge control has been effective in achieving the 4th, 5th, 6th and 8th. However Colt also believes those points can still be satisfied by mandating passive access using the right approach and, most importantly, we are confident that by using that approach Ofcom would achieve the remaining points much more effectively than is possible within the current charge control. It is also important to point out the four objectives cited above are the ones that once achieved, primarily benefit BT.

Colt understands the importance of the allowing BT to recover its legitimately incurred costs (objective 8). However, it is not an adequate reason for denying passive remedies. Colt does not, and has never, sought to arbitrage the regulated pricing of active access. Indeed, this is not the reason why Colt uses passive access in the countries in which it is available. If it is true that the price of PIA for residential NGA is set at a level that undermines the pricing of leased lines, it is entirely possible to institute another price does not. For example, the business product could include different options more often required by business providers such as SLAs for delivery and fault management, or a fee to have access to a tool in to check duct availability etc.

Question 23: If you do not consider that the current charge control has been effective in achieving Ofcom's objectives, what changes do you consider should be made and why?

See responses to question 2, 11, 19 and 22.

Question 24: Given the expected decline in TI service volumes over the current control period, do you consider an alternative type of control, such as a simple charge control with charges capped by reference to their current level, would be more appropriate and proportionate in the next control period? If so, why?

We have no comments on this question.

5 ANNEX A

[Confidential.

Figure 15

Figure 16

Figure 17

]

6 ANNEX B

Figure 18 Service characteristics and distinction between typical residential grade and business grade

Characteristic	Consumer grade	Business grade
Bandwidth Rate at which data is transferred (bit/s)	Technical maximum or an expected average	Contractual minimum or average
Contention Dedicated to an user or whether shared between several users	Rarely (but sometimes) specified. 50:1 contention ratio typical	Ratio usually specified. Ratios range from 20:1 to 1:1
Service layer Conceptual layer in the network. Lower layer allows more flexibility for deploying functionality at higher layers	Typically layer 3 service. Suitable for single site deployment.	Typically layer 2. Suitable for multiple site deployment and the establishment of a wide area network.
Symmetry The ratio between upstream and downstream bandwidth	Typically high downstream but low upstream bandwidth	Typically symmetrical (i.e. same upstream and downstream bandwidth)
Latency Measure of delay in transmission over a transmission path	Variable – dependent on bandwidth capacity of the network and congestion. Not guaranteed	Low. Leased lines services available with specified latencies of e.g. 40ms, 20ms, 10ms, 8ms
Jitter Measure of the variation of delay in transmission over a transmission path.	Variable – dependent on bandwidth capacity of the network and congestion. Not guaranteed	Low. Leased line services available with specified jitter margins of e.g. < 3ms
Resilience Provision of alternative resources (equipment, or route, ie path) to protect against failure	Not available	Options available, e.g. by supporting either: - dual parenting (same site connected to two exchanges); or - ring architecture

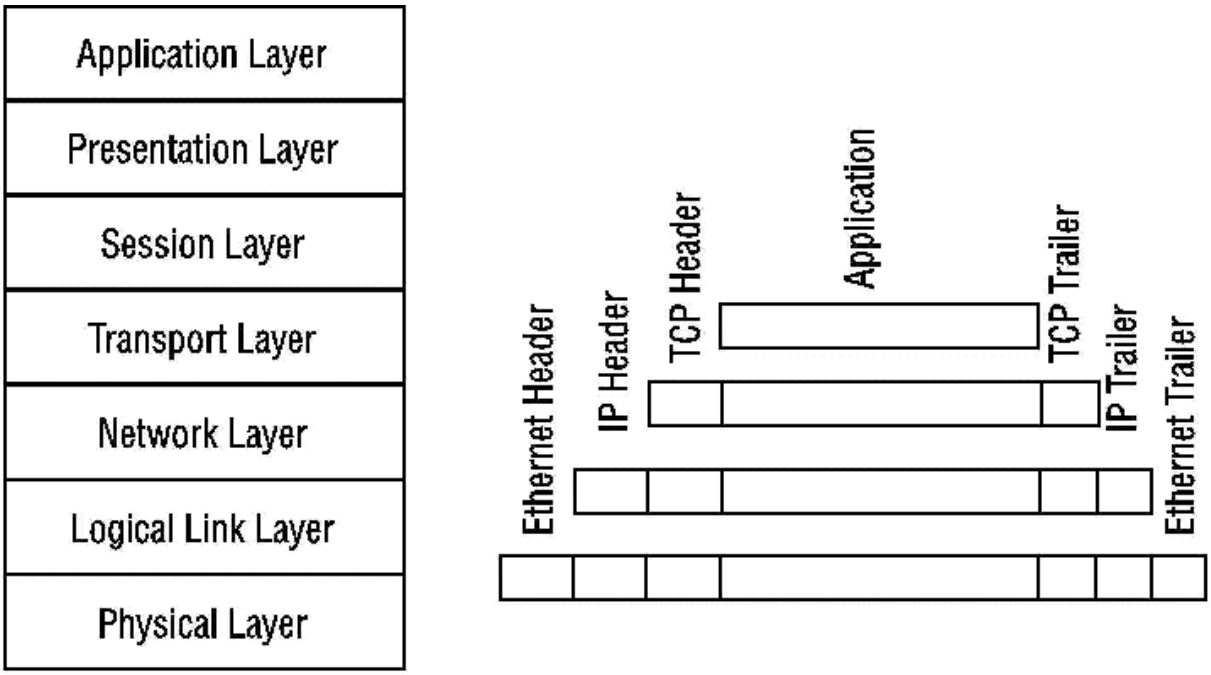
Availability The up-time percentage	"Best effort" with no committed SLA	Committed availability 99.95%-99.975%, with SLA and financial penalties
Time to repair	Typically "best effort" with no commitment, or 24 hrs indicated	Shorter e.g. 4-8 hours with SLA and financial penalties
Security A measure of confidentiality and integrity of communications service	Perceived less secure as carried over shared infrastructure	Medium to high. Perceived more secure as transmitted over dedicated capacity. Higher security options also available using dedicated infrastructure

