Bringing it all together

The Economic Benefits from Providing Businesses with Competitive Electronic Communications Services

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Purpose of Study

The purpose of the Study is to establish the role of electronic communication services in stimulating the performance of businesses especially in their use of telecom networks to implement successful ICT strategies.

This Study comprises a number of Reports written by various academics, consultants, customer representatives, and BT. These Reports examine the state of competition in the provision of telecom services, the wider impact of ICT on innovation, trade and productivity and the role of regulation in stimulating a genuinely competitive environment.

Each Report is the sole responsibility of the named author(s).

Professor Martin Cave has provided a Foreword to the Study which explains why the needs of businesses should be taken more seriously by policy makers when it comes to the design and implementation of regulation for electronic communications.

The Study also includes an Overview Report which links together the individual Reports, showing how all the issues addressed in the Study are important when setting regulatory policy for electronic communications services. The Overview Report is a joint Report with signatories who are to be associated with its conclusions. The Overview Report is also available in French, German, Italian, Spanish and Portuguese.

BT welcomes any comments on this Study which should be addressed to Andy Tarrant and Paul Richards, at the contact addresses shown on the next page.

Further copies of the Study are available from:

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The Study, including the translations of the Overview Report, can be accessed at the following website:

http://www.btplc.com/Thegroup/Regulatoryinformation/Consultativeresponses/BTdiscussionpapers/Electronic/index.htm

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Foreword by Professor Martin Cave

In debates about the regulation of electronic communications services in Europe, attention is primarily focussed upon households and small businesses as the customers. Many of them are voters; their individual spends are relatively low but collectively large; and they are unlikely to exercise countervailing market power against large suppliers many of which in the EU are dominant or even superdominant historic monopolists.

This study invites readers not to turn the priority given normally to small end-users on its head, but at least to rebalance it, by abandoning the easy and comfortable assumption that large corporate users can invariably be sure of getting the high quality services they need without regulatory intervention.

There are two underlying reasons why this new way of looking at electronic communications services (ECS) is necessary. First, electronic communications services are used both as consumption goods and as inputs into further production processes which ultimately provide final output; hence the standard terminology of 'end-users', rather than 'consumers' of such services. In the case of consumption goods, such as households' voice calls, cable television, IPTV etc, it is possible to assess directly the consequences of any configuration of prices, qualities and quantities – by measuring losses of consumer surplus associated by potential misuse of market power. The same end-user services used by SMEs benefit from this procedure by extension. In the case of ECS used exclusively as an input, the demand is derived from the ultimate use, which might be in any sector of the economy. As a consequence, the chain of reasoning between misuse of market power and loss of consumer surplus is much more complex.

We have to consider, in particular, the effect on the European economy of the loss of competitiveness associated with poor quality services. And here there is strong evidence, set out below, that advanced services, based upon communications networks, have a major and even a disproportionate effect upon the growth performance of national and supranational economies. This implies that a failure by Europe in the field of regulation of corporate telecommunications services can have effects quite as grave as a failure adequately to regulate the supply of services to householders and SMEs.

Secondly, the kind of services required by large corporate users – by virtue of their geographical dispersion and nature, particularly the inclusion of a significant element of value-added – have the capacity to facilitate trade in telecommunications services. The classic model for services is to take production to the consumer (think of haircuts or restaurant meals). At best this will involve foreign direct investment. But where the location of production can be moved, there is scope for additional efficiency gains, based on the classic factors which have been used to show the benefits of trade since Ricardo analysed the exchange of English corn for Portuguese wine. These include factors such as comparative advantage, dynamic economies of scale, technological leadership and so on. The famous 'death of distance' in communications now makes trade possible. Harnessing this additional element of competition is a feasible option in respect of a considerable component – maybe 50% – of value added in the supply of corporate services. By the same token, protectionist firms will have an incentive to use non-price distortions of trade to protect their home markets from imports. In other words, we have a classic case of great benefits from, and equally great incentives to thwart, the completion of the internal market.

These two underlying considerations show the potential benefits of creating a truly competitive market in corporate services. On occasion, regulators have sheltered behind the comfortable view that there is a sufficiently large number of potential suppliers and buyers with sufficient countervailing market power, to make economic regulation unnecessary. Perhaps as a consequence, the Commission's draft revised Recommendation of markets subject to *ex ante* regulation, which (correctly) starts with analysis from the harmful consequences of non-regulation on end-user markets, there is very little reference to corporate users. Nor is there in the Commission's Communication on reforming the regulatory framework of July 2006.

In essence, this report subjects that assumption to sustained critical analyses, and it finds a much more nuanced picture with respect to market power than is found in the conventional version. The reason that the conventional wisdom is not true is that large corporate customers require a combination of services, and some of which, deep in the value chain, rely upon key wholesale inputs which are bottlenecks dominated by one provider. A supplier which cannot supply the full range of services is often disqualified from gaining a contract.

This arises from the following set of circumstances:

- Corporate clients have a requirement for all their sites to be connected seamlessly; typically the sites include branches in small town and key workers' homes, as well as office blocks in central business districts;
- A high quality of service is required; if parts of an operator's offer cannot provide it, this whole offer risks being ruled out;
- Fixed mobile convergence is often regarded as a necessary input, not least to counter manifestly excessive mobile roaming rates; where this dominant fixed operator is also the largest mobile operator, foreign competitors may not get a chance to compete;
- On top of this sit the tradable software solutions which create the distinctive arena of competition among those seeking to provide services to the corporate market.

As a result of the difficulties of piecing together a seamless offering for corporate clients, the pan-European market for corporate services is underdeveloped. The obstacles lie largely with national incumbents, fixed and mobile, which seek to deny international competitors the key wholesale inputs – high quality bitstream, unbundled loops, leased lines, broadband resale products, MVNOs – which they need to meet the tender requirements. The tragedy of the situation is that the only winners from this situation are the less proficient historic monopolists as the more proficient ones are well-placed to gain a good share of the European market. The invariable losers, however, are the major corporate customers in Europe, which fail to get the services they need to be globally competitive. This in turn has a knock-on effect on the European-wide economy.

In these circumstances, it is vital to ensure that the current trend of regulation, building on successful growth of infrastructure competition for the mass market, does not impede the development of competition for pan-European services still further. Even in the US, there has been a recognition, at least in principle, that wholesale inputs for business services require a different approach than inputs for other services. Different wholesale inputs are often needed, and quality requirements can rule out of consideration some of those providers which may competently serve the mass market.

What, then, needs to be done? The report first identifies significant failures by NRAs properly to implement the current regulatory structure. These failures bear down heavily on both ‘large’ and ‘small’ customers of ECS, and must be rectified. Regulators attempting to design consistent remedies must examine residential and business markets separately and may even find on occasion that the same product has to be treated differently with respect to these two groups.

Secondly, arrangements have to be in place, and implemented, for the regulator to ensure the necessary inputs for the provision of seamless corporate services. The key to this may be the recognition that it is (at the minimum) a pan-European end-user market, the proper analysis of which may outstrip the analytical competence of any individual NRA, and its ability to devise and enforce remedies. On this argument, the task should fall either to the NRAs collectively in the ERG or to the Commission. At present the Commission seems the more secure repository of the task.

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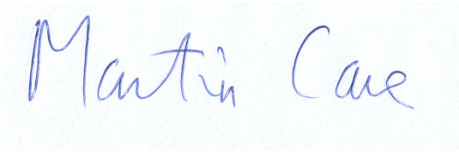
The Economic Benefits from Providing Businesses with Competitive Electronic Communications Services

Overview Report

The Undersigned Endorse This Overview



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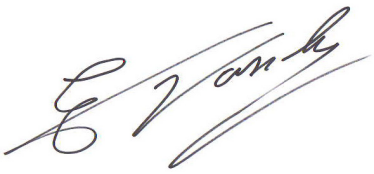

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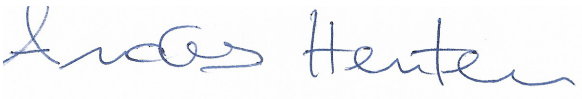

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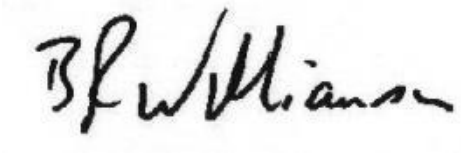

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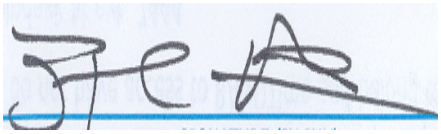

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Summary

The study consists of a number of Reports. The major theme is the benefit of connectivity and ICT as drivers of innovation, productivity, growth and the internal market. A second theme is the necessary regulatory approach which should be adopted in order to ensure the benefits of ICT and connectivity are realised. These analyses are underpinned by a Report reviewing the requirements of business customers and this opens the study.

ICT has the Power to Boost European Productivity

This study is being published at a timely point. European Union legislators are considering whether sector specific regulation continues to be necessary and, if so, what form it should take. The European Council has identified that European productivity lags that of the United States and that the primary cause is the poor take up of information and communications technology (ICT) by European business in general. The Council's declared objective is that regulatory tools should be tailored to remedy this situation.

The means by which multi-national companies are attempting to improve their productivity is through the adoption of cross-border ICT systems. These systems are dependent on the underlying connectivity between customer sites and the services which are provided by telecommunications networks.

Businesses Need Ubiquitous Connectivity to Benefit from ICT

Companies as consumers of telecommunications are very different from residential purchasers. Residential consumers generally require connections in one place in one Member State (or in the case of mobile, a single connection). Businesses, however, in order to implement and benefit from ICT systems, require multiple sites to be connected simultaneously on a cross-border basis. We describe this as a requirement for "ubiquitous connectivity". As a consequence, they are dependent on the availability of mutually compatible telecommunications inputs. Compatibility extends beyond the technical ability to interconnect to include supply conditions such as the time in which products are made available or repaired and the price at which they are made available.

Telecommunications inputs at certain levels in the network are supplied in competitive infrastructure markets (for example cross-border links on most routes). This has allowed some companies, either from an ICT or a telecoms background, to become pan-European aggregators of supply (often including their own network elements), lowering costs to end-user businesses. As a consequence, the increasing trend is for multi-nationals to outsource their entire telecommunications demand to a single company. However, access inputs largely remain monopoly products.

Regulation can Ensure the Provision of Non-Discriminatory Access Inputs Needed for Connectivity

In principle, the fact that access inputs largely remain monopoly products should not be a problem since a European regulatory framework exists and it requires national regulators to ensure the harmonised provision of non-discriminatory access inputs. However, there is currently a wide variety in the quality of implementation of access regulation. This, as a number of end-user customers also state, reduces the ability to implement seamless pan-European ICT systems. It also restricts the ability of small and medium sized enterprises (SMEs) to benefit from these systems.

Regulation Must Change to Achieve this Ubiquitous Connectivity

The picture may become even more serious. As we move into a Next Generation Network (NGN) environment, policing some of the traditional regulatory remedies will become more difficult.[1] As a consequence, delivering the necessary access inputs will, if we genuinely wish to see improvements in European productivity, require a complete shift in the attitude of the owners of access inputs so that they seek to meet the needs of wholesale customers rather than fighting them off for as long as possible. The current European regulatory regime needs to change to deliver the required change in attitude.

Regulatory Independence and 'Equivalence of Input' are Needed

Where access providers are part of vertically integrated suppliers of national telecommunications products, they must genuinely be required to supply all wholesale customers (including their own service arm) with monopoly access inputs on an identical basis. This is likely to require three fundamental changes.

The first is that the bodies charged with delivering harmonised access regulation, the national regulators, need to be made properly independent so that they can promote this.

The second is that these regulators need to have the power to ensure that the workforce and management of the access provision unit is re-orientated towards serving the industry as a whole as opposed to its own national service provision arm. This is most likely to be achieved through 'equivalence of input'.

Focus on Appropriate Access Products is also Required

A third change is likely to be required to ensure the supply of access inputs fit for cross-border businesses. Regulators that are entirely focused on residential consumers might only require the non-discriminatory provision of access products which are fit for residential needs. In this respect, it should be noted that local loop unbundling, a major current focus for regulators, is only a niche product for businesses and one that will not be future proof.

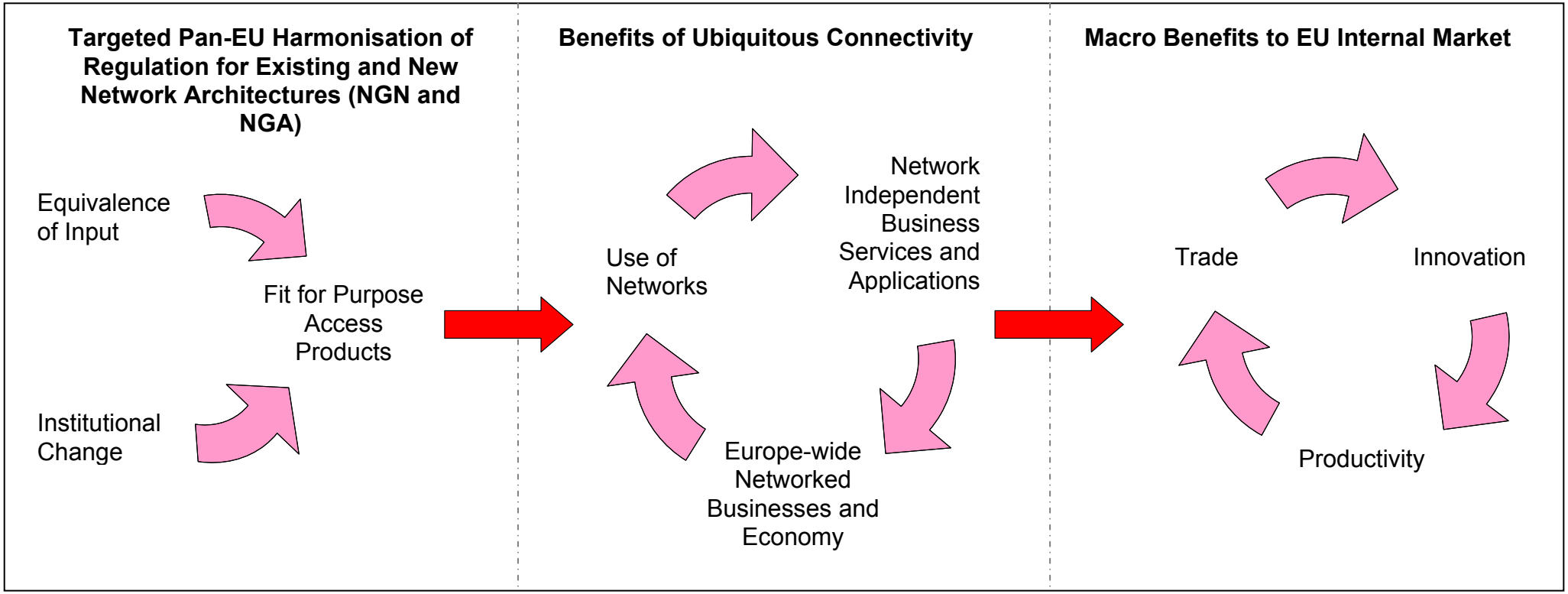
Regulators are unlikely to develop a consciousness of the requirements of the European single market unless there are institutional developments that encourage them to do so. In this respect, we take the view that increases in European productivity based on ICT deployment require that the actual regulatory remedies deployed at national level need to be reviewed for the quality of their content either by a reformed European Regulators Group (ERG) or by the European Commission.

Figure 1 illustrates the mutually reinforcing changes to regulation, the structure of the telecommunications sector and wider changes in the business environment which would flow from ubiquitous connectivity.

[1] With NGN and Next Generation Access (NGA), common costs will likely become a larger share of overall costs and the principle of "cost reflectivity" will become harder to apply for specific products and services.

Figure 1

The Dynamics of Regulation, Ubiquitous Connectivity and Economic Welfare



Source: BT

This diagram describes the outline relationship between regulation of the telecommunications sector, the impact on the use of networks by businesses and the consequential benefits to the wider economy and internal market.

Business Needs

Businesses Needs Ubiquitous Connectivity to Implement their ICT Strategies

Businesses have used telecommunications services to implement their ICT strategies. This has enabled them to begin to transform the way in which they design, produce, distribute and sell products and services. Underpinning the implementation of these ICT solutions is a degree of 'ubiquitous connectivity'. In addition, traditional geographic borders of markets and customers are breaking down, while demand is rising for more network services to support business-critical applications and provide information and data processing capabilities.

Businesses, especially multinational corporations (MNCs), need to operate or be provided with cost-efficient, secure and technically resilient networks that are seamlessly interlinked. In this regard, business customers, surveyed by INTUG, compare their ability to achieve this level of connectivity in the EU unfavourably with their experience in the United States due to the fragmented nature of supply of access products across 27 European national markets and the absence of standardised offerings.[2] They note that suppliers who attempt to meet their ICT demands and put together single networks based on a combination of self build and inputs from the mesh of national suppliers often have difficulty in obtaining the right kind of products from national incumbents.

Among companies surveyed, one commented as follows:

> 'It is particularly frustrating for the company that a pan-European broadband contract is simply impossible.'

Another commented:

> 'This contrasts sharply with the US where a customer can simply go to AT&T or Sprint and get a nationwide, continent-wide service including voice. Some companies' American management are incredulous that this cannot be done in Europe, and see this as a major disadvantage of operating and selling services in Europe.'

Other key themes to emerge and statements from customers include the following.

- A rising demand for connectivity

  'These changes have led to increased bandwidth requirement at ICT centres and at remote access points, and much greater dependence on integrated communications with third parties – customers, suppliers and outsourcers.'

- Poor provision of services and a lack of focus to meet the needs of MNCs

  'The company is limited by a lack of tried and trusted incumbents in Europe…The situation is usually "take it or leave it" with little flexibility or urgency to meet customer need.'

- Concerns on the costs of advanced services and insufficient dialogue about future plans

  'Worryingly, apart from the UK, the company has had little communication from incumbents on NGN roll out plans.'

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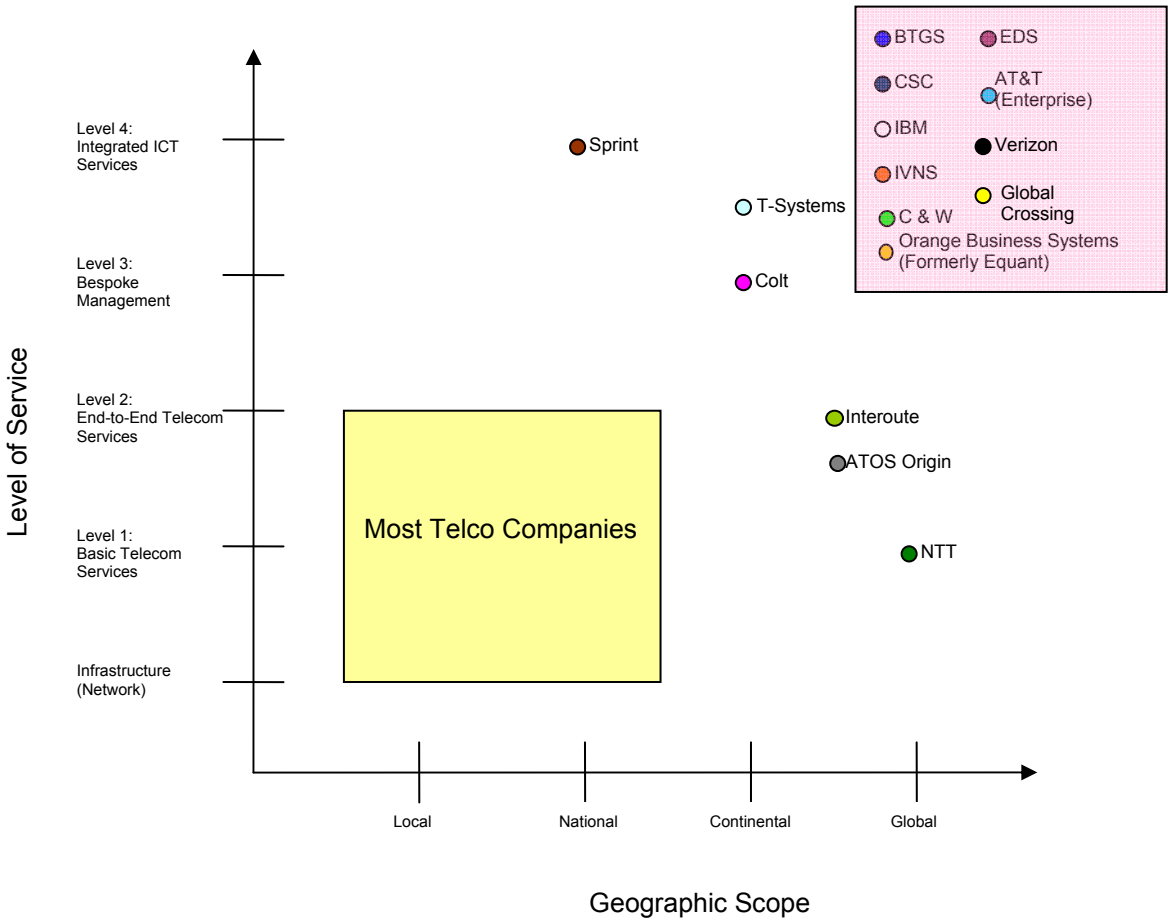
[2] However, the US does not offer a suitable mode for Europe. There are positive aspects in that there continues to be some residual access regulation for the provision of business services in the U (as noted in Report 6 Annex 2), a position which varies from that relating to the provision of consumer broadband. However, business access regulation continues to decrease in the USA and there is a debate over the effectiveness of what remains of the business access regime as it is currently implemented. While business users do have the benefit of obtaining ubiquitous access in the US, there is some dissatisfaction at excessive concentration in the market and in particular its impact on prices. (See for example US Government Accountability Office, Report to Chairman, House Committee on Government Reform, FCC Needs to Improve its Ability to Monitor and Determine the Extent of Competition in Dedicated Access Services, GAO 07-80 (Nov. 2006); centre for Survey Research and Analysis at the University of Connecticut, Views of the Proposed AT&T/SBC and MCI/Verizon Mergers: From the Perspective of Fortune 1000 AT&T and MCI Customers, September 2005, filed by the Alliance for Competition in Telecommunications with the FCC during its review of the mergers). While unlikely to be desirable in any event, it is also wholly unrealistic to imagine a semi or wholly ubiquitous infrastructure monopoly provider coming into existence throughout the EU-27. This means effective access regulation is vital in the EU.

Figure 2 demonstrates that few incumbent telecommunications infrastructure operators have moved into the provision of applications and cross-border networks.

Most incumbents (not all) are situated in the box which indicates focus on local or national needs and a comparatively unsophisticated set of products. They therefore have little interest in, or understanding of, meeting the needs of business, including multi-site customers and especially MNCs which span several countries, nor incentives to address their needs.

Figure 2

Provision of Telecom and ICT Services



Source: See associated Report: 'Trends in the ICT Environment and Business Customer Requirements for Connectivity', Section 3.5.

The levels on the vertical axis of the chart show successively higher elements of service activity being undertaken, starting out with the simple provision of essential telecommunications infrastructure services up to an outsourcing contract in which the company contracts with a third party to run its ICT systems. Such activity can be conducted on a localised basis or extend to a global basis (horizontal axis). See associated Report for further explanation.

The Forms of Access Needed to Provide Competitive Business Services

The Needs of Business are Complex and Require Complementary Multiple Access Technologies

The emergence of different broadband technologies has seen a degree of convergence between the types of technologies used by business and private households. However, there is a lack of proper understanding of the real needs of the business sector. In particular, there is sometimes a belief that there is no longer any competition issue with respect to the supply of network services to businesses, because the telecommunications sector is competitive: "…*there is already competitive provision of high bandwidth IP networks for corporate customers. The unresolved issue is around provision to households, and to some extent SMEs.*" Peter Phillips, Ofcom, 2006[3].

The reality is that competitive provision for the supply of fixed access services for business sites is in Europe generally limited to business districts in larger cities. However, a cross-border company operating on a multi-site basis needs to connect not just city centre sites but operations in out of town sites, widely distributed retail sites, home-workers and so on. Furthermore, pan-European fixed/mobile converged solutions are hampered by the refusal of mobile operators to offer satisfactory mobile virtual network operator (MVNO) products (if any at all) and, in general, the inability of mobile operators to provide products on a pan-European basis.

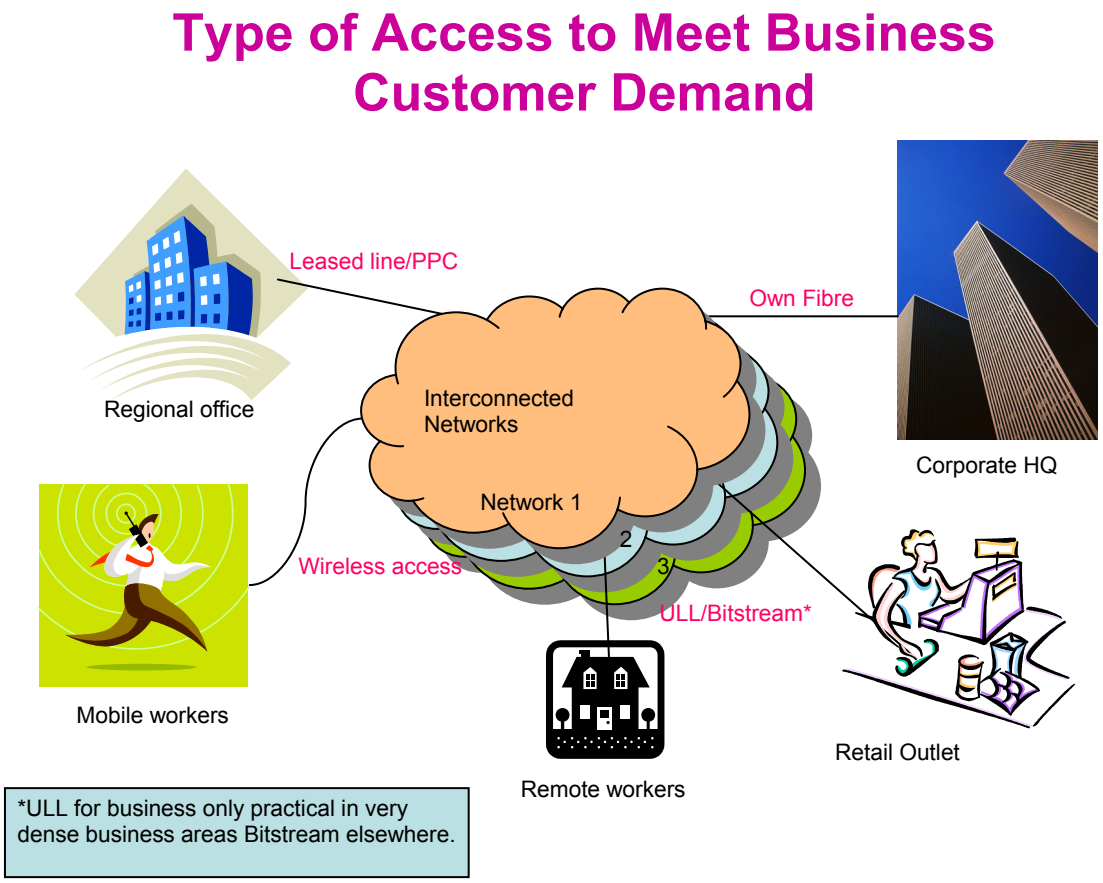
In essence, business customers need the ability to access single company wide platforms over every access system that they use; they need a range of sites accessed simultaneously with technologies selected for each individual site on the basis of which is economic for the volumes generated; their employees on the move must also have the ability to access the core systems; and these requirements must be met across international borders. These varying access requirements for multi-site businesses are shown in Figure 3 below.

As a consequence, business customers need ICT solutions provided over multiple networks; they need large sites connected with fibre and smaller sites connected with lower volume, cheaper broadband products. These solutions need increasingly to be accessible from a mobile network.

[3] http://www.ofcom.org.uk/media/speeches/2006/09/globaltel06 25|09|06, "Seizing the opportunities from convergence". We note that when Ofcom published a discussion document on the extent to which leased lines market in the UK could be disaggregated on a geographic basis in June 2006, it found that BT continued to have market power with respect to wholesale supply with the exception only of the market for very high bandwidth circuits.

Figure 3

Access Requirements of Multi-Site Businesses



Source: BT

This diagram shows how businesses connect their sites and workers with each other and with other businesses through a variety of fixed and wireless telecommunications networks and services.

Access to the Incumbents' Networks Remains Essential

Clearly, where infrastructure competition is economically feasible, it is desirable. However, it will not be economically feasible everywhere and research suggests that alternative fibre-based infrastructure networks are likely to provide connectivity, at the very most, up to a third of any Member State by geography. To give two examples: in the UK, the coverage of UK business by alternative infrastructure providers is likely to be feasible in approximately 10-20% of the country. In Spain, there is a low level of availability of competitive infrastructure outside major metropolitan areas. Outside Madrid, BT is almost wholly reliant on the incumbent to supply leased line services. This means that regulated access will remain necessary in order to permit ubiquitous connectivity.

LLU at Best is a Partial Solution for Business

Regulators tend to focus on local loop unbundling (LLU) as the principal access product which should be made available in areas where it is not economic for new entrants to build a parallel network. However, LLU is a density driven product and currently focused on the mass residential market where information from the UK suggests that the break-even point to make LLU worthwhile is 250-350 customers to be connected at a particular exchange. These large volumes are necessary to justify the cost of the network link from the unbundled exchange to the core network. This link is known as backhaul. Due to the even more limited potential for aggregating business customers, LLU remains only a niche product for supplying products to business customers.

Access Products Made Available Must be Tailored to the Economic Realities of the Business Services Market

In order to connect sites to which there is not sufficient demand to build fibre, ICT solutions providers therefore need products which include both the loop and backhaul. These products are generally categorised as leased line interconnection (also known as partial private circuits) and bitstream.

If incumbents invest in fibre-to-the-kerb or fibre-to-the-premises then the natural point of interconnection will move deeper into the network. In this situation, unbundling will not even comprise a niche product for the provision of business services; it will simply cease to be relevant at all. Unbundling at the street cabinet, in the case of fibre-to-the-kerb, is unlikely to be economically viable due to the increased costs of backhaul per customer and the small number of customers connected to any street cabinet.

NGA, NGN and the Potential for Competing Services

Our view is that the focus on infrastructure replication in telecommunications has led to insufficient focus on the lessons from ICT generally, where the separation of platforms and applications has led to increased innovation. The future development of telecoms, with Next Generation Access (NGA) and Next Generation Network (NGN) network architectures, will tend to entrench and extend the uncompetitive element of the network further from the customer. However, it will potentially increase the scope for a services layer, which is geography and network independent, provided this is anticipated and supported by appropriate regulation. If the latter occurs, this would, in turn, provide greater scope for competition, service innovation and differentiation, and the development of services focused on the needs of business customers.

If appropriate regulation is not adopted, we are likely to see end-user customers obliged to deploy sub-optimal ICT systems, on occasion limited by the access input to deployment on a national, instead of a pan-European, basis.

A shift in focus towards facilitating a pan-European services layer independent of multiple networks, anticipating the deployment of fibre access over time and electronic interfaces for access, would facilitate choice for customers, eliminate the costs that arise due to manual processes of interconnection, and open up greater scope for entry into the services and applications market.

The argument that there is a trade-off between promoting competition and promoting investment may therefore be misplaced, since competition in the services layer can flourish and be supported by investment in NGN and NGA networks and in turn drive demand for those networks. To the extent that infrastructure competition is feasible, so much the better, but success should not depend on it.

The Benefits of Change

Innovation, Creativity and Experimentation

Connectivity has the potential to provide new sources of innovation, creativity and experimentation for both large firms and SMEs. Since the 1970s, ICT diffusion and adoption has seen a shift from an 'industrial age' based on cheap inputs of energy to an 'information age' based upon cheap inputs of information. It is creating new products, services, firms and industries and is beginning to provide the firm and networks of firms as a whole with the advantages that the assembly line under mass production gave the plant.

In the first wave of change, the needs of large firms were a key stimulus to innovation in products and services offered by suppliers and operators in the ICT sector. This process of business telecommunications outsourcing has occurred in three phases as illustrated in Figure 4.

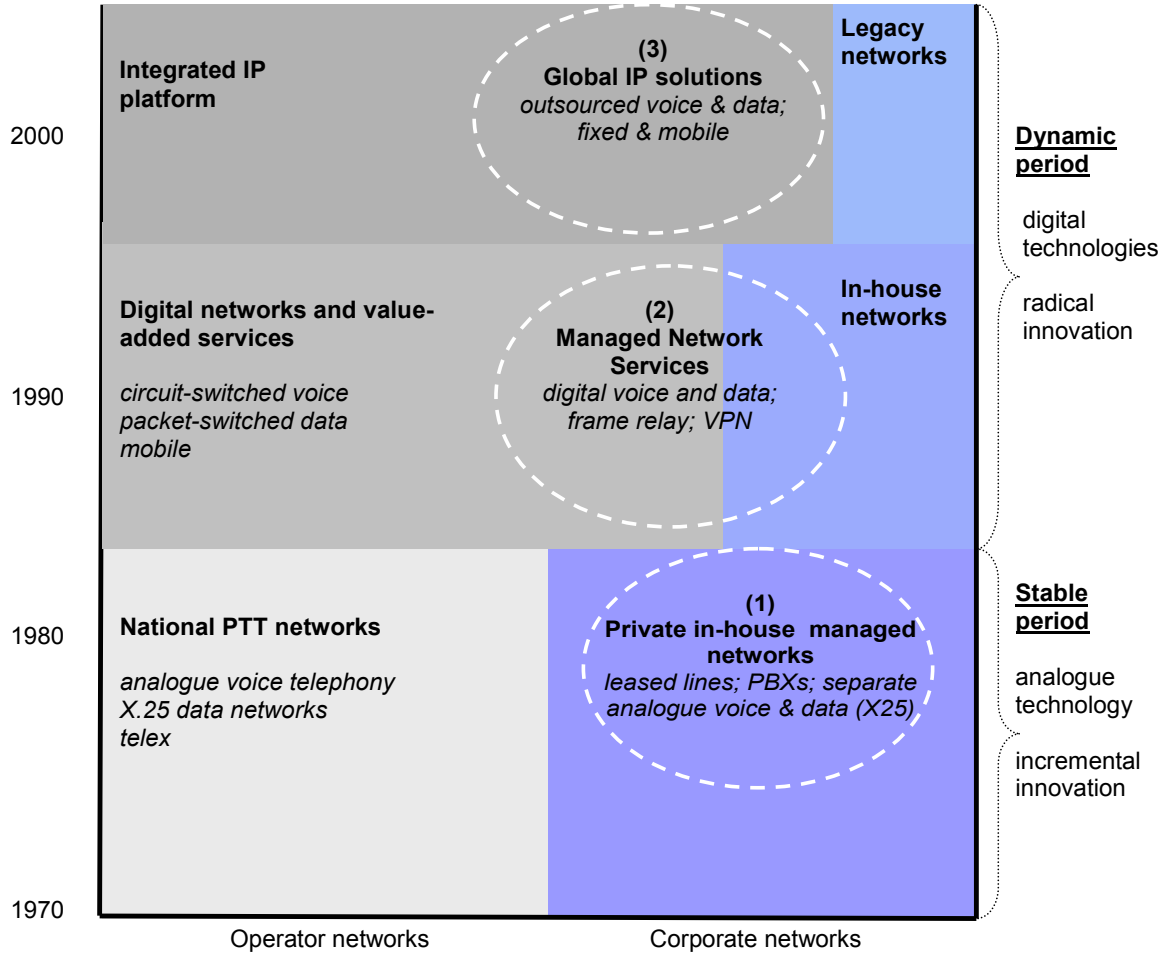
Large firms have used ICT to support the design and development of new technologies, products and services. New feedback loops are being created between design, production and customer demands. ICT is also being used to reorganise the internal and external structures of firms: activities previously performed in-house by an organisation can be undertaken as electronic transactions with partners in long-term relationships. As a result of ICT enablement, vertically integrated organisations are beginning to be replaced by new forms of horizontal forms of collaboration as shown in Figure 5.

By way of example, Zara, the Spanish fashion retailer, has introduced ICT to move a product from design to the shelves in its shops in no more than 30 days. It deliberately incurs shortages on its shelves and ICT is used to respond rapidly to shortages by supplying customers with exactly the goods required at any one time and with much less risk of left-over stock. Shop managers are equipped with personal digital assistants (PDAs) so that information can be sent directly to the company's planning department.

In the second and more recent wave of change, the benefits of connectivity and collaboration are beginning to spread to SMEs. Some SMEs are now using ICT to promote innovation and to achieve more sustainable sources of competitive advantage. However, the potential benefits of ICT for innovative performance in the EU as a whole will not be felt until connectivity fully extends to the whole SME community.

Figure 4

Changing Operator and Corporate Network Capabilities



Source: See associated Report: 'Innovation and Business Connectivity', Section 2.2.

This diagram shows some of the phases of innovation and change which are enabling businesses and public sector organisations to benefit from ICT and connectivity.

Figure 5

Connectivity and Business Organisation

Vertical Model ⇨	**Emerging Horizontal Model**
Command and control	Connect and collaborate
Vertical and hierarchical organisations	Horizontal and flat organisations
Top-down strategy and management	Bottom-up innovation and creativity
Networks: 1) proprietary and closed in-house corporate networks 2) nationally-based PTT networks	Networks: 1) interconnected corporate networks on IP platform 2) web-enabled global network
Value creation by vertically integrated organisation	Value created by multiple forms of collaborative and outsourcing, including large firms, SMEs, customers, and individuals
Closed innovation driven by corporate R&D	Open innovation working in collaborative teams with external organisations

Source: See associated Report: 'Innovation and Business Connectivity', Section 3.1.

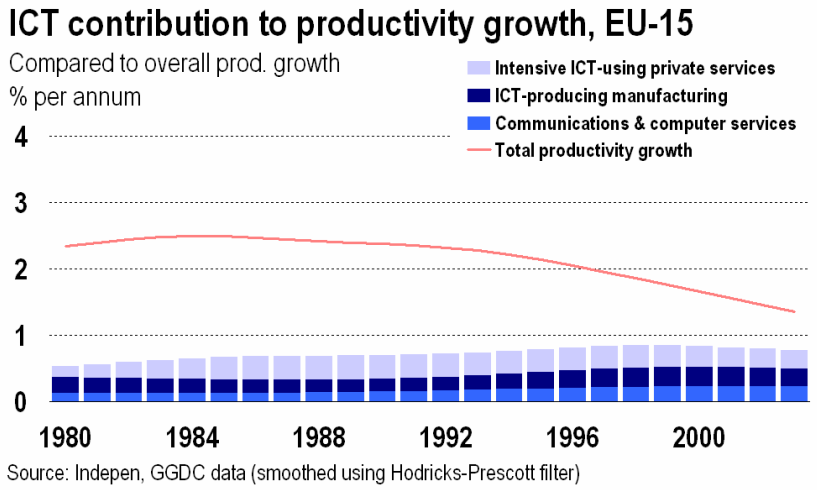
This diagram shows the emerging changes in business strategies and organisation facilitated by ICT and connectivity which are driving productivity and growth.

ICT, Productivity and Income Growth

The observation by Nobel winner Robert Solow in 1987 that *"You can see the computer age everywhere but in the productivity statistics"* has been replaced by a new paradox, namely that you can see the computer age in the productivity statistics in some countries but not others, even though much of ICT is tradable and therefore available everywhere. In fact, globally ICT has contributed to economic divergence rather than economic convergence. ICT has also contributed to divergent outcomes between the US and Europe and to divergence within the EU-15, as shown in Figures 6 and 7 below.

Figure 6

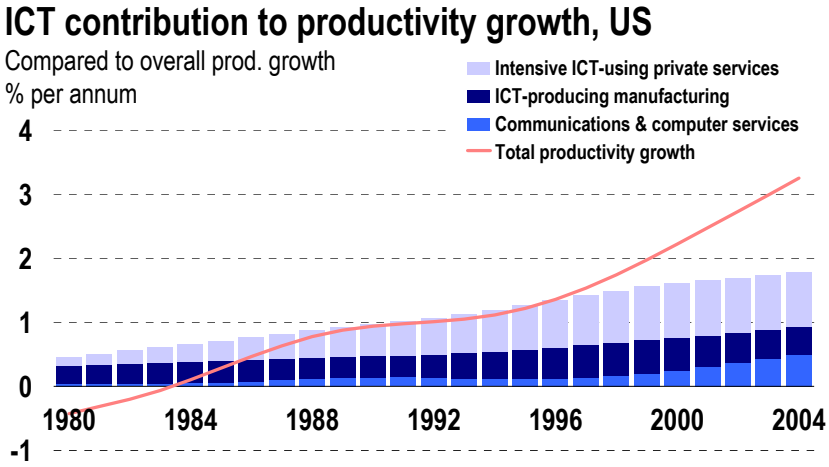
ICT and Productivity Growth in the EU



Source: Indepen, GGDC data (smoothed using Hodricks-Prescott filter)

Figure 7

ICT and Productivity Growth in the US



Source: Indepen, GGDC data (smoothed using Hodricks-Prescott filter)

In the US, overall productivity growth (the red line in Figure 7) has risen dramatically, whilst the contribution of ICT, and intensive ICT-using services in particular, has risen substantially. In the EU-15 (Figure 6) the only reason that the contribution of ICT to productivity growth has risen is that overall productivity growth has declined. Within the EU-15 ICT has to date also contributed to divergence rather than economic convergence.

Two factors related to location appear to be at play.

First, the main economic benefits from ICT stem from its use, and *effective* use depends on economic flexibility: complementary changes to organisation and management that are harder to make in some countries than others for a range of legislative and regulatory reasons.

Second, organisational changes, including the emergence of modern manufacturing and wholesale and retail distribution, depend heavily on connectivity and the effective use of communications networks which are inherently non-tradable and more developed in some places than others.

The conditions that foster effective and profitable use of ICT, and therefore ICT knowledge investment include complementarities between changes in organisation, management and business processes, and the use of networked computers from ubiquitous connectivity. However, connectivity will not be a “magic bullet” as the range of factors are complements and it is necessary to get every factor right in order to see good outcomes.

There is a growing empirical literature that supports a view that networking is a distinct and complementary technology to computers *per se*, and that traditional growth accounting understates the contribution of networks and network services to productivity growth, both due to the way in which telecommunications investment is measured and the failure to capture telecoms’ essential nature – it is the network medium on which computers ride.

Trade and the Internal Market

EU internal market directives have sought to ensure that local access to telecommunications networks in each Member State is regulated on a common basis in order to allow common trading conditions for cross-border operations for service markets that are increasingly international. However, there are still wide variations in respect of the access conditions for alternative operators to the infrastructures of incumbent network operators. These deficiencies in the internal market are regulatory in nature and will not go away by themselves.

As well as being a significant and growing market in themselves, telecommunications services are now an increasing driver of trade, especially in services more generally. Telecoms services provide the platforms over which such wider services can be supplied. However, the internationalisation of services is lagging behind that of goods and the internal services market is not developing as well as the internal goods market.

Hence, although services constitute more than 70% of GDP in the EU countries, service trade only makes up approximately one quarter of total European external trade. From 1996 to 2004, the increase in internal EU service trade was exactly the same as the increase in external EU service trade. The increase was, in both cases, high at 84%, but the fact that the growth was the same in both cases may suggest that the reduction in many formal trade barriers which membership of the EU requires has not promoted a more substantial growth in the internal market for services in the EU. Further, the EU has a more active internal market in goods than services even when the higher propensity of goods to be traded in the first place is taken into account.

There may be parallels in trade to Solow's productivity paradox, with ICT being used without any visible effects on trade and particularly for services. To date, priority in research has been given to understanding aspects of the link between ICT and productivity and growth. Much more research is required to understand the effects that ICT could have on the establishment of a larger internal services market, both with respect to non information-intensive services and information-intensive industries, and also the potential quantitative value of foregone growth in the trade of services due to continuing barriers, such as ineffective or widely diverging telecommunications access regulation.

Regulation of the Electronic Communications Sector (ECS)

Regulation Fit for Business Purposes

Businesses need seamless access to provision of telecommunications services across geography, and service providers therefore need seamless access to local access networks in order to offer fit for purpose communications services to businesses on a competitive basis.

Variation in the quality of access regulation limits the scope for the emergence of truly pan-European and global service providers who are de-layered from national network operators and boundaries, and competitive. Whilst access networks are inherently local, services provision should be pan-European or global to meet the needs of today's and tomorrows businesses. The problem is straightforward: similar competition problems are often not addressed by similar remedies in each of the Member States.

In terms of the way we think about telecommunications regulation there has been too little focus on:

- The needs of businesses in addition to those of private households.
- Regulatory requirements in relation to facilitating pan-European and global applications.
- Service provision versus local infrastructure competition and unbundling of network elements.

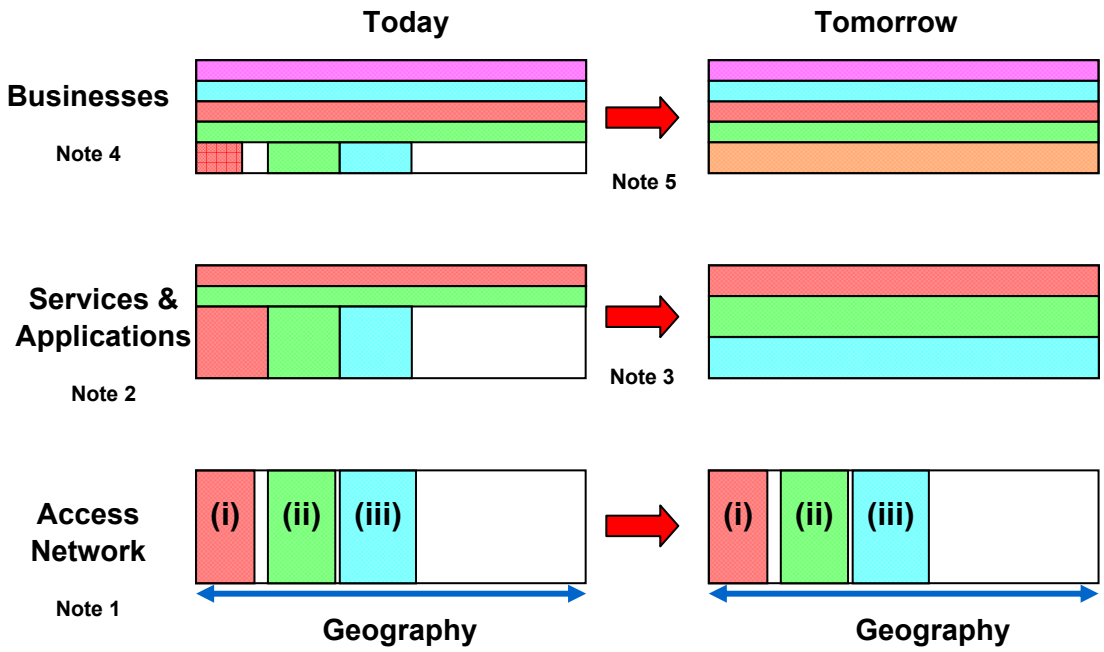
The shift in mindset that is required is analogous to that which happened in relation to computing and software, with hardware going local whilst supporting global software applications across a diversity of platforms. This paradigm shift is depicted in Figure 8.

The horizontal dimension of Figure 8 (geography) is illustrative only. The position of 'Today' is described as follows. At the Access network layer, the diagram indicates different access networks by geography, typically corresponding to national boundaries. Competitive access may exist in some locations, but not all of them. Services and applications are also to a degree localised, but may be offered by suppliers who utilise cross-border ICT systems. These suppliers are as likely to be from outside the telecoms sector as within it. For their part, businesses may be organised on a local or national basis but may not be able to integrate their ICT strategies in an optimal fashion. This may also be the case for MNCs, given the absence of true pan-EU fully integrated ICT solutions encompassing fixed and wireless technologies.

In the environment of 'Tomorrow', the access services still need to be integrated across network platforms and different countries. In turn, this facilitates a genuine market in the next layer up (Services and applications), and these services can be supplied by third parties which do not need physical presence in the actual location of the customer – they are provided across communication networks. Such services may be internet based applications such as VoIP, but also the internal and external business applications which are provided across communications networks, such as Purchasing and Human Resource systems, Financial Management and so forth. A move to ubiquitous access provision would facilitate the separation and growth of an independent and competitive horizontal services layer.

Figure 8

Business Communications and Organisation: Today and Tomorrow



Source: Indepen

Notes to diagram:
Access network i, ii, iii.

1. Networks are physical in nature, often corresponding to national boundaries (represented by the vertical bars). They will remain so in tomorrow's communications framework. Competitive access may exist in some locations but not all of them.

Services and applications

2. Some global or European telecoms service providers have started to provide cross-border, pan-European services and applications (the horizontal bars). Most incumbent infrastructure providers still provide services aligned with national access networks (the vertical bars).
3. In tomorrow's communications framework, services and applications are provided by network and geography independent suppliers.

Businesses

4. Businesses are increasingly dependent on supplier and customer relationships which cross national boundaries and access networks (horizontal bars). Some relationships are still aligned with national service provider access networks (vertical bars).
5. Supplier and customer relationships are simplified and independent of national boundaries and access networks.

These developments will have a profound impact on the structure and organisation of the business users which are able to implement co-ordinated and efficient ICT systems wherever they have a presence or a commercial relationship with another party. Competition in this environment is facilitated by connectivity and the benefits are not limited to multi-site companies or MNCs.

While it may be the case that localised ICT systems with their associate business activities are supplanted by more efficient national or supra-national systems, this will act as a spur to economic development enabling additional specialist companies to gain access to markets which were previously not open to them. Above all, connectivity and simplification of ICT systems are key drivers to opening up new business opportunities and enabling all businesses including SMEs to benefit from these developments.

Three mutually reinforcing changes are needed to move from today's to tomorrow's communications framework as depicted in Figure 8:

- First, a focus on the provision of access products which are fit for purpose for the needs of international business and its service providers. These should anticipate the evolving network architecture in terms of NGN and NGA. In particular, LLU should not be viewed as a substitute for bitstream access or partial private circuits in either the short or long term.
- Second, there is a requirement for the availability of network access on an equivalence of inputs basis in terms of product specification, pricing, and product ordering for all service providers. Equivalence of input requires that the service arms of vertically integrated incumbents use exactly the same access products and their underlying systems as their competitors. This would provide an incentive for the provision of fit for purpose products and genuine non-discrimination since vertically integrated service providers would have to use the identical products and systems to their competitors/customers. Non-discrimination could more readily be made transparent and verifiable. The anticipated NGN evolution of network architecture provides an opportunity to build full equivalence in from the outset, thereby reducing the costs of requiring it.
- Third, institutional reforms are needed to both reinforce the independence of national regulators from national policy pressures and to make them more accountable at the local and European level via the ERG acting as an agent for targeted harmonisation, and the Commission having a power of veto over recommendations subject to recommendation from the ERG.

Focus on the Provision of Appropriate Access Products

Businesses need seamless access to provision of telecommunications services across geography, and service providers therefore need seamless access to local access networks in order to offer fit for purpose communications services to businesses on a competitive basis.

The focus has been on infrastructure competition, either in terms of competing networks or competing network elements based on unbundling of bottleneck facilities such as the local loop. However, access is inherently local and the economic scope for national infrastructure competition is far from ubiquitous. The solution must therefore be, in part, regulatory, since the business market and service providers in turn require ubiquitous access, and access on equivalent terms if service provision is to be competitive and pan-European.

Technical progress and the likely evolution of network architecture also point to an extension of the bottleneck facility further into the network as fibre ultimately bypasses local telephone exchanges, and potentially to reduced infrastructure competition in the medium term as the capability of fibre leap-frogs other access technologies.

National regulators can ensure that appropriate access products are available by recognising the distinct nature of the business market during market reviews and in their choice of remedies. This recognition becomes more important if geographical sub-markets are analysed since sub-markets may be competitive for households or business customers, but not necessarily both.

The ERG could also support a shift in focus in terms of its remedies document and ongoing work programme.

Equivalence of Input

The European Framework includes the principle of non-discrimination in relation to the services provided by vertically integrated network operators with significant market power to their own service arm and other service providers. However, recognising that discrimination may be a problem, and doing something effective about it, are different things.

In practice the process of addressing discrimination via detailed intervention is time consuming, and prone to increasing complexity as the forms of discrimination become more subtle. This was the underlying reason why a different approach was adopted in the UK with Ofcom adopting the principle of equivalence of input whereby network access must be provided at the same price, on the same terms and utilising the same product ordering systems to the incumbent's own retail arm and other providers.

We note that equivalence of inputs in itself does not necessarily require specific outcomes in terms of particular products, service standards or price levels. The key point is that access products are available on the same terms to all service providers. This in itself will also require the application of ICT systems to measure delivery of equivalence.

Supporting Institutional Reforms

Institutional reforms are required to support a move to ubiquitous access to fit for purpose business access products. In particular we propose that national regulators are assured of greater independence from national policy in implementing the framework i.e. national regulators cannot be given directions (giving them a similar level of independence to that provided by central banks when exercising their European functions).

We also propose that the Commission has power of veto over remedies subject to a formal opinion from the ERG. In our view, enhancing the role of both the Commission and the ERG would force both institutions, under the surveillance of the Court, to base their decisions on technical findings and not to make decisions on a political basis.

In addition, it would remain necessary to ensure that national appeals mechanisms do not unduly delay the timely implementation of proportionate remedies. Consequently, the addition of time limits for national court processes and, at the very least, the adoption in the Directives of a threshold for granting of interim injunctions consistent with the threshold under European Competition Law should be considered.

Conclusion

Much has been achieved under the current Communications Framework, but it is time to move on recognising what we have learned and anticipating future developments. We propose the following:

i. A key goal of the Framework and regulatory conduct should be the promotion of ubiquitous access to access infrastructures that recognises the different and changing needs of business users, current and anticipated changes in network architecture, and changes in the ICT sector and wider economy. This would support the development of an innovative pan-European market in telecommunications services and applications.

ii. To achieve this objective a new remedy should be incorporated in the Framework allowing regulators to implement equivalence of inputs supported as appropriate by functional separation. Equivalence of inputs for SMP services would promote non-discriminatory provision of fit for purpose access products.

iii. Market analysis should take into account the particular circumstances of business users and guidance to this effect should be developed alongside the increasing focus on geographical sub-markets, recognising that bottlenecks in relation to business services may differ from those applying to residential services. The choice of remedies, where appropriate, should also involve explicit consideration of business users. For example, local loop unbundling, as opposed to bitstream access, may not be fit for purpose when the needs of multi-site businesses are considered.

iv. To support these changes we support institutional reforms to ensure that national regulators are independent of national ministries, that the Commission has power of veto over remedies subject to a formal opinion from the European Regulators Group and subject to the surveillance of the Court. Finally, to ensure timely implementation of the Framework, we propose the addition of time limits for national court processes, or the adoption of a threshold for gaining interim injunctions consistent with the threshold under European Competition Law.

Trends in the ICT Environment and Business Customer Requirements for Connectivity

A Joint Report Prepared by BT, Ed Vonk and Nick White*

PURPOSE OF REPORT

This Report sets the scene for all the other analysis undertaken in this study on need for the competitive provision of telecommunications services to multi-site businesses. It explains the key drivers behind their demand for connectivity and why connectivity is a vital part of their business strategies to implement ICT in a cost-effective manner. This Report includes the results of a detailed survey of business attitudes to telecommunications regulation in the EU.

* Ed Vonk is CEO of the Enterprise Virtual Private Network Users Association (evua). Nick White is Vice-Chairman of the International Telecoms Users Group (INTUG).

CONTENTS

Executive Summary

This Report describes the reasons why ICT is central to the strategies of companies doing business in Europe. The Report highlights in particular the role of connectivity as a key driver to the successful implementation of ICT solutions and how connectivity breaks down geographic boundaries.

To demonstrate these propositions, the Report examines a number of key features in this sector including: the structure of supply in ICT provision; the reasons why demand for high quality resilient networks is growing rapidly; the relationships between business customers and their ICT suppliers; the benefits of outsourcing as a means to achieving economies of scale and scope (product diversification).

The enormous benefits of ICT are only achievable when all businesses are provided with the most cost-effective access services enabling the seamless interlinking of both fixed and wireless technologies. This enables all sites of all businesses from SMEs to Multi-National Corporations to be interconnected. Proportionate regulation enabling the transparent non-discriminatory supply of access services in each and every location of the EU therefore has a vital role to play for business customers of telecommunication services.

As part of this study, a survey of multi-site businesses which span across the EU was made to solicit their views on the link between their strategies and telecommunication regulation.

The case studies reveal concern about the inconsistencies of access offerings across Europe and the detrimental effect this can have on deploying pan-European management and information systems. They also record, a fear that this may become worse in a Next Generation Network environment. Many incumbents have little appreciation of the needs of multi-national companies and frequently policy-makers have also not established any dialogue with them either.

1 Introduction

1.1 The Importance of Understanding Business Requirements

This Report is pivotal to this whole study. It provides the *evidence* for the need to give much greater attention to the perspective of businesses. Businesses are the source of innovation in the supply-side of the economy. The Report demonstrates two things.

First, it explains how businesses are using telecommunications services in their ICT strategies as vital inputs into achieving seamless connectivity between their sites to run business-critical applications.

Second, it shows why competition in the supply of these services is *only* feasible where *all* suppliers are able to meet stringent requirements of linking all of their customer sites together using cost-effective access technologies.

Such sites could be spread throughout one region, one Member State, the EU or indeed the whole world. For these businesses such geographic breakdowns are of little meaning, except to the extent that the lack of regulatory harmonisation precludes the competitive provision of their telecommunication access networks.

In the authors' experience, the requirements of businesses are rarely appreciated by policy-makers. Very few NRAs have forums where the requirements of businesses are addressed, and the market reviews are not always the ideal way in which to explore these strategic issues as market reviews tend to be sporadic and oriented toward mass market consumers. At the very least addressing the needs of businesses through market reviews should be supplemented by on-going research and dialogue between customers, suppliers and NRAs.

In the broader political framework, the focus is more usually on the needs of mass market consumers, such as the growth in broadband usage for residential customers. The revolution in business practice based on connectivity as part of ICT is not widely understood nor are the implications drawn out for regulatory policies.

This Report provides some context to the business ICT environment, and uses case examples to illustrate these issues and in particular, how **ubiquitous connectivity** is fundamental to business prosperity and innovation.

In particular, the Report sets out the case for treating businesses, and especially multi-site businesses, as having requirements which to a considerable degree are distinct from those of other users of telecommunication services, and which merit serious consideration by policy makers and by NRAs.

1.2 The Meaning of Ubiquitous Connectivity

Ubiquitous connectivity refers to the requirement of firms to seamlessly connect all their sites and nomadic workers together in intranets (or Virtual Private Networks – VPNs), and for these individual intranets to be cross-connected to those of other firms through extranets. Connectivity is ensured through the provision of telecommunications services which combine the characteristics of both fixed and wireless access technologies in the most cost effective way.

The technical nature of the access services needs to be sufficiently robust to support the applications across those networks. Some applications will be neutral or able to be run largely independent of the underlying access technology, whereas others may be more affected by certain specific technical features and in particular the quality of service.

A significant proportion of the value of such services consists of the software based solutions combined with the connectivity.

Such connectivity is usually supplied in response to tenders for multi-site connectivity with the software/application development bundled together. A network operator that is unable to supply connectivity simultaneously to every site will be excluded from bidding at all, as it is not usually desirable to split the contract geographically or by part of application.

Competition in this sector comes from a variety of suppliers, some of whom are also providers of access in certain geographies and others who come from a background in the provision of software. Tenders may be undertaken by separate organisations or jointly but one feature is common to all bids – they all have to include ubiquitous connectivity.

1.3 Report Structure

As background to appreciating the business customer requirements, this Report first describes the economic environment which is driving businesses in Europe to seek growth and productivity improvements through investment in ICT. This is set out in Section 2 which highlights the trends of regionalisation and globalisation of business processes in many industries in pursuit of economies of scale and scope. This Section also discusses the fundamental requirements for businesses arising from these sector trends.

Section 3 provides some detail on the specific products and services required from telecommunications providers in terms of underlying network access products. It also identifies the principal suppliers in Europe of these products and services and difficulties experienced by such suppliers in providing pan-European services to their customers.

Section 4 of the Report concludes with case study examples from business enterprise customers, describing their business needs and their concerns regarding the acquisition of network services.

2 Trends in the ICT Environment and Business Connectivity

2.1 Overview of Key Trends

Business requirements for connectivity need to be understood within the general trends in the broader economy. This Section highlights three such factors:

- The nature of 'globalisation' in which traditional geographic boundaries of markets and customers are breaking down.
- The rising demand for business connectivity and 'bandwidth' arising from businesses needing to acquire and process more information for their own internal uses, for their commercial relationships with their trading partners, and demands from external bodies such as financial and regulatory agencies arising out of growing obligations for transparency and governance.
- The imperative for businesses to operate cost-efficient, secure and technically resilient networks.

Economic growth in the world economy is based on (and also promotes) the growth of ICT services. Successful European economies require effective and efficient European *business processes* for a wide range of activities and commercial applications. These include the following: HR activities; Financial Transactions; Buying; the Management of the Supply Chain; Customer Relationship Management; Brand Management/Market Research; Advertising and Promotion; and Distribution. These activities need to be feasible across all the areas of activities and to reach all geographic points in all Member States.

The growth of businesses in general comes from increasing their scale and scope. This can be achieved partly through geographical expansion and increasing the range of customers that can be served from common means of production, and partly by acquisitions/mergers which facilitate a wider product range.

Growth also comes from cost reduction and competitiveness. These often require improved connectivity with business partners, for example in the supply chain and from better communication with end-customers through multi-channel marketing.

The text below elaborates on each of these themes and draws out some of the high level commercial and regulatory implications.

2.2 Globalisation and Geographic Borders

European businesses compete in regional, international, and in many cases in global markets. The size of these markets is increasing, due to liberalisation and competition and associated foreign inward investment. This also produces an increase in the number of competitors. Whilst European companies have growing access to Chinese and Indian markets, they also face competition from Chinese and Indian suppliers that until recently only served their domestic markets.

In addition to the impact of mergers and acquisitions of businesses operating in their areas of core competence, globalisation is driving the same businesses to outsource non-core ICT processes to ICT 'integrators'. These are suppliers with the experience of working across trans-national and regional boundaries to provide networking and software solutions for the entire requirements of the customer.

These organisational trends in many industries produce a jigsaw of inter-linked organisations and companies. To ensure the smooth operation of the ICT applications they use – both individually and jointly – the links between them must be: seamless, efficient, flexible and transparent. As a corollary, these requirements also apply to the network products and services they use to link themselves to each other, and to gain access to the information and applications required to run their business processes.

2.3 The Rising Demand for Connectivity

Business customer demands for network services to support these applications and to provide information are dramatically increasing. This is arising from generic economic growth in economies as a whole but also driven by a trend for multinational businesses to standardise and consolidate the way they manage their businesses across regions and globally through the streamlining of business processes. Significant commercial benefits can be gained by the introduction of ICT at regional and global levels to business activities, making speed of response to market both faster and also more effective.

For example, materials planning and buying at a regional level not only 'leverages' the purchasing of inputs in large volumes to reduce costs, it also enables closer management of stock levels, thus reducing working capital and provides greater transparency to monitor the relative performance of factories. This requires standardisation of information and applications at regional and/or global levels in support of the buying processes. The same logic applies to all business processes, whether it be customer relationship management, innovation, marketing, cash management, or Human Resources.

In all such cases, a European-wide process only delivers the full benefit if *every* part of the business is connected to the *same* applications and can access the same information *consistently*. Whilst a company can define a standard process and can standardise its information and applications, it cannot achieve the optimum return on investment in ICT as a whole if the required connectivity is unavailable to parts of its business operations. A fragmented and incomplete network landscape thus blocks investment in ICT and reduces the benefits of ICT.

In addition to this geographical consolidation, access to the activities and commercial applications described above also requires the provision of information. Businesses need to exchange large amounts of information with each other to co-ordinate their activities at wholesale, distribution and retail levels. In other words, information exchange is needed at all of the intermediate processes of production to ensure the provision of tailored and timely goods and services. These distinct dimensions of business are key drivers which are raising demand for connectivity within businesses and between them.

There are also some very important external factors. The retreat of government in many parts of the world from 'command and control' of utility services such as energy, transport and telecommunications services, has been replaced by a rise in regulatory governance. This applies to the telecommunications industry as well as to many other industries which have been privatised and liberalised. Privatisation has also led to a greater consumer and investor demand for continuing improvement in business performance and to greater corporate social responsibility.

The requirements for seamless connectivity apply to workers which are based in fixed locations (including those working from home) and nomadic workers. The demand for mobility and remote access is one key implication of this requirement and the need for seamless connectivity therefore spans fixed and mobile communications. Fixed/Mobile integration is a critical enabler. The two networks have a "symbiotic" relationship – high costs of mobile data e.g. for international roaming, stifle demand for fixed network usage.[1] Conversely, fragmented or unavailable fixed network access facilities block innovation using mobile communications for example for product tracking in distribution.

This trend has been described by one analyst as necessitating a framework of "co-opetition" in which at least four parties may become involved:

> 'The supplier landscape of competitors (and partners) for enterprise fixed-mobile bundled services includes service providers, systems integrators, and hardware and software vendors – all contributing a piece of the puzzle toward fixed-mobile service and technology convergence'.[2]

The increasing sophistication of the international financial system underpinning these business trends and the much publicised business failures of certain multinationals have also created demand for greater transparency, more information and demonstrable compliance with company laws and shareholder requirements.

In summary, the way in which the global economy is moving has required businesses to provide enormous amounts of information and data-processing capabilities for a very wide range of stakeholders. These demands are above and in addition to information requirements which are focussed on the needs of communicating to external customers, for example via the Internet.

2.4 The Requirement for Resilient Interconnecting Networks

The consequence of the trend towards multi-site multi-national companies (MNCs) relying on complex information, management and measurement systems, is a growth of data intensive interoperable ICT data systems. Increasingly these also incorporate sophisticated voice and video communication systems. These networks are provided by systems integrators and multinational telecommunications service providers using telecommunications networks to connect customer sites and thereby facilitate inter-site communication.

This requires that individual network services which, for reasons of historical monopoly supply tend to be specific to each individual country, be capable not only of interconnecting with each other, but also of interoperating the relevant network applications *seamlessly*. This must also be done in a way which allow *multiple* applications to be possible, and which will allow the overall network to be operated to defined service levels.

A joint survey[3] by the EVUA (Enterprise VPN Users' Association) and Ovum found that the two main concerns for Chief Information Officers (CIOs) of business users of data networks were: (a) cost; and (b) the capability of different access networks to provide a common "virtual" network. A wide range of other factors were also important as shown in Figure 1.

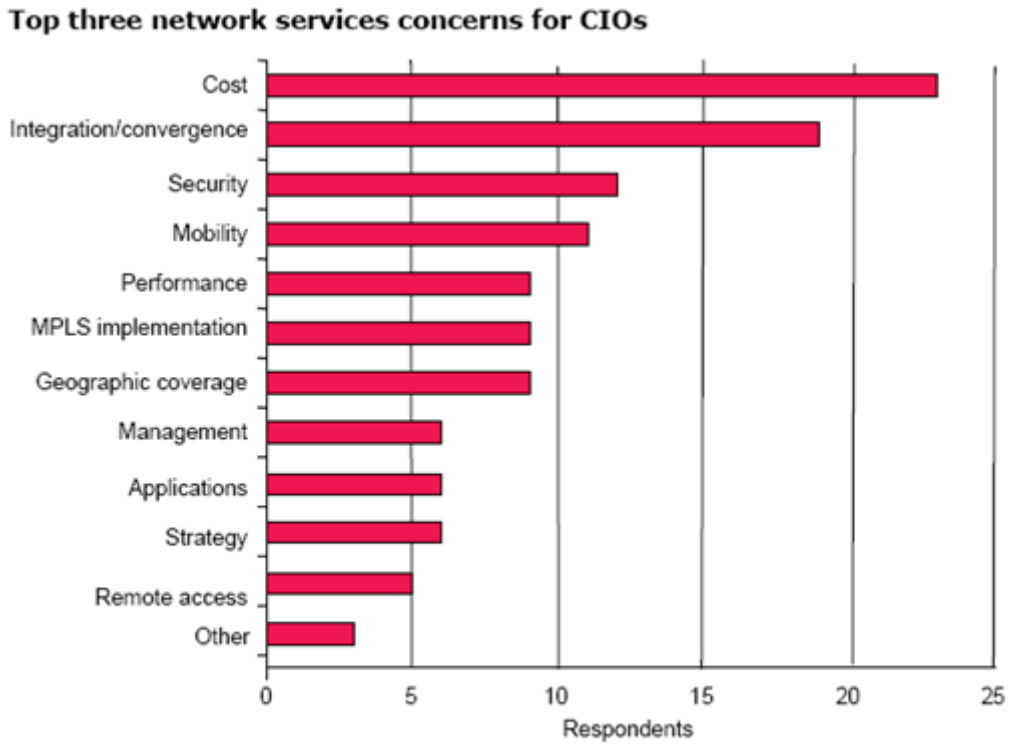
[1] See the associated Report 'The Use of Access Technologies'.

[2] 'Fixed-Mobile services will lead technology convergence', by Brownlee Thomas for Forrester Research, March 2006.

[3] EVUA survey conducted in 2005 (IP-Enterprise@Ovum).

Figure 1

Top Network Services Concerns for CIOs



Source: EVUA/Ovum

CIOs collectively identify cost and integration as their clear top two concerns, but have a wide range of other concerns of a mainly technical nature, including security, mobility, performance and implementation of multi-protocol label switching (MPLS) technology.

2.5 High Level Implications of These Trends

The geographical dispersion of sites and the use of flexible direct and indirect workforces, for example through outsourcing require remote, seamless and high speed connectivity. This implies interconnection not just between fixed networks, but also between fixed and mobile networks. Many companies are operating with flexible workforces operating nomadically or from home. In such circumstances, the access requirements may be somewhat lesser in terms of bandwidth, but the locations are likely to be more rural or at least suburban rather than just in city centres. In such locations where there is often only one physical infrastructure provider, it is vital that bitstream access products are made available on non-discriminatory terms.

Although technical progress and optical networking have greatly reduced the costs of telecommunications services, businesses remain concerned about network costs as the survey above illustrates. Competition is pivotal to ensuring these cost reductions materialise in practice. Where there is competitive network supply, the market will achieve this in time. However, where there is not competitive supply, which is often the case (but not always) in access and termination in networks, reasonable prices will only likely be offered where there is proportionate regulatory intervention.

Excessive prices raise the overall cost of connectivity and are therefore likely to reduce demand for the deployment of ICT solutions.

In order for networks to be technically capable of achieving interoperability, common standards need to be deployed with open interfaces. There is a risk, in the absence of regulatory intervention, that national network operators may be tempted to adopt proprietary standards to prevent the migration of their captive national customers to cross-border competitors. They may also be tempted to withhold investment in the development and implementation of newer technologies in order to retain the revenue and high margins of their “cash cow” legacy services. Succumbing to these temptations would result in a handicap for their domestic business customers by limiting their capability for ICT investment in enhanced network services to improve their business productivity.

Incompatibility of standards is also likely to have implications for the quality and security of data communications. An example of this problem in Europe is the refusal of some incumbent operators to provide guarantees for service quality for access inputs at the level which is necessary to meet the security needs of those putting together global solutions for companies with mission critical communications. This may prevent those companies from designing and implementing sufficient resilience and business continuity in their operations.

3 The Services Provided to Business Customers

3.1 Introduction

This Section reviews the nature of the products which multi-site businesses require and the nature of competition for those services. The purpose of this analysis is to illustrate the range of applications which are business-critical and which are underpinned by network connectivity. This section examines the range of companies competing to provide these services and the critical importance of ubiquitous connectivity. The broad regulatory issues arising are identified and explored in detail in the accompanying Report on the Application of Regulation ('The Application of Proportionate Regulation to the ECS').

3.2 The Nature of Business Applications

This discussion presents a very brief explanation of networks and applications for fixed networks; a much more detailed description of fixed and wireless networks is contained in the accompanying Report, 'The Use of Access Technologies'.

For business services, access connectivity represented by the inner circle in Figure 2 is most commonly provided by a third party leased line (often referred to as an access 'pipe' which is a point-to-point service of high service standard and which does not involve any switching).

In the last few years, the traditional interfaces of leased lines have been extended to include Ethernet which is the universal standard for Local Area Networks (LANs). Access may be distinguished by bandwidth and quality of service features but little else. This form of access is a "low level" service (in terms of the OSI network layer model) and therefore highly platform independent, meaning that most electronic communications services can run over it as long as appropriate network speeds and quality of service are provided.

Bitstream access is also an important access for businesses where the bandwidth requirements may not be too great and where the applications may not have particularly stretching technical requirements. Nonetheless, the meeting of minimum technical specifications for bitstream access are necessary and the harmonisation of the specifications for bitstream services is important for multi-site business users.[4]

The key differentiators between the offerings of different service providers are the network applications, some of which are represented in the outer circle of Figure 2. Any combination of those shown, or all of them at the same time, can be offered over the same access pipe.

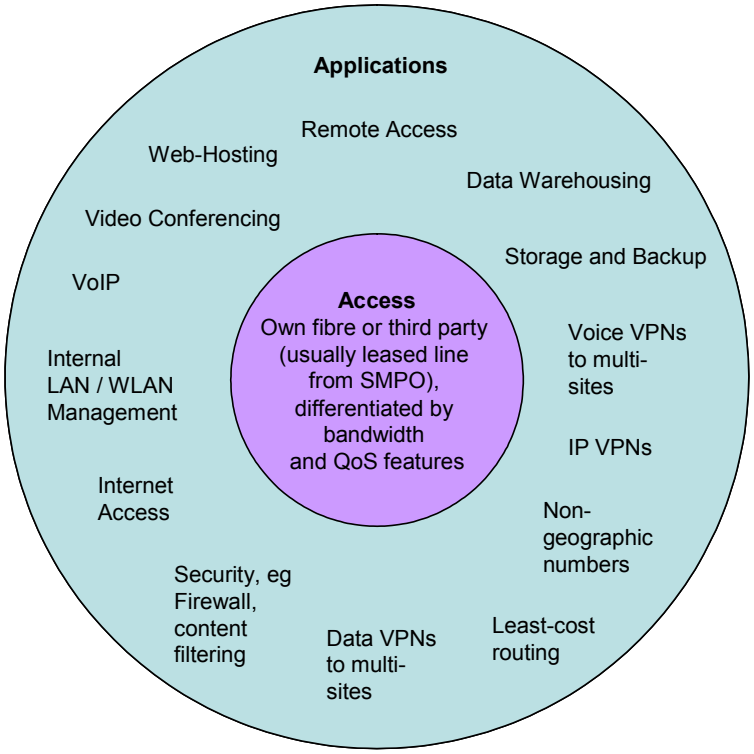
Network applications have at least three important properties:

- Developing applications is R&D intensive, involving substantial sunk costs and risk. Sometimes the applications are developed in-house by the service provider. Sometimes product development can be outsourced to specialists.
- The quality, range and diversity of the applications offered differ substantially between providers.
- Supplying these applications often involves a high degree of bespoke tailoring to each individual customer's needs. There are very few 'one-size-fits-all' products in this market and customisation involves a high fixed cost.

[4] As noted in Footnote 8 below.

Figure 2

Nature of Business-to-Business Network Services



Source: BT

Network services are made of access links for data transport (the inner circle) and applications (the outer circle). The applications in the outer circle cannot be provided without access links. Typically, the value of the applications represents the greater economic value of an outsourcing contract.

In summary, suppliers of services incur significant costs in developing their business offerings and need to do so with confidence that the underlying network access can be provided on a non-discriminatory and efficient basis, as this underpins the conditions for fair competition for all of the applications which are provided in addition to connectivity itself.

3.3 The Multi-Site Nature of Supply

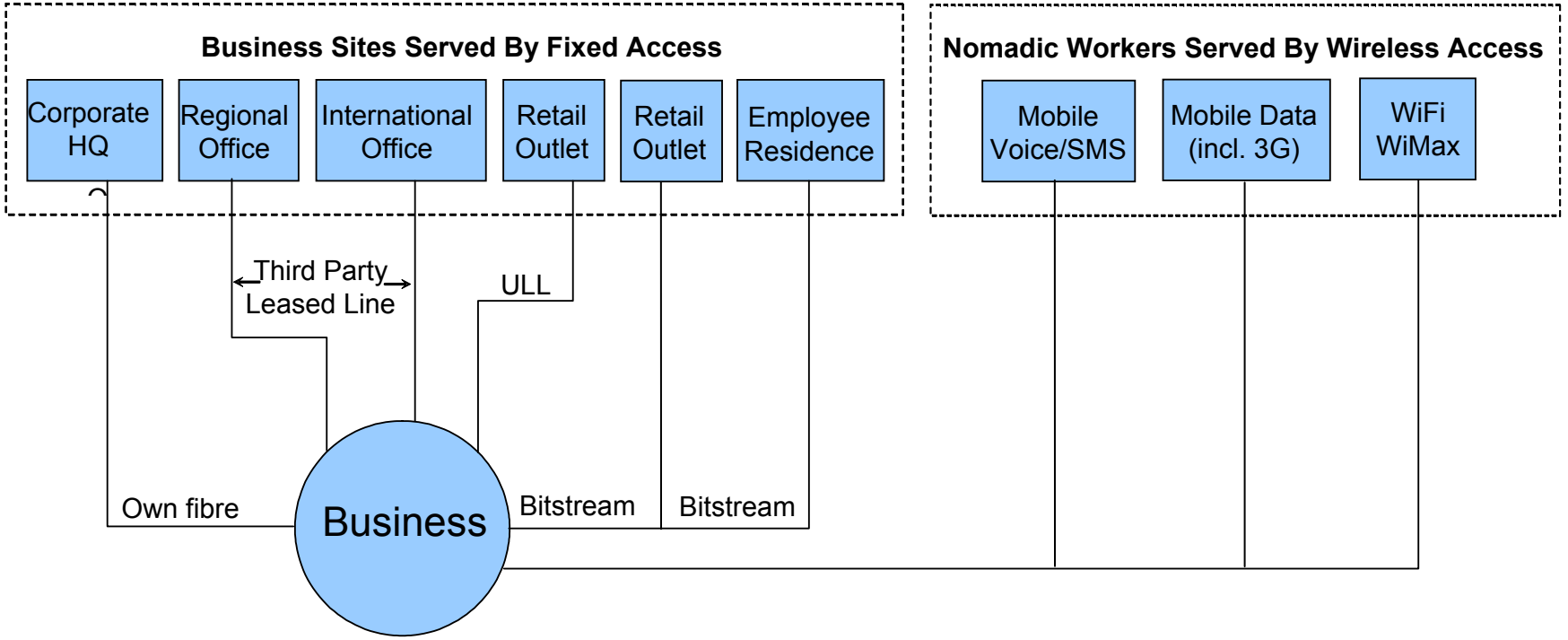
A key difference between business and residential services is the multi-site nature of business services. A supplier must be able to provide connectivity at the right speeds and at the right level of security to all the business customer's sites if the supplier is to make a successful tender.

A customer of this type cannot operate at all if parts of its operation are not completely integrated into its seamless information and management processes.

Figure 3 below illustrates how suppliers typically provide services to their business customers across fixed and mobile networks.

Figure 3

Access Requirements of Multi-site Businesses



Source: BT

A typical business customer network, showing the various different user sites, all of which may have distinct access requirements in terms of data throughput and resilience.

The customer locations which use fixed access technologies are described in schematic terms as follows.

On the left of Figure 3 is the Corporate HQ, typically accommodating hundreds or even thousands of employees and often located in a business district. High bandwidth requirements often justify the supplier providing its own fibre-to-the-premises, especially if the HQ is close to the supplier's own network.

Second from the left is a regional office, which is usually smaller than the HQ, has fewer employees, lower bandwidth requirements and is typically further from the supplier's infrastructure. A regional office may be, but is not necessarily, located in a central business district (often such offices are located in suburban or rural business parks with lower real estate and labour costs). Because of these factors, the supplier often has to rely on third party access provided by national incumbent operators to connect these sites to the corporate network. This would typically be with a leased line.

Third from the left is an International office i.e. an office in a separate country. Customers running a global network will usually require a single operator to provide access to all their international sites. Access will provided either by own-build fibre or by a third party leased line.

Third from the right is a retail outlet based in a concentrated location, where unbundled local loops (ULL) are a possible access mechanism for the supplier. However, unbundled loops are an atypical product for business service supply for the reasons discussed further in the accompanying Report 'The Extent of Competition in Serving Business Customers from Fixed Infrastructures' and are shown here for completeness.

Second from the far right is another retail outlet in a more provincial location where unbundled local loops are not economically viable. In this case the only economic means of connecting it to the network is to use an intermediate access product such as bitstream access.

This is an important access technology, as noted by one business analyst commenting on the migration to All-IP environments:

> "Much of this (migration) is being driven by the availability of DSL and alternative access solutions to leased line and by enterprises continuing to expand their networks by adding sites and transmitting more time-sensitive, business-critical information. Businesses will continue to require greater flexibility and scalability to easily incorporate additional sites, such as branch offices. They will also require greater bandwidth capacity to transmit more-complex applications and require greater security and backup in case of downtime as more information is transmitted over networks''. (page 6).
>
> "The increasing availability of broadband, in particular DSL, as an access option has enabled greater connectivity for smaller businesses and branch offices. About 60 percent of IP VPN connections are accessed by DSL in Western Europe'' (page 8).[5]

[5] 'Market Trends: Top Trends and Action Items In Data And Internet Services, Western Europe 2005-2010', Gartner, 14 June 2006.

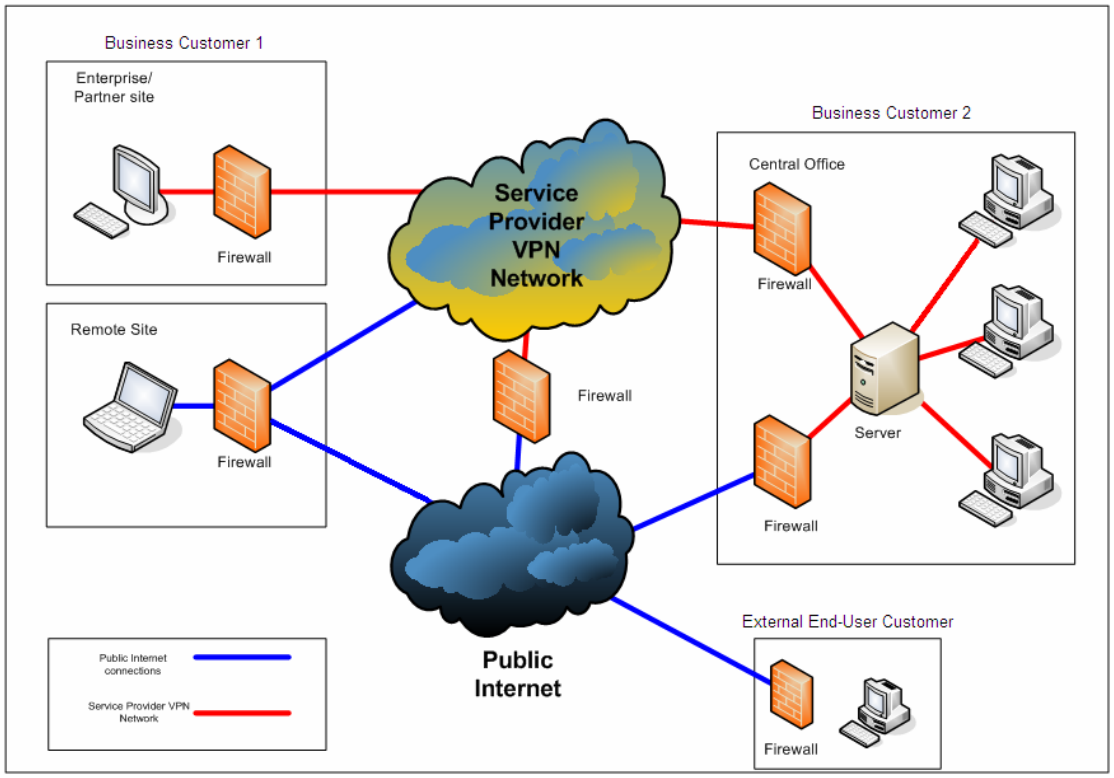
On the far right is the residence of one of the customer's employees, who needs to connect to the corporate network from home to access email, intranet resources and centrally stored data using remote access. The employee can connect over an existing broadband connection, provided by any service provider. However, many customers prefer their employees to connect to their networks using a secure managed IP-VPN connection, which requires the service provider to provide the connection. Fully unbundled local loops will normally not be economic as this also requires the telephone service to be transferred. Therefore shared unbundled loops i.e. the high frequency path only or bitstream access would be required. Again, even shared access will likely only be economically viable in locations with a reasonably high density of demand.

Finally, as shown on the right hand side, there will potentially be many nomadic workers using a range of wireless technologies including mobile voice and SMS, WiMax, 3G etc.

This describes how a business will operate its telecommunications network. However, businesses need to link to each other for the seamless exchange of information. The Internet is one possibility but increasingly businesses exchange information with each other across secure connections of extranets and Figure 4 shows how this can be achieved. Ubiquitous connectivity thus requires all business to have connectivity with all of their own sites and for this to be matched by connectivity between businesses using reliable and secure telecommunications networks.

Figure 4

Firms Acquiring Connectivity with Each Other



Source: BT

This diagram shows how two Customers can link their applications and business processes via a Service Provider Virtual Private Network using secure access links. They can also establish connectivity via the Public Internet which is what an end-user customer of the business may also do.

In summary, a range of access technologies will be used depending upon the precise circumstances of the location and bandwidth requirements of each site. All of these are needed for a viable economic solution.

3.4 The Benefits of Outsourcing to a Single Supplier

The business customer requirement for connectivity could potentially be satisfied simply by very basic network connections and businesses could then manage their own applications that run over the top of them. However, the focus on core business described in Section 2 applies also to the management of communications applications.

European businesses operating on a cross-border basis typically want a single provider to manage the exercise of creating and managing a cross-border network. Outsourced management is cheaper and more efficient. There are two basic reasons for this. The first is that the linking of many national networks with rather different market conditions lends itself to a specialisation which third parties can acquire and 're-sell' to many businesses. Secondly, the development of applications which sit on top of the underlying network connectivity can also – with development – be supplied to many businesses. **In other words, outsourcing enables economies of scale, scope and specialisation to be achieved and diffused throughout the economy. It is ubiquitous connectivity which makes this possible.**

The trend to outsourcing is well established in the industry, as the following analyst notes:

> "European organizations are now focusing on core business processes and are relying on outsourcing partners to leverage economies of scale, exploit new technologies, and source the wide range of necessary skills" (page 1) See par 2.2 of A1.
>
> "Outsourcing continues to shape the growth of the services markets. Over recent years, sluggish economic conditions and challenged IT budgets have ensured that outsourcing has been the principle driver of growth within the IT services market. It has allowed organizations to drive out costs, access specialist expertise and technologies, and refocus management skills away from non-core IT functions towards those challenges driving competitive differentiation" (page 5)[6]

Competition between providers is also evident:

> 'In its latest managed services deal, Verizon Business announced this week that it will be linking up the global sites of Denmark-based multi-national natural ingredients producer Chr. Hansen with an MPLS-based business network.
>
> Peter Skov, key account manager at Verizon Business stated: "We will be delivering all of their business critical applications, handling all of their traffic, and providing IP services like video conferencing." He said that part of the reason Verizon was awarded the contract was because it is able to prioritise network traffic by dividing it into six different classes, thereby improving performance.
>
> ***Until now Chr. Hansen has used four different regional providers including AT&T, BT Infonet (now part of BT Global Services) and Verizon, delivering different network solutions***.
>
> "***Chr. Hansen wanted to grow the business, and as part of doing this they decided they wanted a single network provider***," said Frank Enevoldsen, country leader, Denmark, Verizon Business. "A fully outsourced network service allows customers to switch the focus back to their core business, without worrying about network issues.'"[7]

However, no supplier can offer **ubiquitous connectivity** on a global basis even if it comes from a background as a telecommunications infrastructure provider. It is unlikely that one provider can cover all of any customer's sites through its own access networks if they need service on a cross-border basis, although this will be more feasible the more limited the number of countries and sites within those countries for which coverage is required.

[6] 'Western Europe IS Outsourcing Services Market', by Jennifer Thompson, for IDC, April 2006.

[7] "Trend towards managed services continues", Total Telecom 01/02/2007 (Nick Wood).

As a consequence, the supplier will almost always have to purchase access from other infrastructure providers. A supplier with a background as a software company may, but not necessarily, have to buy in more access inputs, or it may partner with an infrastructure provider or several infrastructure providers, or manage them on behalf of the client which remains the purchaser. Conversely, an infrastructure provider may have to buy-in applications products, partner with one or several applications providers, or manage relations with applications providers on behalf of a client which remains the purchaser.

In summary, business services have the following characteristics:

(i) Much of the value is in applications and largely independent of the network infrastructure over which they run (as long as the necessary bandwidth and quality of service network characteristics are met).

(ii) They are complex and diverse. The range of business services is much wider, more complex and has greater scope for product differentiation than residential services.

(iii) They are usually provided to multiple sites, often spanning international boundaries.

The nature of these products is therefore quite different from PSTN telecommunications products.

3.5 The Principal Suppliers to Business Customers

There are a substantial number of operators competing to provide service to multi-site, multi-country customers. A number of pan-European business service providers are part of a larger vertically integrated company which include either one national incumbent (BT, TDC Song) or several national incumbent fixed networks. The latter situation arises where incumbency in one country has been extended by acquisition of incumbency in another country (France Telecom, Deutsche Telekom).

Figure 5 below includes the main companies involved in serving business customers. Their involvement differs by:

a) Horizontal axis: geographic scope (from local to world-wide), so that only companies on the right of the scale are competing on a genuinely global basis.

b) Vertical axis: value added of service offered (from basic infrastructure (network) to integrated ICT services.

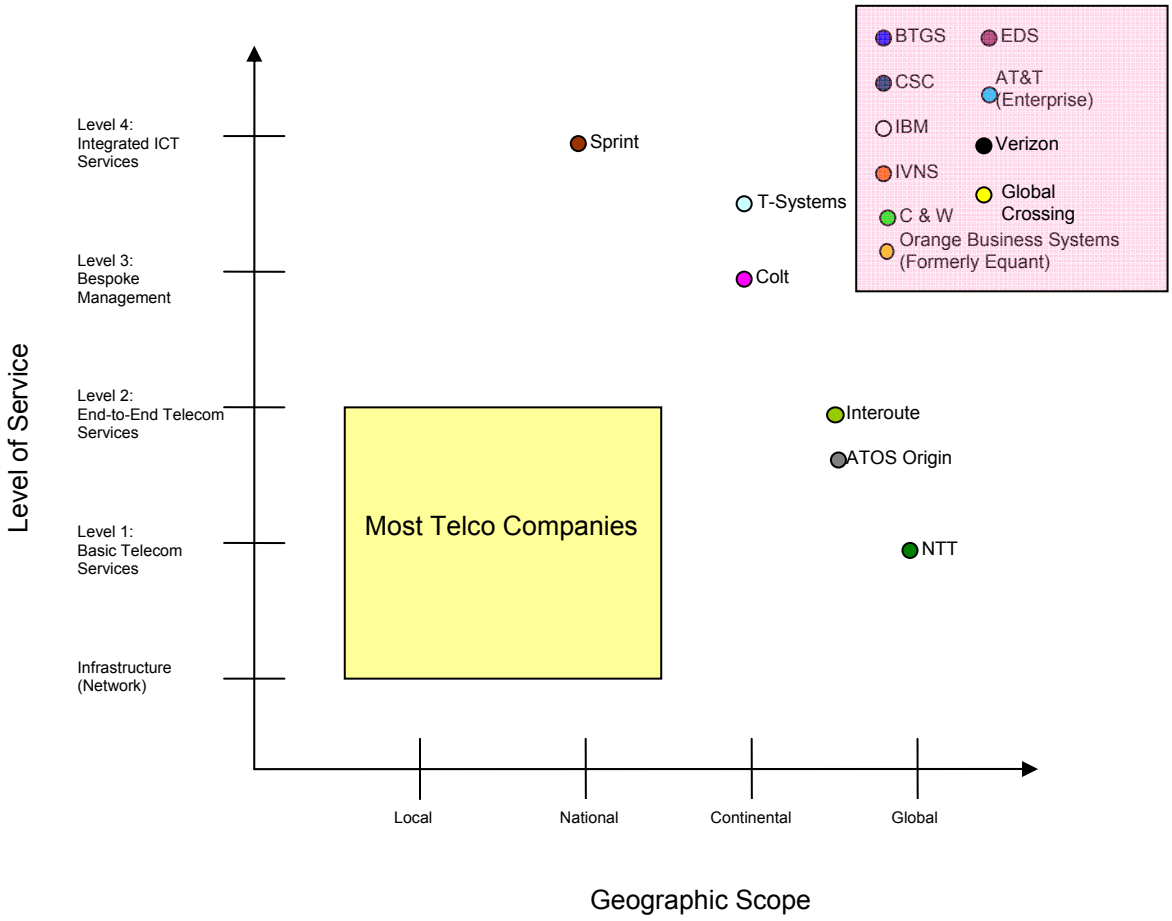
The Levels are described below essentially in technical terms, with the lowest level consisting of telecommunications services and the highest levels including greater functionality of the services being provided. (The Levels structure (levels 1 to 4) has been adapted from the Commission's market definition in AT&T/IBM (Case No. M/1396).)

"Level 1" comprises the provision of telecommunications transmission capacity between two different points offered as a stand alone product; e.g. domestic local and long-distance leased lines, International Private Leased Circuits (IPLCs), wholesale International Direct Dialling (IDD), as well as indirect services such as switched transit, hubbing and re-origination.

"Level 2" adds physical and logical layers, such as interconnecting routers and switches, and the physical management of such devices; e.g. the provision of managed bandwidth, basic Virtual Private Network, Frame Relay, and Asynchronous Transfer Mode services.

Figure 5

The Provision of Telecom and ICT Services



Source: BT

This diagram shows the principal suppliers of services to multinational business customers, classified by geographic scope and level of service. The group of companies in the far top right hand quadrant all offer a similar range of services and their exact position on the diagram holds no particular meaning.

"Level 3" adds a higher degree of management by the service provider. This might include the physical and logical management of the customer's network and premises devices, potentially through to the desktop; e.g. managed Internet access, file transfer, transaction routing and universal messaging services to managed data network services ("MDNS") and network outsourcing services.

"Level 4" covers services including the highest degree of IT functionality, by which the supplier is closely involved within the customer's activities, acting within its LAN and managing both IT and communications equipment on the customer's premises, or managing customer's applications and content; e.g. provision of IT-intensive communications services, such as content hosting services, EDI service, managed workgroup services, and corporate messaging services.

What this graph shows is that only a very few incumbent infrastructure operators have moved into the provision of applications and cross border networks. Because of this, the majority of incumbent operators have little interest – or necessarily understanding – of the needs of multi-site customers, nor any particular incentive to address their requirements.

3.6 Consequences of the Absence of Suitable Access Products

Where the conditions of access to the national incumbent's fixed network are not available on a non-discriminatory basis, then the vertically integrated arm with preferential access may be able to tip multi-site multi-country bids in its favour.

A further problem exists in some Member States where the national incumbent may have little interest in providing services that cater for this market. In such scenarios, it may decline, for example, to provide the quality of repair service that business service users need, for example over bitstream and leased lines.[8]

Conversely, competition issues may be exacerbated where the national incumbent does identify the retail national business services market as an important source of revenue. This may give it an incentive to suppress demand for pan-European solutions by restricting or over-pricing supply of wholesale inputs to pan-European service providers so that business customers remain with a national solution.

The unavailability of the necessary network access products and services in Europe or their overpricing has economic consequences for customers, providers and the EU itself.

- Customers have to pay much higher prices for a pan-European service because of inflated access prices in some member states or alternatively to avoid this have to deploy fragmented network and ICT systems and therefore lose the ability to leverage scale of operations.
- Customers have to split contracts inefficiently between Member States because the customers preferred choice of access input is not available or not available on a ubiquitous basis or not available at the necessary service quality levels in a specific country;
- Customers have to use inferior applications overall because a requirement for seamlessness means that the access technology in the "worst" country requires that this is adopted overall.

The availability of appropriately priced access products is not the only issue. Business customers that currently have national communications applications connected by national infrastructure may encounter obstacles to migrating away from an existing national solution when they wish to move to a more efficient regional or global solution which is not provided by the incumbent.

[8] Quality of service has two aspects in the context of telecommunications networks. The first concerns basic features of service provision such as the time it takes to be supplied with a service or for a fault to be repaired. The second aspect concerns the technical specification of the underlying service itself. There is some variation here across different incumbent operators some of whom will offer higher specifications of services while others do not. This makes it more difficult to operate a pan-European network with a range of applications on that network.

The more efficient solution may involve substituting the access product currently being used for a cheaper alternative from the same incumbent. The incumbent may seek to make this transition impossible or onerous and this may make the adoption of an enterprise-wide efficiency by the business customer impossible. Costs will rise with long lead times, long overlap times and delays in moving off the contracts that provided the original access links.

4 Case Studies of Companies

4.1 Background

In the course of December 2006, eleven global MNCs and one trade association (representing global MNCs) all with business activities in Europe, were asked on an anonymous basis, to record their views on industry trends and the interaction of their plans with telecommunications regulation.[9] Their views are contained at Annex 1.

Only two of the companies interviewed used BT Global Services as a supplier of networked data services.

4.2 Views of Businesses

Table 1 summarises the customer interviews.

A number of key themes emerge from the company surveys which are illustrated with quotes below. The themes covered are:

- The rising demand for connectivity from business re-structuring.
- The absence of standardisation of service offerings in the EU, which is inhibiting convergence and integration, and which compares unfavourably with the US.
- Poor provision of services and general lack of focus on the needs of MNCs.
- Concerns on the costs of advanced services and insufficient dialogue about future plans.

These themes are discussed in turn below.

4.2.1 Businesses Re-Structuring and Demand for Connectivity

Several of the companies report major changes to the structure of their ICT operations, driven by organisational change and rationalisation. As a consequence, there is a growing demand for bandwidth and a trend to require higher transmission speeds even at remote locations, as well as a trend to use web enabled applications.

Company 'A' states the following:

> 'Company A's business history in the last three decades reflects the changing environment and the changing needs of multinationals operating in Europe. From a point of diversification into many business activities, globally and within Europe, there has been progressive convergence and consolidation.
>
> This has been achieved by focusing on core competencies, core markets and core brands, consolidating core business processes geographically, outsourcing transaction processes, and globally managing ICT infrastructure initially and then Applications. New information demands have been generated by these changes, to enable operation of processes at an aggregated and consolidated level.
>
> The impact has been changes to the location of business and ICT activities, constant acquisitions and disposals, new web-based interactions with customers and consumers, outsourcing of financial and HR transaction processes and of network services, and offshoring of ICT operation and development, and of contact centres.

[9] The interviews were made by Nick White of INTUG and the views expressed are those of the organisations alone.

> These changes have led to increased bandwidth requirement at ICT centres and at remote access points, and much greater dependence on integrated communications with third parties – customers, suppliers and outsourcers.'

4.2.2 Standardisation and Integration

The increase in demand is across all types of networks which need to be interconnected seamlessly and most respondents are building networks to support fixed and mobile integration. The current position is not adequate as the following quotes illustrate.

Company 'B' states the following:

> 'The company's major IT thrust currently is the roll out of a global ERP system, based on a single SAP entity for transaction processing across all major business processes. This is a corporate initiative to radically improve business efficiency and productivity. It requires seamless access to global systems, including from wireless/mobile links everywhere, based on consistent, seamless telecommunications services globally.
>
> The fragmentation of services in Europe prevents the company from leveraging its scale and scope, so it suffers high prices for access circuits and long lead times for leased lines. In some cases, linking to rural sites at adequate bandwidth has proved to be difficult, even with the incumbent. It is particularly frustrating for the company that a pan-European broadband contract is simply impossible, meaning that it is burdened administratively and in cost terms with negotiating multiple inconsistent contracts in terms of price and service levels and performance. The same situation applies in mobile where it is unable to conclude any meaningful contract which can enable it to leverage its size and achieve any kind of seamless network.'

The views of the association representing ICT users in the oil sector include the following conclusion:

> 'Within Europe, neither the requirements for bandwidth, nor the demand for standardized interfaces and common tariff structures, can be met in optimum manner at present. There are less restrictions within industrialized areas, but more restrictions outside.'

Company 'C' which is a global oil producer and distributor, states:

> 'The company has found that regional telecommunications suppliers experience difficulties when in the role of an Altnet trying to get telecommunications access services from national incumbents. This has hindered the Company's programme to reduce the complexity of 150 suppliers in 2002 to a much smaller number today. Regional suppliers experience differences in costs of up to 30/40% compared with incumbents. In the Nordic region, it has not proved possible to establish even sub-regional consistency of supply, as there is no true homogeneous network.'