7 ANNEX C

What is Carrier Grade Ethernet?

7.1 TCP, IP, ETHERNET: HEADERS AND PAYLOADS AT EACH LAYER

The OSI 7-layer model defines how network services pile up as a protocol stack. Practically, when sent on a wire or as a radio wave, a telecom digital message is composed of a payload, provided by the application using the protocol stack, surrounded by one envelope per underlying layer of network service. Each envelope is composed of a header and of a trailer that come before and after the payload.

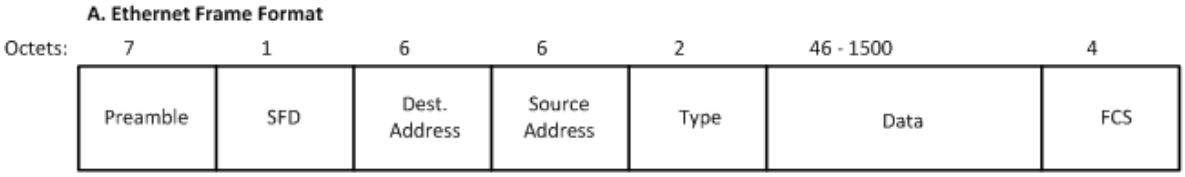


Maximum Transmission Units

Maximum size of IP datagram is 65535, but the data link layer protocol generally imposes a limit that is much smaller. Ethernet frames have a maximum payload of 1500 bytes. IP datagrams encapsulated in Ethernet frame cannot be longer than 1500 bytes. The limit on the maximum IP datagram size, imposed by the data link protocol is called **maximum transmission unit (MTU).**

What size is a standard Ethernet frame?

An Ethernet frame has 8 byte preamble, 6 byte source and 6 byte destination mac address, mac type of 2 bytes, and 4 bytes CRC. Assuming the MTU payload to be 1500 the total number of bytes comes to 1500 + 8 + 6 + 6 + 2 + 4 = 1526 bytes.



Between each frame there is a inter frame gap of 12 bytes which constitutes 9.6micro seconds gap between each frame. This is essential so that frames do not mix up. So the total size of each frame going out of a host is 1538 bytes.

There is an obvious reason why the frame payload size was chosen to be 1500 bytes. A frame size of 1500 bytes, offers, maximum efficiency or throughput.

Why does Carrier-Grade Ethernet require larger frames than standard Ethernet LAN frames?

The original IEEE 802.3 Ethernet standard addressed Local Area Networks, i.e. networks sharing the same wire in the same building. In order to transport a 1500 byte IP payload, an IEEE 802.3 frame added a 26 bit header & trailer, resulting into a 1526 Byte Ethernet frame.

The success of Ethernet as the LAN layer-2 standard has driven demand for LAN interconnection, typically between the sites of the same company or between the different buildings of a campus. LAN Interconnect was performed at the beginning through IP routers, which did not guarantee the continuity of the Ethernet layer. For this reason, LAN interconnect progressively gave way to Ethernet bridging (in a campus or over the WAN). This required a first extension of the standard Ethernet IEEE 802.3 protocol called IEEE 802.1q, used to bridge customer networks.

Continuity between these customer LANs was guaranteed at first through dedicated Ethernet equipment over dedicated fibres, but this did not allow operators to enjoy any economy of scale. Ethernet over SDH was a temporary solution but it did not cope with increasing bandwidth demand.

The solution came from further extensions of the Ethernet protocol brought in by the Metropolitan Ethernet Forum which are referred to as Carrier-Grade Ethernet. These flavours of Ethernet have gradually developed over the last 10 years. We elaborate below on two of them, IEEE 802.1ad and IEEE 801.ah, to illustrate the extra functions brought by each of them.

IEEE 802.1ad (also referred to as QinQ).