4.2.3 Unfavourable Comparisons with the USA

Several respondents highlight a view that access products in the US are more consistent and suppliers are more responsive to innovative business demands than in Europe. They express frustration at having to deal with multiple suppliers and integrate fragmented services. Contracting with networks entrants (Altnets) may not improve things as they also experience difficulties themselves getting the quality of service from incumbents.

Company 'E' states:

> 'There is also no availability of QoS products suitable for voice yet. Least Cost Routing still throws things out on to the PSTN generating extra charges. This is inhibiting business productivity for European enterprises, with variable availability and performance of delivery mechanisms.
>
> This contrasts sharply with the US where a customer can simply go to AT&T or Sprint and get a nationwide, continent wide service including voice. Some companies' American management are incredulous that this cannot be done in Europe, and see this is a major disadvantage of operating and selling services in Europe.
>
> Many of the company's clients/prospects are reviewing their outsourcing and off-shoring arrangements. If Europe had a more competitive infrastructure, some might consider in-shoring again to enable contact centres to leverage more flexible, local resources, which their own customers would often prefer.'

Company 'H' states:

> 'current provider is facing obstacles from the incumbent in trying to undertake a network upgrade'.

Company 'J' states:

> 'Networking in the US is considered to be better than Europe in terms of consistency, efficiency, performance and cost'.

The views of the association representing ICT users in the oil sector includes the following assessment:

> 'The limitations in Europe are evident when comparing them with offshore operations in the Gulf of Mexico which fall under a single regulatory telecom regime, with all platforms within the footprint of the local telecom service providers. The same will certainly happen in China, Russia and India. The fragmented European telecom regulatory and service industry does not allow the Oil Industry to operate in Europe at the same per unit ICT infrastructure cost as in the US, and within a few years will compare unfavourably with China, Russia and India.'

4.2.4 Poor provision of service and high prices

Several companies complain at long lead times for the provision of leased circuits in Europe, a general lack of focus on the needs of MNCs and there is criticism of unrealistically high prices for advanced services

Company 'D' states:

> 'In countries with only one carrier, access circuits prove to be more expensive'.

Company 'E' states:

> 'The company is limited by a lack of tried and trusted incumbents in Europe, who instead seem to be trapped by bureaucracy and are not addressing the needs of multinationals adequately. The situation is usually "take it or leave it" with little flexibility or urgency to meet customer need.'

Company 'G' states:

> 'inconsistency of provisioning times is very evident … business applications are hampered by limitations in connectivity'

Company 'I' states:

> 'A similar issue applies to mobile communications where exorbitant pricing for 3G data, and 2G roaming and fixed to mobile termination, has deterred investment in new applications. The cost of data and call charges is a factor in roll out of any converged offerings, making it very unattractive at present.'

4.2.5 Insufficient Dialogue with MNCs on NGNs

Finally, some companies express frustration at the inability to engage with suppliers on the consequences and potential improvements expected from the introduction of NGNs.

Company 'F' states the following:

> 'NGNs are of interest for business development, e.g. to support multinational travel agents, to whom they plan to provide value added services "piggy backed" on their current basic services. It is important for the company that its value added applications can be supported by a consistent NGN network infrastructure throughout Europe. Worryingly, apart from the UK, the company has had little communication from incumbents on NGN roll out plans.'

4.3 Implications of Findings

Company 'A' states the following:

> The company is typical of multinationals seeking to grow their business in Europe. The economic objectives arising from improved productivity are entirely dependent on the ability to obtain consistent network services of equal capability throughout Europe, in order to replace the old fragmented business processes with a single regional process.'

The views of these companies are fully supportive of the goals of the regulatory framework and the efforts of policy-makers to promote the EU as a place in which businesses can thrive. This is the key driver behind the i2010 initiative.

But the current situation falls far short of what is needed.

Table 1

Summary of Findings: Business Customer Survey

Customer Description	Key Developments & Requirements	Key Concerns Regarding Telecoms
A. Fast Moving Consumer Goods provider.	Seamless network support throughout Europe. Use of ICT for productivity gains. Centralised sourcing of ICT. Consistent network services throughout Europe and ubiquitous broadband services.	Inconsistent standards and legacy processes. Delay in provision of services especially broadband outside urban areas. Equal access for its pan-European supplier to wholesale products price, availability, lead times, quality of service, billing and management. Fear of regulatory holidays exacerbating existing fragmentation.
B. Consumer Goods Manufacturer.	Main manufacturing in rural sites. Seamless access to global systems including wireless. Wants pan-EU broadband and mobile contracts but not possible at the moment.	Its pan-European service provider receiving low priority to get access links to main hubs in Europe including in Italy, Spain and accession countries. High prices and long lead times for access services. Inadequate attention to corporates by regulators.
C. A global oil producer and distributor.	High bandwidth requirements with specific technical requirements. Need for suppliers to have global reach.	Fragmented solutions with difficulty in outsourcing. Limitations in supply of DSL services by incumbents. Insufficient competition.

Customer Description	Key Developments & Requirements	Key Concerns Regarding Telecoms
D. Pharmaceutical research and manufacturing.	Use of broadband by homeworkers. Use of fixed and mobile products.	Time taken for access circuits. Potential for fragmented and inconsistent roll-out of NGNs or reduced choice.
E. Management consulting, technology and outsourcing company.	Consistent seamless service throughout Europe in terms of quality including voice. More focus on supporting homeworking to counter job losses due to off-shoring.	Incumbents not addressing needs of MNCs. Altnets unable to supply ubiquitous end-to-end service. Lead times for the supply of access services.
F. Travel industry.	Consistent NGN roll-out for applications.	More difficult to build networks in Europe than US. Absence of discussion about NGNs except in UK.
G. In payments network and travel.	Business growth dependent on high quality communications.	Inconsistency in provisioning times. Need for better connectivity in the accession countries.
H. Pharmaceutical company.	Actively involved in infrastructure projects.	Problems in one country to undertake network upgrade.
I. Pharmaceutical company.	Large UK and US MPLS network. Interested in NGN services including IP telephony but incumbents reluctant to engage. Use of videoconferencing to reduce travel costs.	Incumbents slow to roll out MPLS networks. Improved services for home workers, higher bandwidth width and better prices. High price for 3G data services. Need for greater competition.

Customer Description	Key Developments & Requirements	Key Concerns Regarding Telecoms
J. Financial services organisation.	Networks represent a significant expenditure. Development of new applications which are feature rich. High speed data transfer, replication and back-up.	Believes that networking in US better than Europe in terms of consistency, efficiency, performance and cost because can go to just one access supplier.
K. Consumer technology corporation.	Extensive MPLS network, IP videoconferencing and VoIP and plans for HDTV over IP.	Limitations in supply of access in Europe. Competitive suppliers to get access to new NGN services.
L. Oil Industry	Demand for flexible home working rising rapidly Consolidation of ICT platforms and hosting locations	Fragmentation of the telecoms regulation and service providers does not allow the oil industry to operate in Europe at the same per unit ICT infrastructure costs as in the US and within a few years will compare unfavourably with China, Russia and India. Neither the requirements for bandwidth, nor the demand for standardised interfaces and common tariff structures are being met. Concern that NGN developments will lead to further fragmentation

Annex 1

Company Surveys

Company A

Company A's business history in the last three decades reflects the changing environment and the changing needs of multinationals operating in Europe. From a point of diversification into many business activities, globally and within Europe, there has been progressive convergence and consolidation.

This has been driven by market expectations of higher rates of continuing business volume and value growth, higher margins and improved earnings per share and favourable (top third) Total Shareholder return compared with a peer group of 21 Fast Moving Consumer Goods (FMCG) Multinationals.

This has been achieved by focusing on core competencies, core markets and core brands, consolidating core business processes geographically, outsourcing transaction processes, and globally managing ICT infrastructure initially and then Applications. New information demands have been generated by these changes, to enable operation of processes at an aggregated and consolidated level.

This has required standardization of definitions of products and services, and consistent financial processes and measures. Requirements for financial compliance (e.g. Sarbanes Oxley 404 and IFRS) have increased the pressure for consistent business measurement.

The impact has been changes to the location of business and ICT activities, constant acquisitions and disposals, new web-based interactions with customers and consumers, outsourcing of financial and HR transaction processes and of network services, and offshoring of ICT operation and development, and of contact centres.

These changes have led to increased bandwidth requirement at ICT centres and at remote access points, and much greater dependence on integrated communications with third parties – customers, suppliers and outsourcers.

ICT costs are only 1.6-1.7% of turnover (less in some regions), with telecommunications at around 0.3% (higher in some more remote regions). Cost cutting in ICT is therefore of limited direct benefit in improving margins, which run at around 14%. ICT investment can, however, enable margin and growth improvement through leverage of regional networks in support of more effective management of the business at a regional and global level. It is not so much the cost of the process per se, but what it enables which matters. Europe is now one region, needing absolutely seamless network support.

The priority for ICT investment and network implementation to generate productivity improvements is therefore more in support of regional and global business processes and information provision, than in direct cost savings from outsourcing or off-shoring, useful though this is. Examples of new regional and global business processes requiring high bandwidth seamless networks are:

- Supply chain, including buying of raw materials, packaging and indirects;
- Brand development and marketing (including promotions and advertising);
- Innovation, with a globally managed funnel of process and product projects;
- Customer development, including vendor managed category inventories; and
- Financial consolidation, from 200 operating companies (one per country).

As the business process environment changes, so the ICT landscape must also change. This has seen the evolution of service-oriented architectures and a conscious long term plan to establish a limited number of suppliers in each area or “footprint”.

Much stricter and more centralised sourcing of ICT products including network services has resulted, with local decision makers eliminated from the selection and management process, and choice based on strategic fit. The ICT environment has also changed into one where fewer, less frequent, but bigger and bolder steps or changes are implemented.

Tactical RFPs and piecemeal innovations for short-term functional gains are much more difficult to justify since anything included in the landscape must be scalable globally, or at least regionally, and interoperable with everything else.

The company is typical of multinationals seeking to grow their business in Europe. The economic objectives arising from improved productivity are entirely dependent on the ability to obtain consistent network services of equal capability throughout Europe, in order to replace the old fragmented business processes with a single regional process.

Exclusion of some Member States or radically different (longer) timescales of availability or inconsistent standards, add cost and require an extended period where productivity deteriorates whilst the legacy and new processes co-exist and have to interoperate. This continues until the old legacy process can be completely eliminated everywhere. It is a case of “the final turn of the screw holding the bookcase to the wall”. The benefits come at the end of migration.

Ubiquitous availability of high-speed access technologies (broadband) is key to the success of European business process support. Provision outside urban centres is inadequate. Increasingly, these access technologies must embrace fixed and wireless capabilities seamlessly. Enabling of Enterprise process productivity improvements is of far greater impact than enhanced consumer broadband facilities for web site access.

Business processes in the company do not recognise a significance in national boundaries between Member States. The market has become regional in terms of customers, consumers and suppliers. Arbitrage between countries and the development of grey markets has made such processes transparent.

Network service providers must be able to offer European-wide services to their multinational clients which means being able to operate on an equal basis in each Member State without discrimination by the local SMP players. This requires absolutely equal access at retail level to wholesale products in terms of price, availability, lead time, objective quality of service, billing and operational manageability.

The future European network landscape cannot therefore tolerate inconsistent political agendas or regulations, or barriers which impede the kind of process based productivity improvements outlined above. Regulatory mechanisms are needed at European level to prevent fragmentation and to encourage competitive investment in infrastructure, in particular new higher bandwidth access technologies.

This is not helped if some Member States opt for regulatory holidays for incumbents, which will deter, rather than encourage, investment and introduce complacency. National plans for Next Generation Networks (NGNs) need co-ordination of design and implementation, to stop stifling of competition, obstruction of access, or impeded interoperability.

Company B

Company B is a global Consumer Goods Manufacturer and Marketing organisation whose products are distributed and retailed in 80 countries throughout the world. It has grown through strong brands and regular major acquisitions. It employs 20,000 staff and manages IT procurement at global level.

The nature of its business and the characteristics of its leading products mean that many of its major production locations are in rural sites. Sales forces operate largely at national level, requiring extensive domestic mobile access. Overlay teams managing brands and distribution and functions at regional and global level incur huge costs for mobile access and usage as they travel, in Europe and further afield.

The company's major IT thrust currently is the roll out of a global ERP system, based on a single SAP entity for transaction processing across all major business processes. This is a corporate initiative to radically improve business efficiency and productivity. It requires seamless access to global systems, including from wireless/mobile links everywhere, based on consistent, seamless telecommunications services globally.

The company's principal Telecommunications service provider is experiencing significant difficulties in getting adequate access circuits to its main hubs in Europe. The provider is continually given low priority compared with incumbents. Italy and Spain have proved particularly difficult, as have the recent EU expansion countries where competitors in the access market are not yet effective.

The fragmentation of services in Europe prevents the company from leveraging its scale and scope, so it suffers high prices for access circuits and long lead times for leased lines. In some cases, linking to rural sites at adequate bandwidth has proved to be difficult, even with the incumbent. It is particularly frustrating for the company that a pan-European broadband contract is simply impossible, meaning that it is burdened administratively and in cost terms with negotiating multiple inconsistent contracts in terms of price and service levels and performance. The same situation applies in mobile where it is unable to conclude any meaningful contract which can enable it to leverage its size and achieve any kind of seamless network.

The company believes regulatory priority should focus more on the corporate market, and that there should be more action taken on LLU to regulate maximum lead times and minimum service levels for access circuits and for IP-based products, e.g. VoIP. It also believes that National regulators should do more to force incumbents to provide interfaces to international network service providers.

Company C

Company C is a global oil producer and distributor, operating in an industry which has a high priority on regulatory and fiscal compliance. This is causing it to consolidate ICT into major data centres which serve local branch offices remotely. It has 2000 sites worldwide, of which 600 are in Europe, covering all countries. Its main ERP applications are based on SAP for Financials, HR, Customer Relationship Management, Materials Management, Production Planning etc, with a few residual specialist legacy applications (which are preferably off the shelf).

The applications are largely web-enabled and as a result there is a major focus on latency and response times. Bandwidth demands are increasing with current access at 45Mbps in major sites and 2-4Mbps in smaller sites. The applications tend to be asymmetric, with an increasing interest in Quality of Service differentiation for some application combinations. There is some use of Citrix to address response time/latency issues.

The company has found that regional telecommunications suppliers experience difficulties when in the role of an Altnet trying to get telecommunications access services from national incumbents. This has hindered the Company's programme to reduce the complexity of 150 suppliers in 2002 to a much smaller number today. Regional suppliers experience differences in costs of up to 30/40% compared with incumbents. In the Nordic region, it has not proved possible to establish even sub-regional consistency of supply, as there is no true homogeneous network.

Their regional partner has had to assemble "bits and pieces" to produce a solution. Performance and network management is harder, making it more difficult to resolve problems, resulting in an inferior SLA. This convinced the company to take back its outsourced router management to in-house operation, since the fragmented environment was resulting in low priority in problem resolution being given to their solutions provider by up to 150 different providers.

The partnership between solutions provider and local access provider must deliver an end-to-end service, whereas at present in many cases the regional player is unable to manage the third party (incumbent) service element. In one case, the Company had to send their own representative to resolve a DSL problem with the incumbent.

The limitations on networking in Europe also deter the introduction of collaboration tools, thus handicapping the potential effectiveness of multinational teams. The company is keen to break down the walled gardens limiting use of DSL and public Internet facilities. They have found some reluctance on the part of incumbents to provide simple Internet access, as they would prefer to sell their own MPLS-based services, saying that Internet can only be a "best endeavours" offering – i.e., with no commitment to Quality of Service.

The regional players are creating barriers to block the solutions large users seek. This will be increasingly unacceptable to large users such as this Company, since they require maximum flexibility in connectivity to their own sites, to third parties and to newly acquired organisations within their group. The atomising of business processes, with much outsourcing and off-shoring, also requires more flexibility of connectivity and greater use of Internet-based access.

The Company is therefore keen to see more effective competition, and is also keen to reduce its number of providers further, but these providers must have global reach. It would like more choice and a better quality of service. It is concerned that if incumbents seek an entrenched position, and do not offer network neutrality, no one will invest in the backbone and businesses will suffer.

Company D

Company D is a huge pharmaceutical research and manufacturing multinational, established by a series of acquisitions. It has a well established telecommunications organisation, with the key decisions taken in the United States. There is a global data centre in the United States, with regional centres in one EU Member State and a new one under development in another EU Member State, located at a carrier's computer centre for ease of access to network services.

There is a greater understanding within the company's IT HQ of the US environment than the Rest of the World including Europe. Regional telecommunications teams are therefore operating in Europe/Middle East and AsiaPac.

The company has 3 main divisions – (i) Research with 50Mbps+ between UK and the US; (ii) Manufacturing and Distribution, which uses mainly packages but some local applications for production planning, materials management etc; (iii) Marketing, which is mainly a field force of road warriors using hand held and mobile devices, requiring regular resync with central data bases. The mobile field force does not require high speed access, but tends to use ADSL or Cable broadband from home, rather than dial-up Internet for cost reasons.

The company's dominant network (non-European) supplier has to go to European incumbents for access lines to the MPLS cloud. It takes about 3 months to get access circuits of 2-8Mbps. The company does not generally require higher speed circuits at present. Service quality is usually OK when installed.

Recently, the company began to use an alternative provider for some of the more difficult to reach locations and they now have around 10% of European business. Since this provider has nodes in most member states, there is little exposure to transborder cost penalties, but in countries with only one carrier, access circuits prove to be more expensive. There is already significant variation in circuit prices, with Denmark and Sweden being cheapest.

When seeking to reach places outside Europe, such as Egypt, with MPLS, national access circuits are provided by the second provider, but at high cost. In the more exotic places, it has also been necessary to use other providers to achieve up to 2Mb Internet access to 50 locations around the world for IP VPN. Access circuits are provided by local ISPs.

NGN planning is left to the company's main providers, with the assumption that service quality will be protected by SLAs. There would be concern if there was a fragmented and inconsistent roll-out of NGN in Europe, or if it reduced choice of access carrier for their providers, thus increasing passthrough costs to the company. The company assumes that the actual backbone capacity, including with NGN, will be sufficient to meet business need.

The company would be concerned if this exposed them to risks of increased latency through contention for bandwidth, e.g. if priorities were not equitably assigned by incumbent software. Examples exist in the residential market where a carrier switch for triple play has resulted in a severe deterioration in switched telephony quality.

Use of VoIP by the company is limited, and is principally on the research link from UK to US. It is likely that voice will feature in the next RFP due in 2007. The proposals will be mainly for MPLS or equivalent for data applications, but VoIP will be integrated over time.

Company E

Company E is a global management consulting, technology and outsourcing company. It has three insights into the European telecoms market – as a user, as a systems integrator for outsourcing contractors, and as a main consultant to incumbents implementing projects themselves.

The company is limited by a lack of tried and trusted incumbents in Europe, who instead seem to be trapped by bureaucracy and are not addressing the needs of multinationals adequately. The situation is usually "take it or leave it" with little flexibility or urgency to meet customer need.

AltNets on the other hand listen to business needs and produce creative solutions but then face difficulties in implementation. They are unable to provide a full end-to-end service. The incumbents claim to be at a disadvantage from regulatory constraints, and yet continue to enjoy governmental support, due to fears about job losses and the immense amount of money spent by them in lobbying governments.

In outsourcing, it is essential to provide consistent seamless service throughout Europe in terms of quality. In this role, lead times are one area of major difficulty when dealing with ISPs and trying to roll out an MPLS solution.

There is also no availability of QoS products suitable for voice yet. Least Cost Routing still throws things out on to the PSTN generating extra charges. This is inhibiting business productivity for European enterprises, with variable availability and performance of delivery mechanisms.

This contrasts sharply with the US where a customer can simply go to AT&T or Sprint and get a nationwide, continent wide service including voice. Some companies' American management are incredulous that this cannot be done in Europe, and see this as a major disadvantage of operating and selling services in Europe.

Many of the company's clients/prospects are reviewing their outsourcing and off-shoring arrangements. If Europe had a more competitive infrastructure, some might consider in-shoring again to get contact centres virtual leveraging more flexible, local resources, which their own customers would often prefer.

If National Governments wish to protect or better still generate jobs, the company believes that instead of focusing on incumbents, they should look to the broader picture where net job loss is greater due to off-shoring and seek to reverse the trend by enabling more effective domestic access facilities, e.g. to support flexible and home working. This would have the added benefit of a social dividend of better work-life balance, and reduced commuting thus helping climate change issues.

It would also lead to economic growth by leveraging the "fringe workforce" unable to currently operate to its full capability due to lack of adequate high speed access facilities. These have to be ubiquitous, and need to leverage wireless access like WiFi/wireless broadband to reach everyone in some Member States. This will only become affordable in a truly open and competitive access market.

Company F

Company F is a global organisation in the travel industry with locations in most countries. It has a long history of international networking which is absolutely critical to its business operations.

The company tends to use incumbents for its networking needs, but welcomes the presence of the alternative network operators to give competition.

The company's business experience indicates that it is harder and more costly to build networks in Europe than the US, but easier than reaching some of the more remote of their 220 locations worldwide, where monopoly operators are still dominant, and where facilities are sometimes hard to obtain.

The company can meet the bandwidth needs of its current application portfolio in Europe, as booking systems have low volume demands, with little voice or video content, but this could change.

NGNs are of interest for business development, e.g. to support multinational travel agents, to whom they plan to provide value added services "piggy backed" on their current basic services. It is important for the company that its value added applications can be supported by a consistent NGN network infrastructure throughout Europe. Worryingly, apart from the UK, the company has had little communication from incumbents on NGN roll out plans.

Company G

Company G is a leading global payments, network and travel organisation operating in over 130 countries worldwide. Its business growth is dependent on high quality communications, as it progressively rolls out an MPLS network to replace its current Frame relay infrastructure.

The company has outsourced its network operations to a global solutions provider, who needs effective agreements from all incumbent carriers. This often proves to be a challenge. The provider shares its experiences with a group of leading customers operating as a "regulatory action committee" and the inconsistency of provisioning times is very evident. More pressure is required to remedy the situation.

Better connectivity is vital, particularly in emerging nations, including the EU expansion countries in Eastern Europe. Business applications which are hampered by limitations in connectivity include internal regional administration for Europe, Middle East and Africa, plus wider broadband links for information based applications.

Company H

Company H is a major pharmaceutical multinational with extensive operations in Europe. It is actively involved in infrastructure projects at present, including an open RFP for a WAN.

Whilst the current situation regarding the price of access products in Europe does not give them serious concern, there are examples of operational difficulties, for example in a Member State where their current provider is facing obstacles from the incumbent in trying to undertake a network upgrade. Site visits are proving hard to arrange and lead times are unduly long.

Company I

Company I is a massive pharmaceutical multinational, formed by a series of complex mergers and acquisitions. It has large UK and US MPLS networks, and multi Gigabit MANs in its main sites. It has found incumbents reluctant to roll out new MPLS networks, reflected in high pricing and slow responses to RFPs. Responses to a global RFP varied considerably in quality and enthusiasm around the world. This has meant that the business is handicapped in moving forward by price and bandwidth availability. The constraints have not stopped them rolling out MPLS but have been a factor affecting QoS-based facilities that run on top of it, due to the unrealistic costs of such services.

The company is very interested in NGN services, e.g. IP telephony to support converged internal networking and to replace third party hosted audioconferencing (which is used extensively with 96m minutes per year). Whilst the technology exists from their preferred equipment and software vendors, it has proved difficult to persuade network service providers, particularly incumbents, to implement VoIP, presumably due to fears of lost revenue from legacy PSTN-based services. The equipment suppliers are a "breath of fresh air" compared to incumbents when it comes to new technology.

As an example, legacy PABX nets with 7 and 8 digit dialling could be replaced by IP trunking, including digital mapping of DPNSS between the two parts of the network, using a PGW carrier grade server, but there seemed to be a reluctance to implement such converged technology by network service providers. This would enable improved productivity through centralised operator service and centralised voice mail. Eventually the incumbent's hand was forced to begin implementation. There is still no road map beyond the next 18-24 months – more proactive discussion on the business opportunities offered by NGNs is needed.

Videoconferencing is on the increase also, following cuts in travel budgets, particularly in Europe. Video cards are being used in all its business divisions.

These need a step change in available access bandwidth for staff. B2B applications in the Extended Supply Chain linking business partners also require more interoperable network services. This will be a key enabler to improved industry productivity.

The company requires home connectivity for many of its staff with more bandwidth than the current ADSL 8Mbps/400kbps offerings. This is not yet a constraint, but is certainly a factor to consider in looking at convergent technologies where 400kbps is not enough to run converged services. Availability from ISPs varies widely, as does effective QoS products. Where higher bandwidths do exist, they are priced prohibitively. The remote workforce have laptops, SecureID cards and 3G for access, e.g. via WiFi hotspots. They would really like to achieve full convergence with much more of their traffic on-net.

A similar issue applies to mobile communications where exorbitant pricing for 3G data, and 2G roaming and fixed to mobile termination, has deterred investment in new applications. The cost of data and call charges is a factor in roll out of any converged offerings, making it very unattractive at present.

The company would be willing to invest more in telecommunications and ICT in general to improve business performance, but feels constrained by service providers and their pricing strategies, despite the existence of suitable technology. It would welcome a more open and competitive market, but there seems to be “no light at the end of the tunnel”.

Company J

Company J is a leading global financial services organisation with operations in more than 50 countries. It is a huge user of telecommunications and is almost seen as an ISP in its own right. Its network carries millions of calls a week with a trend towards use of VoIP which will require very significant IP network bandwidth for voice alone.

The company has 60,000 staff around the world using remote access on at least an ad hoc basis, with around 5,000 in the EC making regular remote access use at home or on the move – 1500 spend most of their time travelling. There is heavy Blackberry use, needing much greater consistency of the mobile environment in Europe.

ICT has had many organisational changes in the company in recent years, including centralisation, outsourcing, insourcing and devolution to independent Lines of Business. This has led to a multiplicity of telecom providers, making interoperability and consistency of infrastructure offerings important.

The central technology group makes most major technology and supplier decisions, but Lines of Business still have the option to pursue their own direction in some situations. The desktop has been standardised in most cases from c80 different images to 2 main standards for 90% of desktops.

There are many data centres globally with three in the UK, triangulated for resilience, and a global triangle between the UK, the US and Asia. The company recognises the benefits of a competitive telecommunications market, and is keen to see prices reduce further as networks represent a significant expenditure for the organisation.

New applications are becoming more feature rich. The adage for networks is “the faster the better” due to the criticality of latency in the applications used and the need for consistent response even during peak traffic periods. Utilisation of bandwidth needs to be kept very low to achieve this.

Citrix has been introduced to improve response times, but for mainstream information services like financial data feeds it is essential to achieve data base transfers, replication and back up as quickly as possible.

Integration with information service providers in the financial markets also requires high-speed links to third parties and consistent interfaces to infrastructure. Home bandwidth requirements for application access are increasing rapidly, with 4Mbps ADSL becoming inadequate.

Whilst no specific evidence has been provided yet, there is a belief that networking in the US is considered to be better than Europe in terms of consistency, efficiency, performance and cost.

Company K

Company K is a global consumer technology corporation with a long history of product innovation. It is well advanced with implementation of convergence, with an extensive MPLS network, IP videoconferencing and VoIP, and plans for HDTV over IP and the progressive elimination of PBXs and PSTN.

The company is, however, experiencing some limitations in the supply of access in Europe today, and is keen to see continuing improvements in network access availability.

It is important to them that competitive suppliers in Member States, such as their main supplier, are able to gain access to new NGN services.

Oil Industry

The oil industry spends billion of Euros per annum to maintain and develop ICT networks to serve their businesses, where networks are used for both general applications such as the Microsoft Office suite, Call Centre applications, CRM and ERP, as well as industry and company specific applications such as Instrument Control Systems, Seismic programs and Mobile Communications. Global presence and the often rural and offshore areas of operation demand high quality ICT infrastructure services outside where the incumbent and, if present, competing telecom operators, have their footprint.

For this reason, the oil industry operates high quality fixed and mobile private networks to support the demand for access to the company’s suite of applications. Over the last 10 years these private networks have supported access to the Internet and third parties for Business to Business E-commerce. The demand for (mobile) voice communications was always high and still is due to the stringent requirements for safe operation. It is very typical for the oil industry to have more mobile devices than employees and this figure has only grown over the last year with the introduction of GSM and competing technologies.

The oil industry spends typically between 0.5 to 2.5% of its cost on ICT infrastructure services (depending on the country and nature of the operation) and this figure has not changed over time. The cost of ICT is always something to watch, seeking lower cost alternatives within the restrictions set for safe operations. At the same time, the demand for safe operation and protection of the environment is justifying spending money on new ICT solutions.

Taking into account the sometimes hostile environments, the oil industry is spending billions to provide better infrastructure services to enable lower offshore platform manning levels, to reduce the number of specialists that have to operate in a remote country, as well as better tools to monitor transport and fleet movement.

ICT is a cost factor, but is also an enabler of core business cost reduction. ICT infrastructure services are a must, but not at any price. There are always alternatives, and there will always be pressure on the telecom industry for cheaper and better solutions.

One option to reduce cost is to standardize on technology, operational processes and the number of suppliers. The oil industry is used to transborder working, e.g. with oil facilities on the Continental Shelf in Europe spread over the UK, the Netherlands, Norway, Denmark and Germany. Oil companies have to deal with local regulations for almost everything including telecoms, as well as different telecom service offerings and service footprints. Despite this, consistent, highly reliable telecom infrastructure must connect even the most remote platforms and control pipeline and platform operations to the highest standards possible.

The limitations in Europe are evident when comparing them with offshore operations in the Gulf of Mexico which fall under a single regulatory telecom regime, with all platforms within the footprint of the local telecom service providers. The same will certainly happen in China, Russia and India. The fragmented European telecom regulatory and service industry does not allow the Oil Industry to operate in Europe at the same per unit ICT infrastructure cost as in the US, and within a few years will compare unfavourably with China, Russia and India.

The oil industry is also looking to reduce cost by outsourcing activities that are not core business and which can be executed more efficiently by other parties. For ICT infrastructure, there is a mixture of services from public operators and those managed in-house, with the split dependent on a country's quality of public services, and the outsourcing strategy. Most on-shore ICT infrastructure services in Europe today are provided by public operators, except the management layers (security controls, etc.) and private mobile radio. Off-shore, however, varies from country to country for historical reasons, and depending on the position and attitude of the incumbent operator. Changing strategy and service off-shore is more difficult than changing on-shore, and for this reason outsourcing is more prevalent on mainland Europe than off-shoring.

The oil industry is a huge bandwidth consumer as well as having a high number of locations to serve. Pipeline systems, oil fields, petrol stations and offices and employees' private houses all require connection to the (virtual) private network in a consistent way. The demand for home and flexible working is rising rapidly, contributing to higher efficiency. At the same time, there is consolidation of ICT platforms and hosting locations, with resulting high bandwidth demand.

The increasing cost of higher bandwidth is being justified against lower overall Total Cost of Ownership for applications. The increasing availability of higher bandwidth is reducing the overall cost, but the ICT infrastructure costs are increasing as a percentage of TCO. The oil industry is in the fortunate position of being able to test and prove concepts of operation where bandwidth restrictions do not apply, e.g. where the oil industry has built its own infrastructure with fibre to each office, industrial location and field/pipeline monitoring point. The savings that can be made in this way are huge, and for this reason the demand on public telecom infrastructure services is still growing.

Within Europe, neither the requirements for bandwidth, nor the demand for standardized interfaces and common tariff structures, can be met in optimum manner at present. There are less restrictions within industrialized areas, but more restrictions outside.

A severe hindering factor is the lack of DSL services and/or the slow roll-out of these services. For instance, in France not all private LPG tank control systems can be connected by DSL, whereas oil companies can do this in Sweden.

The oil industry is also moving to NGNs to integrate fixed and mobile communications in order to run all applications over a single network. NGNs must support Quality of Service to allow voice to be supported. MPLS, IPSec, DSL and public Internet services are the major building blocks. DSL is a promising solution for the last mile to smaller locations and, with growing availability, use is increasing. Unfortunately where DSL is available, Quality of Service is often not part of the service offering and therefore it is less attractive for Virtual NGN networks.

Another hindering factor for roll out of virtual NGN is the uncertainty about the operator's control over QoS, with concerns that NGN operators may use this control to lower VoIP quality or even to block it completely. To make NGN services a success, operators need to facilitate transparency for users and ignore the nature of the content. Regulators need to drive this consistently throughout Europe.

The Use of Access Technologies by Businesses

Report Prepared by Anders Henten*

Purpose of Report

The telecoms sector is experiencing rapid change from the ongoing convergence process, in which the whole value chain (content, service, infrastructure, and end-user terminal industry) is evolving. Significant gains are being experienced from the efficiencies and synergies enabled by digitalisation, all-IP platforms and the deployment of technologies like optical fibre in extended access networks and from mobile/wireless platforms using new protocols and standards.

Convergence on the supply-side (the 'all-IP paradigm') might suggest that the new wireless platforms (in particular WiMAX, satellite, mobile – 2G, 2.5G and 3G), and broadcast platforms could substitute for the traditional access services which were used to construct business data transport networks. Potential substitution might in theory arise even for the new fixed infrastructures associated with NGAs and NGNs, which are themselves evolving out of bitstream xDSL and equivalent cable networks. Such substitution might arise for business applications or mass market applications, or both.

An alternative view is that the platforms will be largely 'complementary' to each other in that they will co-exist with each other. That is to say, they will tend to be used jointly for rather different applications or in different geographic locations. In both circumstances they would have certain features of uniqueness suggesting that they would not displace each other in the broader marketplace but rather all have their uses. This is a fundamentally important question for regulators and policy makers as it goes to the heart of the debate on the need for *ex ante* regulation of the platforms themselves.

This Report addresses this issue by looking at the potential supply-side characteristics of the different platforms and likely demand-side requirements to evaluate which hypothesis is more likely. The Report concludes that for the purposes of businesses wishing to construct data transport networks, the majority of demand for different access technologies will be 'complementary' and not substitutable and networks will tend to augment rather than displace each other.

The regulatory implications for access are also highlighted including the requirement for symmetry of treatment of the fixed and wireless platforms. Businesses wish to integrate and purchase their services as a 'solution' and as a result competition therefore requires parity of treatment across the platforms where they are complementary to each other.

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CONTENTS

Executive Summary

Principles of Complementarity and Substitution

This Report offers an analysis of the different access technologies used by businesses as well as residential users with respect to their capability as complements rather than substitutes. That is to say, the technologies augment each other rather than displace each other as direct substitutes in the marketplace.

The nature of convergence trends in the sector means that it is not straightforward to establish the precise distinction between substitution and complementarity. On the one hand, the generic capability of many platforms to use digitisation and 'all-IP' capability means that in principle they should be able to compete for a wide range of applications more directly and be substitutes. However, the precise technical specifications of different platforms are not the same and this translates into different product specifications and prices at the downstream level. In practice, this is likely to mean that multiple access technologies will co-exist.

This outcome is potentially reinforced when it is appreciated that different platforms actually make use of each other in any case such as to originate and terminate sessions and so displacement at one level e.g. at the retail level, may be compensated to a degree by increased demand at another level e.g. the wholesale network level.

Use of Access Technologies

Development of broadband technologies has established a basis for a degree of convergence between access technologies deployed for business users and residential consumers. Business users and especially SMEs, increasingly use broadband networks (mainly DSL) to connect to the Internet and to create connectivity between the different parts of the companies in dispersed geographical areas using Virtual Private Networks (VPN).

Different DSL technologies compete directly with broadband provision through cable TV networks although the latter are very largely just focussed on the residential market and not on businesses as they are mainly developed in areas with high population density. High speed versions of DSL have problems in reaching a small proportion of the population in rural and suburban areas where copper loop lengths may be extended. These may be important limitations for some businesses depending upon their location and bandwidth requirements. In particular, businesses may wish to have symmetric capability with other technical assurances and which is not suited to the characteristics of the DSL services above relatively low bandwidths of about 2mbit/s. (In some circumstances it may be possible to extend this capability using multiple copper pairs.)

Fixed WiMAX might be able to cover rural and suburban areas in a cost efficient way. This geographical complementarity between WiMAX and traditional broadband infrastructures is important in the potential development of these access technologies. WiMAX may also be offered in urban areas and might then be in direct competition with traditional broadband infrastructures. However, WiMAX is in its introductory phase and there are huge challenges to maintain a stable connectivity with the Quality of Service (QoS) parameters needed by business users. The commercial viability of WiMAX beyond its theoretical technical capabilities is as yet unproven.

Mobile networks may also be seen as complementary infrastructures to fixed broadband in the sense of augmenting downstream capabilities. Two developments are important, which to different degrees may change this picture. Firstly, mobile networks may deliver higher bandwidths in the future and consequently, compete with fixed broadband capability at certain speeds. Secondly, developments in nomadic use of IP services, may in the future increase the capabilities of fixed broadband in providing access to services such as voice telephony, which for example, may be useful when roaming abroad. In turn, this may facilitate greater competition with mobile infrastructures.

Overall Assessment

The degree of complementarity and substitutability cannot be determined based purely on technological characteristics of access infrastructures. It also depends critically on market deployment and on how operators (entrants and incumbents) introduce these services into their portfolios. Entrants may wish to position emergent technologies as substitutes but they face significant challenges from the sunk and regulated legacy infrastructures.

While there is no definitive answer to the level of complementarity and substitutability of the emerging access technologies (as this will depend on several factors such as available resources, the organisation of the market, the level of development, etc.), two clear conclusions can be made in the context of business services.

Firstly, where optical fibres are in place in the access network, they will out-compete all other fixed (wired and wireless) access technologies, and only technologies which offer wide-area mobility i.e. a high degree of product differentiation will co-exist with optical fibres as a complementary infrastructure. Downstream demands will largely but not entirely be independent of each other and so the platforms will augment rather than substitute.

Secondly, mobile WiMAX and the future generation mobile networks have the *potential* to technically substitute for the current generation of mobile networks as well as broadband infrastructures in legacy networks, such as DSL. WiMAX would not substitute for businesses requiring high bandwidth using fibre. However, considerable development will be required for this to become a commercial reality.

Consequently, for corporates and multi-site firms in particular, multiple access technologies will be used to provide connectivity for VPNs and to a large degree, the platforms will be used in a complementary fashion.

The ability of business customers to acquire competitive services for their access solutions will be critically dependent on the correct regulatory analysis to enable third party service providers to acquire rights of access across both fixed and wireless networks. In these circumstances, the only way that competing operators can access the networks and offer competing services to end-users on a cross-border basis is through unbundled access products, like PPCs and equivalents across wireless platforms.

1 Introduction

1.1 Objectives

The aim of this Report is to examine different access technologies and their role in the marketplace. The Report presents an analysis with the emphasis on the degree of complementarity and substitutability in the use of different access technologies for mass market and in particular for business users, encompassing wired/wireless and fixed/mobile infrastructures.

1.2 The Regulatory Implications of Inter-Platform Competition

The current list of markets which are in the Commission's Recommendation include PSTN origination and termination, leased line terminating segments, and origination of bitstream access. In other words, all of the principal access services of the fixed networks are covered as susceptible to regulation. Currently mobile telephone networks are covered for both origination (Market 15) and on an individual basis, for termination (Market 16). However, there have been suggestions that the regulation of access (Market 15) will be dropped in the next version of the Recommendation.

Increasingly, both fixed and wireless platforms will be multi-purpose. That is to say, they will be capable of providing the end-user with access to a range of services and applications. This is one interpretation of convergence and it leans toward regarding the platforms as essentially competing head to head with each other and more generally, toward the appropriateness of a path of deregulation.

An alternative to this paradigm is to consider the platforms as essentially augmenting each other, each having certain unique features which, for the most part, do not suggest aggressive inter-platform competition but rather more one of customers being able to get the best out of both by using them differently.

In economic terms, the two alternatives of direct competition versus augmentation are described as substitution and complementarity. If two products or services are substitutes, they may be in the same economic market; if they are complements they would have to be in separate economic markets. Annex 1 presents a brief exposition of some of the technical economic issues arising to determine whether networks are substitutes or complements.

In a strict economic sense, two products are complementary if raising the price of one of the products leads to a reduction in use of the other. For substitutes, the increase in price implies an increase in demand. In other words, complementarity and substitution are defined with respect to *price changes*.

This Report uses the term of 'complementarity' in the sense of service augmentation rather than in the formally precise way in economics. In other words, complementarity of platforms means 'co-existence' based on downstream products which are used mainly, but not entirely, independently from each other. Substitution in this Report is defined with respect to price changes in the downstream services themselves which are likely to imply that the upstream platforms are also economic substitutes.

The regulatory implications of this distinction are profound. If platforms are mainly substitutes, then the assessment of market power (the basis of regulation) in a finding of no market power in a world of inter-platform competition. If on the other hand – as the Commission Recommendation suggests – the fixed and wireless platforms are mostly complements, then under the principle of technology neutrality it suggests that separate assessments are made with both platforms subject to regulatory scrutiny.

Businesses may not be the same as consumers in this regard – all depends upon how the downstream applications are being used. As set out in the associated Report ('Trends in the ICT Environment and Business Customer Requirements for Connectivity'), businesses are indeed using and purchasing both fixed and wireless services in a complementary fashion.

Regulatory symmetry requires the following. Where the applications are substitutes and in the same economic market, the regulatory obligations for access (origination and termination) need to be matched for example to ensure parity of 'on-net' and 'off-net' calls. Where products are used in a complementary way but purchased as a bundle, the key issue for competition is replicability – whether all the providers of the constituents of the bundle provide the element of that bundle on fair terms such that competition for the totality of the bundle is effective. This issue is discussed in more detail in the accompanying Report, 'The Application of Proportionate Regulation to the ECS'.

1.3 The Development of Access Technologies

The development of access technologies in recent decades has been dominated by the following key trends:

Customer Demands for Extended Capabilities of Existing Services

- The development and deployment of IP narrow and broadband technologies.
- Further development of leased lines, mainly used by large enterprises and larger SMEs including Ethernet presentation (service) instead of traditional PDH/SDH presentation.

Deployment of New Technologies, Services and Platforms

- The emergence of different next generation access networks (NGA), including fixed, mobile and wireless networks driven by the need for high bandwidth, mobility, flexibility and fast access to markets.
- The dominance of Ethernet technology first in Local Area Networks (LAN) and now to a degree extending also into Metropolitan/Wide Area Networks (MAN/WAN).
- The development of next generation networks (NGN) which most often relates to the core networks and denotes the development of all IP networks, based on different core network technologies.

Broad Sector Trends (Convergence)

- The convergence process i.e. the integration of different services on one and the same network driven by the ability of different access networks to provide similar services and recognising the fact that the operation and maintenance of different dedicated networks for different services is not optimal.
- Emergence of new network products, which give third party operators access to the facilities of the incumbent operators such as Local Loop Unbundling and Bitstream access in DSL and Partial Private Circuits in the leased line market.

During the past few years – and even more so in the years to come – a growing number of new access technologies have reached (or are about to reach) the marketplace. In fixed line markets, this includes DSL technologies using the local access copper wires, cable modems and fibre access. In mobile markets, new 3G technologies like HSPA (HSPDA & HSPUA) are being developed and marketed. Moreover, there are the new wireless technologies, first and foremost WiFi and WiMAX, which potentially may be able to substitute for wired access but which also can be developed into possible substitutions for other mobile wireless solutions.

These are all different access possibilities, which can substitute for as well as complement one another. In the fixed network area for the service of residential customers, DSL and cable modem technologies are the most common competitors at the moment, but fibre access is also developing (in some countries faster than in others). In the mobile area, 3G has been very slow to take off and GPRS and EDGE have consequently found room. This delay has also created a window of opportunity for other wireless solutions such as WiFi and WiMAX.

Finally, it should be noted that complementarity and substitutability can be analysed from a supply-side point of view, i.e. how companies supplying goods or services will adopt new technologies and products into their existing product portfolios and how new providers can enter the market.

1.4 Report Structure

This Report is structured as follows.

Section 2 presents a brief overview of the current uses of different access technologies by mass market consumers and businesses and key conclusions on the future likely position of these technologies.

Section 3 goes into more detail on the differing requirements of mass market and businesses i.e. a demand-side perspective on why differing access technologies may be more or less attractive for their applications. Broadly speaking these two sections relate to the **Customer Demands For Extended Capabilities of Existing Services** described above.

Section 4 looks at issues of **Supply-Side Deployment of New Technologies, Services and Platforms** and gives an assessment of the risks associated with commercialisation of technologies.

Section 5 looks at sector trends in **Convergence** and gives a brief overview of the issues which will need to be addressed to develop these technologies.

The Report is supplemented with a series of Annexes which support the main body of the text.

2 Overview of Access Technologies

2.1 Introduction

In this section, the characteristics of access technologies are analysed with respect to business and mass users. The aim is to identify to what degree there are different requirements for the networks and how the services differ regarding these two user segments for the key access technologies. Key conclusions are set out with respect to each technology indicating for businesses in particular whether they are likely to be in competition with each other or used in a complementary fashion. Annex 2 contains a detailed description of different access technologies.

Business users need reliable and secure access technologies which are optimised for the applications running across their access technologies. Depending on the size of the firms, there tend to be different requirements on the access infrastructures. Traditionally, low capacity leased lines and later ISDN were the preferred access technologies for SMEs and higher capacity leased lines for larger firms.

With the emergence of different broadband technologies, the situation has changed and there is a degree of convergence between the types of access technologies used by companies and private households. Both consumers and businesses are using DSL as an access service. Critically for businesses, DSL may be used extensively by large firms to connect their sites together where the capacity demands of some of these sites can be met using bitstream rather than dedicated leased lines i.e. the distinction is now much less of one between large and small firms but rather between large and small sites and whether or not the applications at those sites have particular requirements. Cable TV networks are mainly used by private households, as these networks are generally developed in residential areas.

Fibre networks, DSL, and wireless solutions are all used extensively by business users, however with different requirements when it comes to the required performance parameters like security, up-time etc. Pricing is also different for business users. Many business users are highly mobile and nomadic and mobile access to corporate networks is an essential characteristic of their use pattern.

2.2 Leased Lines and PPCs

Leased lines or private circuits give the users permanent (or semi-permanent) connections between two end points, for example between a remote office and the main company. The major characteristic of leased lines is that no per-call switching is involved. Leased lines are attractive to companies that have large amounts of traffic between two fixed points: ‘They can, for example, be used to connect the PABXs at two sites so that the calls between the two sites bypass the public networks and hence avoid call charges… Leased lines are also useful for connecting company’s computer systems and Local Area Networks together’.[1]

Leased lines have always been charged based on the flat rate principal i.e. users pay a flat rate no matter how much the line is used. Charging depends on two main parameters: the capacity of line and the distance between the two end points. Capacity varies from 64 Kbps to different rates in the SDH hierarchies of capacity (155 STM1, 622 STM4, etc.).

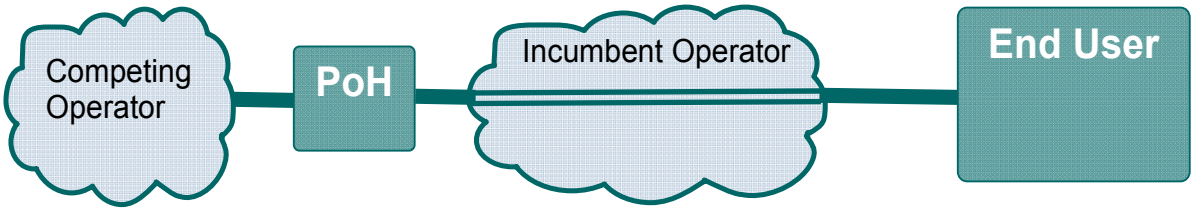
[1] www.flexwork.eu.com/members/tech_brief/tb20.pdf

Recently, dark fibres and lambdas (light paths) are being used to create connectivity similar to the use of leased lines. Lambda technology involves a single wave length on an optical fibre, so that the end users connect their own end devices and have full control of the wavelength.[2] The use of dark fibre is efficient in small geographical areas and lambda for larger areas. While the leased lines are provided by the telecom and especially the incumbent telecom companies, the business of dark fibre and lambdas are dominated by alternative operators such as utility companies, municipalities, railway companies, etc.

In order to deal with the access bottleneck and to allow new entrants to connect customer sites to their network infrastructure, a relatively recent product has been developed called a Partial Private Circuit (PPC). PPC is a private circuit from the end user, through the incumbent operator's network and to a Point of Handover (PoH), where the connection is delivered to the competing operator. The competing operator will buy PPCs from the incumbent and deliver different access products to end users in different markets/countries. A simple set up of PPC is depicted in the following figure:[3]

Figure 1

Network for a Single End PPC



Source: BT

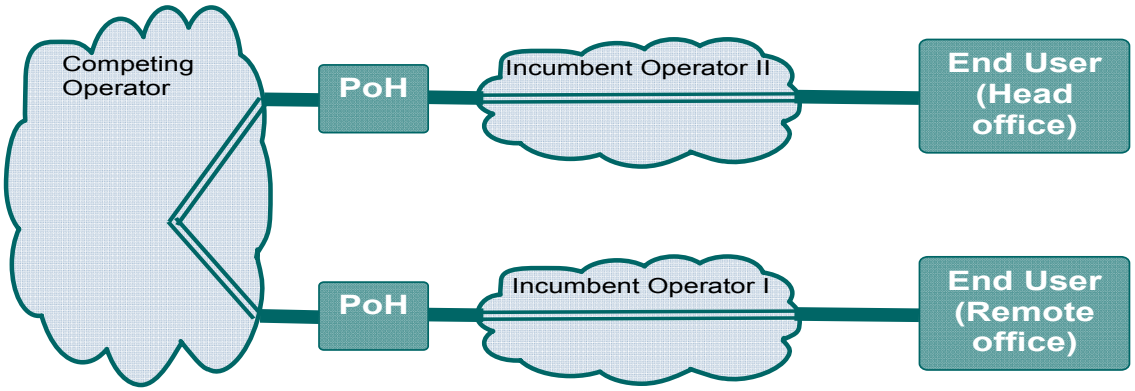
In the following figure it is shown how a competing operator can use two PPCs to create a Leased Line between two locations (head office and remote location). PPC is a critical means for competing operators to deliver business services across different markets and countries. The precondition is, however, that the product is available in different markets.

[2] See amongst others the deployment of lambda in the establishment of the nationwide Research and Education Network in Canada (CA*net 4).

[3] Simplified version of figure 1 in PPC, Product Handbook, BT Wholesale's Partial Private Circuit Portfolio, issue 2.3.

Figure 2

Network for a Double End Leased Line



Source: BT

Assessment. While some substitution for leased lines has arisen from bitstream access, this access technology will remain a critical building block for businesses and especially in the building of multi-site VPNs.

2.3 xDSL

DSL is, presently, dominating the access infrastructures for residential and for SMEs for Internet connectivity. From the beginning, DSL has been in direct competition with broadband through cable TV networks for residential customers. In recent years, access technologies based on optical fibres and WiMAX are also competing with DSL but actual take-up is very limited to date. Further, as discussed below, there are also complementarities between WiMAX and DSL.

The theoretical maximum bit rates of ADSL is 8.1 Mbps, however, more advanced standards like ADSL2 offers bandwidths of about 12 Mbps downstream and 1.2 Mbps upstream. In ADSL2+ the capacity is doubled and bit rates of over 20 Mbps positions DSL as a viable standard when it comes to future triple play services. There are other variants in the DSL family like VDSL, VDSL2 and UDSL, which are described in more detail in Annex 2.

In principle, bitstream access (BSA) can be supplied to businesses using unbundled local loops (LLU). However, LLU will not be an optimal choice for a competing operator to deliver services to its business users, as it requires extensive presence in the Local Exchanges to be able to maintain a profitable/viable business.[4]

Assessment. This access technology will remain a critical building block for businesses and especially in the building of multi-site VPNs where the applications do not require a high degree of resilience or a high level of bandwidth.

[4] See accompanying Report 'The Extent of Competition in Serving Businesses from Fixed Infrastructures'.

2.4 Cable TV

The cable TV infrastructure is another traditional broadband infrastructure, however with varying bases installed and with great potentials for delivery of broadband connections. From a business user's point of view, cable TV networks are mostly not relevant, as they have primarily been built in residential areas.

Assessment. This access technology is largely independent or neutral as far as businesses are concerned except for SMEs in certain locations and whose requirements are similar to those of mass market consumers.

2.5 PLC

Power Line Communications (PLC) was announced as a competing broadband technology to the DSL and cable TV networks. The deployment of the technology has been extremely limited and in its current application is not of interest to business users.

Assessment. This access technology is largely irrelevant as far as the businesses market is concerned.

2.6 FTTx

Access networks based on optical fibre are of huge interest to large companies. Optical fibre infrastructures are implemented using different architectures which are commonly denoted FTTx (FTTHome, FTTArea, FTTCabinet, FTTCurb, …). Optical fibre networks already connect large volume sites and are potentially becoming more relevant for small businesses and residential households as well, such as for the delivery of IPTV.

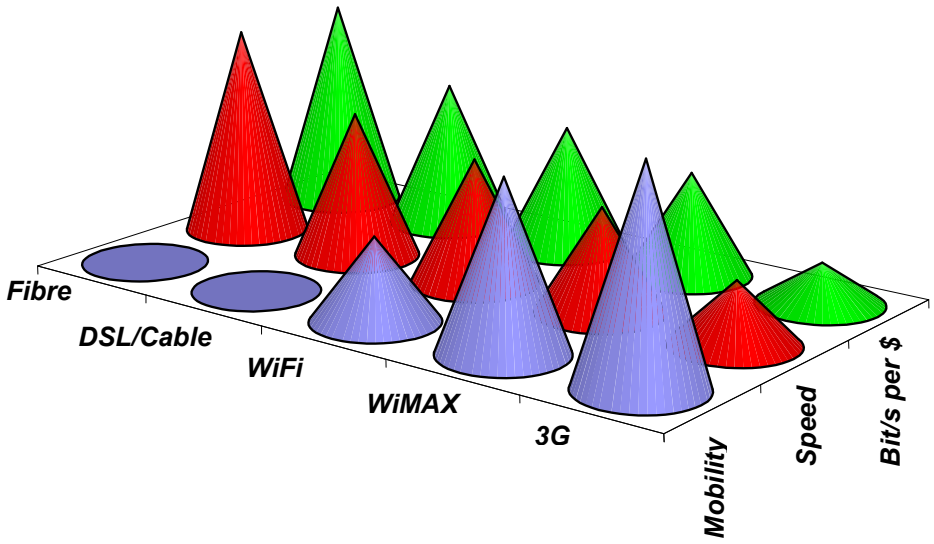
Fibre networks definitely out-compete other fixed (wired and wireless) access infrastructures in relation to large business users, and when they are in place and a right business model is available, they will also out-compete other fixed access networks in residential areas. This inherent bandwidth/cost performance can be seen in Figure 3.

Assessment. FTTx where installed will have major impact on the capacity capability of access networks and the attractiveness of fixed infrastructure versus other access technologies and to augment the capability of current bitstream access services. The implications of regulation of FTTx are therefore critical both for entrants and for competing access infrastructures[5].

[5] See accompanying Report, 'The Extent of Competition in Serving Business Customers from Fixed Infrastructures'.

Figure 3

Performance Features of Access Technologies



Source: OECD (2006)

This diagram shows the inherent trade-off between mobility and bandwidth. The higher cones represent better performance in a given category. So for example, 3G offers more mobility than WiMax or the fixed access technologies. However, the performance on a unit price basis is much lower.

2.7 WiFi

WiFi is not really an access technology but a complementary infrastructure located within a radius of up to 150 metres of premises with the enabling equipment, to enable flexible connectivity to different access networks for businesses as well as private users. Businesses are offered WiFi access in the form of 'hot spots'. WiFi is the local extension of a fixed broadband infrastructure.

Assessment. This access technology has a role for the businesses market including for nomadic workers. The regulatory issues which are relevant include availability of spectrum and where appropriate, provision of appropriate backhaul services at regulated terms and conditions.

2.8 WiMAX

WiMAX is one of the most interesting access technologies with a *potential* to, both compete and be complementary to traditional DSL and cable TV broadband at the same time. In urban areas, where DSL and cable TV are available, WiMAX may become a potentially competing technology. In the rural and suburban areas, WiMAX is complementary to the traditional broadband and may solve one of the main problems, i.e. the coverage of less densely populated areas.[6] WiMAX in fixed and stationary reception mode does not compete with mobile infrastructures. However also here, WiMAX is interesting, as the mobile version of WiMAX can compete with the fixed access infrastructures as well as with the mobile access infrastructures.

With regards to WiMAX, it is important to have in mind that the technology is new on the market and while its potential is promising, the actual implementation and provisioning are unstable and both will need to go through a process of development before commercial viability is established in the marketplace.

Assessment. This access technology has a potential role for the business market including for nomadic workers. However, it cannot in the current and foreseeable future be regarded as a full competitor to fixed or other wireless technologies.

2.9 Satellite

Satellite is a complementary infrastructure to other infrastructures. In areas where there is no other infrastructure, business users can use satellite as an access network. It is also possible to use satellite for the provision of broadband connections. The return path must be established through other networks like PSTN. The technology used for implementing down-stream IP connectivity is IP Data Cast (IPDC). IPDC can also be used in terrestrial broadcast networks and is seen as a viable candidate to offer broadband services to mobile devices in combination with the regular mobile networks.

Assessment. This access technology has only a very limited potential role for the business market in the EU and is not of significance in regulatory assessments.

2.10 Mobile 2G and 2.5G

In mobile 2G and 2.5G, several technological developments have been introduced to increase the capacity of the networks and to enable the provision of new services on these platforms. Standard bandwidth for data services in GSM networks is 9.6 Kbps (and 14.4 Kbps) per time slot.[7] However, when using HSCSD technology, a maximum capacity of 38.4 Kbps will be achieved if 9.6 Kbps per time slot is used (and 57.6 Kbps in the case of 14.4 Kbps per time slot).

GPRS, on the other hand, is packet based and is optimized for IP traffic. In GPRS, a maximum capacity of 171.3 Kbps can be achieved. EDGE can be seen as a technology with the same characteristics as GPRS but with more efficient modulation techniques and, consequently, higher capacities per time slot. Theoretically, it is possible to achieve a maximum capacity of 472 Kbps. However, a maximum overall capacity of 384 Kbps is more realistic.

[6] This will depend very much on the characteristics of the population. In the UK, broadband across copper is attainable by over 99% of the population.

[7] One time slot corresponds to the capacity of one standards GSM connection

In summary, these technologies are capable of delivering modest capacity which is limited for businesses of any size. However, they do represent direct competitive alternatives for some applications such as voice.

Assessment. These access technologies have an important role for businesses market. For the most part they are likely to be used in a complementary fashion to fixed networks but for some applications direct competition will be feasible.

2.11 Mobile 3G

Two major 3G standards, W-CDMA and CDMA2000, are described briefly in the following text.

W-CDMA (Wideband Code Division Multiple Access) is an access scheme defined by the ITU. It is presently developing into being the main technical platform for 3rd Generation mobile services. W-CDMA is capable of delivering up to 384 kbps in outdoor environments and up to 2 Mbps in fixed in-door environments. CDMA2000 (Code Division Multiple Access 2000, with the ITU name IMT-2000 CDMA Multi-Carrier) represents a family of technologies that includes CDMA2000 1X and CDMA2000 1xEV, which is capable of offering up to 3.09 Mbps.

These are potential capabilities which do not match the capability of fibre or the more advanced forms of xDSL and so like WiMAX, are likely to be complements rather than substitutes.

Assessment. In commercial and regulatory terms, these access technologies are in a similar position to Mobile 2G and 2.5G albeit they are at an earlier stage of development.

2.12 Conclusions

There are a number of access technologies like Powerline and Satellite which have very specific features but do not in the main address business connectivity or multi-site requirements. Similarly, satellite is very important for mass market and TV broadcasting which do not feature as important for businesses.

The underlying economics of fixed access networks remains largely unaffected by wireless solutions for businesses except for applications. Bitstream access is a suitable alternative to leased lines for certain sites/applications. Where it is deployed, FTTx will be the dominant access technology for businesses as it will outperform other access solutions.

Mobile will therefore generally continue to be a complementary infrastructure to fixed infrastructures except for certain applications such as voice which require low bandwidth and here regulatory treatment between fixed and wireless networks needs to be based on replicability to make the equivalent offers in the marketplace. If and when mobile infrastructures deliver high bandwidth broadband connections in a cost efficient manner, they could become candidates as wider substitutes to fixed networks. However as discussed in Section 5, if this occurs, it is not likely to happen in a foreseeable timeframe to affect current regulation.

Technologies like WiFi will be complementary to fibre by offering local area mobility and flexibility. WiMAX has a greater potential than other mobile solutions, but is still in its development phase and its commercial success is yet to be proven.

3 The Requirements of Mass Market and Business Users

3.1 Outline

Businesses and mass market consumers have differing requirements for access technologies which arises from the nature of the applications themselves i.e. the downstream uses of access. In turn, this means that different platforms may be more or less appropriate depending on the precise circumstances. This brief section sets out some of the background to these issues.

Annex 1 contains further information on the requirements of specific services to enable them to be offered by different access technologies. The following text summarises the detailed expositions contained in Annexes 2 and 3 of the characteristics and requirements of access technologies with respect to business versus residential users.

3.2 Mass Market

Access infrastructures for private households have recently been driven by the provision of connectivity to Internet services. Presently (and in the near future), access infrastructures will, in addition to Internet connectivity, provide telephone services using VoIP and TV services using IPTV (triple play services, i.e., Internet, telephony and TV). Furthermore, there will be a number of different services such as video on demand, audio (music) on demand, computer games, etc. To offer these services, the connectivity providers must meet certain requirements as to the available bandwidth but also, to some extent, to Quality of Service (QoS) parameters.

For example, consider a household with two parents and a few children; the available capacity must support the provision of, at least 3 concurrent TV services, Internet connectivity with decent bandwidth (about 2 Mbps), VoIP and game services. This will require a bandwidth of about 20 Mbps, which can be provided in the advanced DSL, cable, WiMAX (potentially) or fibre networks. Cable and advanced DSL are concentrated in the urban areas; WiMAX may have a competitive advantage to be offered in suburban and rural areas; fibre networks will be a more future oriented development and start in the urban and suburban areas.

The above scenario concerns the integration and provision of services that people are used to access plus some new services like video/audio on demand and computer games. However, the service characteristics are changing; HDTV will become one of the preferred formats of future TV and broadband access networks would have to be upgraded dramatically to be capable of offering these types of services. While in the current and ‘near future’ phase of development there are a variety of access infrastructures in a competitive market, in this future scenario, optical fibres and future generation wireless networks would dominate this market. Satellite can also deliver HDTV and is the dominant broadcaster of pay TV in some countries.

IPTV/radio denotes delivery of TV/radio over the IP protocol. IPTV can be transmitted in different networks that are based on the IP protocol. One of the major IP networks is the Internet, but Internet is not the only IP network. Dedicated/Managed IP networks can be established, and in current networks, the IP protocol can be used widely without having specific relations to the Internet. Managed IP networks have an obvious advantage for the distribution of IPTV compared to the Internet, because it is possible to maintain certain levels of QoS in these networks. In Managed networks, the network provider can allocate resources so that different services/applications perform in the most optimal way, where in the Internet it is a complex issue to guarantee specific levels of service quality.

IPTV is a service targeted primarily at private users. However, IPTV services can be used in different private and public companies/institutions for e-learning, remote diagnostics, surveillance, etc. Good quality IPTV service require access networks with bandwidth of minimum 500 Kbps and also high requirements to the levels of security, QoS and up-time are applied to the access networks.

For mass market, the major requirement of the network is thus mainly the available capacity and to some degree the level of QoS. The number of access technologies that one household will use is typically limited to one broadband fixed (wired or wireless) network and one mobile network.

3.3 Businesses

In contrast for business users, a variety of different requirements of access infrastructures are essential and there will be a need for a variety of different access infrastructures in the marketplace. These requirements include the following:

a) High level of security. The survival of the companies is based on the protection of their knowledge and information assets. Therefore, the pipe connecting the company to the outside world must be secure. Depending on the size and type of companies, security can either be provided by the service provider or by the company itself, e.g. by implementing local security measures such as firewalls, etc.

b) Constant and large amounts of traffic generation. Depending on the size and type of companies, they will have a number of different servers: web servers, mail servers, streaming servers, etc. to generate traffic to the network almost non-stop. This behaviour of traffic generation is very different from the private user, where consumption of applications/services, (and by that traffic generation), is limited to certain time periods, culminating in the prime times.

c) QoS. Professional business users will have high requirements on the QoS to be sure that the up-time and other performance parameters are at a level that will not contribute to consumer dissatisfaction.

d) Redundancy. For some companies, especially large companies, it is highly important that there is no interruption in their connectivity to the outside world. The need for connectivity to the general public, consumers, potential consumers as well as the connectivity to subcontractors, employees and other parts of the companies located other places – are all important. To establish redundancy, the companies must deploy several different access infrastructures, with one of them to act as the primary infrastructure.

e) Capacity. Bandwidth capacity of the access infrastructure is also important for business users. This depends, however, on the size of the firms and especially the business areas in which the firms are operating. For example, firms involved in information and entertainment services need huge amounts of bandwidth capacity.

f) Mobility and nomadic access. It becomes increasingly important for the business users to be connected and also when they are mobile. Mobility and mobile use is also important for private users. However, for business users it can be essential for value generation and competition. Apart from fixed connectivity, business users will have access to at least one mobile network, and depending on the type of firm, access to more advanced generation mobile networks. In the future, access to alternative mobile infrastructures like mobile WiMAX, may be important.

g) Integration of platforms. Businesses need to be able to utilise both fixed and wireless platforms in a seamless fashion with potentially exacting technical specifications.

In summary, the requirements of different companies for access technologies depend amongst other factors on:

a) Size of the firm/site. Large or small/medium sized enterprises (SMEs) making use of low/high bandwidth.

b) Technical requirements of the application. Where mobility is important, a wireless network is obviously critical.

c) Organisation of the firm. Are the firms organised in the same location or are they distributed with different divisions at different locations? Multi-site linking requires the ability to link all the sites of a company regardless of where they are located. When they are located in several different countries, any provider, including incumbents, will almost certainly be required to purchase access inputs from other telecommunications providers.

Remote access to corporate networks and services (intra/extranet) and tele-working has increased rapidly during recent years. Fixed and mobile access to these services has become essential for business users. Especially mobile access to corporate IP networks has been underlined by analysts as one of the vital services targeted at the business sector. This importance is especially evident in the interconnection of the massive technological and standardisation developments of mobile IP and IMS (IP mutlimedia Subsystem) protocols.[8]

3.4 Implications for Platforms Use

Small and medium sized companies will mostly have access to one fixed and one mobile network. Which access network is the preferred one will depend on the type and location of the business and their bandwidth/application requirements. Smaller companies in urban and suburban areas will often use DSL technologies and larger firms will use DSL for their smaller sites. WiMAX may in time become a viable alternative, while cable TV is mostly used by private households alone. For SMEs located in residential areas with access to cable TV networks, this infrastructure will be as good a choice as others for simple Internet connectivity.

The general development of fibre may in the long run move many SMEs to the FTTx-based infrastructures. Regarding mobile technologies, different generations of mobile services are used by SMEs depending on the type of the firm and their requirements to services beyond voice. Especially for SMEs, mobile WiMAX may become an alternative technology, as it delivers a reasonable level of broadband connectivity in both stationary and mobile environments.

Large companies, including firms operating on the international markets, will on the other hand use several different access infrastructures, because they need high levels of redundancy in their connectivity but also because they can have specific needs that can best be offered by specific infrastructures. For fixed broadband connectivity, optical fibres are definitely the dominant infrastructure, but advanced DSL technologies, new wireless networks, etc., are also important. Mobility and nomadic use are as important here and access to at least one mobile infrastructure is essential.

[8] Including the work of standardisation bodies of 3GPP and 3GPP2.

Companies with a distributed organisation form have unique requirements to the access networks to enable wide (and in some cases global) area connectivity. Hence there will be a need for different choices for infrastructures depending on the geographical distribution of companies. Here, a combination of different traditional broadband networks, optical fibres and digital wireless networks will be used.

4 Service Deployment and Market Impact

4.1 Deployment and Market Assessments

When it comes to outcomes, complementarity and substitution also depend on the market deployment and organisation in the market. An important aspect will be the strategies of the market players on the supply side. If the same operator provides different access technologies, the development of access products will tend to be based on the most efficient combination of those access technologies in relation to the company's product development strategy. However, when new access technologies are offered by new operators concentrating on these new technologies, there will be a higher degree of substitution between the different technologies.

In a theoretical context, the relationships between the incremental or radical character of innovations and the complementary and substitution effects have been widely discussed in the economic literature.[9] An incremental innovation will generally be a complementing innovation in the sense that the innovation does not result in a downstream application which is a direct substitute for existing services but rather is independent of those services. However, a mass of cumulative incremental innovations may eventually result in innovations that substitute for technologies that formerly were dominating because they actually displace those downstream applications. A radical innovation may be augmenting/complementary as well as substitutional – it all depends on the character of the innovation and the nature in the downstream market. Finally, the discussion on the disruptiveness or sustainability of new technologies also depends on the strategies of the market players and how they choose to bring the innovation to market in the context of their existing product portfolio.

According to the theory of Christensen, the term disruptiveness is associated with technologies that, at an initial phase, may have a lower utility than existing technologies but which eventually will win in the market because of their unfolding advantages and displace existing technologies. If a technology is to be disruptive, it will have to be a technology that incumbents in the market will not be inclined to introduce – not because they do not have the technological competence, but because the new technologies are not sufficiently profitable and/or do not fit into the product portfolio. If on the other hand, a new technology builds on and adds to existing technology solutions used by incumbents and consequently is introduced by these incumbents, the term sustaining technology is used.

However, the ability of market incumbents to take up new technologies is often underestimated. Incumbents may not be the first in the market to introduce new technologies that do not build on existing technological solutions. But once it becomes clear that new technologies gain sizeable market shares or have obvious potential, it is often seen that incumbents are able to include new technologies in their product portfolio – even though they may, at first, have been considered as potentially disruptive. WiFi is an example.

[9] Disruptive and sustaining technologies/innovations are primarily associated with the discussion based on the book by Clayton Christensen from 1997, 'The Innovator's Dilemma', Harper Collins Publishers, New York.

4.2 Examples of WiFi and WiMAX

When WiFi first hit the markets, there was a clear view as to the potential disruptive character of this technology as it could eventually substitute for existing mobile solutions and thus constitute a threat to existing mobile operators. However, WiFi has been taken up by many incumbent mobile operators and complements their existing mobile services. This does not mean that WiFi or other wireless solutions do not, in some cases, substitute for existing mobile solutions. But the general picture is that WiFi as a commercial service, in most cases complements the services offered by mobile incumbents.

Depending on the market deployment, the emergence of a new technology or a radical innovation of existing technologies can lead to complementarity. An example could be a DSL operator with a WiMAX license, which also includes WiFi in its product portfolio. The operator can use WiMAX in the areas where DSL might have shortcomings e.g. in some rural areas. In this case, the operator uses the geographical complementarity of the access technologies. The operator can, furthermore, use WiFi technology close to the users to enable more flexibility in the use and to establish in-building and in-house networking.

Another example is the combination of 2G/3G networks with WiFi, for example. The idea here is that while users are communicating in areas without WiFi coverage, they use GSM, and when they arrive to a WiFi covered area, the service is seamlessly shifted to use WiFi. In this way, the operators utilise the strengths of both technologies to offer flexible and cost effective services to the end consumers. This last solution is highly relevant for business users, who have huge WiFi enabled areas in their offices.

On the other hand, a radical innovation could directly result in a substitute technology e.g. when an access technology like WiMAX is offered by a pure WiMAX operator. In this case the WiMAX operator might not use the technology only in rural areas but might also offer broadband in the urban and sub-urban areas and compete with other broadband operators. An example is Clear Wire in Denmark (Danske Telecom), which offers broadband products mainly in and around the larger cities.[10]

4.3 Overall Implications

The potentially disruptive nature of new technologies is seen to depend not only on the underlying characteristics of the technology itself in relation to existing technologies, but also on how it is introduced into the marketplace and by whom. Arguably where there is market power, there will be a tendency for such technologies to be introduced in the least damaging way and to protect existing investments. The threat of potential entry may induce a more focussed response which will permit customers to switch to more efficient or cheaper technologies.

However, the capability of an entrant to use a disruptive technology to overtake an existing functionality requires a very significant advantage in terms of product performance. To date it is very clear that WiFi is a pure complement. For WiMAX there is potential for a greater degree of substitution but so far, it is being used as much as a complement as a substitute and entrants have yet to make any significant inroad into the traditional technologies.

[10] It is estimated that the total customer base is about eleven thousand at end of 2006 making it still a niche service to date (roughly 1% of the total broadband market) and focussed on residential as much as businesses. Information on WiMAX in Denmark is found at the following web addresses,
http://www.dansketelecom.com/dk/index.htm, http://www.clearwire.dk/ and
http://www.dansketelecom.com/dk/Referencer/Case_Stories/Ryslinge_Kommune/index.htm.
It is not clear if all these customers are actually being supplied using WiMAX technology. A similar situation applies in the UK where an entrant using WiMAX has acquired very modest volumes of residential broadband customers.

5 Outlook for Access Technologies and Convergence

5.1 Overview

In this section, an overview is provided of some of the main technological tendencies which will influence the future access technologies. The analysis relates to the development within wireless and mobile technologies as well as to different converged platforms like mobile/broadcast and fixed mobile. More detail on trends in convergence is contained at Annex 3.

5.2 Fixed Mobile Convergence

FMC is, like mobile/broadcast convergence, the materialisation of the complementarity at the architectural level, where the complementarity is used to deliver new and value added services.

Fixed Mobile Convergence or Integration (FMC or FMI) is a broad concept that covers various ways of integration of mobile and fixed (wired/wireless) technologies and services. FMC is not a new development and several FMC services have been on the market for the last five to seven years, but technological and market developments have created new incentives for further development of new types of FMC services.

There are different reasons for the emergence of these services:

- A high portion of mobile calls are done from home and office environments.
- At the same time, the fixed operators are losing voice minutes and want to reallocate some of their traffic from mobile to their fixed network.
- When it comes to data capacity, mobile networks are lagging far behind the fixed networks. Hence, it is much more efficient to connect to the fixed network when it is possible.
- VoIP is getting momentum and many broadband operators offer VoIP services. Integration of mobile telephony and VoIP over broadband opens new possibilities for competition in the voice market.

Due to these reasons, FMC will be developed massively in the near future. However, the efficient provision of FMC is connected to the maturing of technologies deployed in the backbone network and is highly connected to the development of NGN. As outlined in Annex 3, NGN development is complex and evolving itself over many years to come.

These developments in particular will be much more critical for businesses than the type of substitution of voice from convergence of capabilities of fixed and wireless networks discussed above. With respect to voice services, VoIP is becoming increasingly important for businesses as well as residential users. Historically, the possibility of using the Internet as a backbone and the possibilities for the provision of long distance cost efficient voice services have driven VoIP. However, business users will mostly utilise the added value of the integration of VoIP with their internal and external communication systems like synchronisation with calendar, mail, etc. Another important factor is that VoIP services using soft phones (software clients on PDA or laptops) will be of high value for business users travelling around due to the cost effective implementation for the nomadic use.

VoIP services do not have high requirements to the bandwidth of the access networks, but there are certain requirements to the levels of security, QoS and up-time of the networks.

5.3 Beyond 3G

Even though 3G implementation is behind 'schedule' in many markets, there are huge activities for the definition of new standards with the capabilities of delivering higher downstream (and upstream) capacities. This is mainly due to the emergence of new bandwidth requiring services, like video services, mobile TV, etc. Some of the major technologies, denoted as beyond 3G technologies (or 3.5G), are described briefly below.

Flash OFDM (F-OFDM) is a proprietary technology developed by Flaroin. This is being used in commercial services by the US operators Nextel in North Carolina and Cellular One in Texas, and is also being trialled by T-Mobile (Den Haag), Vodafone (Japan), Telstra (Australia), and Aloha Partners (Rhode Island). Joe Barrett, director of marketing, says that these services offer average downlink speeds of up to 1Mbps, with burst rates of up to 3.2Mbps.[11]

HSPA (HSPDA & HSPUA): High Speed Packet Access (HSPA) enables an upgrade to existing W-CDMA networks. The aim of HSPA developments is to upgrade the data bandwidth, spectrum efficiency and also the QoS parameters of 3G networks. It is important to note that HSPA is not a new network but an upgrade to the 3G network (like GPRS and EDGE in relation to 2G networks). HSPDA (the down link version) offers data rates of up to 14 Mbps, which is much higher than the maximum bandwidth of 3G networks of 2Mbps (or more realistic 384 Kbps). HSPUA (the equivalent up link version) offers bandwidths of max 5.76Mbps.

Multimedia Broadcast Multicast Service (MBMS) is also an upgrade to the current 2.5G, 3G, and 3.5G networks. However, the development does not relate to the increase of bandwidth but to the more efficient transmission of point-to-multipoint services. MDMS enables the efficient utilisation of resources when it comes to the transmission of broadcast services, like mobile TV services.

5.4 Mobile Broadcast Convergence

Mobile broadcast converged platforms are the materialisation of the complementarity at the architectural level. Mobile and broadcast networks have different characteristics and target different applications. However, by combining them and utilising the complementary capabilities of these technologies, new and more efficient infrastructure platforms are planned.

One of the main challenges that the mobile industry faces is the demand for increased broadband capacity that is necessary to distribute video, music, games and other digital content optimally to many mobile users at the same time. In parallel to this, the broadcast industry faces a decisive challenge in personalising content and segmenting channels towards a still more fragmented market that, apart from digital TV and radio, includes access to the Internet through mobile terminals. In particular, the youth have their requirements for content and communication through the Internet and mobile services covered, while their consumption of the traditional TV-media is correspondingly reduced.

This has resulted in broadcasters to look for new ways to target this mobile segment by offering streaming of video and music over the net and, at the same time, to integrate mobile SMS services, thereby creating interactivity in relation to existing radio and TV programme platforms.

[11] http://www.ft.com/cms/s/d29a5534-6bd1-11d9-94dc-00000e2511c8,ft_acl=.html

The ability to distribute a large number of programmes and other digital content to many mobile users at the same time and to combine this with the possibilities that lie in the 3G mobile network for new interactive services and business models – are all conditions for creating a corresponding/congruent interest within the broadcast and mobile industry.

At present, there are three main competing standards for mobile broadcast (DVB-H, DMB and MediaFLO), which create the conditions for true mobile/broadcast convergence. DVB-H is designed in the framework of the European DVB program, DMB (Digital Multimedia Broadcast) is based on DAB (Digital Audio Broadcast) standard and is promoted by the Korean mobile/broadcast industry, and MediaFLO is a proprietary standard from Qualcomm.

5.5 Overall Implications

The industry as a whole is evolving in ways where the outcomes of which are hard to predict. Before new technologies can be deployed, they need to be technically robust which in practice means that industry standardisation plays a critical role. The bodies which deal with standards are not wholly co-coordinated themselves and to degrees have differing objectives. No one party can innovate and deploy by themselves alone.

Both the fixed and wireless infrastructures face significant challenges but it is evident that the requirements to increase bandwidth on wireless technologies: (a) are considerable in their own right and (b) are being oriented more toward the perceived requirements not of businesses, but rather of mass market for content of a particular nature, i.e. an asymmetric capability rather than a symmetric one which businesses frequently require.

Where different platforms can directly substitute for each other for certain applications and situations e.g. a voice call in the home, then there is an incentive for arbitrage which can be exploited through devices which can seamlessly switch between the platforms. This will tend to bind the two platforms closer together as the transaction costs of switching are reduced. It does however require there to be an ‘open access’ framework for this to be feasible. In turn, this requires a careful regulatory assessment of where platforms are in competition with each other and where they are distinct.

The overall evidence thus far is that with the critical exception of voice, the fixed and wireless platforms will remain complementary to each other for some time to come, at least in the context of services provided to businesses. The key development which businesses will wish to achieve in a world of IP-convergence is to integrate their fixed and wireless services across platforms which are interoperable and compatible. This is a much more profound issue than the pure substitution currently occurring between fixed and wireless networks for voice calls.

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Annex 1

The Economics of Complementarity and Substitution in Networks

The extent to which platforms are complements or substitutes will depend upon the nature of downstream applications. That is, if two infrastructures are complementary, it simply means that customers are less likely to access one of these platforms when the price of the other goes up.[12] The reasons why this might happen depend on the uses or applications downstream.

In so far as the platforms offer the same downstream services, an increase in price for one will increase the demand for the other and they will show up as economic substitutes. In so far as they offer different characteristics such that customers wish to bundle or consume them together, then the effect of the increase in price on one will be a decrease the demand for the other, and they will show as economic complements. Complementarity in these circumstances requires customers to value the combination of the downstream services to be greater than the sum of the services taken individually.

It is not straightforward to assess the strength of these outcomes in the case of telecoms. In a simple world, each platform would be providing a single downstream application and the degree of substitution or complementarity of the platforms would then be uniquely determined by the relationship between the downstream applications.[13]

First consider the impact of convergence whereby platforms can provide multiple downstream applications and these may have a complex dynamic relationship with each other, sometimes substituting and on other occasions complementing each other. These effects could be price driven or activity driven. In other words, some downstream applications may have an activity-generating influence on each other. So for example, a call made across one platform may stimulate an email on another platform, even though the originator of the call might have regarded these as substitutes.

When there is this kind of overlap and two upstream network-based services offer to some extent the same downstream capabilities but to some extent different capabilities, then the analysis requires an assessment of which of the two effects (substitution and complementarity) dominates. If it is the former, the platforms turn out to be economic substitutes, and if the latter, economic complements. If the two effects are roughly balanced, the products would behave as if they are economically independent (although note, that masks the fact that there are two balancing effects).

[12] The term ‘complement’ or ‘complementary’ in economics can arise as a concept in demand but also in production: for a multi-product firm, products are technically complementary if increasing the output of one decreases the marginal cost of producing the other.

[13] The real telecom world is also characterised by 2-sided service provision and external (network) effects. Platform providers need to design tariff structures in order to encourage both content providers and content users to access the platform. Both will tend to value access as an increasing function of the number of those present on the other side of the market. Optimal solutions can often involve offering service to some groups for ‘free’ (this all depends on the degree to which subsidising one side of the market increases the willingness to pay on the other side of the market). However, whilst recognising this complexity, it is still meaningful to think of platforms as being complements or substitutes in the sense described in the text. That is, *ceteris paribus*, if there is a volume of business going across a given platform, it is clearly meaningful to consider how this is affected when the overall level of price is raised on another platform. Further, it is strongly arguable that the main effect of 2-sided markets will have a greater impact on consumer-focussed operators or businesses, rather than the business-to-business environment which is the focus of this study.

A further complication arises because substitutes in the downstream market often make use of each other's platforms to actually make the application possible. So for example, a mobile phone may make use of the fixed PSTN for termination, and vice versa. Similarly, WiFi will probably make use of a fixed access network. So even though in some circumstances applications will be substitutes in the downstream market, their presence will still affect the usage – critically the competitive price level – of the substitute downstream product itself, as they make use of some common components of the complete set of upstream platforms.

Note however, that if two platforms are serving two completely distinct geographic markets, they cannot be economic complements – they are merely serving different customer groups so they are only 'complementary' in the sense of 'extending coverage'. Similarly where they are provided in the same area but for different customers/applications where there is no cross-price elasticity, they are 'complementary' in the sense of extending product range but this is not defined in the strict economic sense of reaction to a price change.

Two network access technologies may substitute for each other directly if they have similar access and performance characteristics and target the same applications which are directly substitutable in the same areas. In this case, there will be competition between the platforms, determined not only by the degree of technical superiority but also by other than purely technical parameters such as customer experience. If the platforms do not make much use of each other or stimulate complementary activities in the downstream market, then they are more likely to act as substitutes at the platform level itself and one may exit the marketplace.

To illustrate this point, consider the following example. If within a wide area covered by GPRS, for instance, a local area may be also covered by WiFi but users have GPRS as well on their terminals. They will use WiFi when possible as it will be the cheapest option but use GPRS when this is necessary. In the first instance, they are potential substitutes. But in the second occasion where the user is physically mobile, WiFi is not feasible and so when they are mobile; the technologies are complementary in the sense of augmenting each other and they are not feasible substitutes to a price change.[14]

However, users may find that the combination of *both* forms of technology actually yields synergies and efficiencies such that an increase in price of one will still lead to reduced demand (ceteris paribus) for the other. This is particularly prevalent for large businesses who both use and purchase multiple access technologies as a 'bundle'. The feasibility of third parties to replicate the bundle is pivotal to effective competition.

[14] All subject to the caveat described above regarding 2-sided markets.

Annex 2

Technical Features of Access Technologies

This Annex provides a detailed analysis of the different access technologies and gives an analysis with respect to the degree of potential substitution and complementarity in their use based on their technical characteristics and costs.

A2.1 xDSL

Today DSL is the dominating access infrastructure for the traditional broadband infrastructures. From the beginning, DSL has been in direct competition with broadband through cable TV networks. In recent years, access technologies based on optical fibres and WiMAX are also competing with DSL. However, there are also complementarities between WiMAX and DSL. In the following, a description of different DSL technologies is given. Another important aspect is that DSL is a preferred technology for business users, especially for SMEs.

A2.1.1 ADSL

ADSL (Asymmetric Digital Subscriber Line) is standardised in such a way that the frequency bandwidth of regular telephony (below 4 KHz) on the access lines remains for telephony service. Broadband is transmitted on two other frequency bands: One of them is allocated to the low speed upstream channel (25 KHz to 138 KHz) and the other band is allocated to a high speed downstream channel (139 KHz to 1.1 MHz). The theoretical maximum bit rates of 8.1 Mbps is defined by the standard, but the bit rates, which can be achieved in practical implementations, depend on different parameters, for example, on the distance between the household and the central, as the high frequency band of the copper line gets strongly attenuated as the distance increases.[15] This distance dependency results in a situation that some households can simply not be reached by ADSL even though they have access to PSTN infrastructures. Even in a country like Denmark which has quite an advanced PSTN infrastructure, in mid 2004 about 5% of households could not be reached by any ADSL services and only 70% of the population could access a 2Mbps connection.

As seen in the following, the new generations of DSL standards try to overcome these limitations and enable the DSL platform to be competitive in the future broadband market.

A2.1.2 ADSL2, ADSL2+ & RE-ADSL2

In the ADSL2 standard, advanced technologies are implemented to improve the capacity/bit rate, establishing QoS and also, to lesser degree, to improve the coverage. Furthermore, the ADSL2 standard introduces radical innovations when it comes to power consumption, monitoring, etc. The extended possibilities for monitoring and control give the operators a tool to adjust utilisation of resources, so that it becomes possible to deliver reliable capacity in spite of external degrading parameters like ‘Cross talk’ and noise. Improvement of capacity is, furthermore, performed by utilising more efficient modulation technologies, reduction of overhead, deployment of efficient coding algorithms and a number of other techniques. Over short distances, it is possible to achieve bit rates of about 12 Mbps downstream and 1.2 Mbps upstream. Another way of achieving higher bit rates in ADSL2 is by bonding several lines. Here at the ends of the connection, multiplexing and de-multiplexing is deployed to split a connection into several parallel connections at one end and reassemble them at the other end.

[15] Apart from distance, the reachable bit rates depends on other factors like the ‘Gauge’, ‘Cross talk’, ‘bridge taps’ ….

ADSL2 enables the implementation of QoS by, e.g., splitting the bandwidth in different channels with different characteristics and reserve these channels for different applications. It is, e.g., possible to allocate a 64 Kbps of the bandwidth for transmission of regular telephony. This makes it possible to establish a transparent communication path for the transmission of PSTN services (the so-called CVoADSL) without IP conversion or conversion to other protocol. This is a technology that enables PSTN operators to deliver efficient voice and data services. This is, however, not in line with the general VoIP development, which requires interoperable technologies across different platforms.

In ADSL2+, the bit rate is increased by doubling the deployed frequency bandwidth, i.e., by including the frequency band between 1.1 to 2.2 MHz. As mentioned earlier, the high frequencies get strongly attenuated as a function of distance, which implies that the increase in bandwidth is only valid for short distances of under 2.4 Km. Doubling of capacity can be achieved for distances less than 1 Km.

RE-ADSL2 (Reach Extended ADSL2) is designed to optimise the coverage by increasing the power used in the lower part of frequency spectrum in the upstream and downstream channels. Here, it is possible to achieve coverage extension of about 900 meter, which increases the potential market for PSTN operators considerably. The coverage problem is, however, not solved totally and new complementary technologies will be vital to solve the problem of coverage.

A2.1.3 VDSL and UDSL

VDSL enables capacities of about 52 Mbps, which are higher than the ADSL family. This is implemented by including more high frequency bandwidth in the copper cables and by deploying more efficient modulation. Furthermore, VDSL enables high speed symmetrical connections. The coverage of VDSL is, on the contrary, very short and is kept below 1.3 Km. However, due to the mentioned characteristics of copper lines the capacity is very much dependent on the distance and, at the maximum distance, the achievable capacity is about 13 Mbps. This implies that only in the very last part of the network (from street cabins to the households) the current installed infrastructure is used, and a backbone network infrastructure must be established to supply these street cabins. This backbone network will mainly be based on optical fibre technology. This implies, furthermore, that compared to ADSL the cost of deployment is very high.

There are some limitations to VDSL, e.g., the co-existence between VDSL and ADSL is a challenge due to interference. Also interference from AM radio is a source of problems for VDSL. Furthermore, there is a problem of supply of electricity to the street cabins, as in the regular telephony it has not been necessary to have power supply to these cabins. When it comes to interoperability, there are some advantages using VDSL (at least in short term), as it will be possible to offer symmetrical 10 Mbps Ethernet connections. VDSL2 is under standardisation and the aim is to enable bit rates of up to 100 Mbps.

UDSL developed by Texas Instrument is the newest variant of DSL, which tries to utilise the un-utilised resources in the Copper network and to give the PSTN operators the possibility to be competitive on the broadband market. UDSL promises aggregated bit rates of up to 200 Mbps, including 100 Mbps symmetrical connections.

Uni-DSL comprises the whole DSL family: ADSL, ADSL2, ADSL2+, VDSL, the coming VDSL2 standard and UDSL. Hence, the platform gives the operators a flexible possibility to offer a number of different connections to their customers. However, it is important to mention that offering high bit rate connections requires additional network equipment and hence investment.

A2.2 Cable Modem

The cable TV infrastructure is another traditional broadband infrastructure, however, with varying installed bases and with great potentials for delivery of broadband connections. The penetration of cable TV networks varies from country to country. In Denmark, the cable TV penetration is about 70%. Only in few countries like the Netherlands, there is more than 90% coverage, and in many other countries the level is much lower. From a business user point of view, cable TV networks are not so relevant as they are primarily developed in the residential areas.

A cable TV system is a distributive system, where the resources are organised as a number of 8 MHz channels for broadcast TV distribution. Cable TV systems have a huge capacity, however, the total capacity depends on how modern the system is and, consequently, on how much frequency bandwidth of the coax is utilised.

When the cable TV infrastructure is used for broadband provision, a number of 8 MHz channels are allocated to broadband provision. In an 8 MHz channel, it is possible to transmit between 27 and 56 Mbps depending on the deployed modulation technology and some other parameters, e.g., the level of error correction. To enlarge the IP/broadband capacity in the cable TV system, several solutions can be used:

- Using new standards with more efficient modulations technology.
- Modernise the cable TV system and utilise more frequencies (channels) in the system.
- Reallocate more channels from TV to broadband.
- Digitalise the cable TV distribution system. Consequently, one TV service will occupy less frequencies and in this way it is possible to free some resources for IP services.

Or more radically:

- Remove dedicated TV transmission and use the whole capacity for IP and also deliver TV over IP. This solution is, however, strongly dependent on the development of IPTV technology.

The cable TV infrastructure is optimally positioned in the future broadband market due to its capabilities for offering triple/multi-play services. This is because the network is optimised for TV distribution and capable of delivering broadband. Many other broadband infrastructures face a huge challenge in delivering broadcast TV.

One of the weaknesses of cable TV networks in relation to broadband is that it is a shared medium, i.e., a number of users share the capacity in a network segment. Another problem which is connected to the current structure is that it is not a simple task to open the cable networks to a third party operator and establish competition. This is both due to the ‘shared medium’ aspect and because the cable TV networks are not standardised.

An important element in the utilisation of the cable TV structure for broadband is the introduction of VoIP with QoS support. Especially in DOCSIS 1.1, there are specific procedures for establishing a prioritisation to minimise delay and jitter which are highly necessary for VoIP. The problem is, however, that because of the mentioned problem of opening the network to third part operators, the general ‘best effort’ VoIP operators cannot take advantage of these QoS improving measures.

A2.3 Powerline (PLC)

PLC was announced as a competing broadband technology to the DSL and cable TV networks. The success of the technology has been limited and in its current application forms, PLC is not of interest for business users.

PLC utilises the high frequency part of spectrum in the existing power line infrastructures. Electricity supply is provided in the low 50-60 Hz band and the frequencies over 1 MHz can be used for broadband. With regards to the capacity, PLC has been able to match DSL technologies in recent years. One of the important arguments for utilizing PLC as IP infrastructures has been the ubiquity of the physical infrastructure. Power line infrastructures have very high penetration and the idea has been that one can use this infrastructure to offer broadband in an easy way and without establishing a totally new physical infrastructure. Another aspect is that all rooms in a household are connected to the power line infrastructure, and this gives a possibility for new and innovative services within the 'intelligent home' technologies paradigm.

PLC has suffered from several problems with noise and interference, which are solved today to a certain degree in the low voltage part of the power line infrastructure. Even though the major technical obstacles like noise and interference are being solved, there are not that many market players (within and outside the power line business) that see any future for this technology as a means to deliver IP/broadband services.[16]

In Denmark, only one power line company has commercial trials with PLC but they are planning to out-phase it and replace it with FTTH (Fibre To The Home) connections. Other power companies that have a very solid broadband business have decided not to put any efforts on PLC technology from the very first day and solely deploy FTTx technology in their networks. This is the main tendency in power companies' involvement in the IP business and what is evident is that the power companies get more and more involved in the IP/broadband business but mainly by focusing on fibre technology.

PLC is deployed in niche markets with low scale in connection to some FTTx solutions. For example when a big apartment complex is supplied by fibre to the cellar, connecting the apartments to this fibre requires that either the suppliers extend the fibre to all apartments, they establish a new electrical cabling to the apartments, or use PLC to deliver broadband to the apartments. Here, it has been shown that PLC is a good solution when the number of interested apartments is low. The strategy of the provider, in this case, is typically that PLC is used only for Internet connectivity, and real triple/multi play must wait until new broadband infrastructures are established.

A2.4 FTTx

Access networks based on optical fibre are of huge interest for large companies. The optical fibre networks are developing rapidly and becoming more and more interesting for the small business and residential households. Fibre networks definitely out-compete other fixed (wired and wireless) access infrastructures in relation to large business users, and when they are in place and a right business model is available they will also out-compete other fixed access networks in residential areas. However, technologies like WiFi will still be complementary to fibres in implementing local area mobility and flexibility. Mobile infrastructures will be the complementary access networks to fibre networks.

[16] Data communication over PLC can be relevant when it comes to operation and maintenance and monitoring of the power line infrastructures.

Optical fibres are broadband infrastructures with huge potentials. The physical capacity is not indicated by Mbps but by Gbps and with regards to coverage we talk about distances of around 10 Km from the central points. Even though it is possible to offer capacities of Gbps, these capacities are not implemented at the end users' sites. Different reasons for this are amongst others cost of termination and resource planning as well as pricing issues at the service provider side.

Optical fibre infrastructures are implemented using different architectures which are commonly denoted FTTx (FTTHome, FTTArea, FTTCabinet, FTTCurb, …).

Cost of deployment of the optical infrastructures is higher than other broadband technologies but the broadband product which can be offered in the fibre infrastructures are not comparable with the traditional broadband. The development in the last couple of years shows that the implementation of fibre infrastructures becomes more and more viable and that especially the power companies have been very active in the area. This is mainly due to the decreasing cost of fibres, decreasing cost of termination equipments, the general liberalisation, and the possibilities for offering triple/multi-play.

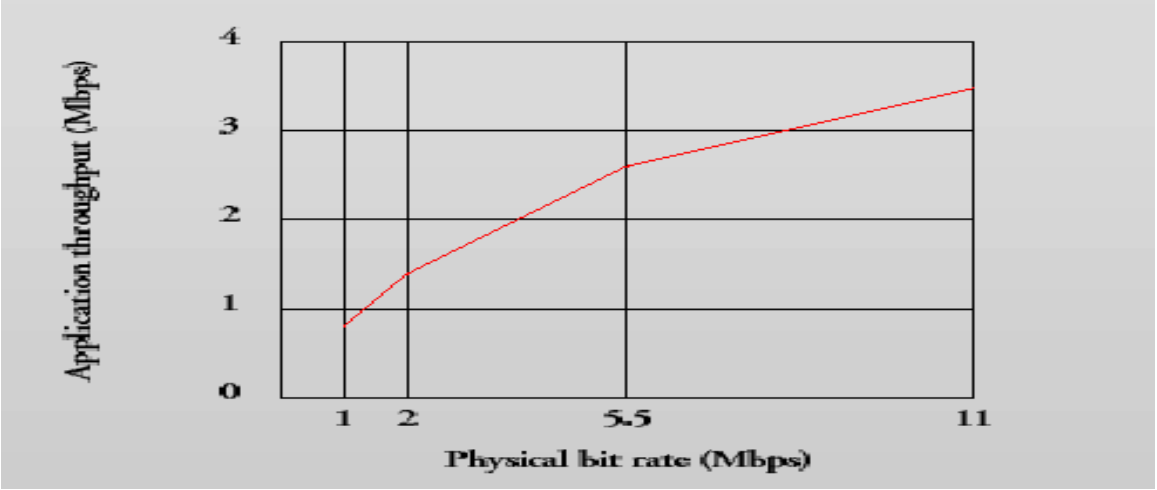
A2.5 WiFi

WiFi is not really an access technology but a complementary local area infrastructure to enable flexible connectivity to different access networks for business as well as private users. Also, specific businesses are offered WiFi like public and commercial hot spots. In this case, WiFi is the local extension of a broadband infrastructure.

The wireless network standard 802.11, which has gained much attention, was published by the Institute of Electrical and Electronics Engineers (IEEE) in 1999. Several variations of the standard have been published since – the best known is IEEE 802.11b, better known to the public as WiFi (Wireless Fidelity). The 802.11b standard uses the unlicensed Industrial, Science and Medical (ISM) band. In the absence of licensing barriers, and because of the simplicity of the technology and its cost effectiveness, WiFi networks have developed rapidly. Indoor coverage of 50 to 100 meter is normal and depending on the standard, bit rates of 11 to 54 Mbps (in some proprietary version even more) are possible. It is, however, important to mention that the net data capacity is far below these figures, as depicted in Figure 4.

Figure 4

Throughput and Bit Rate in WiFi



Actual capacities in WiFi, IEEE802.11b

Source: Measurements carried out by Lars Staalhagen, one of the researchers at COM centre, Technical University of Denmark.

Furthermore, the capacity in a WLAN is shared and the available capacity per user depends on the number of users connected to an access point. WiFi coverage can be extended using outdoor antennas and also point-to-point connections can be established using WiFi.

A2.6 WiMAX

WiMAX is one of the most interesting access technologies with potential to, at the same time, compete and be complementary to the traditional DSL and cable TV broadband. In urban areas, where DSL and cable TV are available, WiMAX may become a competing technology. In the rural and suburban areas WiMAX is complementary to the traditional broadband and may solve one of the main problems which is related to coverage to less densely populated areas. WiMAX in fixed and stationary reception mode does not compete with mobile infrastructures. However also here, WiMAX is interesting, as the mobile version of WiMAX can potentially compete with the fixed access infrastructures as well as with the mobile access infrastructures.

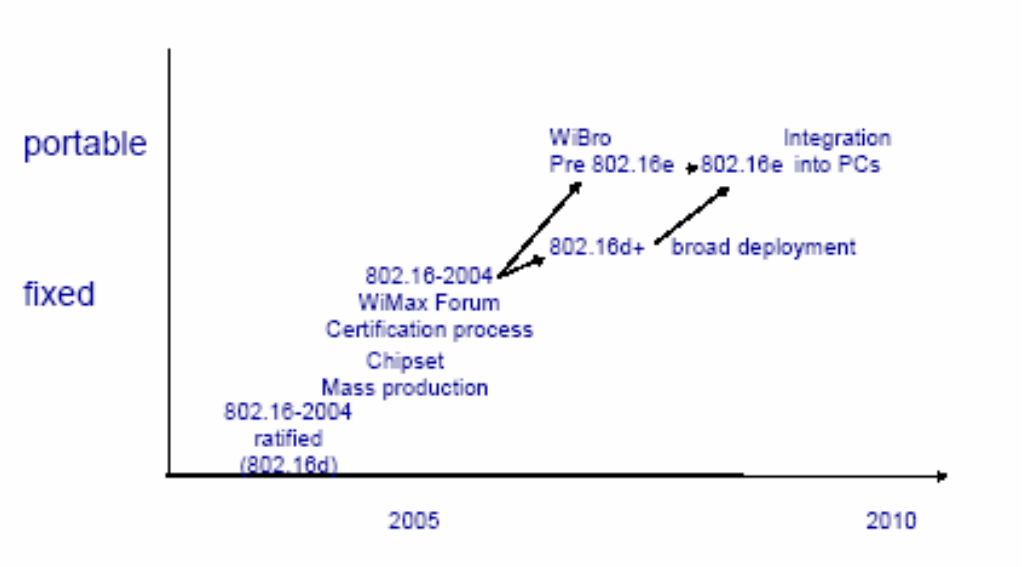
WiMAX is the popular name of IEEE802.16 standard, which may become the international FWA standard. Other FWA standards have shown not to be competitive in the access networks. In some cases FWA is used for business users and in the backbone network. FWA's lack of success in the access networks is due to different reasons, among others the lack of open standards and the requirement for Line of Site in the installations.