Q-in-Q refers to doubling up of IEEE 802.1q. It is also known as VLAN stacking or double-tagging. Some service providers offer transparent LAN services that preserve and extend Customers' virtual LAN groupings across a MAN or WAN. To do this, they use Q-in-Q technology. This enables SP to use a single VLAN to securely transport most or all of a single customer's VLANs across their MAN or WAN backbone. In this case, the SP Edge switch adds an extra 802.1q tag to customer traffic. This tag assigns a unique VLAN ID number to each customer to keep each customer’s VLAN traffic segregated and private. Thus, a single SP VLAN (aka S-VLAN) can carry traffic for a maximum of 4096 customer VLANs (C-VLANs). Since the VLAN ID field is 12-bits in 802.1q VLAN tag, a SP can support a maximum of 4096 customers/service instance. However, the SPs do not assign a unique VLAN ID number to each individual customer, otherwise, it would quickly consume all S-VLANs. Instead, the SP encapsulates multiple customers' C-VLANs into a single S-VLAN. IEEE 802.1ad Ethernet frames require 1534 bytes, 4 bytes more than IEEE 801.1q.

Limitations of Provider Bridged Networks (PBN) based on IEEE 802.1ad are the following:

- PBNs can supports a maximum of 4096 service instances per PBN.
- Service provider switches control their own bridges, but are also required to learn all customer end-station MAC addresses. As a SP supports more customers, the increased number of learned MAC addresses doesn't scale according to needs. When the number of entries exceeds the capacity permitted in the forwarding table, the forwarding table overflows and can potentially cause a broadcast storm in the provider network.

- Customer networks cannot be clearly separated from provider networks. A clear demarcation point determines what services are provisioned and how fault and performance management is performed for the services provided.

IEEE 802.1ah (also denominated PBB, for Provider Backbone Bridges, or Mac in Mac).

The Provider Backbone Bridges (PBB) standard (IEEE 802.1ah) was developed to address the limitations of Provider Bridges (PB) (IEEE standard 802.1ad). PBB introduces a hierarchical network architecture with associated new frame formats which extend the work completed by Provider Bridges (IEEE 802.1ad). In PBB architecture, Customer networks (using 802.1q bridging) are aggregated into Provider Bridged networks (using 802.1ad). These, in turn, are aggregated into PBB networks, which utilize the 802.1ah frame format. The frame format employs a MAC tunnelling encapsulation scheme for tunnelling customer Ethernet frames within provider Ethernet frames across the PBBN. A VLAN ID is used to segregate the backbone into broadcast domains and a new 24-bit service identifier (I-SID) is defined and used to associate a given Customer MAC frame with a provider service instance. There is a clear segregation between I-SIDs and B-VLANs, which was missing in 802.1ad.

PBB networks (PBBN) have following benefits. They:

- impose no change to Ethernet switching process in the core bridges
- support Ethernet private line (E-Line), Ethernet Transparent (E-LAN) and Ethernet Tree (E-Tree) services
- provide a clear demarcation point between the customer and provider domain
- learn customer MAC addresses only through the backbone edge bridges (BEB)
- support up to 224 service instances
- achieve additional PBBN scaling and interconnection using hierarchical and peer PBBN features.

Other issues

IP fractioning. In theory, the need for larger Ethernet frames can be avoided by fractioning IP packets into shorter Ethernet frames. If the size of an IP datagram exceeds the MTU of if the route contains networks with different MTUs, the IP network feature available is called IP fragmentation: the IP router splits the datagram into several datagrams and fragments are reassembled at receiver. Fragmentation can be done at the sender or at intermediate routers. The same datagram can be fragmented several times. Reassembly of the original datagram is only done at the destination host. However, fragmented IPv4 traffic can cause many problems in real life. Not only does it increase the load on router CPUs, but also impacts application performance. Furthermore, traffic fragmentation is used in numerous network attacks, allowing an attacker to bypass firewalls in some situations. Due to all these reasons, one may want to avoid fragmentation at all and/or ensure your network is insulated from fragmented packets. Unlike in IPv4, IPv6 routers never fragment IPv6 packets. Packets exceeding the size of the maximum transmission unit of the destination link are dropped and this condition is signaled by a *Packet too Big* ICMPv6 type 2 message to the originating node, similarly to the IPv4 method when the *Don't Fragment* bit is set.

Security. On the same company Ethernet LAN or VLAN, hosts are considered to be authorised. Ethernet (MAC) addresses are purely local. MAC addresses are “identifier” addresses, not “location” addresses. This is a major Layer 2 value and not a defect. Bridge forwarding is based on the Destination MAC address and on the VLAN ID (VID). There is no need for Ethernet firewalls because

Ethernet continuity between separate private networks does not exist. By ensuring Ethernet VLAN continuity between the sites of a company, carrier grade Ethernet simplifies the networks security architecture of company networks.

IP addresses on the other hand are designed to be universal. IPv4 addresses are numerous enough to provide each human being with an IP address and IPv6 addresses for one IP address per electric bulb! Company networks have to provide connectivity and security. The more connectivity is provided, the more difficult it is to ensure security. This is why company networks are separated from the public internet by firewalls, which filter IP traffic in order to prevent unauthorised or malicious requests.