WiMAX is also developing to become mobile. It may be fixed wireless access now, but is expected to go mobile in 2008. The term FWA is also changed to BWA (Broadband Wireless Access), which encompasses both FWA and mobile wireless access.

WiMAX is like WiFi becoming a standard, which is supported by several market actors. WiMAX is forecasted to be a simple and cheap technology[17] with long coverage and high capacity. Coverage of 50 Km and capacity of around 70 Mbps is possible using this technology. It is, however, important to note that the capacity offered over long distances is only a fraction of the maximum capacity. And WiMAX as access technology is offered for distances of 5 to 10 Km. A key point is that 70 Mbps will only be achieved if the frequency bandwidth of 20 MHz is allocated and assigned by the local authorities. Figure 5 shows a possible roadmap for the development of WiMAX.

Figure 5

Roadmap for WiMAX



Source: BREAD: http://www.ist-bread.org

A competing technology to the mobile version of WiMAX (IEEE.802.16e) is IEEE.802.20 or MobileFi.

A2.7 Satellite

Satellite is mainly seen as a complementary infrastructure to other infrastructures. However, in less developed areas many business users also use satellite as an access network.

The satellites were primarily designed to enable a high-capacity transmission medium for the increasing international telephone traffic. The development of optical fibre technology was also intensified at that time. The optical fibres turned out to be competitive with satellite communication in handling international telephone traffic. One of the alternative uses of the satellites that turned out to be a success was broadcasting, both as a means of distribution to the transmitters and relay stations but also as direct broadcasting to end-consumers.

[17] The real cost of the technology depends on a variety of factors.

It is possible to use satellite for the provision of broadband connections. The return path must be established through other networks like PSTN. The technology used for implementing down-stream IP connectivity is IP data Cast (IPDC). IPDC can also be used in terrestrial broadcast networks and is seen as a viable candidate to offer broadband services to mobile devices in combination with the regular mobile networks. Another implementation of satellite networks, which is highly costly, is the implementation of two way satellite links using VSAT technology. This is mainly used as backbone technology and as access technology to business users, mainly in the parts of the world that are far from fibre backbones. Developing countries are the main users of VSAT.

A2.8 Digital Broadcast Infrastructures

Digital broadcast denotes a set of standards that aim to distribute broadcast signals in digital form in a specific and standardised way. In this set of standards, room is also created for transmission of data services. Data services in digital broadcast standards are either stand-alone data services or program related data. Digital broadcast standards are not worldwide standards and different markets apply to different standards: European DAB & DVB[18], US ATSC or Japanese ISDB standards. The main block of the digital TV standards, namely video compression standard MPEG-2, is deployed in a majority of standards.

The services that will be feasible in the digital broadcasting networks will go beyond traditional TV and radio and encompass a range of new services like:

- Enhanced text TV. By using graphical tools, hypertext, etc. the text TV in digital version can be more advanced and usable.
- Download of software. The broadcasting networks are mostly used in the day and evening hours. The transmission capacity at night can be used to download, e.g., new versions of software to the set-top-boxes.[19]
- Download of newspapers. In the same way newspapers can be downloaded to the set-top-boxes.
- E (T)[20] – commerce. The products can be ordered by remote control, e.g., during advertisement.
- Internet on TV. Access to the Internet as known in the communication networks will not be possible because of capacity-per-user problems of digital TV networks. The solution can be to broadcast a limited version of Internet, e.g., sites that are seen as relevant from a political/ societal perspective.

A2.9 Mobile Networks, 2.5G

In mobile 2G and 2.5G, several technological developments have been introduced to increase the capacity bandwidth of the networks and to enable the provision of new services on these platforms. Standard bandwidth for data services in GSM networks is 9.6 Kbps per time slot.[21] However, many providers offer 14.4 Kbps per time slot using more efficient modulation technologies. To increase the available capacity at the end user's site in GSM networks, two approaches are used:

[18] In Europe the DVB-project – a co-operation between broadcasters, network operators, equipment industry etc. – specifies the standards for terrestrial, satellite and cable distribution of digital TV (denoted: DVB-T, DVB-S and DVB-C). The specifications are then standardised within the European Telecommunications Standardisation Institute (ETSI).

[19] This will need a new generation of set-top-boxes with hard disk.

[20] (T) for TV.

[21] One time slot corresponds to the capacity of one standard GSM connection.

- Deployment of several time slots. This is called HSCSD (High Speed Circuit Switched Data).
- Deployment of packet oriented IP based technologies like GPRS and EDGE.

When using HSCSD technology, a maximum capacity of 38.4 Kbps will be achieved if 9.6 Kbps per time slot is used (and 57.6 Kbps in the case of 14.4 Kbps per time slot). In both cases, the assumption is that all 8 time slots are used: 4 time slots for uplink and 4 for downlink.

GPRS, on the other hand, is packet based and is optimized for IP traffic. In GPRS, the capacity per time slot depends on the deployed technology: CS1: 9.05 Kbps per time slot; CS2: 13.4 Kbps per time slot; CS3: 15.6 Kbps per time slot; CS4: 21.4 Kbps per time slot. In theory, using 8 time slots and CS4 technology, a maximum capacity of 171.3 Kbps can be achieved.

EDGE can be seen as a technology with the same characteristics as GPRS but with more efficient modulation techniques and, consequently, higher capacities per time slot. Theoretically, it is possible to achieve 59 Kbps per time slot, providing a maximum capacity of 472 Kbps. The capacity will depend on the deployed technology (MsC1 to MsC9), and a maximum capacity per time slot of 48 Kbps is considered as realistic in mature EDGE networks giving a maximum overall capacity of 384 Kbps.

One important issue here is that even though GPRS and EDGE are capable of offering high bandwidth connectivity to the end users, the amount of frequency resources in the GSM network are far below the resources necessary to cope with the ever increasing demand of the end users for data services.

A2.10 Mobile Networks, 3G

The main development in the mobile networks has been the development from 2G to 3G and beyond. This has been primarily driven by the lack of frequency resources in 2G to cope with the rapid development and penetration of mobile services and the need for new mobile services with varying demand on bandwidth. The 3G platforms, on the one hand, include new frequency bands for provision of mobile services and, on the other hand, deploy more efficient technologies than 2G resulting in increased spectral efficiency. Furthermore, the 3G technologies have been developed due to their potentials in meeting universal access goal. This has been one of the arguments at ITU for backing the development of 3G standards. Two major 3G standards, W-CDMA and CDMA2000, are described shortly in the following.

W-CDMA (Wideband Code Division Multiple Access): W-CDMA is the access scheme defined by the ITU to be the main technical platform for UMTS or 3rd Generation Mobile services. W-CDMA services are to operate within the following frequency bands: 1920-1980 MHz and 2110-2170 MHz. W-CDMA is capable of delivering up to 384 kbps in outdoor environments and up to 2 Mbps in fixed in-door environments.

CDMA2000 (Code Division Multiple Access 2000): CDMA2000 (with the ITU name IMT-2000 CDMA Multi-Carrier) represents a family of technologies that includes CDMA2000 1X and CDMA2000 1xEV:

- CDMA2000 1X can double the voice capacity of CDMAOne networks and delivers peak packet data speeds of 307 kbps in mobile environments.
- CDMA2000 1xEV includes:
    - CDMA201xEV-DO. 00 CDMA2000 1xEV-DO delivers peak data speeds of 2.4Mbps and supports applications such as MP3 transfers and video conferencing.
    - CDMA2000 1xEV-DV. CDMA2000 1xEV-DV provides integrated voice and simultaneous high-speed packet data multimedia services at speeds of up to 3.09 Mbps.

Annex 3

Convergence and the All-IP Paradigm

A3.1 Convergence

The traditional broadcasting and telecom industries have co-evolved with the Internet, but technological development is making this current sectoral distinction un-sustainable. Content and service provision has already taken place across the traditional sectoral boundaries for some time. Different services can be carried on different infrastructures and the end users' access equipment will be designed to communicate with different services. This process of fusion of content, service, infrastructure and end user equipment is denoted as convergence.

One of the major objectives of the telecom sector during the last couple of decades has been the establishment of a network infrastructure required for enabling convergence, i.e. a network infrastructure with the ability to integrate all available and future services mainly at the core but increasingly also at the access levels of the networks. This objective has mainly been based on the recognition that operating and managing dedicated network technologies for different applications/services is inefficient. Examples include public switched telephone networks (PSTN) for voice telephony, fibre distributed data interface/frame relay/X25 etc. for data services, and specific broadband networks for video telephony. In this process, the idea of integrated service digital networks (ISDN) and broadband ISDN (B-ISDN) was born, and in the late 1980s. B-ISDN, based on asynchronous transfer mode (ATM), was seen as a revolution in the telecom sector as well as in the telecom related academia.[22]

B-ISDN as an initiative failed. Presently, we are witnessing the dominance of the IP networks in the development of new access (and core) technologies as the foundation for the convergence process.

A3.2 Digitalisation and the Internet

The development from analogue to digital is by far the most fundamental precondition for any other technological change in the communication area witnessed in recent years. Digitalisation enables the integration of different services in the same network and enables reaping the synergy in the whole value chain of service production, distribution and consumption. Furthermore, digitalisation enables the expansion of resources in the access and core networks in a technical and cost efficient way.

The Internet is the main technological change that has revolutionised the communication sector. The Internet is based on the Internet Protocol (IP). Today, we are seeing the development towards the deployment of IP in virtually all infrastructures and services. In the following, some of the important characteristics of the IP platforms are outlined:

- Separation between network technology and services.[23]
- End-to-end architecture and extension of intelligence from the core to the edge of a network.

[22] The claim was that the B-ISDN project was based on the huge interest of the incumbent telecom operators in continuing to control value in contrast to the Internet which is based on an open platform. A detailed discussion of the problems connected to this architecture is given in Denton, T.M. : 'Netheads vs. Bellheads – Research into Emerging Policy Issues in the Development and Deployment of Internet Protocols', http://www.tmdenton.com/netheads.htm, 1999.

[23] For a recent suggestion for a radical separation between the network/transmission and service layer, please refer to Feamster, N., Gao, L. and Rexford, J.: How to Lease Internet in Your Spare Time, http://www-static.cc.gatech.edu/~feamster/papers/cabo-tr.pdf

- Scalability.
- Distributed design and decentralised control.

The separation between the underlying network technology and the services removes entry barriers for the service providers. The only precondition for service provision is access to the network. This has created a huge dynamic in the service development on the Internet, but it also creates a revenue sharing problem between the owners of the network infrastructures and the service/content providers. This is obvious in the broadband IP infrastructures that are mainly provided by the telecom operators. As flat rate billing for connectivity has become the dominant business model, the development in the value proposition is mainly concentrated on service provision.

End-to-end architecture and extension of intelligence from the core to the edge of a network is another factor that moves the development and innovation activities to the edge of the network. The concept was first introduced in a paper entitled: 'End-to-End argument in system design'.[24] The main argument here is that an efficient network design can be based on 'dumb core networks', where processing is moved to the edge of the network.

Scalability is another main feature of the IP design. However, one of the barriers for further scalability is the shortage of address room in the current IP version 4 (IPv4) systems.

Distributed design and decentralised control is a further characteristic that obviously has improved the conditions for the development of services, innovation and the creation of new businesses. Different networks can easily connect to other IP networks, including the Internet and acquire value-added from network effects, etc.

These characteristics of the technology create good conditions for the development of competition where several actors can potentially be involved in service creation and provision. The general Internet is the major IP network in the world but it is far from the only IP network. In recent years, several private IP networks have been established and utilised for both corporate and residential services, and the future of communication platforms, like the Next Generation Network architecture, is mainly based on IP technology. However, when it comes to NGN, the level of competition or monopolistic characteristics depend heavily on the chosen architecture for the deployment of NGN.

A3.3 NGN

ITU defines NGN as 'a packet-based network able to provide telecommunication services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport related technologies. It enables unfettered access for users to networks and to competing service providers and/or services of their choice. It supports generalised mobility which will allow consistent and ubiquitous provision of services to users'.[25]

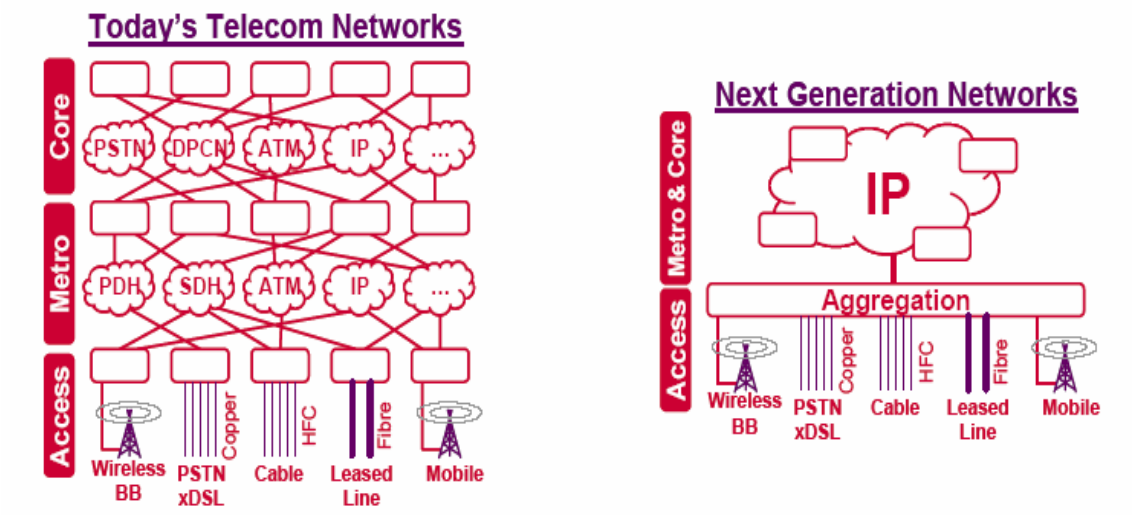
[24] Saltzer, J.H., Reed, D.P., and Clark, D.D.: 'End-to-end argument in system design', ACM Transactions in Computer Systems, 1984, volume 2, number 4, pp. 277-288.

[25] ITU-T Recommendation Y.2001.

We distinguish between the Next Generation Core Network (called NGN in this paper) and Next Generation Access Network (called NGA in this paper). NGA is about new *access* networks, like deployment of optical fibres, which is discussed in a separate section in this paper. The following figure illustrates the difference between today's telecom networks and tomorrow's NGN platforms. Today, the PSTN, mobile networks, cable TV networks, wireless networks, etc. use several dedicated metro and core networks.

Figure 6

Telecom Network Architectures



Source: Ofcom: 'Next Generation Networks: Further Consultation', issued 30 June 2005, closing date for responses: 12 August 2005.

In the NGN platform, all of these different access technologies share the same IP core network. The main arguments for the transition to the NGN architecture are the following:

- It is not efficient to maintain several core networks for different access networks. Substantial cost savings can be achieved due to the economy of scope inherent in a single converged network. BT predicts [26] to reduce costs by £1 billion per annum by 2008/2009 as a consequence of migrating to NGN.
- NGN enables improved time to market for new services and improved customer experience.
- NGN enables the continuation of offering services in the legacy access networks. For example the analogue PSTN access line/service does not need to be changed in the transition to NGN. The main changes here are the efficiencies gained in the core network, especially when one operator owns and operates several parallel core networks. The latter is the case for a majority of incumbent operators. So the operator, on the one hand, utilises the backbone efficiency gains and, on the other hand, continues to make profit from the investments in the access networks.

[26] Ofcom consultation 'Next generation Networks: Further Consultation', June 2005. Available on the Ofcom website, www.ofcom.org.uk.

- NGN enables the provision of value-added innovative services using the possibility that one core network is connected to and manages different access networks. An SMS, for example, can be sent to a mobile subscriber to inform the user if there are problems with the operation of DSL.

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TANAKA BUSINESS SCHOOL

Innovation and Business Connectivity

A Report Prepared By
Bruno Basalisco and Andrew Davies*

PURPOSE of REPORT

The aim of this report is to show how connectivity is fostering innovation in both large and small businesses. The Report examines the historic waves of innovation by large users of ICT and how connectivity is fundamentally changing the nature of production and planning processes. While connectivity has been used most effectively by large firms, the requirements of SMEs to benefit from connectivity are also highlighted given their importance in driving productivity growth in the future.

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CONTENTS

Executive Summary

This report shows that connectivity has the potential to provide new sources of innovation, creativity and experimentation for large firms and SMEs. The advent of connectivity should be understood as part of the longer-term development of Information and Communications Technology (ICT). The ICT paradigm refers to the cluster of technologies for manipulating and transmitting information at low cost that are having a pervasive and positive impact on the productivity, innovation and growth of the global economy.

The report suggests that the uptake and use of ICT is occurring in two overlapping waves of adoption. In the first wave, the needs of large corporate users of ICT (the most profitable market segment) were a key stimulus to innovation in products and services offered by suppliers and operators in the ICT sector.

Large firms have used ICT to support the design and development of new technologies, products and services; to transform their organisational structures and relationships with suppliers and customers; and to create new feedback loops between design, production, and customer demands.

In the second, and more recent wave of adoption, the benefits of connectivity are beginning to spread to SMEs. Some leading SMEs are now using ICT to promote innovation and to achieve more sustainable sources of competitive advantage. However, the potential benefits of ICT for innovative performance of the European economy as a whole will not be felt until connectivity extends to the whole SME community. Policy and regulatory changes are required to ensure that the full benefits of connectivity are enjoyed by large and small firms.

1 Introduction

1.1 Background: Connectivity and Innovation

This report discusses key trends in innovation and business connectivity. It suggests that connectivity can be seen as the most recent phase in the development of Information and Communications Technologies (ICT). This encompasses: telecommunications; computer hardware and components; software and computer services; consumer electronics; digital content and media; automation; and security. This 'techno-economic paradigm' is defined as a cluster of technologies for manipulating and transmitting information at low cost that is having a pervasive impact on the productivity, innovation and growth of the global economy. Recent innovations in ICT incorporating web-based technologies mean that the provision of software-based services can be a source of competitive advantage for both large and small businesses as the internet becomes more widely used.

The EU 2006 Task Force on ICT emphasises the need to improve the uptake and use of ICT by businesses. A virtuous circle of growth may occur because 'the more ICT is used, the more it will generate growth and investment in the ICT sector' (EU Task Force, 2006b). The Task Force emphasised that the European competitiveness and performance in innovation depends on the widespread uptake of ICT by small and medium-sized enterprises (SMEs), which form the vast majority of Europe's innovative community:

> 'The lack of investment in ICT by businesses, in particular small and medium sized enterprises (SMEs), is one of the main reasons behind Europe's decline in productivity growth. A wider integration of ICT by businesses throughout Europe would significantly contribute to improve effectiveness and productivity and could potentially revolutionise and maximise processes and organisations in a number of key sectors (health, transport, services, etc.)'[1]

The Task Force recognised that the limited uptake capability of SMEs compared with large companies needs to be addressed by EU-wide policies to promote the widespread use of ICT.

This report suggests that the uptake and use of ICT is occurring through two overlapping waves of adoption:

- An initial wave, driven by the requirements of a large and profitable segment of the market – large multinational corporations; and
- A second wave, currently underway, driven by SMEs beginning to adopt and use ICT.

The demands of large international firms have played a strong role in promoting innovation in national and global telecommunications systems. These firms encouraged the early introduction of digital transmission and switching technologies, and were behind the early introduction of IP technologies for high-speed voice, data and video communications. Since the 1980s, large corporate use of ICT has gradually progressed from a situation where most of their telecoms and IT requirements were managed in-house, to greater reliance on external operators to meet their needs for global outsourcing solutions.

[1] EU Task Force, 2006a: 1

The report provides examples of how ICT connectivity creates new sources of innovation and competitive advantages for large firms and SMEs. Access to global broadband networks and a proliferation of web-based services – such as web-hosting services, new systems architectures, high-speed network and web software – all supplied by service providers – has created incentives for the widespread adoption of ICT by SMEs.

However, even if the possibility of universal connectivity is realised in the near future, the full advantages of ICT can only be obtained in the longer term if businesses are willing and able to change or reinvent their organisational structures, create new strategies, and develop new skills and knowledge. Friedman (2006) describes this change as a fundamental transition from a vertical 'command and control' to a more horizontal – or flat – 'connect and collaborate' model. This transition creates opportunities for SMEs to work in collaboration with large firms or networks of SMEs in virtual organisations that are able to match the scale and scope advantages obtained by larger firms. This should be of particular interest to EU policymakers – given the relatively strong reliance of the European economy on SME business performance.

1.2 The Challenges for Decision Makers in Business and Government

Ensuring that all firms in the economy gain access to ICT may usher in a new period of creativity, experimentation and innovation. SMEs are the 'acid test' of connectivity-empowered innovation. Network capabilities initially developed to serve large international corporate customers are now being reused and rolled out by PTOs to serve the SME market. However, policy and regulatory may be required so that 'no firm is left behind' by ensuring that the full benefits of connectivity spread to SMEs as well as large firms.

The EU Task Force (2006a) on ICT recommends that the lack of investment and uptake of ICT by SMEs will require policy efforts to:

- Raise awareness of the benefits of ICT;
- Provide training to improve ICT skills;
- Improve access to finance; and
- Create a single regulatory environment to facilitate the creation of an inclusive information society, which extends to all businesses including SMEs.

1.3 Structure of Report

The Report aims to bring together the economic, technical and policy issues in the following way:

- **Section 2** shows how the advent of connectivity must be understood as part of a longer-term historical development of the ICT techno-economic paradigm. It shows how large businesses played a pivotal role in transforming traditional national analogue telephone networks towards the information age, by encouraging the introduction of digital transmission, switching and IP technologies.
- **Section 3** examines case study examples showing how connectivity provides new sources of innovation and competitive advantage in both large firms and SMEs.

2 Connectivity and ICT – Historical Overview

This section discusses connectivity as part of the most recent phase in the evolution of ICT over the past three decades. It discusses:

- The diffusion of ICT as crucible of techno-economic revolution.
- Business users of ICT: in-house vs. outsourced.

2.1 The ICT Paradigm: Information, Flexibility and Innovation

A considerable amount of work has highlighted the wide-ranging consequences on modern economies and societies of ICT diffusion and adoption. In the communications arena, many scholars, policy-makers and industry players share the view that ICT support a 'techno-economic paradigm' based on a cluster of technical, organisational and managerial innovations which are having a pervasive impact on the cost structure of all inputs of production and innovation processes (Freeman 1992).[2]

This change in paradigm, which has been underway since the 1970s, represents a shift from an 'industrial age' based on cheap inputs of energy to an 'information age' premised upon on low-cost inputs of information derived from advances in microelectronics, computing and telecommunications.

The previous industrial period – which started during the last third of the 19th century – was driven by technological advances in electricity, the internal combustion engine, science-based chemicals, steel production, the assembly line and efficient communications technologies.

Telegraph and telephone networks permitted a closer coordination between supply and demand. They established new connections which extended the geographical reach of mass markets supplied by high-volume producers and tied together the far-flung activities of the modern corporation (Chandler 1977). They were used to control the flow of large quantities of raw materials and components entering factories and distributing large volumes of standardised products to national and world markets.[3] Efficient communications minimised the costs of buying, selling, storing and distributing products.

The ICT paradigm is having a far-reaching impact on the global economy by creating *new* products, services, firms and industries and affecting almost every other firm and industry in the economy. It has transformed the ways in which modern corporations design, produce, sell and distribute products and services.

[2] Intel announced its first microprocessor in 1971. In hindsight this turned out to be a revolutionary event, hence a good starting point for the ICT revolution – as suggested by Perez, C. (2002). *Technological Revolutions and Financial Capital. The Dynamics of Bubbles and Golden Ages.* Cheltenham, UK, Edward Elgar.

[3] In capital goods industries, the networks enabled firms to supply customised products and systems to a variety of specifications. In consumer goods producing high volumes of goods not based on specific orders, the communication networks were used to coordinate production output in response to fluctuations in demand.

ICT provides the firm as a whole with the advantages that the assembly line under mass production gave the plant (Perez 1985). The firm and its customers and suppliers become a continuous flow of activities, information, evaluations and decisions.[4] ICT links design, management, production and marketing to create an integrated and highly flexible productive system under corporate control. Flows of data, forecasts and financial information are transmitted almost instantaneously from business units to the head office. Islands of automation in design and production – such as computer aided design (CAD) and computer aided manufacture (CAM) – are connected by data communications networks. Physical volumes and throughputs can be closely controlled to produce a variety of products and services for increasingly segmented markets.

ICT also promotes a 'cumulative feedback loop between innovation and the uses of innovation' (Castells 1996: 32). This is because innovations in ICT include an important element of experimentation in use. This involves a feedback loop between the introduction of new technology, its use and reconfiguration to meet new needs and create new markets. Increasingly, customer experiences are fed back often via the Web to front-end designers to co-create customised mass products and offer personal experiences for consumers (Voss 2003).

ICT is also used to reorganise the internal and external structures of firms and institutions. Long-term contractual relationships can be established with suppliers, using a variety of technology platforms, such as value-added networks, virtual private networks, ERP systems, and the internet. Like the telegraph and telephone, electronic networks of collaboration are used to help reduce stocks of inventories, lower working capital requirements and improve the scheduling of production processes.

This 'electronic quasi-integration' lies between the traditional forms of vertical integration and arm's-length market transactions. In other words, activities previously performed in-house by an organisation, can be undertaken as electronic transactions with key partners in long-term relationships. In this way, ICT is creating entirely new forms of horizontal collaboration and corporate control such as the 'virtual company' in the expanding middle ground between markets and firms.

This process of industrial transformation depends on the extent to which the potential benefits accruing from the long-term techno-economic change are achieved and widely distributed throughout the economy. Carlota Perez (2002) suggests that there is a 'mismatch' between advancing ICT and lagging social and institutional structures. Appropriate skills, knowledge, business processes, organisational structures, institutions and regulatory frameworks must all be developed, improved and gradually perfected to promote the widespread development, diffusion and use of ICT.

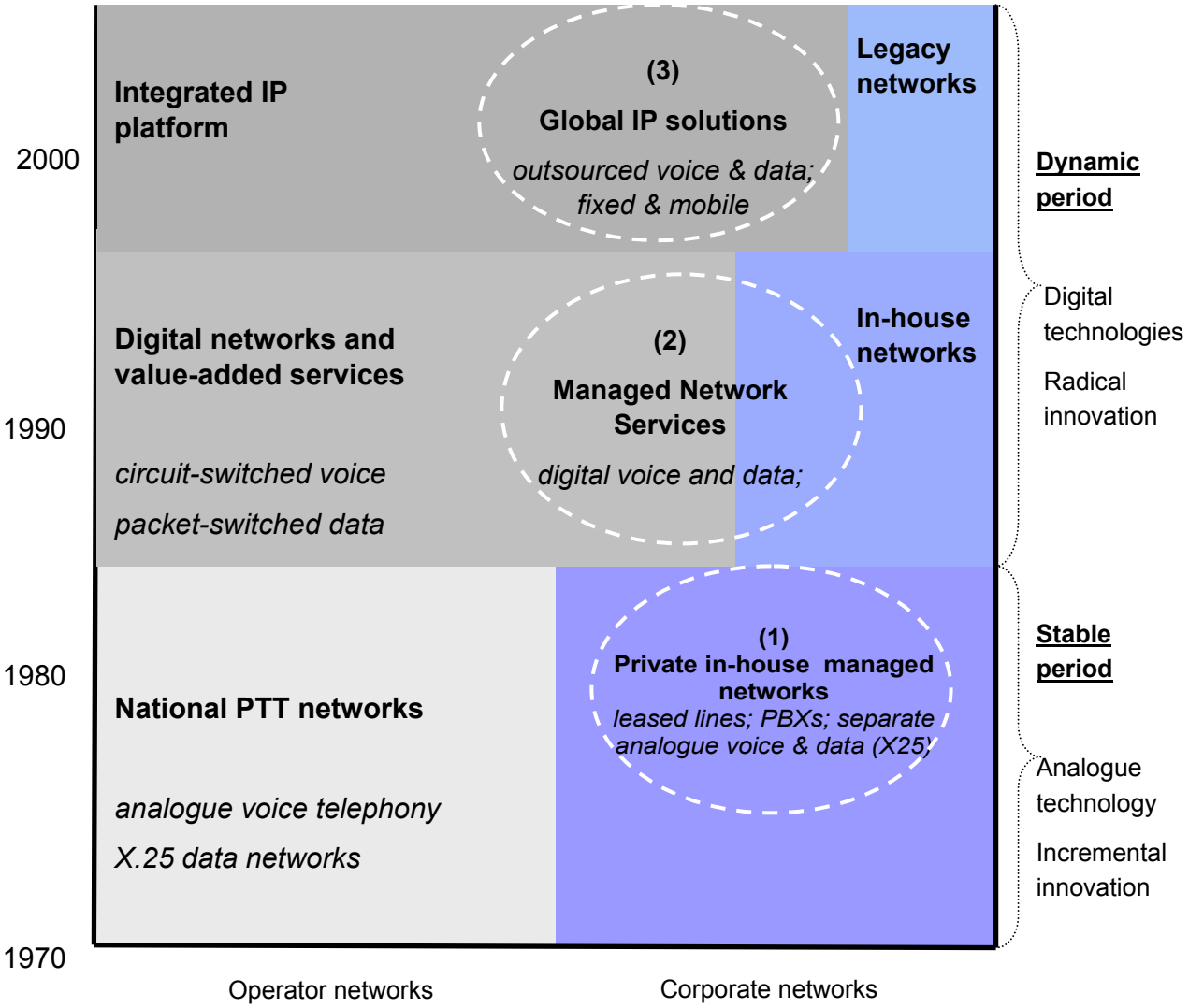
2.2 Large Business Users: Insourcing vs Outsourcing

Large corporate use of ICT has evolved moved from a situation where most of their telecoms and IT requirements were managed in-house to greater reliance on external operators to meet their needs for global outsourcing solutions. This process of business telecommunications outsourcing has occurred in three phases, as illustrated in a highly simplified way in Figure 1.

[4] But 'there is a crucial difference: whereas the assembly line was based on the constant repetition of the same sequence of events, information technology is based on a system of feedback loops for the optimisation of the most diverse – and changing – activities'. Perez, C. (1985). '*Microelectronics, Long Waves and World Structural Change: New Perspectives for Developing Countries*' World Development 13: 441-463.

Figure 1

Changing Network Capabilities: Operator v Corporate



Source: Authors' elaboration

In the first phase, from the early 1960s to the mid-1980s, large corporations developed and managed in-house telephone and data networks, using leased lines and PBX equipment purchased from national PTT operators. Privately operated data networks were used to support the geographical dispersal of large multi-site firms and transmission of growing volumes of data between remote computer terminals in factories, branches of banks, sales outlets and other far-flung locations.

These large multi-site corporations established large in-house telecoms departments to manage private networks, which were composed of PBXs and leased-line facilities with connections to national PTT networks. Voice telephone, computer data and video communications traffic were carried over separately operated networks using analogue technology. A firm's computers were connected to an X.25 data network. But these were prone to congestion and were unable to transmit many new information services such as CAD for interactive communications.

In the second phase, from the mid-1980s to late 1990s, PTOs and newly established operators, attempted to divert corporate telecommunications traffic back onto incumbent carriers' and newly licensed competitors' networks, by offering corporations more advanced networks and applications such as 'managed networks services' (MNS). At this time, PTO investments focussed on large investments in digital transmission and switching technologies to modernise and equip analogue telephone networks for the information age.

Efforts were made to meet the needs of the most profitable market segment – growing corporate demand for advanced data communications by designing and building Integrated Services Digital Networks (ISDN), including smaller scale corporate Integrated Digital Networks to overcome the previous inefficiencies associated with operating separate networks for voice, data and image services. Corporate users could design, assemble and manage private networks composed of the most advanced ICT such as digital PBXs, frame relay and digital leased lines.

Alternatively, responsibility for managing corporate networks could be transferred to operators that used the higher capacity transmission and switching capacity of the public network to provide lower cost services shared with other business users. The development of the 'intelligent network' based on service control points and high-speed signalling was used to replace internally managed corporate networks with more advanced globally managed services called virtual private networks (VPN). New entrants in telecoms markets, though, claimed that incumbent operators used their control over these 'intelligent' features as a weapon to block new competition (Mansell 1990: 507-509).

In the third and current phase, which has been underway since the late 1990s, many large corporations are demanding global outsourcing solutions for many ICT activities previously performed in-house. Large corporations such as Accenture, General Motors, Chartered Bank and HP, no longer want to negotiate with numerous operators in each national or regional market. Instead they are asking their suppliers to provide a single point of contact to manage their global needs for IT and telecommunications.

Previously, corporate networks were proprietary and disconnected from each other, each had its own formats, data protocols and applications. Corporate customers wanted to move from this disconnected world to a converged IP platform for voice and data traffic, which incorporates advances in packet-switching technologies and software applications as they emerge and provides connectivity to suppliers, customers and users throughout the world.

Managing the transition to a converged IP platform is a major challenge for operators that must continue to manage their customers' legacy networks, while migrating towards IP technologies. To achieve this, operators such as Cable and Wireless have switched from their traditional equipment suppliers to manufacturers of IP networks like Cisco Systems and Nortel. At the same time, PTOs are attempting to move out of low-value and increasingly commoditised transportation activities into higher value-added services, such as software applications, systems integration and managing a customer's core business processes.

The outsourcing demands of large international and global firms have encouraged operators to upgrade their networks to create integrated IP platforms for voice and data, fixed and mobile networks and services. Small and medium sized enterprises (SMEs), on the other hand, have traditionally been more reliant on the services that operators decide to develop for them. However, more advanced IP based network capabilities initially developed for profitable corporate markets are now being reused and rolled out at less expense for large numbers of SMEs and residential customers.

3 Business Connectivity and New Sources of Innovation

The concept of IP-enabled platform for 'connectivity' is creating a new era of innovation and collaboration. Industry cases help to illustrate how large firms are responding to the challenge and opportunity of collaborating and competing through a global information network. However, the widespread emergence of connectivity-empowered innovation depends on the uptake of ICT by SMEs. This section discusses the connectivity challenge, provides some case examples of large firms and the growing importance of SME connectivity.

3.1 The Connectivity Challenge

Dramatic improvements in productivity and new opportunities for innovation in the global economy are being driven by the far-reaching impact of the ICT paradigm over the past 5 to 10 years. A cluster of technologies – such as personal computers, fibre optic transmission, the Internet, web browsers and business process software – are converging to form an IP platform enabling individuals, businesses and communities to collaborate and connect in real time through a global digital network. IP enabled connectivity is ushering in a new era of innovation, creativity and experimentation in new products, processes and services (Friedman 2006).

This IP platform allows for activities in the business value chains to be digitised, decomposed and outsourced to suppliers located *anywhere* in the world with access to broadband connectivity. Software applications for standardising processes enable businesses to create, manipulate and transmit digital content – information such as sales, marketing, design, manufacturing, billing and inventory – within and between organisations.

Connectivity promotes outsourcing because each activity in a digitised value chain can be standardised, undertaken by an external supplier and then reassembled. The standardised tasks or modules are often designed, outsourced and put back together by large systems integrators, such as Boeing or IBM (Prencipe, Davies *et al.* 2003).

The advent of connectivity is driven by the diffusion of ICT. However, the advent of universal connectivity depends on the creation of a converged digital environment, with standards that enable the interoperability of ICT products, networks and systems. Even if this technological convergence occurs, further organisational changes are required to ensure that ICT is widely adopted and effectively used. To obtain the full benefits of connectivity, businesses must develop new forms of organisation, create new strategies, and develop new skills and business processes. Friedman (2006) describes this socio-technical change in terms of a transition in models of value creation from a vertical 'command and control' to a more horizontal – or flat – 'connect and collaborate' model.

In the vertical model, value is largely created by large vertically integrated organisations and from the top down. In the flat model, value is created horizontally, through multiple forms of collaboration and increasingly from the bottom up. These two models of business organisation and connectivity are summarised in Table 1.

Table 1

Connectivity and Business Organisation: From Vertical to Flat Structures

Vertical Model ⇨ Emerging Horizontal Model	
Command and control	Connect and collaborate
Vertical and hierarchical organisations	Horizontal and flat organisations
Top-down strategy and management	Bottom-up innovation and creativity
Networks: 1) proprietary and closed in-house corporate networks 2) nationally-based PTT networks	Networks: 1) interconnected corporate networks on IP platform 2) web-enabled global network
Value creation by vertically integrated organisation	Value created by multiple forms of collaborative and outsourcing, including large firms, SMEs, customers, and individuals
Closed innovation driven by corporate R&D	Open innovation working in collaborative teams with external organisations

Source: Adapted from Friedman (2006)

Rather than a simple transition from one model to the next, Friedman (2006) suggests that 'blended models' will emerge in which traditional corporations and governments will work with large corporations, SMEs, new entrepreneurial start-ups and individuals in emergent networks and virtual organisations to create new norms, routines and boundaries for operating in a 'flatter' world.

In the 21st century, the competitive success of SMEs will depend increasingly on their participation in multi-firm collaborative projects, in domestic and international markets. However, firms often use a variety of different networks and software packages which are often incompatible. To enable SMEs to work with large firms or with other SMEs in horizontal relationships, interoperable systems offering seamless connectivity must be put in place so that the various organisations involved can easily exchange information.

Business users became acutely aware of the threats and opportunities of posed by connectivity in the lead up to the Year 2000 problem – also known as 'Y2K bug'. The pervasiveness of an otherwise trivial long-standing software bug reminded companies of how delicate an ecosystem based on business connectivity can be.

Clients, suppliers, competitors alike are all part of a business ecosystem based on the shared confidence in the business processes underlying each firm's operations and transactions. The Y2K problem revealed the high stakes of the interdependence of the business ecosystem. In particular, it showed that investing in state-of-the-art communications technology was no guarantee of competitive success if compromised by the failure of a customer's or supplier's ICT system (Nolan 1998). Similar concerns persisted in the industry after Y2K, prompting many business users to demand more secure and reliable ICT and applications, including the requirement for secure connectivity.

Indeed, Y2K was a major stimulus for many firms to introduce innovative ICT for ageing capital equipment. It highlighted the risks and opportunities afforded by advances in technology at a time when ICT-focussed, unproblematic 'techno-optimism' was the predominant view across business and policymakers (Margulius 2005).

3.2 Connectivity and Innovation: Business Cases

The following case studies of business users of ICT highlight how ICT is creating new sources of innovation and competitive advantage. ICT is used to radically improve the value creation process by promoting responsive, flexible and adaptive feedback loops between:

- Design and production;
- Supply and demand;
- Logistics and distribution;
- Physical and virtual environments.

ICT is used to coordinate product design and production on a global basis. Using a single, standardised hardware, software and email platform, designers and engineers within a firm and its supply chain can work collaboratively on each project. For example, Boeing designs and produces commercial aircraft – such as the 777 and 787 airliners – using a standardised CAD-CAM software application and a dedicated network thereby connecting product development teams and manufacturing organisations located throughout the world.

Before the advent of CAD-CAM and broadband connectivity, the drawings of individual airplane components were 'thrown over the wall', separating design and manufacturing. It was very difficult to keep track of individual parts and to ensure that components could be easily integrated with other components. With access to the same computerised design, engineers and manufacturers can share ideas and data early on the design process. The use of a software clash detection programme for the design and production of the 777 airliner helped to prevent design clashes and interferences between components when integrated into a larger system (Petroski, 1996: 130).

Collaboration between large and small firms often depends on the exchange of information over high-speed networks. ICT is used to coordinate the activities of designers that share and exchange information among the many firms involved in collaborative design projects. For example, BAA developed a software tool known as the Single Model Environment for 3-D and 4-D CAD, for the construction of the Heathrow Terminal 5 (T5) infrastructure, which is one of the largest civil engineering projects in Europe.

BAA developed the single model to coordinate the design, construction and maintenance of T5. All of the design teams involved in the project including BAA, Arup and many other organisations use the single model to create, store and share the same data. Using the same system helps to prevent drawing errors from leading to delays in the progress of the project. Since 2000, 473 CAD users and 3,879 other document users have worked with the Single Model Environment. The single model only works effectively if all designers use one set of standards and processes (Beardwell et al., 2006).

Enhanced connectivity can promote innovation through a closer coordination between supply and demand in established industries, which are traditionally perceived to be low-tech, such as clothing retail and foodservice. For example, Zara, the Spanish fashion retailer, has introduced sophisticated ICT to move a product from design to the shelves in its shops in no more than 30 days. Rather than over-stocking its shelves in anticipation of customer demand, Zara deliberately incurs shortages of goods on shelves. It then uses its ICT system to respond rapidly to such shortages by supplying customers with exactly the goods required at any particular time, with much less risk of left-over stock (Friedman, 2006: 154). Shop managers are equipped with PDAs with transmission capabilities so that information about customer preferences can be sent directly to the company's planning department.

The foodservice industry is now starting to build on its first wave of equipment digitisation – in particular in customer service, control and planning functions. Evidence from its major US trade show (FS/TEC)[5] shows that the industry is adopting more advanced ICT innovations, such as: build-to-order entrées for frequent diners (through PDA, kiosk or via web); virtual settlement (via mobile phone wallet); and know-wait systems for reservation information. These innovations rely on advanced applications located on the premises and connected through extranets to provide customers with a range of new services (Liddle 2005). The uptake of ICT in the foodservice industry requires an understanding that by investing in ICT, companies can reduce their costs and increase the services provided. However, companies will need to change their business practices and relationships with customers in order to realise the full benefits of these ICT applications.

ICT is also used to radically improve the logistics and distribution activities of large established firms. For example, UPS, the US package delivery firm, has moved into the provision of 'synchronised commerce solutions'. It performs a range of supply chain activities previously undertaken in-house by its customers, which are mainly small firms rather than corporations. It offers to analyse each step in a customer's supply chain activities, then redesign, reconfigure and manage the customer's entire global supply chain. UPS has invested $1bn in buying out 25 global logistics and freight-forwarding firms throughout the world so that it can meet the supply chain requirements of business customers on a global basis (Friedman, 2006: 170). UPS is also the largest private user of mobile communication technology in the world. Its drivers make over one million phone calls each day in the process of collecting and delivering packages.

[5] FS/TEC. See http://www.fstec.com/home.cfm

New technologies promoting enhanced business connectivity support new horizontal relationships for creating value – such as among the numerous partners in Wal-Mart's logistics and distribution network. Wal-Mart, the world's largest retailer, has invested in an ICT infrastructure for delivering goods on a global scale in a supply chain consisting of numerous suppliers, distributors, port operators, customs brokers and carriers (Friedman, 2006: 158). It has built its own logistics and distribution system, linking drivers by radio and satellite communications. The network provides real time information about customer purchases which is fed back to manufacturers, so that its retail outlets can be stocked with the goods being purchased by customers at a particular time. Wal-Mart has introduced Radio Frequency Identification chips (RFID) which are attached to each pallet and merchandise box. This supply-chain innovation enables Wal-Mart to keep track of a pallet or box at any stage in the supply chain.

Aspects of ICT are increasingly integrated into everyday physical objects and environments so that they are invisible to the user. Embedded systems are connected with a processor to the internet and offer interactive access to web-based services. Equipped with advanced processing, sensors and network capabilities, these 'intelligent' systems are able to control themselves, their environment and the context surrounding their use (EU ICT Task Force, 2006a: 6). These so-called 'smart ambient environments' use distributed intelligence in terminals and devices to enhance the ways in which people can interact with their physical environment.

For example, Technogym, founded in Italy in 1983 and employing about 2000 staff, is one of the leading suppliers of exercise equipment. Its 'Wellness System' is an innovative product targeted at fitness clubs. ICT is embedded in exercise machines which are connected to a dedicated website. Registration, fitness, workout and comfort preference details are stored and uploaded on each machine every time a user starts a session. Information about a user's workout routines is available for monitoring by the club's instructors (Huang 2001).

The user of this embedded system is like a modern-day version of Leonardo's Vitruvian man: the user is the centre and source of information about his or her bodily movements. The variety of human proportions (across individuals and in the same individual across time through the very exercise) is the pivotal business opportunity for the exercise equipment maker. Each user's presence in the physical space of the gym activates the company's business processes (setup, updating, monitoring, etc.) which are connected to the training services provided. Technogym has gained a competitive advantage through its advanced system design, connecting the final user and the firm through a business relationship with the fitness club. The business benefits gained by the fitness clubs – Technogym's customers – suggest that the Wellness System innovation is highly successful.

ICT can also open up many new sources of innovation in public services, such as e-learning. For example, a Harvard Design School pilot plan[6] has developed an e-learning scheme using embedded systems and network connections to airport lounges across continents. This will provide new types of applications such as offering language learning programmes to passengers in Los Angeles and Barcelona. Each airport lounge reacts to the presence of passengers available to converse in either English or Spanish in the other airport. This is achieved through specially audio/video equipped seats working as intranet interfaces. The designers of the e-learning system created a non-invasive interface mechanism between the virtual and physical connections. When a passenger occupies one of the specially-equipped seats in Barcelona, one armchair in Los Angeles will rise slightly to signal availability to language learning or conversation. Delicate issues of privacy, freedom of expression and interaction must be addressed to promote the connectivity of public spaces such as airports. The service must be able to engage with passengers entering the public space of a lounge area, while being subtle enough to avoid any invasion of private uses of the public space.

As we have shown in previous cases, connectivity which is based on embedded systems and networks stimulates innovation by creating a closer match between physical and virtual environments. These intelligent, software-controlled systems, can adapt dynamically by configuring and reconfiguring themselves to changes in user needs and the environment. Another example is the retail industry. Virtual online shopping differs in one obvious way from the physical experience of 'going shopping': websites do not convey any sense of human presence. From a sales perspective, this can be a shortcoming because virtual shoppers often fail to complete the tasks needed to close the sale, leading to the virtual phenomenon of 'abandoned shopping trolleys'.

This problem can be overcome by connecting online customers with other online shoppers or with customers physically present in stores (Huang 2001). This innovation depends on indicators which show that the other shoppers are present during the online shopping experience. However, not all shoppers like to share their online experience. For some shoppers or some categories of merchandise, anonymity and isolation are sought as an alternative to the physical shopping experience and can be seen as sales-enhancing. Moreover, physical stores have fitting cabinets: some shopping functions have always been associated to privacy. Hence assessing the extent to which the physical and virtual shopping experiences are complements is pivotal to achieve successful innovation through designing a connectivity-empowered retail experience.

3.3 Connectivity and Innovation in SMEs

As we have seen, the demands of large corporate users of ICT played a vital role in the creation of global connectivity based on a converged IP platform. However, large firms should not be the sole beneficiaries of global connectivity. Global connectivity opens up many new opportunities for SMEs to:

- Work in collaborative ventures with other SMEs, large suppliers and customers;
- Become specialist suppliers of components and/or outsourcing services for large business and government organisations; and
- Use access to global capabilities to compete more strongly in local markets and create entrepreneurial ventures.

[6] The plan is by Bong, a graduate of the School. See Huang, J. (2001). '*FUTURE SPACE: A New Blueprint for Business Architecture.* ' Harvard Business Review 79(4): 149-158.

Connectivity ensures that economies of scale and scope previously obtained within the boundaries of a single firm can be achieved through networks of smaller firms working in collaboration. Each firm in a virtual network of organisations can learn from the experience and knowledge of other firms involved in a collaborative venture. This is an advantage for SMEs that have traditionally faced difficulties in gaining access to advanced technological and market knowledge. Increasing access to web-enabled global connectivity services enables SMEs to mirror the scale advantages of large global firms. For example, UPS provides small firms with highly efficient global supply chain services which are tailored to their individual requirements.

Econometric studies have shown that improvements in innovation performance and productivity are related to the uptake of ICT.[7] However, the innovative potential of SMEs is hindered by a number of factors highlighted in the EU ICT Task Force (2006b) report including:

- Lack of awareness of the potential of ICT;
- Poor incentives to adopt ICT;
- Obstacles to access capital and financial markets;
- Lack of the right entrepreneurial skills and mindset; and
- Interoperability of systems to enable SMEs to exchange information with other firms.

SMEs have been slow to adopt ICT because managers and entrepreneurs often fail to appreciate the benefits that ICT can offer in terms of productivity and innovation. SMEs often have to rely on external advice because there is not enough in-house knowledge to select ICT from a diverse and rapidly changing menu of products and services. Moreover, because many applications are not designed for SMEs, specialised service providers must be encouraged to customise their applications for the SME market (EU Task Force, 2006a: 8).

These barriers to adoption have prevented SMEs from gaining the benefits of connectivity obtained by large firms. If these barriers could be overcome, SMEs could provide a wave of ICT adoption and innovation (comparable to the first wave driven by large corporate businesses) with widespread benefits to the whole of the EU economy.

Although some SMEs are unaware of the benefits of ICT, others that recognise the value of investing in ICT are often unable to do so, because of budget constraints and limited access to capital markets. A 2003 survey of a sample of Italian SMEs showed that the investment in ICT (Fast Ethernet, in this case) was delayed because the firms were waiting for the price of technology to decline (Corrocher and Fontana 2006). The survey also confirmed that the adoption of ICT by SMEs is affected by 'network effects': each SME's investment encouraged future investment by other firms.

While connectivity and the diffusion of ICT is a source of innovation, it can also be a boost to the productivity of SMEs. Europe's largest firms are geographically dispersed throughout the world and they rely on effective ICT to support their global activities. However, many of Europe's most productive SMEs are geographically concentrated in highly productive industrial clusters, such as Baden-Württemberg, Veneto, Cambridge. Clusters are defined as 'geographically proximate groups of interconnected companies, suppliers, service providers, and associated institutions in a particular field, linked by commonalities and complementarities'.[8]

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[7] Such as the cross-industry analysis of the Italian case in Antonelli, C. (1997). '*New Information Technology and the Knowledge-Based Economy. The Italian Evidence.* ' Review of Industrial Organization (12): 593-607.

[8] Porter, M. M. E. and C. H. M. Ketels (2003). *UK Competitiveness: moving to the next stage*. Economics Paper, DTI.

Professor Porter's competitiveness report for the UK's Department of Trade and Industry (2003) stressed that these clusters are important sources of new business formation, which in turn increases the capacity for innovation and productivity growth. Amongst its conclusions is a call for a "productivity-driven regulatory context … that raises the pressures and incentives for investment and upgrading. This includes continued efforts to enhance competition policy, … and raising regulatory standards that enable rather than constrain competition." (Porter and Ketels 2003, p.45).

The EU's 2006 'Valencia Declaration on Innovation', which brought together the views of leading European innovation experts and practitioners, came to similar conclusions about how to set the priority actions needed to ensure EU competitiveness.[9] Most significantly, the declaration's first two points for action are:

"1. SMEs need an innovation-friendly environment that enables them to become more actively involved in technological research and development. The European Commission and the Member States should **accelerate the structural reforms** needed to achieve this.

2. **Innovation in services** will support the competitiveness of the EU economy. The Commission and Member States should ensure that their policy tools and instruments support all forms of innovation, including in services."

The innovation practitioners convened in Valencia invited the European Commission and the Competitiveness Council to address these points in order to send out a key message: the EU economy will benefit from policy efforts to raise the profile of SMEs (across all policies enabling EU industry to progress in its quest for further productivity).

Moreover, as described in the previous section, large firms have seen the benefits of working more closely with small firms that are empowered by enhanced connectivity, as seen in the UPS business case. SMEs can also use connectivity to compete in markets traditionally seen as the preserve of large players. Connectivity has allowed SMEs to tap into advanced business solutions – previously accessible only to large players (either in-house or externally). SMEs can achieve significant advances in productivity usually associated with large firms by acting jointly with other SMEs, either as part of clusters or geographically dispersed networks; in both cases connectivity is fundamental in providing the means through which SMEs can fully exploit the linkages between each other.

[9] Europe INNOVA (2006). *Valencia Declaration on Innovation*. Re-innovating Europe: Challenges for clusters and innovative businesses, Valencia. The priority actions were voted by the 600 innovation professionals who participated in the Europe INNOVA Conference 2006 held in Valencia, organised as part of its action in support of innovation policy by the European Commission in cooperation with the Generalitat Valenciana and the City of Valencia. See http://ec.europa.eu/enterprise/library/enterprise-europe/news-updates/2006/2006-11-30.htm

4 Concluding Remarks

This report has shown that connectivity has the potential to provide new sources of innovation, creativity and experimentation for large firms and SMEs.

The development of ICT since the 1980s has largely been driven by the outsourcing requirements of large corporate users. These firms have used ICT to transform their internal structures and relationships with suppliers and customers, create new feed-back loops between design and production, forge a closer match between supply and demand, and deliver entirely new services. SMEs are now beginning to make use of ICT driven connectivity to promote new sources of innovation and to achieve competitive advantage through specialisation and by working in new forms of collaboration with other firms and individuals.

The far-reaching effects of the ICT paradigm cannot be realised throughout the economy and society until the benefits of connectivity extend to the whole SME community. More space is being opened up for SMEs to compete with and co-exist alongside large firms, as connectivity and outsourcing leads to the emergence of 'flatter' models of value creation based on new forms of collaboration, outsourcing and specialisation.

Large firms were responsible for the 'first wave' of business demand for the cluster of digital technologies and converged IP platform that underpins and supports global connectivity. SMEs should be seen as the carriers of a 'second wave', spreading the benefits of connectivity and collaboration to all spheres of the economy and society.

Operators and service providers must be encouraged to promote the uptake of ICT by SMEs by reusing and recombining network capabilities, initially developed for global corporate markets, to provide SMEs with the new ICT products, systems, applications and services.

Policy and regulatory changes may be required to ensure that the full benefits of connectivity spread from large firms to SMEs, individuals and communities. Policy decisions must be taken to encourage competitive and open provision by tackling capital market imperfections, regulatory constraints or barriers to trade that might curtail open access to markets and the provision of connectivity in competitive conditions.

As the EU 2006 Task Force recognises, next generation broadband networks, infrastructures, service platforms and new service applications must be developed for all types of businesses, large and small. But the future competitive position of European industry now depends on the widespread uptake and use of ICT by SMEs.

This Report's policy recommendation is simply that all businesses should be in a position to benefit from connectivity and innovation. This ultimately supports European competitiveness in a world context where globalisation is taking the shape of 'The connectivity of Nations'. This relates to the EU i2010 initiative, which can certainly be seen as an industrial policy framework to serve the future needs of European citizens and all of its businesses, large and small. As we approach 2010, connectivity-based innovation becomes increasingly important to the competitiveness of all EU firms and industries.

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ICT, Connectivity and Productivity

Purpose of Report

The aim of this paper is to address the question as to why ICT has contributed much more to productivity growth in some countries than others, and to place the question of the role of communications networks within the broader question of the relationship between ICT and economic performance.

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CONTENTS

Executive Summary

From the mid-1990s on ICT has had a large impact on productivity and income growth in some countries, but not others. In fact, globally ICT has contributed to economic divergence rather than economic convergence. ICT has also contributed to divergent outcomes between the US and Europe, and to divergence within the EU-15.

A fundamental question is why a technology that is largely tradable and therefore widely available has not contributed to economic convergence. Two factors related to location appear to be at play.

First, the main economic benefits from ICT stem from its use, rather than ICT production, and effective use depends on complementary changes to organisation and management that are harder to make in some countries than others for a range of legislative and regulatory reasons often relating to wider issues of political economy.

Second, organisational changes including the emergence of modern manufacturing and wholesale and retail distribution depend heavily on the effective use of communications networks which are inherently non-tradable and more developed in some places than in others. In addition, the responsiveness of network services providers to customer needs depends on the regulatory and competitive environment which differs significantly across locations.

The stakes are large, with a very modest increase in the contribution of ICT to productivity growth in Europe in the past 20 years, versus a four-fold increase in the contribution in the US starting from a similar base level to that in Europe to an almost two percentage point per annum contribution in 2004.

The conditions that foster effective and profitable use of ICT, and therefore ICT knowledge investment, include complementarities between changes in organisation, management and business processes, and the use of networked computers. Since a range of factors are complements it is necessary to get every factor right in order to see good outcomes.

Improved telecommunications network infrastructure will promote and complement the emergence of modern manufacturing and distribution which rely on make-to-order regime and lower inventories (just-in-time). In turn these changes increase the demand for communication with customers and suppliers, and therefore the demands on communications networks.

There is a growing empirical literature that supports a view that networking is a distinct and complementary technology to computers *per se*, and that traditional growth accounting understates the contribution of networks and network services to productivity growth, both due to the way in which telecommunications investment is measured and the failure to capture telecoms' essential nature – it is the network medium on which computers ride.

Changes in the organisation of economic activity, with growth in intra-industry and intra-firm trade driven by vertical and horizontal production and distribution networks in multinational firms, have increased the demand for seamless multi-site and multi-country network services.

The general shift in importance towards "softer" factors related to the use of ICT, rather than ICT production *per se*, may also have a counterpart in the communications sector in terms of value added services and applications, as opposed to competing infrastructure investment, offering the most scope for innovation and value added growth in the sector.

1 Introduction

The observation by Nobel winner Robert Solow in 1987 that *"You can see the computer age everywhere but in the productivity statistics"* has been replaced by a new paradox, namely that you can see the computer age in the productivity statistics in some countries but not others, even though much of ICT is tradable and therefore available everywhere.

The aim of this paper is to address the new paradox, and to place the question of the role of communications networks within the broader question of the relationship between ICT and economic performance, and the fundamental drivers of success.

At a global level ICT has contributed to divergence in productivity and economic growth, rather than convergence, which is on the face of it surprising given that ICT technology is tradable and therefore available globally. We first therefore set out the empirical facts and discuss the reasons for divergence in the contribution of ICT to growth.

Various explanations have been offered for the divergent growth experience attributable to ICT, between the US and Europe in particular, including:

- Lags – the impact of ICT lags investment and Europe will in due course experience a higher contribution to growth from ICT with no change in the policy environment.
- Broadband and telecommunications regulation – differences in the growth of broadband and possibly related differences in telecommunications regulation might account for differences in outcomes in relation to ICT.
- Size of ICT sector – levels of domestic ICT production are low.
- Investment levels – investment in ICT is too low, and/or that investment in ICT related skills and ICT related R&D is too low.
- Market flexibility – less flexibility in labour and product markets in Europe may be preventing structural change and therefore the productivity and effective use of ICT.

This report finds that only the last explanation – market flexibility – is supported by evidence and offers an underlying explanation of productivity growth differentials attributed to ICT. The other explanations above either do not fit the evidence, or might be better regarded as symptoms of a low productivity contribution than as explanations (for example, low investment in ICT).

At a sectoral level the picture is more complex, with evidence pointing to complementarity between computing and networks which underlines the importance of ensuring that there is timely and efficient investment and innovation in the communications sectors, but also complicates the empirical task of understanding the role of communications and computing respectively in growth.

2 ICT and Economic Divergence

At a global level ICT has contributed to divergence, rather than convergence, in economic performance. This is true at the global level, between the US and Europe, and amongst the EU-15. We conclude that the availability of ICT is not a sufficient condition for its effective and productive use, and other considerations must be contributing to divergence rather than convergence.

2.1 Global Divergence in the Growth Contribution of ICT

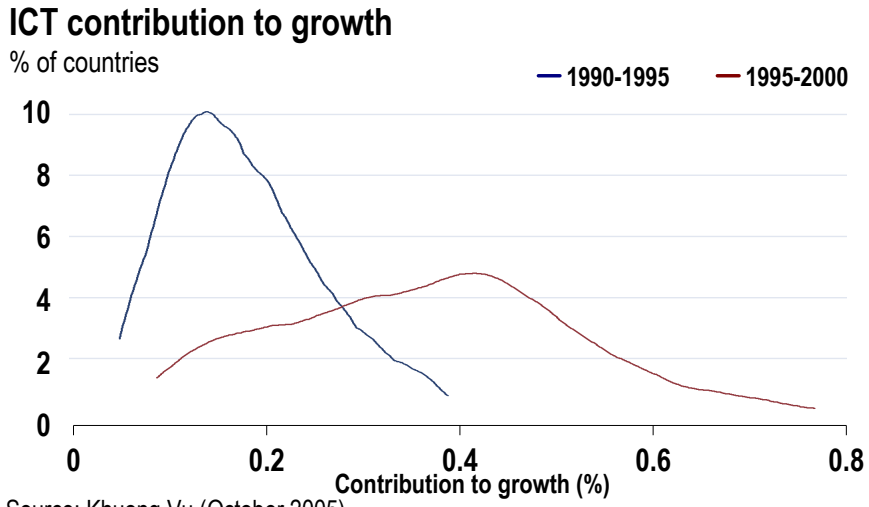
Surveying the evidence Jorgenson and Vu (December 2005) concluded that:[1]

> *"Although the surge in investment in IT equipment and software is a global phenomenon, the variation in the contribution of this investment has increased considerably since 1995."*

Vu (October 2005) considered the contribution of ICT to output growth in the economies for 50 major ICT spending countries, which together account for over 90 per cent of the global ICT market.[2]

Figure 1 shows the contribution of ICT to output growth in absolute percentage point terms (on the horizontal axis), against the percentage of countries (on the vertical axis), for the first and second halves of the 1990s.[3]

Figure 1



Source: Khuong Vu (October 2005)

Two things are apparent from Figure 1:

- Growth – a shift to the right for the peak of the distribution from less than 0.2 percentage points per annum contribution to growth from ICT during 1990-1995 to a contribution greater than 0.4 percentage points per annum.

[1] Jorgenson and Vu. December 2005. "Information technology and the world economy." *Scandinavian Journal of Economics*, Vol 107(4).
http://post.economics.harvard.edu/faculty/jorgenson/papers/handbook_worldgrowthresurgence_050810.pdf

[2] Vu. October 2005. "Measuring the Impact of ICT Investments on Economic Growth."

[3] The two curves have been inferred statistically from the underlying data for the 50 countries considered (using a Kernel density function).

- Divergence – a accompanying spreading out of the distribution across countries between 1990-1995 and 1995-2000 i.e. the difference between the best and worst performers in terms of ICT contribution has grown substantially over time.

Far from the global availability of ICT contributing to convergence of growth outcomes, it has contributed to divergence (albeit with higher growth on average). Differences in the environment, including the general policy environment, therefore appear to matter more in relation to ICT than conventional forms of investment. Nobel winner James Heckman has expressed a similar sentiment:

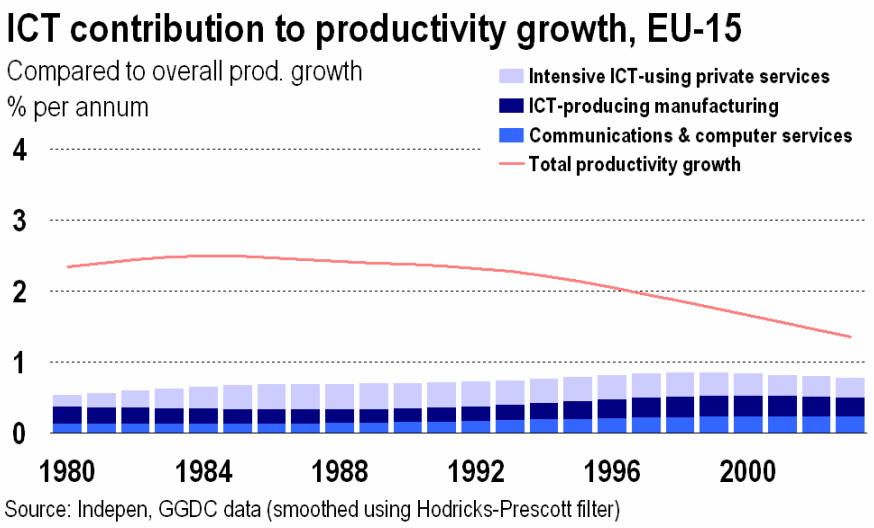
> *"The opportunity cost of security and preservation of the status quo – whether it is the status quo technology, the status quo trading partner, or the status quo job – has risen greatly in recent times."*

2.2 Divergence in Productivity Growth between the US and Europe

A divergence in the contribution of ICT to labour productivity growth per hour worked – a key determinant of output growth in the medium term – is apparent between the US and Europe with an increase in the ICT contribution in the US, but not in Europe over the past two decades.

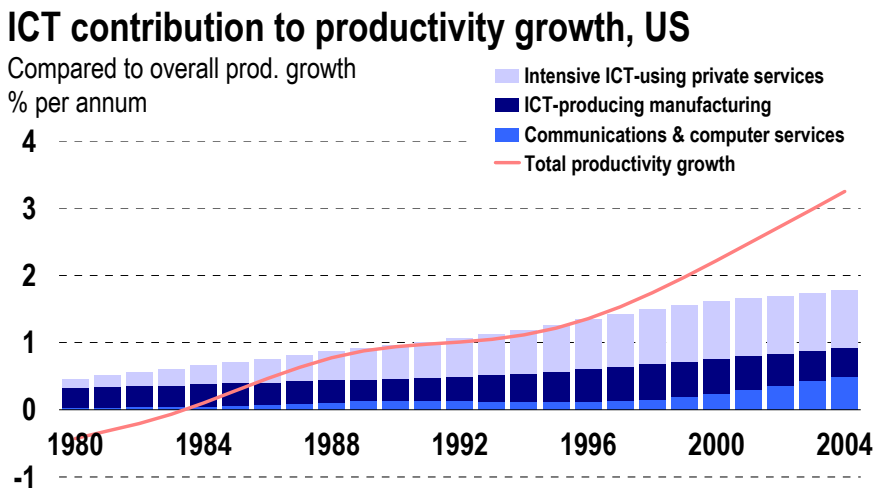
Figure 2 and Figure 3 show overall labour productivity growth per hour and ICT component contributions for the EU-15 and US (with smoothed data, the raw data also indicates a similar pattern, though with much more annual variation). The comparisons are based on data from the Groningen Growth and Development Centre, who have normalised national data into a reasonably comparable database.[4]

Figure 2



[4] Source data from "Groningen Growth and Development Centre, 60-Industry Database", September 2006, http://www.ggdc.net

Figure 3



Source: Indepen, GGDC data (smoothed using Hodricks-Prescott filter)

In the US, overall productivity growth (the red line) has risen dramatically, whilst the contribution of ICT-producing manufacturing (the middle bar in dark blue) has declined slightly since the mid-1990s, and the contributions of communications and computer services and particularly intensive ICT-using private services have increased (the bottom and top bars respectively in mid and light blue).

In the EU-15, overall productivity growth has declined, whilst the contribution of ICT-producing manufacturing (the middle bar), communications and computer services and intensive ICT-using private services have increased only modestly over the past 25 years. The share of productivity growth that is accounted for by ICT has therefore risen, but overwhelmingly because overall productivity growth has fallen.

In summary, ICT, and its use in particular, has contributed to an upsurge in productivity growth in the US and not in Europe.[5]

Jorgenson *et al* (2006) provides a more detailed breakdown of the industry origins of US productivity growth over time.[6] Jorgenson finds that:

> *"The crucial role of IT in the labour productivity acceleration of 1995-2000 was evident in both IT capital deepening and faster TFP growth in IT-producing industries. IT has remained an important source of growth after 2000, although the magnitude of the contribution has decreased. IT capital deepening, for example, contributed about a quarter of the labour productivity acceleration after 2000, but slower TFP growth in the IT-producing industries acted as a brake on labour productivity growth. Non-IT capital deepening revived, TFP growth in IT-using industries sharply accelerated, and TFP growth in the non-IT industries continued to increase its contribution to labour productivity growth."*

[5] The decline in overall productivity growth in Europe, which is not obviously ICT related, is discussed in Robert J. Gordon and Ian Dew-Becker. November 2005. "Why Did Europe's Productivity Catch-up Sputter Out? A Tale of Tigers and Tortoises." http://www.frbsf.org/economics/conferences/0511/1_ProductivityCatchup.pdf

[6] Jorgenson, Ho and Stiroh. October 2006. "The industry origins of the American productivity resurgence." Page 3. http://post.economics.harvard.edu/faculty/jorgenson/papers/IndustryOriginsAmerProdResurg_100206.pdf

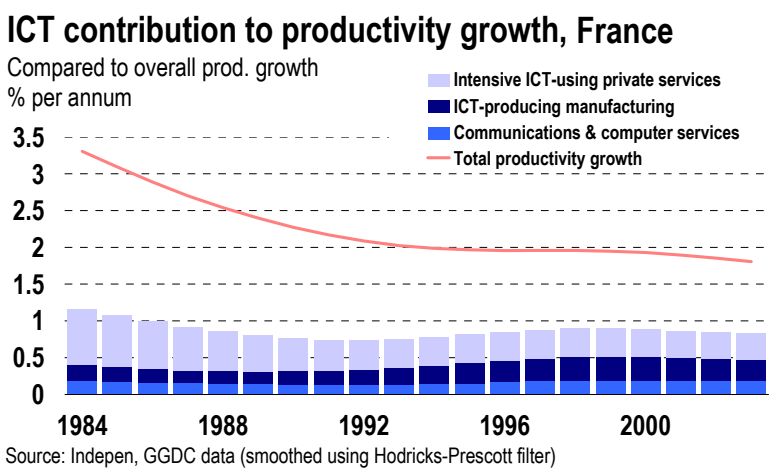
Jorgenson *et al* also caution against over-reliance on classification schemes that place industries into categories such as IT-producing versus ICT-using versus non-IT industries since the categories are inherently arbitrary. However, the Groningen Growth and Development Centre data shown above does utilise consistent definitions of these categories across countries.

2.3 Divergence in Productivity Growth amongst the EU-15

Within the EU-15 labour productivity growth rates have also diverged, rather than converged, since the early 1990s, and ICT appears to have contributed to the recent divergence.

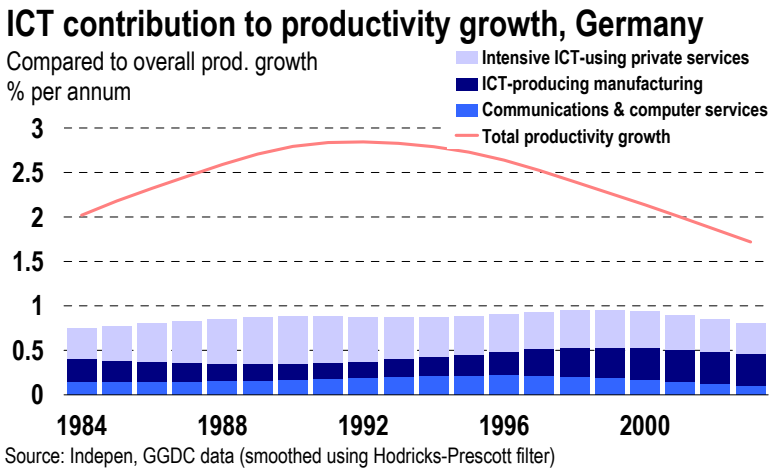
Looking at the four largest economies in Europe – France, Germany, Italy and the UK which together account for almost 70% of GDP in the EU-15 – divergence in both overall productivity growth and the contribution of ICT is apparent (see Figure 4 through Figure7 respectively over page).

Figure 4



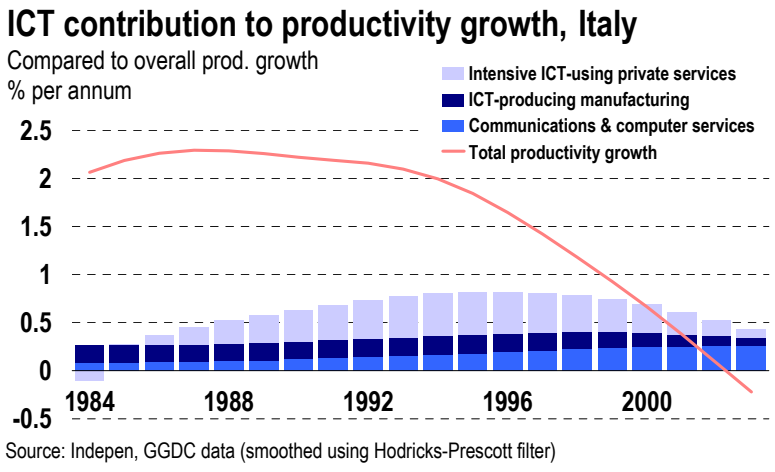
Source: Indepen, GGDC data (smoothed using Hodricks-Prescott filter)

Figure 5



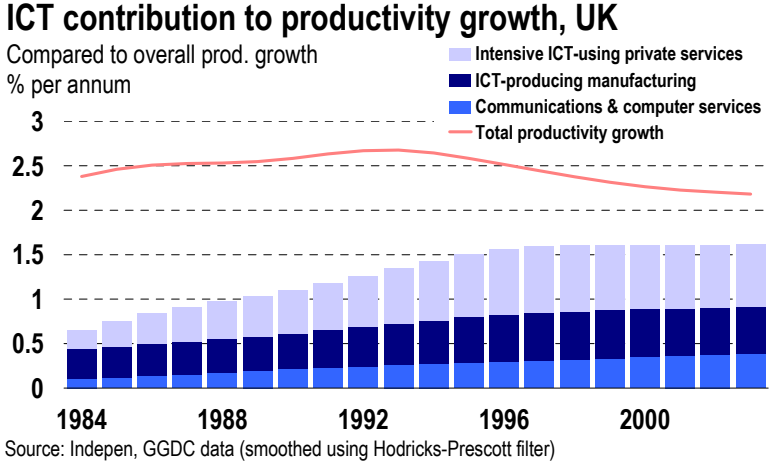
Source: Indepen, GGDC data (smoothed using Hodricks-Prescott filter)

Figure 6



Source: Indepen, GGDC data (smoothed using Hodricks-Prescott filter)

Figure7



Source: Indepen, GGDC data (smoothed using Hodricks-Prescott filter)

Only in the UK has the contribution of ICT production, communications and intensive ICT-using services risen significantly and been sustained. France and Germany have, however, sustained similar levels of overall labour productivity growth.

A further indicator of divergence is provided by the variance in productivity growth rates across the entire EU-15. Figure 8 shows average productivity growth for the EU-15, and the 95% confidence interval across the EU-15 for individual productivity growth rates. The figure shows that the variation in productivity growth across member states was decreasing up to around 1990, but has diverged since then.[7]

Figure 8

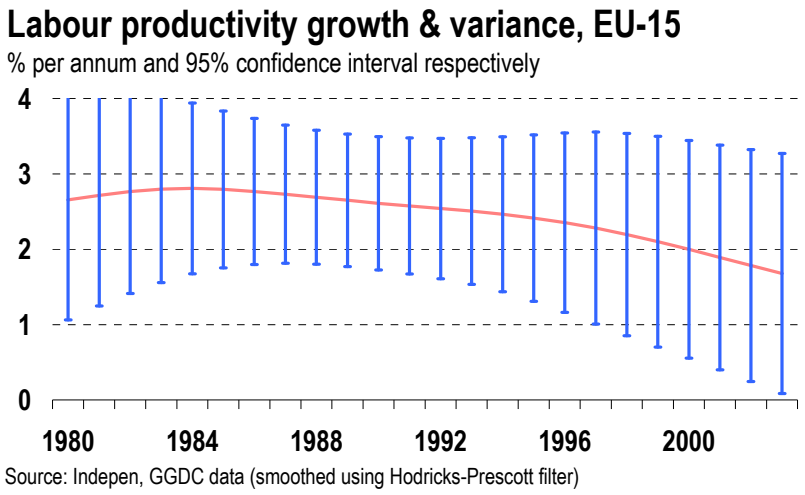
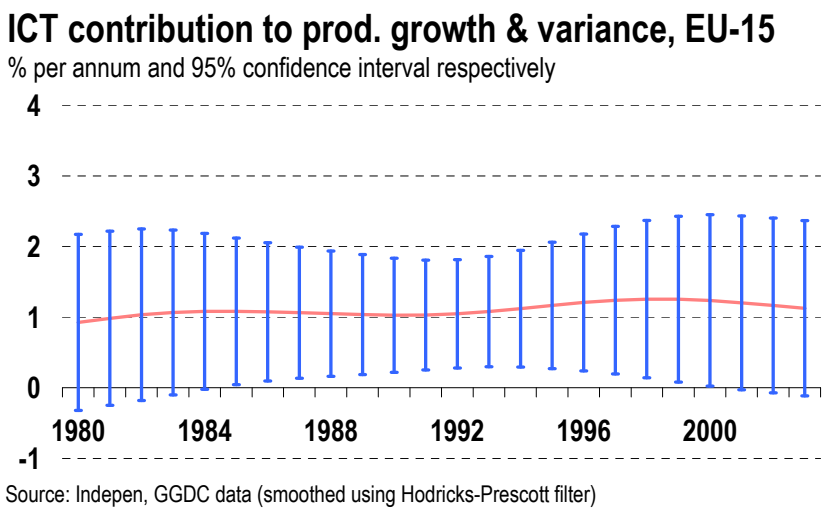


Figure 9 shows the variance in the contribution of ICT to productivity growth rates across the EU-15 which, in line with overall productivity growth, was decreasing up to around 1990, but has diverged since then.

Figure 9



[7] Note that the average in Figure 4 differs from that in Figure 2 due to differences in the way the two aggregate estimates were compiled using GGDC data for the EU-15 versus that for individual countries.

2.4 Conclusion

The divergence in the contribution of ICT to growth and productivity growth globally, between the US and Europe and within Europe does not tell us why this is happening – but it does point to the need for a deeper understanding since the opposite might have been expected *a priori* given that much of ICT is tradable.

Divergence within the EU-15 indicates that, in spite of convergence in terms of a common market in trade in goods and labour and convergent regulation in other areas (including the communications sector), other factors are contributing to divergent outcomes in terms of the contribution of ICT to growth. The next section explores possible explanations for this divergence which have been proposed, all but one of which we reject as underlying explanatory factors.

3 Alternative Explanations of ICT Productivity Boost and Divergence

3.1 Lags no Longer Offer a Plausible Explanation

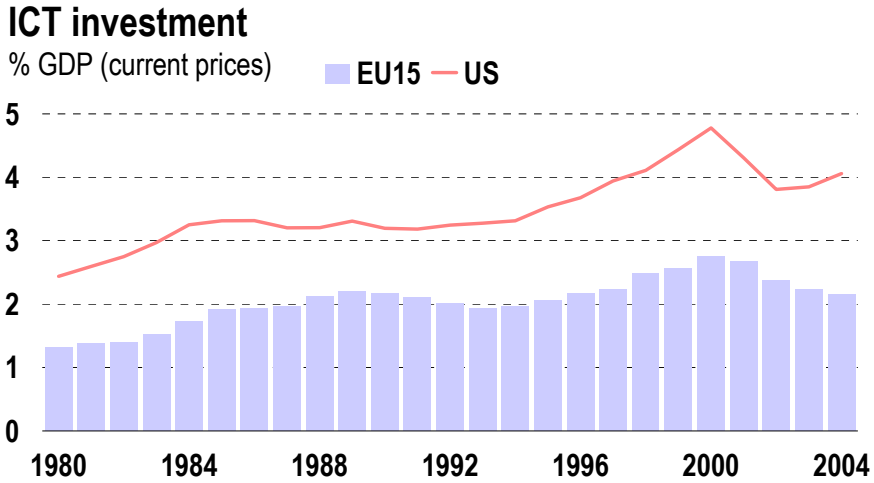
Early explanations of differences in the contribution of ICT to growth across countries included differences in ICT equipment prices driving differences in take-up and different lags in seeing a payoff i.e. it was simply a matter of time before Europe experienced a boost to productivity growth in line with that observed in the US.

However, overall rapid rate of decline in ICT prices mean that price differentials are not a credible explanation of significant differences in the contribution of ICT to productivity growth. Further, lags between investment and a contribution to productivity growth of, say 5 years, are no longer a credible explanation for national differences. Something else is going on.

3.2 Differences in ICT Investment Cannot "Explain" Differences in the Contribution of ICT

ICT capital investment differs significantly both between the US and EU-15 (Figure 10), and within the EU-15 (Figure 11).

Figure 10

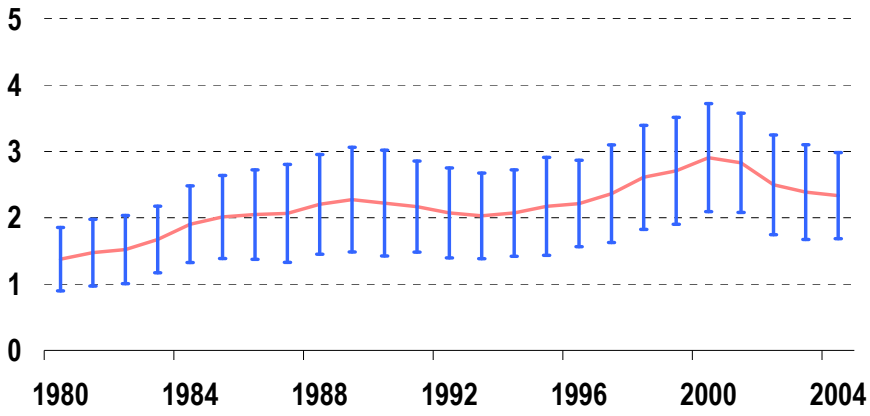


Source: Indepen, GGDC 'Total economy growth' database (June 2005)

Figure 11

ICT Investment levels & variance, EU-15

% of GDP per annum and 95% confidence interval respectively



Source: GGDC and Indepen

From Figure 10 it is clear that investment in ICT as a share of GDP has risen over time in both the US and EU-15, though the US has consistently invested more (on a per capita basis the differences would be even greater given the higher level of GDP per capita in the US).

Within the EU-15, ICT investment has risen, though the productivity contribution of ICT has not. Collectively Europe is not obtaining an increased payoff in terms of productivity commensurate with the increase in ICT investment. Further, the variance in ICT investment across the EU-15 is relatively constant, in contrast to the growing variance in the productivity payoff from ICT (Figure 9). The divergence per unit of investment has therefore grown whilst the variation in investment has not. Other factors appear to be at work.

Since the private sector is free to invest wherever investment is productive and therefore profitable, ICT investment must be less productive in Europe as a whole than the US, and less profitable in some European countries than others. In other words investment is determined within the economy i.e. is endogenous) and does not offer a fundamental explanation as to why investment and productivity growth differ across economies. The question is why ICT investment in Europe is less productive and profitable than in the US?

In other words, observed differences in investment are a symptom of a problem, but do not provide an underlying explanation of differences in the productivity contribution of ICT across countries.

Investment in ICT related human capital and ICT related R&D may be complementary to ICT capital investment and are therefore possible explanations for a divergence in the contribution of ICT to productivity growth. However, the same argument and conclusion reached in relation to capital investment can also apply to human capital and R&D, namely differences in these inputs are symptoms rather than underlying explanations of differences in productivity growth.

Evidence suggests that higher education is particularly important in the post catch-up growth phase which Europe now appears to have entered.[8] Evidence does not point to a particular problem in terms of ICT specific skills,[9] though Europe as a whole may be less open to skilled migrants than the US was during the 1990s. However, as Crafts (2003) has pointed out, vocational based skills – historically arguably a strength in Europe – may be ill-suited to reaping the benefits of ICT where adaptability is required:[10]

> *"Relative to the United States, the traditional European strength in human capital has been in workers with strong vocational training and the relative weakness has been in the production of college graduates. In the earlier post-war period, countries like Germany obtained substantial productivity advantages from their training systems geared to producing craft qualifications. In the ICT era, however, it is strength in depth in higher education that has paid off."*

A problem that manifested itself in terms of a shortage (and/or high price) for particular skills may therefore flow from constraints in the policy environment on the free flow of labour or rigid qualification requirements. It is far from obvious that skills shortages *per se* are an underlying explanation of differences in productivity growth.

In relation to R&D we note that this is to an important extent a global activity with the embodied results of R&D available to all via improved computers and software, for example. National policies to support ICT related R&D may influence the amount of such R&D, though ICT specific R&D can also be expected to be related to the amount of ICT production in economies. However, as the next section demonstrates, ICT production and use are not closely related at the national level, and as discussed earlier the greatest gains from ICT across countries generally relate to ICT use.

3.3 Differences in ICT Production Do Not Explain Differences in ICT Use

Another possibility is that some countries have become significant ICT producers with ICT shares of GDP at around 15%. Given the rapid rate of technical progress in ICT production these economies typically have high overall productivity growth. However, economies of scale in production, and benefits of clustering, mean that only a small number of countries have achieved significant growth on the back of ICT production (for example, Ireland, Finland and Korea).

Figure 12 shows that there is no particular relationship between the overall share of ICT production in GDP and the contribution of ICT capital to growth across countries.

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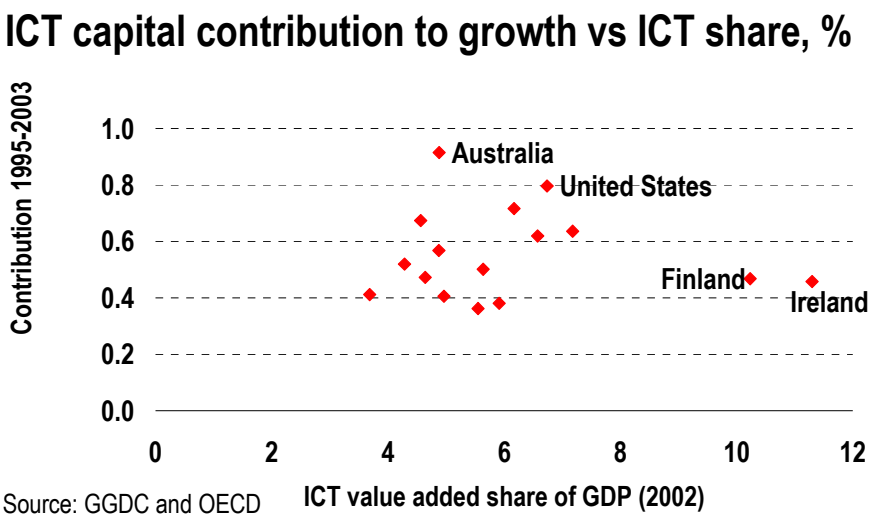
[8] Aghion, Boustan, Hoxby, Vandenbussche. August 2005. "Exploring states' mistakes to identify the causal impact of higher education on growth." http://post.economics.harvard.edu/faculty/aghion/papers/Exploiting_States_Mistakes.pdf

[9] RAND Europe. September 2005. "The supply and demand of e-skills in Europe." http://europa.eu.int/comm/enterprise/ict/policy/doc/eskills-2005-10-11.rand.pdf

[10] Nicholas Crafts. November 2003. "Fifty Years Of Economic Growth In Western Europe: No Longer Catching Up But Falling Behind?" Stanford Institute of Public Policy Discussion Paper 03-21. http://siepr.stanford.edu/papers/pdf/03-21.pdf

Figure 12



Source: GGDC and OECD

ICT production and the share of ICT in GDP does not therefore provide an explanation for the global divergence in the contribution of ICT to productivity growth. In particular, the ICT production shares of GDP in the US and Europe are very close at around 6-7% of GDP.

To the extent that ICT inputs are internationally tradable, there need be no relation between ICT production and use. For example, microprocessors, PCs and shrink wrapped software are produced at a small number of locations globally and are available essentially everywhere at globally determined prices.

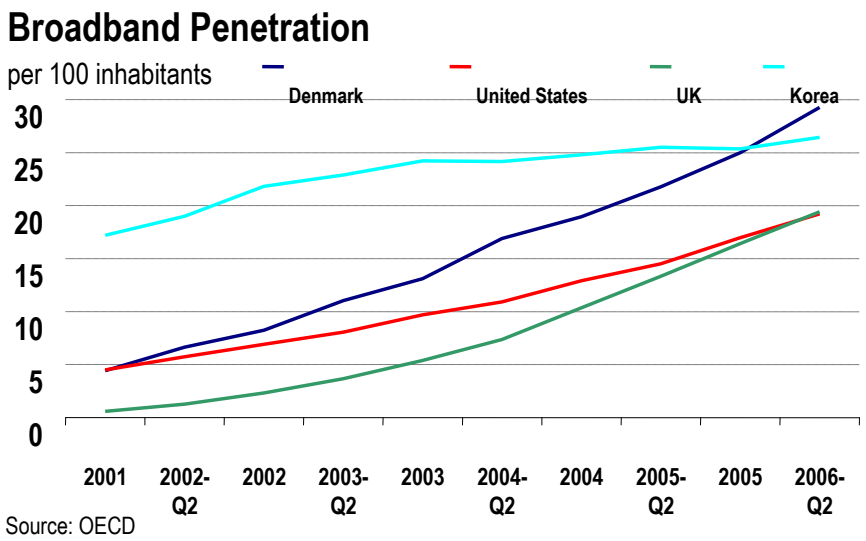
The general shift in importance towards "softer" factors related to the use of ICT, rather than ICT production *per se*, may also have a counterpart in the communications sector in terms of value added services and applications, as opposed to competing infrastructure investment, offering the most scope for innovation and value added growth in the sector.

3.4 Broadband Penetration

Levels of broadband penetration have been cited as an indicator of ICT "readiness", and attention has been focussed on countries – Korea in particular – that had high levels of broadband penetration relatively early on. Figure 13 shows broadband penetration per 100 inhabitants for Denmark (the current leader in the OECD), the US, UK and Korea.[11]

[11] OECD Broadband Statistics, June 2006. www.oecd.org/sti/ict/broadband

Figure 13



Source: OECD

Only Korea had penetration greater than 10 per cent prior to 2002, and the US only achieved 10 per cent penetration in 2004. Korea has now been overtaken by Denmark, the Netherlands and Iceland (not shown in Figure 13) in relation to broadband penetration. While South Korea led historically in the pace of broadband deployment, an OECD review in 2004 found that:[12]

> *"[South Korea] is clearly the world leader in broadband infrastructure and has high levels of consumer use. However business diffusion appears uneven despite rapid progress, ICT investment and use remain around the OECD average in general, and ICT impacts on business may be lower than expected."*

Broadband does not, however, provide a plausible explanation of differences in productivity growth attributable to ICT since productivity statistics currently extend only to 2003, before mass market broadband adoption. Further, to the extent that broadband may have contributed to differences in ICT use post 2000, the US and UK were relatively poor performers, yet experienced strong growth contributions from ICT use.

Broadband, and comparatively recent regulatory changes (removal of mandated access at regulated prices for new fibre access in the US for example), are therefore not part of the story to date in terms of productivity statistics, although the internet *per se* and high speed business connectivity may be.

[12] OECD. May 7 2004. "ICT diffusion to business: peer review. Country report: Korea" http://www.oecd.org/dataoecd/8/6/31787529.pdf

3.5 Flexibility and Complementarities

Recent attention has focussed on the conditions that foster effective and profitable use of ICT, and therefore ICT knowledge investment, including complementarities between changes in organisation, management and business processes, and the use of networked computers. If a range of factors are complements, in the sense that doing more of one of them increases the returns to doing more of the other, then it may be necessary to get every factor right in order to see good outcomes.[13]

Milgrom and Roberts (1995) discuss complementary activities and, in particular, the emergence of "modern manufacturing" which, for example, involves the following specific complementarity:[14]

> *"Factors that increase the attractiveness of a broader product line (such as shifting tastes or a reduction in the costs of more flexible manufacturing equipment) or that reduce the costs of communication (such as improved telecommunications) tend to favour a shift to a make-to-order regime, lower inventories, and more communication with customers."*

Bryjolfsson and Hitt (2000)[15] found that ICT investment and changes in organisational design were complements, whilst Fuss and Waverman (2005) found that computers and networks were complements.[16] Communication networks, and some other aspects of ICT such as word processing software, are also subject to network effects in the sense that the benefits to each user increase with the number of users.

To a considerable extent ICT knowledge investment represents an endogenous choice by firms and individuals, and if investment is profitable one would expect it to occur.[17] However, economic flexibility is a key enabling factor in relation to the demand side for ICT – since effective use of ICT often requires change which may be restricted or delayed by a lack of product and labour market flexibility. DG Ecofin concluded that:

> *[ICT] "provides a striking example of the need for policy makers to promote entrepreneurship and a healthy process of 'creative destruction"* [18]

Whilst an OECD working paper (2006) concluded that:

> *"remaining cross-country differences in product market regulation can partially explain the recent observed divergence of productivity in OECD countries, given the emergence of new general-purpose technologies over the 1990s."* [19]

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[13] John Roberts. 2004. "The modern firm – organanizational design for performance and growth." Oxford.
Complements of this type are also known as "Edgeworth complements" and differ from positive spillovers which occur when the overall benefit from some activity (rather than the returns to increasing the activity) is increasing in the level of another activity.

[14] Milgrom and Roberts. 1995. "Complementarities and fit Strategy, structure, and organizational change in manufacturing." *Journal of Accounting and Economics*, 19.

[15] Brynjolfsson and Hitt (2000). "Beyond computation: information technology, organisational transformation and business performance." *Journal of Economic Perspectives*, 14(4).

[16] Fuss and Waverman. May 2005. "The networked computer: the contribution of computing and telecommunications to economic growth and productivity or why is there no new economy in new Europe? A production function approach." A Digital Transformations Working Paper. http://www.london.edu/assets/documents/NetworkedComputer_WavFuss.pdf

[17] Indeed, if increases in one or more of these inputs is promoted via policy intervention – without some sound foundation in terms of a divergence between social and private returns – then net output may decrease rather than increase.

[18] Denis, McMorrow, Roger, and Veugelers. February 2005. "The Lisbon Strategy and the EU's structural productivity problem." http://europa.eu.int/comm/economy_finance/publications/economic_papers/economicpapers221_en.htm

We conclude that flexibility in terms of product and labour markets, and developed and responsive communications networks and services, are both required to reap the benefits of ICT use which involves a set of complementary changes in management and organisation which require extensive communications network services, in addition to investment in ICT.

In the next section we focus on the evidence in relation to communications networks and the productivity benefits of ICT.

3.6 Conclusion

ICT production is very important to some, particularly smaller, European countries, but cannot be expected to provide a source of sustained growth for Europe as a whole since ICT is likely to constitute a comparatively small share of overall output. The productive use of ICT is key to achieving large sustained improvements in productivity growth across Europe.

Explanations of differences in the contribution of ICT to growth that focus on investment in ICT capital, skills and R&D point to symptoms rather than likely cures for Europe's poor performance – since ICT knowledge investment is endogenous and low investment must reflect low returns.

Focussing on the root causes of low returns in terms of productivity and profitability from ICT and ICT related knowledge investment points to the importance of economic flexibility at a general level as key to "creative destruction" to allow the full benefits of ICT diffusion. In the next section we focus on evidence in relation to communications networks and the role of the networked computer.

[19] Paul Conway, Donato de Rosa, Giuseppe Nicoletti and Faye Steiner. September 2006. Regulation, competition and productivity convergence. OECD Economics department working paper No 509. http://www.olis.oecd.org/olis/2006doc.nsf/43bb6130e5e86e5fc12569fa005d004c/7c4ef660a1b82ba9c12571e7002c04f7/$FILE/JT03213001.PDF

4 Key Role of Communications Networks

Intuitively, one might expect aspects of network communications to play a central role in terms of achieving productivity gains from ICT – a networked computer is fundamentally different from a standalone computer in terms of the benefits it offers. Communications networks are also special in the sense that they must be fit for purpose everywhere, since network services themselves are non-tradable (in contrast to some of the services which run on them, which are tradable).

Alan Greenspan, the then Chairman of the Federal Reserve Board, summed up this view as follows:[20]

> *"Until the mid-1990s, the billions of dollars that businesses had poured into information technology seemed to leave little imprint on the overall economy. The investment in the new technology arguably had not yet cumulated to a sizable part of the U.S capital stock, and computers were still being used on a largely stand-alone basis. The full value of computing power could be realised only after ways had been devised to link computers into large-scale networks…"*

The surge in productivity associated with ICT in some countries from the mid-1990s has also coincided with wider developments which facilitate network communications, in particular the commercial development of the internet (World Wide Web software was first made freely available by CERN in 1993). This association is suggestive, but does not demonstrate a causal linkage. However, a number of studies support a view that computer networking has played an important role in achieving productivity gains.

4.1 Contribution of Networked Companies to Productivity Growth

Production processes are becoming more geographically fragmented, due to outsourcing and fragmentation of individual firms. Rather than producing goods in a single process in a single location, firms are increasingly breaking the production process into discrete steps and performing each step in whatever location allows them to minimise cost and best match local demand.[21] Growth in global vertical production networks and intra-firm trade is associated with lower trade costs. The role of communications networks in facilitating these changes was not tested.[22]

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[20] Alan Greenspan. March 6, 2000. "The revolution in information technology." Before the Boston College Conference on the New Economy, Boston, Massachusetts.
http://www.federalreserve.gov/BOARDDOCS/Speeches/2000/20000306.htm

[21] Bernanke. August 2006. "Global economic integration: what's new and what's not?"
http://www.federalreserve.gov/boarddocs/speeches/2006/20060825/default.htm

[22] Hansen, Mataloni and Slaughter. October 2004. "Vertical production networks in multinational firms."
http://www.mgmt.purdue.edu/centers/ciber/events/GOC/download/slaughter1.pdf

These developments are both a response to, and create demand for, fast and reliable multi-site connectivity i.e. fragmentation and connectivity are complements. There is also evidence that outsourcing firms have higher productivity growth than others.[23] Finally, decentralisation of control within firms and growth in information sharing through global horizontal networks is greatest in firms close to the technological frontier, and is in turn facilitated by multi-site connectivity.[24]

Dirk Pilat, Economic Analysis and Statistics Division, OECD, 2004:[25]

> *"Finally, the largest economic benefits of ICT are typically observed in countries with high levels of ICT diffusion. OECD data show that the United States, Canada, New Zealand, Australia, the Nordic countries and the Netherlands typically have the highest rates of diffusion of ICT. ICT networks in these countries have now spread throughout the business sector and will increasingly be made to work to enhance productivity and business performance."*

A study of Finnish micro-level evidence on business productivity concluded that spill over benefits of ICT in the services sector depend crucially on the internet:[26]

> *"…it seems that the excess productivity effect of ICT-equipped labour typically ranges from 8% to 18%. The effect tends to be larger in services than in manufacturing. The effect is often much higher in younger firms and can even be negative in older firms. Since organisational changes are arguably easier to implement in younger firms and recently established firms have by definition a new structure, we interpret this as evidence for the need for complementary organisational changes. Manufacturing firms seem to benefit from ICT-induced efficiency in internal communication whereas service firms benefit from efficiency in external communication."*

OECD (2005) work on digital delivery in distribution and logistics pointed to the declining share of distribution and logistics in overall costs in Europe (from around 12% in 1993 to around 8% in 2003), and the role of ICT in achieving this. In particular, the OECD concluded that governments can contribute to the adoption of supply chain related e-business solutions and digital delivery in distribution and logistics through attention to, among other things:

> *"bandwidth availability and competitive communications costs, by ensuring that communications and media regulation encourage provision of low cost broadband services."* [27]

Fuss and Waverman (2005) also note the relationship between communications and production processes:[28]

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[23] Kurz. April 2006. "Outstanding outsourcers: a firm- and plant-level analysis of production sharing." http://www.federalreserve.gov/pubs/feds/2006/200604/200604pap.pdf

[24] Acemonglu, Aghion, Lelarge, Van Reenan and Zilbotti. May 2006. "Technology, information and the decentralisation of the firm." CEPR Discussion Paper 5678. http://www.cepr.org/pubs/new-dps/dplist.asp?dpno=5678&action.x=0&action.y=0&action=ShowDP

[25] Dirk Pilat. 2004. "The impact of ICT on economic growth – an overview." In European Information Technology Observatory – EITO 2004. Page 245.

[26] Mika Maliranta and Petri Rouvinen. "ICT and business productivity: Finnish micro-level evidence." Chapter 10, page 232, in OECD (2004).

[27] OECD. April 2005. "Digital delivery in distribution and logistics." http://www.oecd.org/dataoecd/19/8/34884379.pdf

[28] Fuss and Waverman. May 2005. "The networked computer: the contribution of computing and telecommunications to economic growth and productivity or why is there no new economy in new Europe? A production function approach." A Digital Transformations Working Paper. http://www.london.edu/assets/documents/NetworkedComputer_WavFuss.pdf

> *"It is these advances in transmission technology and the fall in costs per voice channel that have helped spur the Internet explosion and the concomitant ability of firms to use communications as a tool to cut costs. For example, Just-in-Time production requires the ability to transfer vast amounts of data speedily between plants, offices, suppliers and stores, often across several continents."* Page 8

> *"It is thus clear that substantial technical advances in telecommunications unrelated to technical advances in computers were occurring over the 1990s with apparently accelerating price declines in communications equipment post 1992-3. These technical advances in telecommunications equipment led to substantially reduced prices for telecommunications services and hence the substitution of telecoms for other inputs. However, the ability to send large amounts of data digitally across the globe also changed the ways in which firms operated i.e., the advances in telecoms did lead to technical change in production in manufacturing and services."* Page 11

A picture emerges of the central role of communications networks in enabling business process change and large productivity gains. Changes in the organisation of economic activity, with growth in intra-industry and intra-firm trade driven by vertical and horizontal production and distribution networks in multinational firms, have increased the demand for seamless multi-site and multi-country network services.

4.2 Methodological Issues in Quantifying the Role of Networks

Demonstrating this empirically is far from straightforward, since beyond broadband statistics, information on the extent and quality of communications networks (in particular, in relation to business services) is scarce. Further, in contrast to some other aspects of capital, changes in the quality and capability of communications infrastructure are not taken into account and this biases the estimated contribution. As Fuss and Waverman (May 2005) noted:

> *"No country, including the US, attempts to incorporate constant quality transmission in its capital or input price national accounts and hence the measurement of the contribution of telecoms to productivity and growth is biased downwards."* Page 8

Further, the growth accounting literature treats different forms of capital as substitutes, and does not capture interactions and non-linearities. Fuss and Waverman (2005) point to the methodological shortcomings of studies which fail to account for the inherent network properties of telecoms:

> *"But even when telecoms are examined, it is analysed as a part of the ICT sector. The networking aspect of telecoms is not analysed. That is, telecoms is treated as either an IC-using sector or an IC-producing sector and its contribution to growth and productivity measured directly. Those studies that do analyse telecoms in this productivity and growth literature do not address telecoms' essential nature – it is the network medium on which computers ride. Hence it is not just the fall in telecoms equipment prices that is important but also the spread of telecoms technology, and the interaction between computing and telecoms development and thus the ability of vast amounts of data to flow among computers."* Page 6

Nevertheless, the evidence of a productivity acceleration in the ICT-intensive services sector, alongside case study evidence in terms of the role of business change and networks, points to the importance of computer networks.

4.3 Contribution of Networking Alone to Productivity Growth

There is also an emerging literature on the role of networking as a distinct and complementary technology from computers *per se*.

A study by Clayton (2000) looked at UK ONS data on firm level productivity, and found that:[29]

> *"Telecoms use, measured by spend on communications services, is significantly related to productivity – over and above the effects of IT capital.*
>
> *"In manufacturing and services there is an 'interaction effect' of IT investment and communications technology use – firms which are heavy IT investors and CT users show an even bigger advantage. However this interaction is equally well explained by employee internet use.*

Motohashi (2003) in a firm level analysis of firms in Japan found that:[30]

> *"It is observed a firm with both collaborative activities and inter firm network performs better than that with either of them. This pattern of complementarity is particularly observed in collaborative production and R&D, which involves substantial coordination between firms. Use of IT may reduce such coordination cost or a firm, being capable in effective use of outside resources, tends to use IT intensively."*

Fuss and Waverman (2005) concluded that the interaction between digitalised telecoms networks and computers has a positive impact on productivity and that digitalisation of telecoms infrastructure substantially improves the labour productivity impact of an increase in the penetration of personal computers.

Atrostic and Nguyen have published two studies in June 2006 and July 2006.[31] [32] Their work utilises new information on US manufacturing plants collected by the US Census Bureau complemented by information on computer capital input. The studies found that productivity is consistently higher in plants using computer networks to control supply chain activities such as inventory, transportation and logistics and that computer networks may be a new technology that shifts the production function, not just an alternative measure of the presence of computers.

Atrostic and Nguyen (July 2006) concluded:

> *"We find that it is important empirically to have a separate measure of how businesses use computers. Production functions estimates using variables derived from new data on computer networks and computer investment show that both variables have positive and significant relationships with plant-level labour productivity. This finding suggests that computer networks are a new technology that shifts the production function, distinct from the productive effect of computer inputs in the production process. We also show that it is important empirically to have good proxies for computer networks and computer and total capital inputs. When we lack good proxies, computer networks appear to be just an alternate measure of computers."* Page 21

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[29] Clayton. August 2005. "IT investment, ICT use and UK firm productivity." National Statistics. http://www.statistics.gov.uk/articles/nojournal/ICTReportAug05a.pdf

[30] Motohashi. 2003. "Firm level analysis of information network use and productivity in Japan." RIETI discussion paper series 03-E-021. http://www.rieti.go.jp/jp/publications/dp/03e021.pdf

[31] Atrostic and Nguyen. June 2006. "How businesses use information technology: insights for measuring technology and productivity." US Bureau of the Census. http://www.ces.census.gov/index.php/ces/1.00/cespapers?down_key=101755

[32] Atrostic and Nguyen. July 2006. "Computer input, computer networks and productivity". Centre for Economic Studies US Census Bureau. http://www.nber.org/books/CRIW03-BH/atrostic-nguyen7-26-06.pdf

4.4 Conclusion

This section builds on the conclusion of Section 3, namely that general economic flexibility is important to the productive use of ICT and that a range of other possible explanations for observed differences in the ICT contribution to productivity growth across countries are either not supported empirically, or do not offer underlying explanations of differences.

The key conclusion from this section is that different elements of ICT investment, in particular the extent of computer networks and the use of computers, are complements. Traditional growth accounting understates the contribution of networks and network services to productivity growth, both due to the way in which telecommunications investment is measured and the failure to capture telecoms' essential nature – it is the network medium on which computers ride.

Future empirical work might therefore be focussed on identifying the impact of different components of ICT and the complementarities between them. This may require a sectoral rather than a national focus for empirical and case study work.

Further, the fact that there are complementarities between networks and computers in enabling the effective use of ICT points to the importance of communications networks from a public policy perspective. The general shift in importance towards "softer" factors related to the use of ICT, rather than ICT production *per se*, may also have a counterpart in the communications sector in terms of value added services and applications, as opposed to competing infrastructure investment, offering the most scope for innovation and value added growth in the sector.

The Impact of ICT Adoption on Internal Trade and the Internal Market

By Anders Henten*

Purpose of Report

This Report examines the evidence for the impact of liberalisation in the provision of telecommunications services and consequential effects on trade and the internal market for the provision of services. In spite of many initiatives to harmonise telecommunications services, there remain some significant differences in prices and supply conditions and internal trade has not grown any faster than external trade in the EU.

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CONTENTS

Executive Summary

The establishment of an internal European market for goods and services has been a central policy objective of Member States for decades. Although telecommunications services were initially excluded from this policy, this position began to change with the liberalisation measures which began to be implemented in the 1980s. The central question addressed in this paper is how far Europe has come in terms of the harmonisation of its markets for telecommunications services so that an undistorted internal market in goods and services can develop.

Harmonisation is important for the internal market as it permits operators from any country to service customers in foreign countries, including business customers with cross border operations. Following telecommunications liberalisation, the conditions for international operators have improved, telecommunications operators can provide cross-border services.

However, a notable feature of telecommunications, like other network industries, is that much of the local access network appears to be a monopoly product for many services. Consequently, Member States collectively agreed on liberalisation through internal market directives that local access in each country should be regulated on a common basis in order to allow common trading conditions for cross-border operations. The evidence in this paper suggests there are still wide variations in respect of the access conditions for alternative operators to the infrastructures of incumbent network operators. Greater harmonisation would still therefore seem a policy imperative for the creation of competitive cross-border telecommunications networks throughout the EU.

As well as being a significant and growing market in themselves, telecommunications services are now an increasing driver of trade, especially in services more generally. Telecoms services provide the platforms over which such wider services can be supplied. This paper therefore also considers the implications of telecommunications harmonisation for the internal market and, in particular, for other services.

The internationalisation of services is lagging behind that of goods so that, although services constitute more than 70% of GDP in the EU countries, service trade only makes up approximately one quarter of total European external trade. Whilst this figure may not in itself be considered surprising in that services tend not to be traded across borders as much as goods, it is disappointing that from 1996 to 2004, the increase in *internal* EU service trade is exactly the same as the increase in *external* EU service trade. The actual increase in both cases is high at 84%, but the fact that the growth is the same in both cases may suggest that the reduction in many formal trade barriers – which membership of the EU requires – has not promoted a more substantial growth in the internal market for services in the EU.

That the internal market in services is failing to grow as fast as it might is also suggested by the fact that the ratio between intra and extra EU trade for goods is higher than that for services; and that the ratio has been increasing for goods but not for services. The ratios mean that the EU has a more active internal market in goods than services even when the higher propensity of goods to be traded in the first place is taken into account. The internal services market is not developing as well as the internal goods market.

This paper also raises the question as to whether there might be a “trade paradox” (like the former productivity paradox) with ICT being used without any visible effects on trade and particularly for services. However, trade in information intensive services appears to have increased more than trade in non-information intensive services. This could indicate a positive effect of the use of ICT. However, much more research is required to understand: (i) the effects that ICT could have on the establishment of a larger internal services market, both with respect to non information-intensive services and information-intensive industries; and (ii) the potential quantitative value of foregone growth in the trade of services due to continuing barriers, such as ineffective or widely diverging regulation.

To date, priority in research has been given to understanding only certain aspects of the link between ICT and productivity and growth. The spur that a fully competitive ICT market might provide for the internal market in services, and the impact this in turn might have on productivity, has received far less attention.

Even without such research, it seems plausible that a reduction of the barriers to the deployment and use of cross-border communications networks might be one means to assist in remedying the apparently disappointing pace towards achieving a large and vibrant internal services market in the EU.

1 Introduction

When the EU and the European countries embarked on a policy of liberalisation of telecommunications in the 1980s, the purpose was not only to break up a monopoly sector. It was also to harmonise the conditions within the telecommunications markets in Europe and, consequently, to help create an internal European market – on the supply side of telecommunications as well as among the business sectors using telecommunications. Liberalisation and harmonisation were to go hand in hand. Large European industrialists had, e.g. through the European Round Table of industrialists (ERT), advocated strongly for more harmonised conditions for international companies operating in different countries using telecommunications facilities as their communication and information infrastructure.[1] Prices for leased lines, for instance, were very diverse from country to country, and generally extremely high.

The issue of liberalisation as well as harmonisation of telecommunications markets has, thus, been on the European policy agenda for more than two decades. With the Lisbon process, the interrelationships between the telecommunications sector and other business sectors have forcefully come to the fore of the policy agenda once more.[2]

The topic of the present report is therefore the harmonisation (or lack of harmonisation) of telecommunications markets in Europe and the implications for the development of internal trade and the internal market in the EU. The focus is on business users and more specifically on service industries.

Firstly, in Section 2 there is a presentation of important policy initiatives taken to date, their impact on the internal market and the implications of information and communication technologies (ICT) on internationalisation. Section 3 illustrates the heterogeneous character of interconnection conditions in Europe followed by a discussion on the issue of standardisation and the problems created for international operators by the absence of standardisation. Section 4 addresses the issue of internationalisation of services with a service industry case study in Section 5. Finally, conclusions are drawn in Section 6.

[1] See http://www.ert.be. On the origin of ERT, see http://www.ert.be/origins.htm.

[2] CEC: 'The Lisbon European Council – An Agenda of Economic and Social Renewal for Europe', DOC/00/7, 28 February 2000.

2 Impact of ICT Connectivity on Trade

2.1 EU Initiatives

The creation of a common market was foreseen in 1958 in the Treaty of Rome. However, the establishment of a truly common market has met many problems along the way and has resulted in a long list of policy initiatives designed to increase integration of the European economies. One of the most important initiatives in this regard was the 1985 White Paper by the European Commission with approximately 300 initiatives for implementing an internal market, resulting in the Single European Act of 1986.[3] Another initiative marking the ongoing intention to help create an internal market has been the support for Trans-European Networks (TEN) starting in 1995[4] with telecommunications as one of the network infrastructures (transport and energy being the two others). TEN was an offspring of the internal market initiatives from the 1980s, based on the argument that an internal market would not be established without efficient Trans-European infrastructures.

The strengthening of an internal market for ICT goods and services was also a driver behind the establishment of a European research programme in the telecommunications area (RACE) in 1985. European standardisation (especially the establishment of ETSI in 1988) and the New Approach to technical harmonisation and the Global Approach to conformity testing all aimed to strengthen the internal market. The struggle for the establishment of a truly common, internal and single market in Europe is not therefore a new endeavour, but has been an ongoing activity for many years.

The telecommunications specific EU initiatives, beginning in the first part of the 1980s, were also related to the intention of creating a truly internal market in the EU. In 1984, the European Council agreed on a recommendation concerning the implementation of European harmonisation in the telecommunications area.[5] Furthermore, the range of directives coming out of the Green Paper from 1987[6] had the dual goal of liberalising the telecommunications area and harmonising the conditions within the European telecommunications markets – illustrated by the fact that the Commission used the former article 90 (presently, article 86) in the European Treaty for breaking up the monopoly of incumbent operators and the Council used the former article 100A (presently, article 95) to establish harmonised conditions on the European markets.

The purpose of these initiatives were not only to create new conditions within the telecommunications markets for operators, but also to create better conditions for the users of telecommunications services. Harmonised conditions for business users are particularly important for the establishment of an internal market for all the different kinds of business sectors. On the user side, it is, moreover, worth mentioning the EU e-commerce directive from 2000 and the focus on improving conditions for the advancement of e-commerce.[7]

[3] CEC: 'Completing the Internal Market – White Paper from the Commission to the European Council', COM(85) 310 final, June 1985. Regarding Single European Act, see http://europa.eu/scadplus/treaties/singleact_en.htm.

[4] Financial Regulation (EC) No 2236/95. The telecommunications part of TEN is called eTEN.

[5] Recommendation 84/548/EEC.

[6] COM(87) 1290, June 1987.

[7] Directive 2000/31/EC.

Recently, the EU policy initiatives regarding the use of telecommunications as a tool for improving the efficiency of other business sectors have taken their point of departure from the i2010 initiatives.[8] Here the focus has mostly been on the productivity gains related to the use of ICT – less focus has been on the trade implications of ICT. More specifically, however, the i2010 initiative puts emphasis on 'the completion of a single European information space which promotes an open and competitive internal market for information society and media' (in addition to the two other prioritised areas, 'Innovation and Investment' and 'Inclusive European Information Society').[9] A Task-Force led by DG Enterprise comprising of ICT stakeholders has recently concluded on a generic basis that inconsistent national legislation and regulation is proving to be a barrier to the development of a single market in ICT.[10]

2.2 Analyses by International Organisations

In Section 4, a brief overview is presented of research approaches to the implications of ICT on trade and internationalisation in general. The present sub-Section provides a short summary of studies published by international organisations.

The UN body UNCTAD (United Nations Conference on Trade and Development) was one of the first international organisations to take an interest in the implications of ICT for the internationalisation of the production and distribution of goods and services from an analytical point of view.[11] Other international bodies, including UN organisations, have been working in more practical ways, looking for instance at trade facilitation through electronic communications, e.g. EDI (Electronic Data Interchange).[12]

The focus in the work of UNCTAD has mostly been on the implications for developing countries, including new potential ways of taking advantage of the participation in international trade and divisions of labour, and on the necessity of improving Internet connectivity.[13] In the context of developed nations, the OECD has undertaken relevant research in connection with The Growth Project.[14] This project has mostly been concerned with the factors affecting growth in general but has also dealt with implications of the use of ICT.

Also worthy of mention – among the works of many different international organisations – are the activities of INTUG (International Telecommunications Users Group).[15] INTUG represents residential as well as business users and has advocated continuously and strongly for more fair and harmonised conditions for telecommunications users. International roaming prices have been a particular focus of INTUG's activity during the past few years.

[8] SEC(2005) 717.

[9] Ibid. page 4.

[10] Task Force on ICT Sector Competitiveness and ICT Uptake, Working Group 6, "Achieving a Single Market" October 2006

[11] For instance: UNCTAD: 'The Tradability of Banking Services: Impact and Implications', ST/CTC/168 Current Studies Series A, No. 27, Geneva: United Nations, 1994.

[12] United Nations Centre for Trade Facilitation and Electronic Business.

[13] See, for instance, the Information Economy Reports issued by UNCTAD – the latest one being 'Information Economy Report 2005', UNCTAD/SDTE/ECB/2005/1.

[14] http://www.oecd.org/document/32/0,2340,en_2649_34325_2506528_1_1_1_1,00.html

[15] http://www.intug.net/main.html

This brief overview provides only a limited insight into the many contributions on the implications of ICT on business conditions in general and for internationalisation. However, in spite of the varied contributions, quantitative assessments of the effects of ICT use on trade and other modes of internationalisation remain, at best, very rudimentary and scanty. Whereas in the field of productivity, an increasing number of assessments of the quantitative relationships between ICT use and productivity are published,[16] and have also been the focus of much attention in relation to the European Lisbon process, the impact of ICT on trade has not been accorded the same attention.

[16] See, for instance, Bart van Ark et al: 'ICT and Productivity in Europe and the United States: Where Do the Differences Come From?', CESifo Economic Studies, vol. 49, 3/2003, pp. 296-318.

3 The Lack of Harmonisation of Interconnection Markets

3.1 Global Telecommunications Services

The issue of harmonisation and the creation of a truly internal market needs to address the relations on the supply-side between the operators in the markets. In order to be able to service their business customers internationally, providers of global telecommunications services (GTS) must, in most cases, have access to the telecommunications facilities of local network operators. Access markets in Europe are national and will probably remain so for many years to come, and so it is important that other operators should be able to secure access on fair and equal conditions.

Business companies working internationally usually prefer to have one principal telecommunications service operator servicing their communication needs. The services they demand could be the setting-up of secure connections between the different sites of the companies internationally, data management, data storage, etc. This market segment is growing at a faster pace than the telecommunications market in general. Reflecting the key capabilities needed to meet end user requirements in this field, the main operators in this market tend not to be traditional telecommunications operators – though BT is one of the larger players in the field. Other large operators are IBM, EDS, HP and Accenture as shown in Table 1 which presents revenue, growth and market share figures for, what is termed, worldwide enterprise network IT services. The source of the information is Gartner Dataquest, and their estimation is that the global revenue in the market was approximately 130 billion US$ in 2004 and that it is growing rapidly. Their figures also indicate that it is a relatively fragmented market with the largest operator (IBM) having 6.5% of the global market and the 10 largest providers having 27.3%.

Table 1

Top 10 worldwide enterprise network IT services revenue, billion US$, 2004

Rank	Vendor	Revenue	Growth (%)	Market share (%)
1	IBM	8.4	12.7	6.5
2	EDS	4.1	6.3	3.2
3	HP	3.5	12.2	2.7
4	Accenture	3.5	19.7	2.7
5	BT	2.9	24.6	2.3
6	Fujitsu	2.8	11.4	2.2
7	T-Systems	2.7	20.2	2.1
8	Cisco Systems	2.6	9.6	2.0
9	Atos Origin	2.4	13.4	1.9
10	Northrop Grumman	2.2	10.8	1.7

Source: Gartner Dataquest, August 2005
http://www.btbusinessupdate.com/BTBusinessUpdate/Article.asp?ArticleCode=48947579&EditionCode=51224495

3.2 Interconnection Charging

To illustrate the discrepancies in interconnection charging in EU countries, interconnection charges for fixed-to-fixed, leased lines, and unbundled local loop are presented in the following sub-Sections. Figures are taken from the 11th Implementation Report.[17]

3.2.1 Fixed-To-Fixed Interconnection Charges

In fixed-to-fixed interconnection, the differences in charges range from a ratio of approximately 5 to approximately 10. In all three cases of fixed-to-fixed interconnection charging, the UK is the cheapest country and Lithuania is the most expensive. In table 2, the five cheapest and five most expensive countries are listed with respect to local level, single transit, and double transit interconnection.

[17] CEC: 'European Electronic Communications Regulation and Markets 2005 (11th Report)', COM(2006) 68 final.

Table 2

Interconnection Charges For Call Termination On Incumbents' Fixed Network (Peak Time),

Five most expensive and five cheapest countries (in Euro cent), October 2005

Local level		Single transit		Double transit	
LT	2.61	LT	3.48	LT	3.48
SK	1.31	MT	2.80	SK	2.81
CZ	1.05	SK	1.94	MT	2.80
LU	0.92	FI	1.46	AT	2.25
HU	0.83	CZ	1.28	ES	2.14
FR	0.53	DK	0.72	CY	0.96
IT	0.47	EE	0.69	DK	0.91
DK	0.47	CY	0.56	EE	0.85
CY	0.35	SE	0.40	SE	0.72
UK	0.25	UK	0.35	UK	0.62

Source: EU 11th Implementation Report, COM (2006) 68 final, volume II, pages 28-29

3.2.2 Leased Lines Interconnection Charges

In the case of interconnection charges for leased lines, the differences in charges likewise range from a ratio of approximately 5 to approximately 10. At the cheapest end, one finds Greece, the UK, Cyprus, and Finland, while Belgium, Spain, and Ireland are among the expensive countries.

Table 3

Monthly Rental For Leased Lines

Five most expensive and five cheapest countries (in Euro), October 2005

64 kbps part circuit		2 Mbps part circuit		34 Mbps part circuit	
BE	171	ES	596	IE	3,125
SE	164	IE	522	ES	2,772
LT	132	BE	490	IT	2,600
FR	113	LU	384	DK	2,519
NL	104	FR	383	BE	2,204
AT	49	AT	145	EE	743
FI	48	EE	145	AT	721
PT	43	PT	134	UK	715
UK	37	UK	115	FI	692
EL	36	CY	78	CY	331

Source: EU 11th Implementation Report, COM (2006) 68 final, volume II, pages 36-39

3.2.3 Prices for Unbundled Local Loops

With respect to local loop unbundling, the prices for the connection part fluctuate more than those for the monthly rental. In the 11th Implementation Report, the monthly average of total costs per fully unbundled loop and shared access are presented. The monthly costs for a fully unbundled local loop range from 9.3 Euro in Italy to 18.6 Euro in Slovakia, i.e. a ratio of 2, while the costs for shared access range from 2.85 Euro in Cyprus to 14.63 Euro in Slovakia, i.e. a ratio of 5. In table 4, the costs for the five cheapest and the five most expensive countries are shown.

Table 4

Monthly Average Costs per Full Unbundled Local Loop and Shared Access

Five most expensive and five cheapest countries (in Euro), October 2005

Full unbundled local loop		Shared access	
SK	18.6	SK	14.83
CZ	17.9	CZ	9.75
SI	16.5	PL	9.57
IE	16.3	IE	9.13
PL	15.9	AT	8.48
DK	9.9	DE	3.74
LV	9.8	UK	3.34
EL	9.6	BE	3.20
LT	9.4	NL	2.95
IT	9.3	CY	2.85

Source: EU 11th Implementation Report, COM (2006) 68 final, volume II, pages 69 and 71.

3.3 Regulation and Operator Practices

The overall result of the interconnection price comparisons is to show that prices are significantly different from country to country and that – even though there will be differences in the costs in different countries based on differences in labour and power costs, for instance – the size of the price differences cannot be explained by underlying cost variations but must partly be ascribed to pricing policies of the operators offering unbundled services.

In addition to the pricing issue, there are various other aspects which also contribute to the heterogeneity of the European telecommunications markets and which, furthermore, complicate the delivery of global telecommunications services (GTS) for international operators. Examples are ordering processes, provisioning time, co-location conditions, etc. (Surprisingly, given their actual importance in determining the use of an access product, there does not appear to be much comparative cross-border information published). Other factors are the level and kind of regulation in the different countries – essentially, the emphasis that the different countries place on implementing non-discriminatory practices applying to competing operators.

In the annual implementation report by the European Commission, the implementation of EU directives to promote competition is surveyed. In the 11th Implementation Report, a range of key regulatory issues are examined. These are number portability, interconnection regimes, carrier selection and pre-selection, wholesale line rental, LLU and bitstream, and cost orientation.[18] In all areas, there are member states that have not yet implemented all EU directives. This mainly applies to new member states, but there are also older member states that are lacking in this regard, and there are substantial differences in the way rules are implemented. Furthermore, this only tells part of the story regarding differences in the conditions for alternative operators. Not only are there differences in implementation, but the practices on the national markets are even more diverse.

3.4 Standards

Standards also constitute an area of great concern to international operators. Standardisation has been part of the overall policy for harmonising conditions in the European telecommunications market for more than two decades. ETSI was established in 1988 with the purpose of strengthening pan-European standardisation. The basic structure is that standardisation is performed in ETSI (and other standardisation organisations) and that standards are only in very few cases mandatory, i.e. established by political authorities. The European policy institutions can propose and fund standardisation work being performed in different areas. However, the actual standardisation is performed in standardisation organisations involving the interested parties, e.g. commercial players in the field.

In addition to the official standardisation organisations (in Europe, CEN, CENELEC and ETSI in the IT and telecommunications areas), there are a host of international standardisation consortia formed around specific technology developments where the participants primarily are the commercial companies having an interest in these technologies. Furthermore, there is Internet standardisation taking place in the Internet organisations, first and foremost IETF, and there are also important standardisation initiatives coming out of the IEEE context, for instance the 802.11 standards. Moreover, there are proprietary standards which are created de facto in the markets.

Even though this can create uncertainties in the processes of standardisation, the many different standardisation initiatives and organisations, and therefore also standards, are a necessary complement to other conditions on the market. Nevertheless, differences in standards are a challenge to operators working in different national environments. It is, therefore, necessary to continue fine-tuning and adapting the understanding and policies relating to technology developments, competition, liberalisation, standardisation, and globalisation. The European Commission seems to be aware of the importance of these concerns and has launched a strategic review of the European ICT standardisation policy process.[19]

[18] CEC (2006) *European Electronic Communications Regulation and Markets 2005* (11th Report), COM(2006) 68 final, volume I.

[19] COM(2004)674 final on 'The role of European standardisation in the framework of European policies and legislation'

4 Trends in the Internationalisation of Services and Markets

4.1 The Internationalisation of Telecommunications Markets

One of the original background drivers of the European policy of liberalisation and harmonisation of telecommunications was to be able to compete with the US and Japan in this area. The anticipation was that a policy of liberalisation and harmonisation would lead to greater innovativeness and that the relaxation of the close connections between the national incumbent operators and the national/regional equipment manufacturers would lead to bigger and more internationalised manufacturers. This aim has certainly been met. There have been several shakeouts among equipment manufacturers and only a few large manufacturers with a European point of departure are left in the market – first and foremost Alcatel, Ericsson, Nokia and Siemens (the last two may be on the point of merging) as well as a large number of SMEs.

Equipment production is thus genuinely internationalised. Also backbone connectivity has become internationalised with a number of international backbone-only providers and incumbent fixed-line companies operating international backbone networks. However, when it comes to physical provision of last mile and backhaul access or mobile termination, the European telecommunications market mostly consists of national markets.[20] These national markets are characterised by the dominance of one national incumbent in land-line communications and 2 to 5 network operators in the mobile field.

In the case of international telecommunications networks provided to major business customers, these will typically be provided by a single operator across borders, but that operator will buy network components from other operators, where necessary to extend its network reach. For telecommunications companies that provide international services to business customers, the implications are that they are heavily dependent on the national access providers and on the conditions these providers offer to interconnecting alternative operators.

Although the local access input is based in a national market, it is an input to services that are offered on a cross-border basis. Traditionally, services have been considered as less tradable than goods, but any simple demarcation along these lines between goods and services, particularly in telecoms, is outmoded. Telecommunications operators compete across borders to supply ICT platforms to customers who themselves operate across national boundaries using these ICT platforms.

[20] It should be remembered that this applies to many different markets. Goods are also sold at different prices in different national markets even though the costs are similar. Prices and offers are differentiated according to the local circumstances. But telecommunications is an extreme example of this.

4.2 Modes of Internationalisation

The international business users, which this report is especially interested in, are predominantly the international providers of services. Services constitute on average approximately 70% of GDP in the economically developed countries but only make up approximately 20% of global trade. However, in terms of foreign direct investments (FDI), services constitute 55-60% of the stock of all FDI. The reason for this disparity is that many services are difficult to trade internationally. Without going into a long-winded discussion on the definitions of services – and the many exceptions to such definitions – the basic historical difference between goods and services is that goods could be separated more easily from the immediate producers and sold on anonymous markets, while production and consumption of services often took place simultaneously and, therefore, required a close relationship between the producers and users in the production/consumption phase. The result is that services tended to be more locally/nationally bound than goods.

However, increasing digitisation is leading to services becoming more tradable particularly as a great deal of such trade is based on information. The UK Finance Ministry has recognised this trend in a document on the strategic orientation of the UK economy:

> "The ICT revolution has intensified international trade in services, extending the frontiers of international competition into sectors that were once sheltered. Traditionally, international trade in most services has not occurred because such services were thought to require buyers and sellers to be in the same place at the same time. Many services, however, do not require physical proximity, but have usually taken place face-to-face because of technical constraints, habits or customs. Such services involve the exchange, storage, processing and retrieval of information. Production and consumption of services can now be separated through the standardisation of process and the capacity for data storage or because geographical distance is not a barrier for the simultaneous production and consumption of services, for example through call centres … use of ICT enables information to be codified and digitised. This information can be stored and exchanged in electronic form, and allows services that use it to be provided remotely, often much more cost-effectively than they could be locally. Such services range from simple data-handling activities to services that involve the application of a high degree of skill. Thus advances in ICT have solved the technical problem of transporting and storing many services."[21]

It should also be noted that trade (defined as a product crossing a national border) is only one of four different basic modes of internationalisation – the three others being foreign settlement, movement of customer, and movement of producer[22] (in international trade statistics, the two last-mentioned modes are counted as trade in addition to traditional trade).

[21] HM Treasury: "Long term global economic challenges and opportunities for the UK", p.14

[22] There is, indeed, a multitude of different forms of internationalisation, for instance international alliances. However, the four modes mentioned above are the ones used by WTO in their negotiations and agreements.

This Report addresses the implications of ICT for the internationalisation of services. First, it needs to be mentioned that some of the most important implications of ICT are the same as with respect to goods, i.e. the use of ICT in marketing (websites, etc.) and in the contacting and contracting between traders. Secondly, ICT is important in improving communications between different departments/affiliates of international companies or between international alliance partners. And, in the case of movement of producers, for instance international consultants, ICT is also important for organising work processes. Finally, ICT can be used as a means of transportation for information services. Once information is digitised, it can be transported on communication networks – nationally and internationally – and thus be traded easily. In fact, information services can potentially be traded even more easily than goods – taking cultural barriers into consideration – as the costs of transportation are low compared with the transportation of goods.

In the research literature, the most productive period in terms of research on the implications of ICT for the internationalisation of services was in connection with the Uruguay Round of trade negotiations in the late 1980s and early 1990s, where services for the first time came on the agenda of GATT/WTO. The general expectation was that trade in services would increase once trade agreements resulted in liberalisation of trade in services and once ICT was increasingly implemented in services. Increases in trade in services have, indeed, been witnessed – but no more than in the trade of goods. Trade in services has consistently, for many years, constituted approximately 20% of all global trade, meaning that trade in services has not increased more than trade in goods. In that sense, and knowing the special affinity between communications services and many service industries (either as a means for organising the workforce or as a means of transportation for information services), it might be said that there is a "trade paradox" as in the case of the Solow productivity paradox. The productivity paradox has in the last few years been 'solved' in the sense that ICT investments can now be seen in the productivity statistics. However, with respect to trade in services, the significance of ICT has not yet been confirmed at the aggregate level.

4.3 Trade

Europe (EU25) is 'doing better' than, for instance, the US and Japan in the sense that external EU25 trade in services constitutes 26% of total external EU25 trade, while the comparable figures for the US and Japan are 21% and 19%, respectively.[23] The UK in particular, but also the Netherlands and Denmark, are strong in trade in services. Approximately one quarter of total external EU25 exports of services comes from the UK, and the UK has a massive surplus on its service trade balance – of the 42.8 billion Euros trade surplus of EU25 in 2004, 82% is attributed to the UK.[24] These are also countries where the regulatory regime for access to the incumbent networks tends to be assessed as comparatively strong.[25]

[23] Eurostat: Op.cit. p. 8.

[24] Ibid. p. 13.

[25] Reference needed to ECTA Report

The larger share of EU service trade is internal trade among EU countries. Of the approximately 857 billion Euros service exports of EU25 countries in 2004, approximately 494 billion Euros was internal EU25 exports.[26] However, with respect to the development in service exports EU-externally and EU-internally, it is surprising to see that they have developed at the same pace. From 1996 to 2004, EU15 internal service exports have increased 84%, and the figure for EU15 external service exports is likewise 84%.[27] This could be interpreted in different ways, either in a positive way concluding that EU countries have been as successful on the world market as on the internal EU market, or in a negative manner that the EU has not succeeded in expanding the internal EU service market any more than it would have expanded anyway.

A comparison of service and goods trade also documents that internal service trade is not developing as fast as could have been expected (or hoped for). On the basis of Eurostat figures, the development of intra and extra EU trade in services and goods has been calculated.[28] The calculation (table 5) shows that the ratio between internal and external trade is significantly smaller in the case of services than in the case of goods and, furthermore, that the ratio between internal and external trade is constant for services while increasing with respect to goods. This illustrates that the internal EU market is a far greater success in the case of goods than in the case of services.

Table 5

Intra- and Extra-EU15 Trade In Goods and Services, 1995-2004

		1995	2000	2004
Goods	Intra-EU15 as % of GDP	15.0	19.3	18.6
	Extra-EU15 as % of GDP	8.6	9.6	9.4
	Ratio intra/extra	*1.7*	*2.0*	*2.0*
Services	Intra-EU15 as % of GDP	3.31	4.27	4.50
	Extra-EU15 as % of GDP	2.67	3.58	3.71
	Ratio intra/extra	*1.24*	*1.19*	*1.21*

Source: Daniel Gros: 'EU service trade: Where is the single market in services?', CEPS, 2006.

[26] Ibid. p. 21.

[27] Ibid. pages 39 and 44.

[28] Daniel Gros: 'EU service trade: Where is the single market in services?', 13 February 2006.

When examining the different sub-categories of services, the picture is more mixed (see Table 6). Extra EU15 transportation has increased substantially more than intra EU15 transportation. Sea transport has in particular been growing. With respect to travel, it is the other way round, which reflects the fact that internal EU-travel has risen more than non-EU citizens travelling to EU countries. Concerning other services, some intra EU15 exports have increased more than extra EU15 exports. This especially applies to communications services and insurance services, while the opposite, surprisingly, is the case with miscellaneous business, professional and technical services – especially the sub-categories shown in table 6. Much more research is necessary to understand the causes for the variation between these different sectors.

An open question is whether the internal market for services functions better in the US than in the EU. In the area of productivity, comparisons with the US fuel a great part of the discussions on the productivity problems in the EU. The internal trade question is, however, difficult to determine, as internal US trade is not recorded – as in the case of internal German or UK trade, for instance. Only nationally external trade is recorded.

One hypothesis could be that there is a higher level of internal trade of goods as well as services internally in the US compared to the EU, as the US to a far greater extent is a united market. One indirect indicator of this – as internal trade is not recorded – could be an increased concentration or clustering of industries in the US in comparison with the EU. However, direct comparisons hardly exist. One direct comparison of computer industries in the US and the UK has, however, been made by Rui Baptista and Peter Swann.[29] But the conclusion is that there is no evidence that clustering effects are weaker in the UK than in the US. The only certain conclusion that can be drawn is that far more research is needed in this field.

Regarding the implications for ICT of these developments, a solid conclusion on this would require a bottom up comparison of ICT investments and their use in the same business sector categories as in the trade figures. This would allow consideration of the role of ICT alongside many other factors, such as legal or cultural factors, which also influence trade developments. It does seem to be the case that there is some correlation between sectors where ICT plays a larger role (in information intensive services, such as insurance) and higher growth while in sectors that are less ICT intensive (e.g. construction) trade has grown less or reduced. On the other hand, other sectors that would also appear to be quite ICT intensive (e.g. business, professional and technical services) appear to have lower than average growth rates. However, we cannot currently estimate how much higher growth might have been in the absence of barriers.

In the following Section, a service industry case is considered in order to illustrate the implications of ICT for internationalisation.

[29] Rui Baptista and Peter Swam: 'A comparison of clustering dynamics in the US and UK computer industries', Journal of Evolutionary Economics, volume 9, number 3, August 1999, pp. 373-399.

Table 6

Intra and Extra EU15 exports from 1996 to 2004

	Export increase 1996-2004 Intra EU15, %	Export increase 1996-2004 Extra EU15, %
SERVICES	84	84
Transportation	46	82
Travel	62	35
Other services	124	108
Communication services	232	100
Telecommunication services	132	38
Construction services	-9	-2
Insurance services	248	90
Financial services	154	148
Computer and information services	593	449
Misc. business, professional & technical services	112	116
Legal, acc., man., cons. and public relations	257	221
Adv., market research and polling	77	119
Research and development	47	185
Architectural, engine. and other tech.	48	64
Personal, cultural and recreational services	107	129

Source: Calculated on basis of Eurostat: 'European Union international trade in services: Analytical aspects', European Commission, 2006, pages 41 and 44.

5 Service Industry Case – Engineering Consultancy Services

5.1 The Nature of Engineering Consultancy

Engineering consultancy is a 'people business' in the sense that approximately 80% of the costs are manpower costs. The question is how ICT affects the development in this business area, i.e. how ICT supports and changes the business processes and activities, which can be codified and digitised and communicated on telecommunications networks. This includes the issue of the role of ICT in the internationalisation (trade and foreign settlement) of engineering consultancy services.[30]

Engineering consultancy has until recently been to a large extent a national business. This, of course, changes from country to country in the sense that engineering consultancy service companies from countries with a strong international (e.g. colonial) legacy, such as the UK and France, have had a more international profile than companies from countries with a weaker international outreach. However, engineering consultancy has started to become generally more international during the past 10-15 years. The most important drivers of this internationalisation are: (i) the tendency to follow customers abroad; (ii) in the EU context, the EU public procurement rules; (iii) the fact that size and global experience become more important in getting contracts; (iv) the need to enrol highly qualified labour power; (v) international engineering standards; and (vi) ICT.

5.2 The Internationalisation of Engineering Consultancy

The internationalisation of engineering consultancy services partly depends on consultants travelling abroad to perform their consultancy operations. Foreign establishment and/or partnering and alliances are other ways of having an international outreach. Finally, engineering consultancy services can be exported, in the genuine meaning of the word with products crossing national borders. This happens when consultancy advice is delivered on a medium, either paper or in a digital format. In all cases, good communications infrastructures are important. The work of the consultant 'in the field' can be improved with better contact with the 'home base'. The organisation of the work processes and the possible divisions of labour between different establishments can also be strengthened by means of communications services. Moreover the potential for increasing genuine exports are greater with the digitisation of drawings and models and calculations and with efficient communications infrastructures.

The aim of this report is not to discuss which of these modes of internationalisation will gain prevalence. However, the likelihood is that they will all develop and support one another. And, given the fact that internationalisation in the area will increase and that, despite digitisation of work processes and results, engineering consultancy will still, primarily, stay a 'people business', it is also likely that foreign establishment will play a central role. This will allow engineering consultancy companies to build new business areas, to acquire an international presence and size, and to tap into the qualifications of employees in other countries.

[30] This Section partly builds on work performed for UNCTAD on the tradability of consulting services (see, UNCTAD: 'The tradability of consulting services', Geneva, UN, 2002) and on research into the work processes of the engineering consultancy company Ramboll.

5.3 Case Study

An example of an engineering consultancy company, which has increased its international (or at least, regional) presence, is the company Ramboll, which has a Danish point of departure. The engineering consultancy companies in the Nordic countries are relatively large when taking the size of the countries into consideration. Among the 50 largest engineering consultancy companies globally, 5 of them have their base in the Nordic countries and Ramboll is the second largest among the Nordic companies. Ramboll considers the whole Nordic region as its home market and divides its markets into three zones: the Nordic home market; the Baltic region, Russia and Ireland; and the rest of the world. Ramboll has approximately 90 local offices in the Nordic region and 50 in the two other market zones. The business philosophy is that local presence is necessary, epitomised in the slogan 'Local partner – global knowledge'. It is the experience of the company management that it is relatively difficult to provide consulting for customers in foreign countries because of the lack of local knowledge. However, having local offices allows the company to have the necessary local knowledge and at the same time take advantage of the knowledge in offices in other countries. Knowledge can be transferred internally in the company between its different affiliates.

This is one of the areas where high quality and inexpensive communication infrastructures are important. Engineering consultancy work uses tools requiring high bit rates when transferred, for instance CAD drawings and, even more so, 3D models, which are presently being implemented. The requirements of engineering consultancy companies will, therefore, be for a high bit rate, high quality, and reliable but as inexpensive communications services as possible. The key word is seamlessness and, in reality, 'invisible' communications infrastructures.

The communications policy of Ramboll allows the different business units to use different communications providers and solutions. The merger into the present Ramboll-corporation is relatively new and different systems have, therefore, been joined. The common platform is MPLS (Multiprotocol Label Switching) and VPN (Virtual Private Network). Concerning the physical access networks, fibre and DSL are generally used – fibre for larger sites and DSL for smaller sites.

Between the main business units of the company (Ramboll Denmark, Ramboll Finland, Ramboll, Norway, Ramboll Sweden, Ramboll Management, and Ramboll Informatik), the Danish telecom incumbent TDC is the main provider. In the case of Ramboll, TDC thus functions as the main GTS providing international connectivity among the business units internally. However, other providers are also used.

6 Conclusions

6.1 The Internal Market

The establishment of an internal European market has been on the policy agenda for decades. This applies, in general, to all goods and services (and capital and labour power) and more specifically, during the past 20 years, to telecommunications services. It also applies to the understanding of the role of an internal market for telecommunications services as a driver for the internal market for other goods and services. The basic conception is that an internal market will lead to an increased division of labour and the efficiency gains that this will entail and that seamless inter-European telecommunications infrastructures are an important means to this end. The overall question in the present paper is how far Europe has come in terms of the harmonisation of its markets for telecommunications services and what the implications are for the internal market for other goods and services.

The paper focuses on the internationalisation of services, as this is an area where the internationalisation is 'lagging behind' – at least as compared with goods. Even though services constitute more than 70% of GDP in the EU countries, service trade only makes up approximately one quarter of total European external trade. This, in itself, is a cause for concern – even though Europe in the service area is 'doing better' than the US, as the external US service trade only constitutes approximately one fifth of all external US trade. However, the basis for comparison should not be the external trade percentages but the internal US and EU trade rates. This can only add to the concern regarding the development of the internal market. From 1996 to 2004, the increase in internal EU service trade is at the exact same level as the increase in external EU service trade. The increase is, in both cases, relatively high at 84%. However, the fact that the figure is the same in both cases could indicate that there is no special internal service market developing in the EU. This is emphasised by the fact that the ratio between intra and extra EU trade is bigger in the case of goods than in the case of services and that the ratio has been increasing for goods but not for services.

6.2 The Impact of ICT and Telecommunications Services

Trade is not the only mode of internationalisation. Foreign establishment or movements of producer or customer are other forms of internationalisation. With respect to trade as well as foreign establishment, information intensive activities seem to play an important role. In the case of off-shoring, it is often information intensive activities such as finance, accounting, IT support and human resources which are being located abroad. In the case of trade, the increases in the internal EU trade in information intensive service is, generally, at a considerably higher level than service trade in general. This could be an indication of the role played by ICT in increasing the internationalisation of information intensive services.

In the case of information intensive services, ICT can fulfil a special role. The use of ICT has implications for the internationalisation of all goods and services. Transaction costs can be lowered and communications between affiliates and partners can be improved internationally. However, ICT has an additional role in relation to information intensive services, namely to function as a means of transportation of information services. To the extent that information services can be codified and digitised, they can be transported on communications networks and thus more easily internationalised.

This leads to the examination of the situation in the European telecommunications markets. The European telecommunications policy has been to facilitate the creation of a truly European (and international) market for telecommunications equipment. Backbone infrastructures are, furthermore, highly international, and services are also potentially (and with respect to Internet, actually) internationalised. However, access markets are, largely, national. This poses a problem in terms of harmonised access conditions on the European market.

The market for global telecommunications services (GTS) is a rapidly growing but also relatively fragmented market. However, the continued growth of the GTS market will depend partly on the access conditions offered to operators in this market. In this context, the paper documents that interconnection charges are very diverse among European countries. Furthermore, the paper discusses the problems related to the differences in technical standards used. The basic issue is that while service markets increasingly are international, the access markets are national, and if a harmonised European service market is to develop then it is likely that access markets need to be harmonised to a higher degree.

Seen in a historical perspective, the conditions in the European markets have vastly improved since the 1980s when industrialists complained about telecommunications connectivity. At that point of time, business users could have difficulties just getting international connectivity. At present, the issue is the quality and price of connectivity. The overall conclusion must be that the conditions for international operators have improved during the past couple of decades, but that there are still problems to be solved with respect to the access conditions for alternative operators to the access infrastructures of local/national network operators and the often very heterogeneous conditions for end users. Problems regarding access conditions for alternative operators make it more difficult than otherwise for such operators to service customers in foreign countries, including business customers with an international outreach.

6.3 Proposals for Further Research

With respect to trade, the paper raises the question as to whether there is a “trade paradox” (like the former productivity paradox) with ICT being used without any visible effects on service trade. However, the paper documents that trade in information intensive services has risen more than trade in non-information intensive services. This could indicate a positive effect of the use of ICT. However, much more research in this area is required. While much academic work has been performed on the implications of ICT on trade from a qualitative point of view, there is very little information on the quantitative correlations between ICT use and trade. This is also reflected in the Lisbon agenda and the i2010 initiatives and the analyses on which this agenda is based. There the focus is on productivity and growth. But little is said about trade and internationalisation in general and the effects that ICT could have on the establishment of an internal market and the effects that might have in turn on productivity and growth.

There are three major interconnected research themes which could further enlighten the issues that have been examined in the present report:

- The internationalisation of services;
- The implications of ICT and specifically telecom networks and services on the internationalisation of services; and
- The importance of regulation to the operation of global telecom service providers.

The first theme – on the internationalisation of services – is extremely important, as it seems that the development of the internal market for services in the EU is witnessing a range of problems. Research on service internationalisation has been on the agenda for a long time now, but much more research is needed on the factors affecting the internationalisation of services. While considerable effort has been expended during the past few years to start documenting trade and foreign investment in services, much more work in this area is still needed. However, equally important is the requirement to address and analyse the determinants of service internationalisation. It would be especially helpful to formulate measures of the international divisions of labour in services, for instance clustering of service industries, which will facilitate a comparison with the geographical divisions of labour in the internal US market, where there are no internal trade statistics.

The use of ICT and specifically telecom networks and services will facilitate trade in services as well as foreign establishment. However, in spite of this fact, there could be said to be a 'service trade paradox' – as the productivity paradox a few years ago. Even though there is a special relationship between information intensive services and the use of ICT, service trade develops more slowly than the trade in manufacturing goods in the internal EU market. This calls for further research and it would be especially productive to examine the quantitative relationships between trade in services and the use of ICT. Lately, an increasing amount of information on the quantitative relationships between the use of ICT and productivity developments has been produced. Similar information on ICT and service trade would be helpful for the policies for furthering the development of the internal market.

An issue which has hitherto received very little attention research-wise is the development of international network services (GTS) used by international companies. The internationalisation of telecom operators has been and continues to be studied. However, the means by which international operators are able to operate a multitude of foreign markets is a topic which is very under-researched. This field should include an examination of how these markets develop and also on the implications of regulation for the development of these markets.

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The Extent of Competition in Serving Business Customers from Fixed Infrastructures

A Report Prepared by BT and Ovum*

PURPOSE of REPORT

Businesses and public sector organisations make extensive use of fixed infrastructures to build their data and voice networks. Wireless solutions also have an important role in providing connectivity for businesses albeit mainly for rather different applications and circumstances.

The purpose of this Report is to assess the extent of competition for business access services provided over fixed networks to assess whether relaxation of wholesale obligations on incumbent operators is appropriate. Put another way, is the stance of – 'one rung on the ladder of investment' represented by LLU adequate to meet current and future needs of businesses?

This Report examines the evidence for competitive fibre networks and the use of LLU to provide business services. It concludes that the natural economies in access place significant limits on the scope for alternative fibre-based infrastructures. For similar reasons, the widespread use of LLU to serve dispersed business sites is generally an unlikely proposition.

There is therefore a need to continue with regulated wholesale access services in most locations to serve businesses including leased lines and bitstream access.

Looking ahead, the advent of NGA networks and the possible demise of copper networks will make the provision of wholesale access products even more important. This is because competitive entry is likely to be rendered less feasible by the increase in the economies of scale and scope which will likely result from the higher access capacity available from NGA networks.

* The participation in this study by Ovum is limited to this Report. In addition, some information contained in this Report is quoted as sourced by BT which alone takes responsibility for its accuracy.

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Executive Summary

The following are the key conclusions which are covered in more detail in the subsequent sections:

The Availability of Alternative Fibre Based Networks

- Major centres throughout the EU attract multiple networks provided by operators who are frequently multi-national and focussed on providing services to large multi-site customers. Outside these centres, alternative networks are limited in number and often provided by operators focussed on local or regional needs only.
- The existence of an alternative network in a particular centre or region does not in itself mean that it is able to provide access for multi-site customers, either because it may not serve particular sites and it may not offer wholesale business services to third parties at all.
- The nature of multi-site customers means that many of their sites are outside the major centres served by alternative network providers.
- Alternative fibre-based infrastructure networks are only likely to be able to provide connectivity to a limited number of business sites (perhaps up to a third in the more competitive Member States). In many cases therefore the only potential provider of access is the incumbent.
- For a service provider to serve multi-site customers, access will invariably need to be purchased from the incumbent even if some sites can be served by alternative network providers.

This means that alternative networks are far from ubiquitous, and so provision of a service to multi-site business customers implies a heavy dependency on sourcing access from incumbent operators.

Local Loop Unbundling (LLU)

- LLU is currently focussed on the mass consumer market and there is limited supply for multi-site business use.
- The limited bandwidth available with LLU makes it less suitable for large businesses which typically have high bandwidth requirements and more stretching service standards such as repair time and resilience.
- The economics of LLU are strongly density driven, making it viable only in areas of the highest density of demand which tend to be in residential areas.

This means that LLU is unlikely to be anything more than a niche product for serving business customers.

Outlook for Fixed Infrastructure Competition

The following inferences can be drawn:

- There is little prospect that the scope of alternative fibre networks will increase in the short to medium term to materially affect the current situation of limited direct competition outside major financial and business centres.
- Some studies and initiatives are taking place to assess whether alternative regulatory models like duct sharing may assist in reducing network build costs and lowering the risks of access investment, but the effect of such measures is far from certain.

- The extension of fibre by incumbents deeper into their access networks will impact on the economics of providing alternative networks, particularly to provide services to businesses.

This means that developments are unlikely to change the current situation significantly with regard to the availability and suitability of alternative networks and LLU for business customers.

Regulatory Implications

- Business customers, like consumers, need a choice of services and suppliers. The current regulatory policies of encouraging alternative networks, wholesale access services provided by incumbents to service providers and (to a degree) LLU, all promote customers choice.
- For the foreseeable future, services to business customers will continue to require a mix of access services from alternative networks, wholesale offerings from incumbents, and in limited cases, from LLU.
- Wholesale bitstream access and leased line type services should therefore continue to be generally provided by incumbents for the provision of business customers to operate corporate applications across their networks.

1 Introduction

The Report reviews the status of access markets in the European Union from the point of view of business users of Electronic Communications Services (ECS).

This study is particularly concerned with businesses which have multi-sites i.e. they require connectivity of all of their sites, irrespective of their precise locations and independently as to whether directly competing access infrastructure is present at those sites or not. This is described as a requirement for ubiquitous connectivity. [1]

Associated Reports in this study ('The Use of Access Technologies' and 'Innovation and Business Connectivity') show that:

- Fixed networks will work largely in a complementary fashion with wireless networks and significant substitution between them will not occur for the foreseeable future.
- Access to wholesale services across the fixed platforms will have major implications for a wide range of businesses to benefit from universal connectivity.

These firms have exacting requirements for access services across both fixed and wireless platforms and they play a pivotal role in the digital economy. The regulatory remedies for sustaining competition in the provision of services to such firms and public sector organisations are therefore critical.

The European Regulatory Framework (ERF) requires the National Regulatory Authority (NRA) to conduct an assessment of competition in each relevant market to identify the possible existence of Significant Market Power (SMP). Where SMP is found, the NRA must apply a remedy, which may involve the mandatory provision of access to the SMP operator's network.

The current list of relevant markets includes a number of wholesale access services and this Report is concerned with the adequacy of these services to promote competition in the downstream markets for the provision of services to multi-site businesses and public sector organisations.

Many NRAs have specified several forms of regulation of fixed access platforms as remedies under the ERF. However, there have also been proposals to reduce the number of regulated broadband access services in order to promote incentives for alternative ECS providers to develop competing facilities. These proposals are generally made in the context of the provision of services to mass market consumers and not to businesses.

[1] Ubiquitous connectivity refers to the requirement of firms to seamlessly connect all their sites and nomadic workers together in intranets, and for these individual intranets to be cross-connected to those of other firms through extranets. A significant proportion of the value of such services consists of the software based solutions combined with the connectivity. Such connectivity is usually supplied in response to tenders for multi-site connectivity. An operator that is unable to supply connectivity simultaneously to every site will be excluded from bidding to service any site. Consequently, investment in competing networks providing business services is only rational where these new networks can be complemented by access inputs acquired from the ubiquitous operator.

The so-called 'ladder of investment framework' is mentioned in the "Remedies Paper", by the European Regulators Group (ERG).[2] The paper encourages NRAs to distinguish between different parts of an ECS network in terms of their potential for competition: the closer the facilities are to the end-user, the harder it is to obtain economies of scale and density and therefore the less likely it is that competition will develop. The ladder of investment framework suggests that by initially specifying "long" access remedies, an NRA can encourage entry by alternative suppliers who might then develop their own facilities as they gain scale and scope.[3]

Some commentators have also suggested that regulators should proactively encourage new entrants to 'climb the ladder of investment' by signalling the removal of access obligations and thereby to provide competitors with an additional spur to develop their own facilities. Following this line of reasoning, NRAs should replace existing 'long' access remedies with Local Loop Unbundling (LLU) because it is 'short' and requires alternative operators to invest in their own facilities.

In most regulatory analyses of the ladder of investment, mass markets (consumers) are not considered separately from businesses.

This Report will demonstrate that failure to make this distinction is potentially extremely serious in that:

- Alternative fibre-based Metropolitan Area Networks (MANs) are likely to be significantly limited in scope in providing connectivity to anything more than a limited number of business sites (at most a third in those Member States with the most competitive telecommunications markets); and
- LLU is unlikely to be anything more than a niche product for serving these businesses with the types of services they require now and in the future as demand for bandwidth increases.
- Wireless technologies and cable networks are not likely to be substitutes for services across fixed networks of incumbent operators for their key applications of company and Internet connectivity.

Consequently, maintenance of wholesale bitstream access and leased line type services on a reasonably ubiquitous basis will continue to be essential, even if LLU does prove to be successful for delivery of services to mass market consumers.

This Report develops the case for this policy conclusion as follows.

Section 2 examines the evidence on the scope of competing fibre-based infrastructures to serve business customers, drawing on detailed information in Germany, Spain and the UK.

Section 3 considers whether, from the point of view of business users, ECS regulation in Europe should move towards Local Loop Unbundling (LLU) as the sole form of regulated access. In other words, whether access to the full copper loop (or multiple bonded copper loops) will be adequate to provide the equivalent functionality of leased line access.

Section 4 assesses whether there is the likelihood of substantial new infrastructure-based competition from the widespread deployment of MANs and the potential implications of extended fibre in access networks from Next Generation Access Networks (NGAs).

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[2] Available at www.erg.eu.int ERG (06) 19.

[3] "Long" in terms of the distance over which interconnecting traffic is conveyed before handing it over to the access seeker's network.

2 The Location of Business Customers and Competitive Infrastructures

2.1 Background

In an ideal world, there would be competitive fixed infrastructures capable of more or less independent operation with each access operator having their own access networks (copper, fibre, co-ax etc).[4] In practice, fibre networks are not extensive in the EU in the sense of geographic spread. The main alternative fixed infrastructure provided by the cable operators have not in the main targeted businesses either, as their principal strategy is focussed on multi-play offerings for consumers.

Competitive infrastructure supply for businesses is not widely available and the amount of competition also varies within and between different Member States of the EU. It is beyond the scope of this paper to examine in detail the reasons for this situation in all Member States and as illustration four case studies are provided below which include evidence from France, Germany, Spain and the UK. These illustrate the limitations of alternative networks and the situation at a generic level for the EU.

Businesses are of many sizes and are not all concentrated in city centres. There is also some variation across the EU in the profile of business types. Germany has many medium-sized firms while the UK has a relatively small number of fairly large firms. Spain has few larger multi-nationals but a more dispersed set of businesses. All countries have companies which are dispersed to greater or lesser degrees.

Information on the precise number of customers which have multi-site requirements can be deduced as important from a number of sources. For example, France Telecom published[5] the following statistics relating to their business customers:

- 19,000 principal large consumer sites have leased lines with bandwidth of 10 Mbit/s to 10 Gigabits, mostly in 10 major cities.
- 200,000 secondary sites in the range of 500 kbit/s to 20 Mbit/s are served by a mix of copper and fibre.
- 300-500,000 small sites are served by copper-based xDSL services.

According to the UK Office of National Statistics, there were an estimated 4.3 million (private sector) businesses trading in the UK at the start of 2005.[6] Small businesses (those with fewer than 50 people) accounted for 99.3% of the total, producing 47% of private sector jobs and 36% of all business output (turnover). Just 0.6% of businesses (26,000) are medium-sized (50-249 people), representing 12% of private sector jobs and 15% of output. The largest companies (with over 250 employees) make up only 0.1% of all UK businesses (6,000 in total), but provide 41% of private sector jobs and 49% of private sector economic output. Public sector organisations are similarly highly concentrated in their purchasing behaviour across large national and regional authorities and Non Governmental Organisations.

[4] There may however be grounds for promoting facility sharing in some circumstances.

[5] Page 63 of "L'evolution des activites fixes voix et donnees en France" of 10 June 2003. Source: http://www.art-telecom.fr/uploads/tx_gspublication/projdec-arcep-06-0592.pdf

[6] http://www.sbs.gov.uk/SBS_Gov_files/researchandstats/SMEstats2005pr.pdf

The statistics show that a large portion of the population work in large companies and these tend to be multi-site businesses. These 6000 businesses (and a significant number of the medium sized companies) tend to have multiple sites. In some cases this is many thousands of sites, as for example with large retail organisations. The larger number of large business customers (compared with Spain for example) make the UK an attractive target for business service supply and more likely to have a high level of business-focussed access deployment. The comparative geographic concentration of economic activity in telecommunications UK makes access competition more viable in any case.

As mentioned above, any evaluation of appropriate regulatory strategy should take account of the special requirements of ECS providers serving business customers, particularly the need to provide connectivity across multiple sites where competitive conditions may differ substantially. The crucial point is that the inability to provide connectivity at a single site might be sufficient to disqualify a service provider from consideration for supplying a multi-site business customer.

To illustrate these themes, the following sections outline the scope of alternative fibre networks and provide illustrations of the geographic dispersion of customer sites.

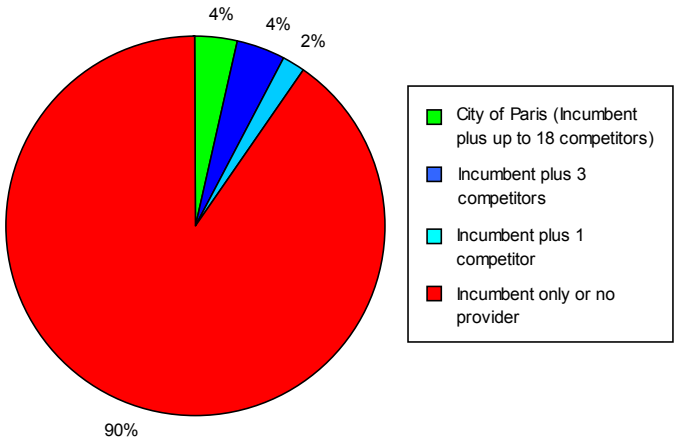
2.2 Metropolitan Area Networks in the EU

MANs tend to be highly concentrated; multiple operators tend to go to the areas of highest demand and few operators will be present outside these areas.

Outside the conurbations such as Amsterdam, Brussels, London, Paris and Frankfurt, market entry is often by operators which have only a regional focus with only the incumbent having universal coverage. As an example, Figure 1 shows the presence of MANs in France. There are many entrants in Paris but very few outside. Major populations will not be covered by competitive fibre networks at all. This general pattern is common across most of the EU.

Figure 1

Coverage of Business Fibre Access Operators (by population)



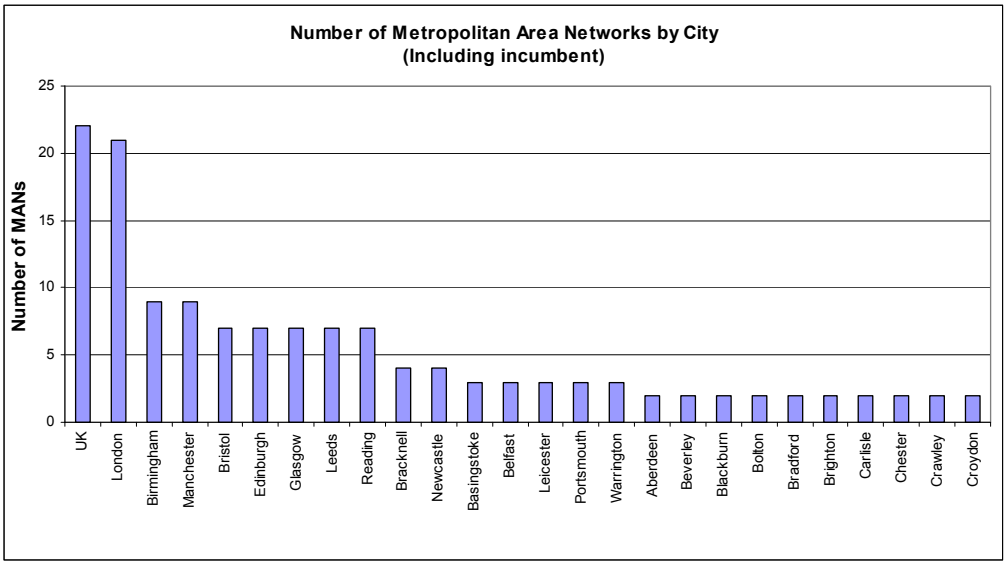
Source: BT

This chart indicates that on the basis of population, which will be correlated to a degree with the number of businesses, only very small areas of France are accessible by competitive fibre networks.

This is also clear in the UK, where the major business and financial conurbations and those areas which have large financial activities tend to attract multiple rival networks. This can be seen in Figure 2 below which shows the number of MANs for a selection of cities and the identification of the serving operators in those cities.

Figure 2

Number of MANs by City in the UK



Source: BT

This Figure shows the number of alternative fibre networks including that of the incumbent present somewhere in the towns and cities indicated. For example, in Croydon (far right hand side) there are two operators while in London (far left hand side) there are over 20 operators. Presence does not imply that the network is widespread in that town, apart from that of the incumbent.

Although the larger cities (London, Edinburgh, Birmingham, Manchester, etc.) have seven or more alternative networks which typically are multi-national operators, a large number of substantially sized cities (Blackburn, Bolton, Chester, Croydon etc.) have only one operator besides the incumbent. This operator is more likely to be a regional or just UK operator and not a multi-national operator. A large number of towns and cities do not have any alternative entrant at all.

The fact that different entrants may be the only competitor to the incumbent in some towns means that sourcing network access across a range of locations can be expensive and in many cases simply impossible. Not all entrants choose to provide wholesale access as the cost of systems development may be high and the commercial case for wholesaling access services relatively weak. (This issue is discussed in more detail below in the context of LLU entrants).

Further, these simple representations of presence (a MAN) do not show the extent of genuine competition, nor whether a wholesale offer would be made. A MAN may represent a reasonably extensive fibre network or it may consist of a very limited network which is little more than a Point of Presence (PoP) which has been installed to meet the requirements of one particular customer.

Hence even where a city is listed as having a number of access providers, this should not be taken to imply that all businesses within that area have such a choice. The network may only cover a city centre and not suburban or peripheral areas. This can be seen by examining the network maps published by UK ECS provider, Energis, before it merged with Cable and Wireless (C&W).

Figure 3 below shows the maps of two of Energis' MANs: one in Leeds, and one in Basingstoke. Energis' Leeds network is reasonably extensive but the one in Basingstoke is very sparse. Therefore, whilst Energis would be reported as having a MAN in Basingstoke, in reality a considerable proportion of business customers in this area would not be in a position to take service from them without third party access.

Figure 3

Illustrations of the Energis Network

Source: Energis

These diagrams show the presence of the Energis network in two towns. The white marks on the left hand side indicate a reasonably extensive network in Leeds while the very limited line on the right hand side shows a restricted network in Basingstoke.

On the basis of these network maps, it is possible to estimate the proportion of UK business customers that would be in a position to take service directly from Energis. Based on detailed geographical analysis, BT's analysis suggests that approximately 4% of business sites in the UK are within 500m (a realistic maximum distance for an ECS provider to build a dedicated fibre spur) of Energis' MANS.

C&W also publish network coverage data, although they do so by stating the postcode districts in which they have coverage (e.g. OX7). These are relatively large geographical areas and C&W are unlikely to have network covering the entire postcode district. However, calculating the number of business sites within these districts provides an estimate of the upper bound of C&W's network coverage; this shows that 26% of UK business sites are within these listed postcode districts and the *accessible percentage will be lower*. Clearly, even this player has only at best a minority of business sites directly accessible from its own network without extending it further.

Ofcom have also gathered information on the location of alternative operator's PoP sites and have identified postcode sectors in which all large business sites are within 500m of at least two alternative operators.[7]

These areas account for around:

- 11% of the low bandwidth traditional interface leased lines market.
- 19% of high bandwidth traditional interface leased lines market.
- 9% of the alternative interface leased lines market.

Taking all this limited information into account, it is reasonable to estimate the coverage of UK businesses by alternative infrastructure providers to be in excess of 10%, but lower than 20% of businesses.

These figures will vary somewhat by sector of the economy and cannot be translated directly to an EU-wide context. However, given the facts that: (i) the UK has a concentrated business environment both in terms of geography and type of business enterprises; and that (ii) entrants tend to duplicate footprints in the same sorts of areas, the data are indicative of an upper bound for MAN coverage in most EU countries.

Using the detailed evidence on the UK as an upper bound, it is highly unlikely that more than one fifth of business sites would be accessible by entrants using alternative fibre access networks. In many countries the extent of coverage is likely to be considerably less.[8]

Business customers often require connectivity at multiple sites, typically widely dispersed regionally and often across national boundaries. The availability of competitive supply is not uniform and is dependent upon the type of region in which the business is located. In some regions, mainly large urban regions, there may be a choice of access provider. In some regions such as suburban and in smaller cities, there will be less choice and in many regions such as small cities and rural areas, there will be no choice at all. The following case examples give further illustrations of these features.

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[7] 'Disaggregated Markets', Discussion Document, Ofcom 28/3/06. Available at: http://www.ofcom.org.uk/consult/condocs/disagg/consultation.pdf. While this analysis is based on the PoP rather than the fibre itself and two Altnets rather than just one – both of which would tend to underestimate the extent of potential competition – the results were heavily influenced by the City of London which is also not representative of the UK as a whole. Note however that Ofcom's definition of coverage is not the same as the basis of the analysis presented using presence of competitive of the actual fibre network. Some of the maps on the scope of competition in the UK are contained at Annex 1.

[8] A recent study in the US has identified very similar findings, see the Report by the US government Accountability Office GAO-07-80 'FCC needs to improve its ability to monitor and determine the extent of competition in dedicated access'. This found (Table 20) that in Metropolitan Statistical Areas, less than 6% of buildings had a competitor present where the building had demand of 2 Mbit/s and only 15% where demand was 45 Mbit/s or above. The report can be accessed at – www.gao.gov/cgi-bin/getrpt?GAO-07-08. A summary of the nature of access regulation for the provision of business services in the USA is contained at Annex 2.

2.3 Connectivity Requirements of Businesses – Germany Case Study

To illustrate the wide variation in the types of area in which they must provide connectivity, BT has provided data showing where it purchases PPCs from the incumbent. These data are shown in Figure 4 below. In Germany, as in other Member States, BT supplies multi-sited corporates. These sites tend to be spread all across the country; they are by no means located in business parks or other centralized places.

The following map shows BT's overall geocoded leased line procurement distribution as per end of 2005.

In some locations, entrants can self-supply access through city centre fibre rings; in other locations they can buy access from alternative access buyers. However, in most of the country, due to the very wide geographic distribution of demand they have to buy access from the incumbent. As discussed in the following section, in most local exchange areas, unbundled loops are not a viable economic proposition for serving business customers as it is not economic to connect main distribution frames (MDFs) in areas where a relatively small number of customers are located.

The broad picture of fragmented geographical competition in Germany is strongly supported by the evidence presented in the NRA (BNetza) Annual Report of 2005 which comments as follows:

'In addition to DTAG, there were over 60 companies offering DSL lines in 2005, either through resale or self-operated infrastructure. Most of these providers are companies that have set up their own access networks in particular cities or regions and therefore only offer services at a local level. In addition to these regional operators, there are a small number of companies who offer DSL lines throughout Germany.'[9]

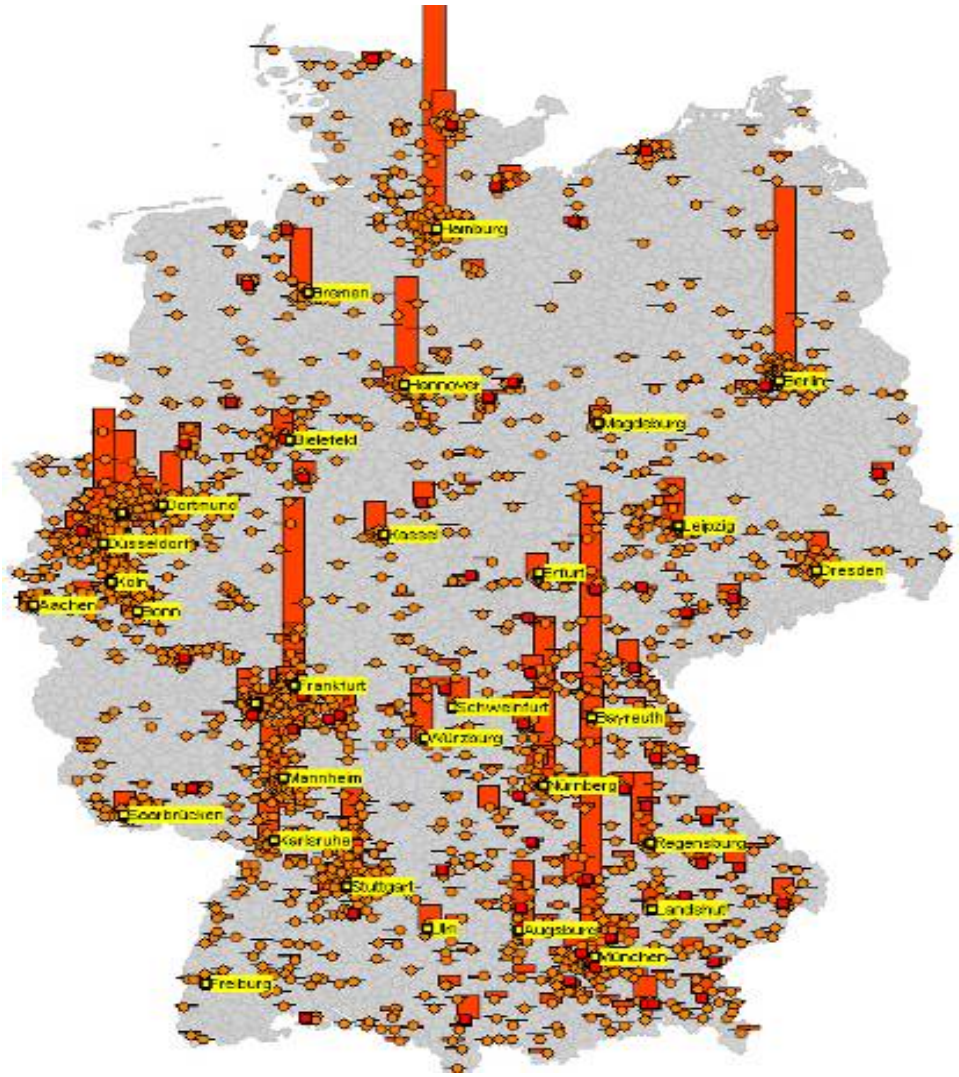
BNetza estimates (page 27) that the incumbent held a market share of 88% in the provision of fixed telephony channels at the end of 2005. The share of entrants was less than 9% in 2005 first quarter but for some entrants the share – 'was far in excess of the national average of 8.8 percent, and even exceeded 20 percent in some local networks'.

The overall picture emerging from these statistics is that competition is highly localised in particular cities or regions, as entrants attempt to acquire the necessary economies of scale and density.

[9] http://www.bundesnetzagentur.de/media/archive/6970.pdf, page 29.

Figure 4

Demand for Leased Line Services in Germany (BT)



Source: BT

This diagram shows demand by BT's customers for leased line service. The large red bars show high demand (e.g. in Frankfurt) but also very distributed demand throughout the country.

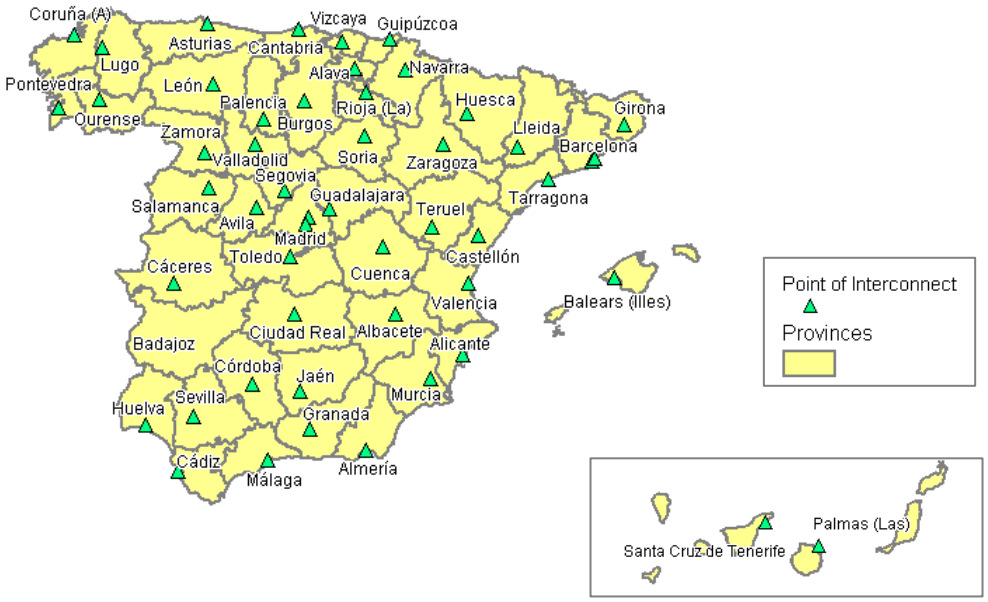
2.4 Connectivity Requirements of Business Customers: Spain Case Study

EU countries are not uniform in their interconnect arrangements. These differing approaches can have significant impacts in the costs facing an entrant. Some countries, like the UK, allow an operator to interconnect on a national basis. This allows the operator to aggregate demand on a national basis significantly reducing backhaul costs and making supply of services economic.

However, in Spain an operator must interconnect on a regional basis given that the incumbent is obliged to offer PPCs only up to 70km. The points of interconnect are illustrated in Figure 5.

Figure 5

Points of Interconnection in Spain



Source: BT

This map shows the administrative regions in Spain and the mandatory point of interconnection where entrants are obliged to have presence. Note that on 30 April 2005, Royal Decree 424/2005 revoked this requirement which does not apply to new entrants.

While some regions may have a reasonable level of demand to warrant a point of interconnection and the associated backhaul costs, other regions have a lower level of demand. The cost of backhaul from some of these regions is very high, for example from the Canary Islands. This lower level of demand raises the costs of backhaul per service, and as a result the cost of entry.

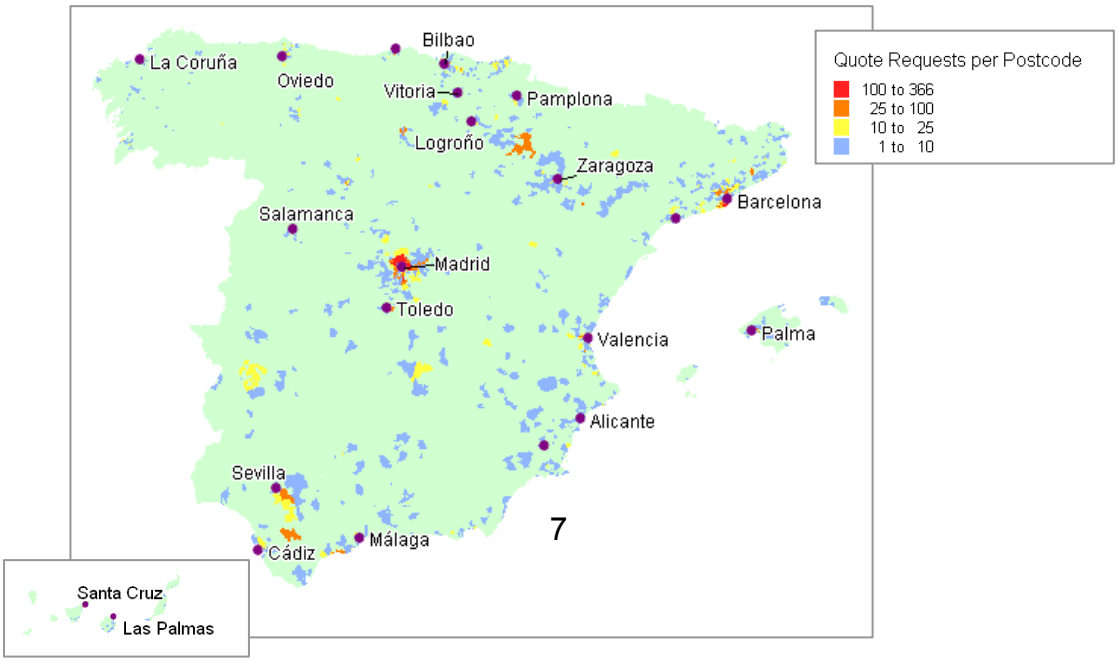
Furthermore, like many other EU countries, while the majority of demand for business services in Spain is focussed in a small number of postcodes, there are also many areas of modest demand outside major conurbations. A more disaggregated breakdown of potential demand presented in Figure 6 shows that while demand is limited to within less than 12% of postcodes in Spain there are many areas of such demand outside major conurbations.[10]

[10] This is demand from international customers only for terminating segments in Spain. National demand is more dispersed than this diagram suggests and for example banks have many branches spread throughout the individual regions.

Figure 6

Demand for Leased Lines to BT in Spain

Spain Leased Line Demand Overview:
Quote Requests per postcode area



Source: BT

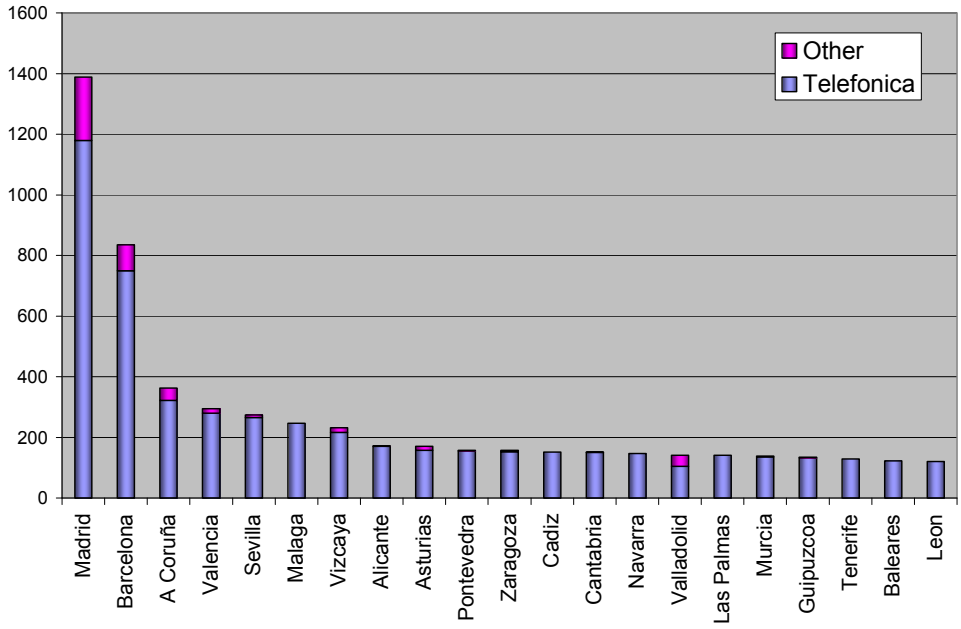
This diagram shows the distribution of BT's demand for leased lines (terminating segments) in Spain. While the major cities account for most of the demand, there are still many areas of modest demand outside conurbations.

Figure 7 gives the breakdown of the supply of leased line inputs to BT between the incumbent and alternative access providers across the major cities and towns. Outside Madrid, BT is almost wholly reliant on the incumbent to supply leased line services. Taking Spain as a whole, BT acquires more than 90% of third party circuits from the incumbent.[11]

[11] A major alternative infrastructure provider in Spain with widespread network coverage and hence potential alternative supplier is oriented very strongly to residential customers and not toward business connectivity provision. As noted above, the possible presence of an alternative fixed infrastructure is no guarantee of a competitive wholesale marketplace.

Figure 7

Supply of Leased Lines to BT from Other Providers in Spain



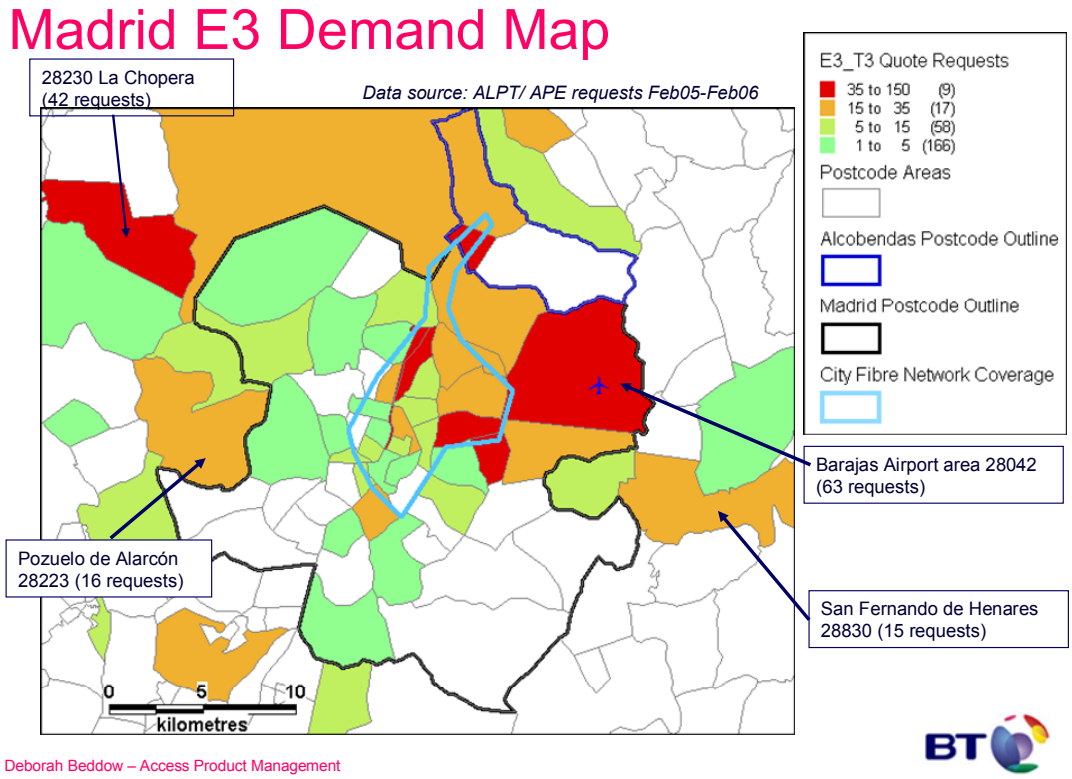
Source: BT

This shows the sources of leased line access in Spain. The blue on the charts shows that the incumbent is the main supplier even in the capital Madrid.

As in the UK, the presence of a competitive MAN even within a postcode area does not imply that access services will necessarily be competitive within the totality of that area. Figure 8 shows the key zones of Madrid and the extent of BT's network. It can be seen that there are many requests for supply beyond the reach of its network.

Figure 8

Madrid E3 Demand Map (BT 2006)



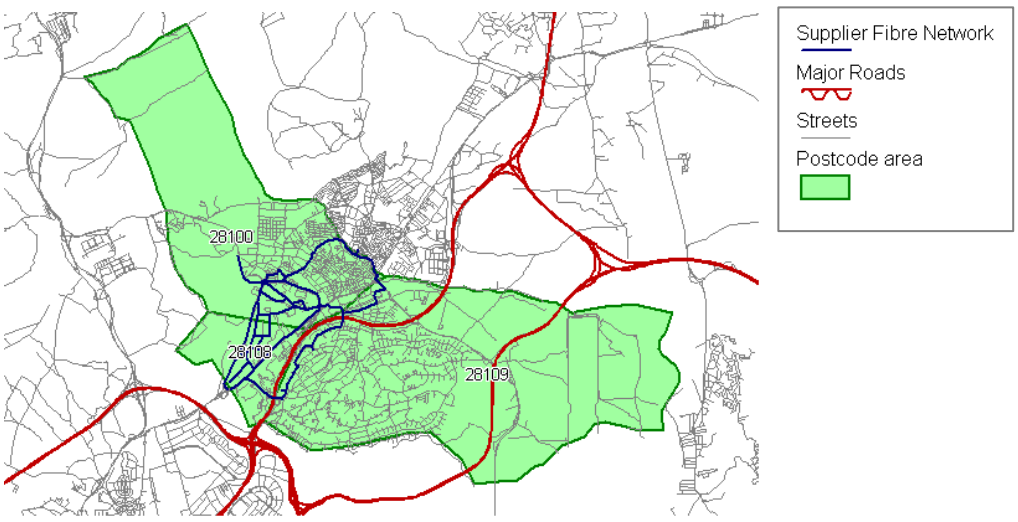
Source: BT

This map shows the demand from global corporates in the different areas of Madrid; the darker the area, the higher the demand. BT's fibre network in blue does not extend to many of these areas. Four postcode areas are highlighted as examples with the number of requests last year in brackets.

Alternative reasonably comprehensive infrastructures which may offer wholesale services such as provided by another particular major Altnet (Figure 9) do not necessarily offer reach to all buildings, even in Madrid.

Figure 9

Altnet Coverage within Three Madrid Postcode Areas



Source: BT

This map gives a very granular breakdown of three areas in Madrid and the scope of another entrant.

These diagrams are intended to demonstrate that the presence of infrastructure competition will inevitably be rather piecemeal at national and local levels. Alternative infrastructure operators serving businesses are not like cable operators as they have to build on a very selective basis. Even where they are present, they do not necessarily offer wholesale services or even aim to serve all business customers. The reason for this is straightforward – even if a fibre cable passes near to a customer site, there are still the costs of ingress to the building and equipment costs. A minimum level of demand of at least E3 level (or 4xE1) would generally be needed to justify a connection.[12]

Spain demonstrates the existence of three issues facing market entrants like BT who are focussed on the business market segment:

- Regulatory rules for interconnect can act as a barrier to entry.[13]
- There is a low level of availability of competitive infrastructure outside major metropolitan areas.
- The existence of potential competitive supply within metropolitan areas does not necessarily mean actual availability of competitive supply.

[12] E1 and E3 refer to the European standards for leased lines.

[13] Note that the particular requirements for regional POI in Spain is expected to change – see the accompanying Report on Regulatory Remedies ('The Application of Proportionate Regulation to the ECS').

2.5 Competitive Footprint Analysis: Conclusions

This section has examined four countries in the EU to highlight the unique challenges that face suppliers of ECS who target business customers.

Using the UK as a likely example indicating the upper bound for the rest of the EU, this section has highlighted the fact that while geographic coverage of alternative networks can be reasonably broad, only 10-20% of business sites are likely to be in a position to receive access directly from third parties besides the incumbent.

Existence of an alternative network in a region, does not necessarily equate to availability, as some networks are not set up to provide wholesale or business services. They are therefore often not an alternative to the incumbent for the supply of access services.

Finally, interconnection policies are not uniform across the EU.

3 Is Local Loop Unbundling The Solution?

3.1 Background

In a number of Member States there are several types of regulated access for high bandwidth services. These include LLU, bitstream access with IP handover, bitstream access with ATM handover, Ethernet access and Partial Private Circuits.

Moving towards LLU as the only regulated broadband access platform is seen by some commentators as having significant advantages, for example, reducing regulatory cost and complexity, and encouraging competitive provision of facilities.

In this section it is shown that LLU may be viable in certain niches for businesses, it has much stronger potential for mass market applications and is not realistically capable of being an effective substitute for other regulated high bandwidth access services for business customers.

In summary, the key reasons are as follows:

- **Economic characteristics of LLU**. The economics of LLU are strongly density driven. Benefits of density arise in reducing the costs of backhaul as well as the utilisation of the equipment in the exchange. Consequently, LLU is not economically feasible in most locations outside areas of the highest density of demand. Outside these areas, it is only viable to purchase a bitstream service from the SMP operator. Density is an important driver for business services which tend to be more dispersed across exchanges with fewer absolute numbers of business lines on an exchange.
- **Limited bandwidth**. Under current EU regulation, LLU relates to copper access. For most large business customers, a single loop does not provide adequate bandwidth. This is why high bandwidth business users usually purchase optical fibre based access (for example traditional interface or Ethernet interface leased lines). It is technically possible to use bonded multiple copper loops to provide higher bandwidth (up to 2M/bits) and this technology is used by some LLU entrants. However, this requires separate operational processes quite different used to serving mass market consumers across the shared metallic path and therefore issues of density arise.
- **Business focus**. There is no evidence in any Member State of substantive entry to serve businesses with LLU and the provision of service across copper pairs may not even be possible where there is no obligation on the incumbent to supply new copper lines. In the limited cases where LLU is used to serve business customers, in BT's experience it tends to be found in situations where a company undertaking unbundling for residential supply has extended a portfolio intended for mass market consumers. Therefore it may not offer the service performance level which is needed to link many business sites together.[14]

[14] Anecdotal evidence obtained by BT suggests that where entry has occurred using LLU and multiple copper pairs, this is where the provision of bitstream access and wholesale PPCs are not provided at all, or are very limited. In other words, they may be very much a 'second best' solution.

3.2 The Economics of LLU

Annex 3 gives a detailed explanation for the modelling which is presented below. This uses information from the UK, but all the evidence in this Report points to a broadly similar picture in most Member States.[15] This shows that entry is likely to be selective, with the same entrants going to the same exchanges; this is similar to the pattern which prevails for fibre-based entrants discussed in the previous section.

The analysis finds that entry with LLU starts to become viable when:

- There is a level of efficient utilisation of those network components that are relatively insensitive to volume; and
- This efficiency allows the service to be provided more cheaply than a wholesale bitstream service (where provided) or equivalently, the incumbent's retail service.

While there are a number of factors affecting the viability of entry, the analysis finds that the typical breakeven point is between 250-350 customers to be connected at a particular exchange for that exchange to be worth targeting to provide a bitstream access service.[16]

Figure 9 below shows a typical distribution function of exchanges with the number of households connected. The higher the number of households, the more likely it is to reach the required break-even point of 250-350 customers to make LLU worthwhile (some LLU operators put the upper bound of this scale rather higher indicating up to 500 customers would be required). As the number of households declines, the likelihood of the breakeven point being reached also declines.

This diagram illustrates the crucial point: exchanges for which LLU is unambiguously 'profitable' are likely to be the minority in absolute terms and a significant number of exchanges will not be able to support LLU.[17]

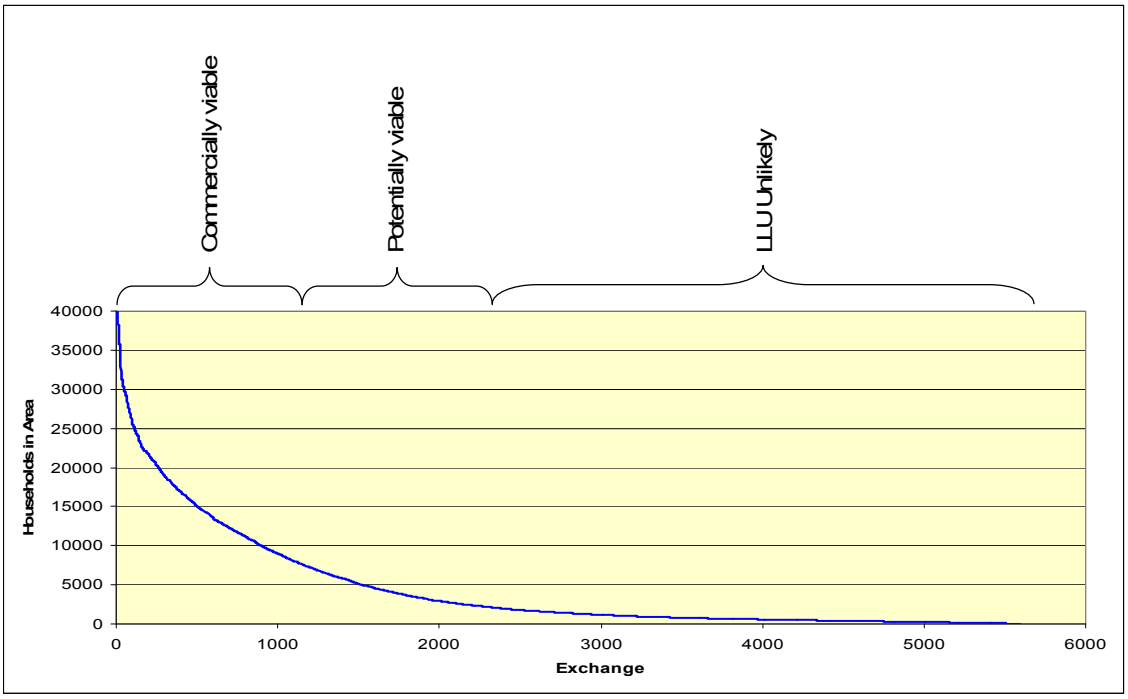
[15] See also 'The Competitive Dynamics of DSL in Western Europe: prospects for local loop unbundling and bitstream', Martin Scott and Raushan Sagalbayeva, Analysis Consulting, December 2006. This Report comes up with similar estimates of the viability of LLU as this study.

[16] This is against a benchmark of residential customers. The breakeven point for businesses may be lower than this in some circumstances depending upon the bandwidth which they require and the competitive alternatives from other access services. BT's experience however is that most of the substitution which has occurred between leased lines and bitstream access has been at very low bandwidth of 64 kbit/s and this is easily accommodated in services intended for mass market but with a symmetric capability. The corollary however is that density of demand is critical for such low bandwidth requirements.

[17] Clearly though the absolute number of customers on these exchanges will be much smaller.

Figure 10

BT Assessment of Viability of LLU (UK)



Source: BT

This diagram indicates which exchanges in the UK are likely to be viable for an LLU operator to enter. As the number of households at the exchange falls, the likelihood of entry falls.

Cost sensitivities

BT's modelling – which is in line with industry estimates – has found the cost components most sensitive to scale are:

- **Backhaul**. This is the largest cost component and is subject to very large economies of scale.
- **Equipment**. At low volumes of end-users, the next largest component is that of equipment (DSLAM and nodal equipment) which has lesser economies of scale, because as volumes rise these need to be replicated.

Based on these costs, the absolute average cost of entry between the most dense exchanges (first such quartile) and the least dense exchanges (bottom quartile) could easily be a factor in the range of 15-20:1. This partly explains why alternative operators target the same exchanges and why the majority of exchanges attract little interest.

Additional reasons for selective entry using LLU are:

- The larger exchanges in terms of end-users tend to have shorter copper loops. This assists in the provision of higher bandwidth per end-user.
- The larger exchanges tend to be clustered in areas where there is proximity to serving nodes and backhaul is much shorter than in less urban areas.

- The shorter lengths for backhaul are more likely to be associated with competitive supply for backhaul itself. Provision of backhaul services by the incumbent is not mandatory in many Member States in any case.
- The areas of high density will likely have similar socio-demographic characteristics and consumer patterns of demand.

3.3 The Evidence on LLU Entry in the UK

LLU is only a niche service for the supply of ECS to business customers. There are three reasons for this:

- **Smaller numbers of business customers**. Even in dense urban regions, the strongly density driven economics affects business services more acutely because of the smaller number of suitable business customers in each exchange area. Although business customers will often purchase a richer suite of services, which may lower the breakeven point, in most exchange areas there are far fewer business customers than residential customers.
- **Multi-site demands**. The multi-site nature of many businesses requires connectivity in more sparsely populated areas where LLU is uneconomic. In these regions, alternative forms of access will be required, such as bitstream based access provided by the SMP operator or PPCs.
- **Bandwidth demands**. LLU (or indeed any form of copper based access) may not meet the bandwidth requirements of large business customers.

By analysing data on number and type (residential or business) of customers in an exchange area it is possible to examine the targeting strategy of LLU operators. Figure 11 below can provide some hints at the targeting strategy of *'Entrant A'* in the UK. The pattern of entry is similar to most LLU operators in the UK.

This diagram shows all the exchanges in the UK positioned according to the number of business and household locations within the exchange area. Shown in red are the exchanges in which *'Entrant A'* has set up LLU. From this diagram, two things become apparent.

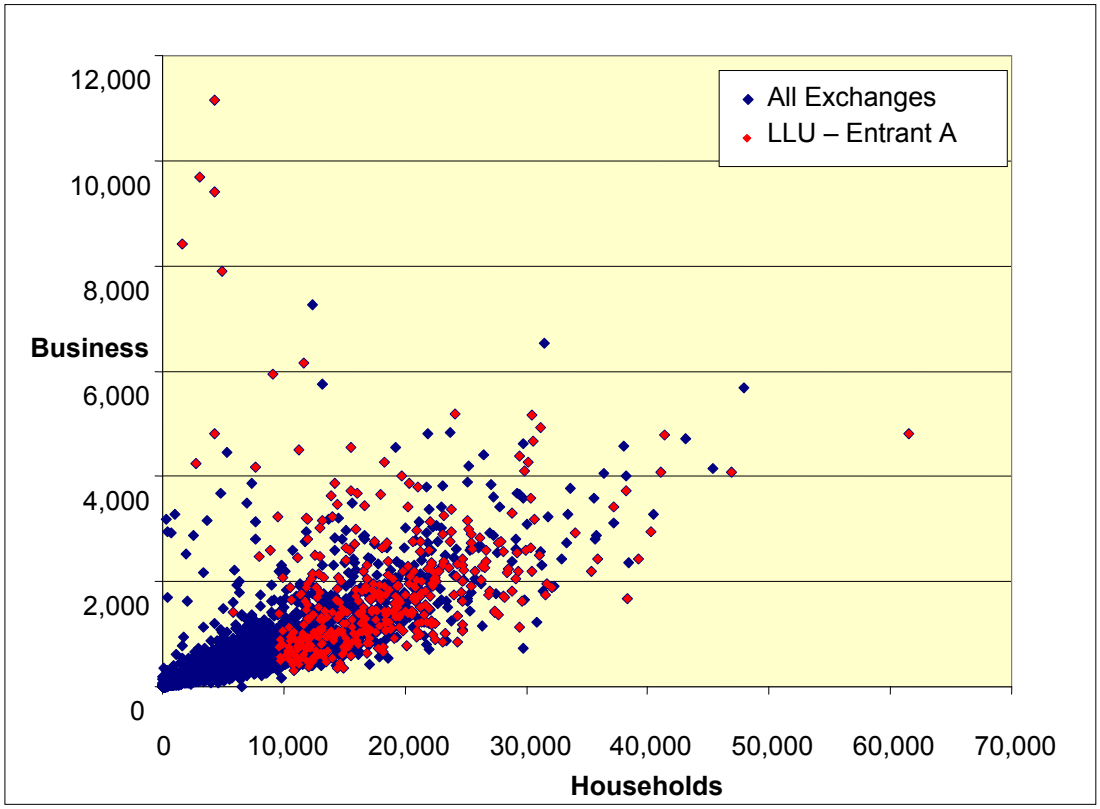
- Exchanges in which this *entrant* has set up LLU are exclusively those with relatively large populations.
- Competitive supply using LLU is weighted towards exchanges supporting higher residential populations. There are a few unbundled exchanges with high businesses and low residential concentrations but these are the exception rather than the rule.

The vast majority of LLU operators are targeting the same group of exchanges with high numbers of residential users to deliver a bitstream access services suitable for asymmetric Internet access.[18]

[18] This may well extend to triple play solutions including TV delivery as well as voice and Internet access.

Figure 11

Presence in Local Exchanges of an LLU Entrant in the UK



Source: BT based on public information

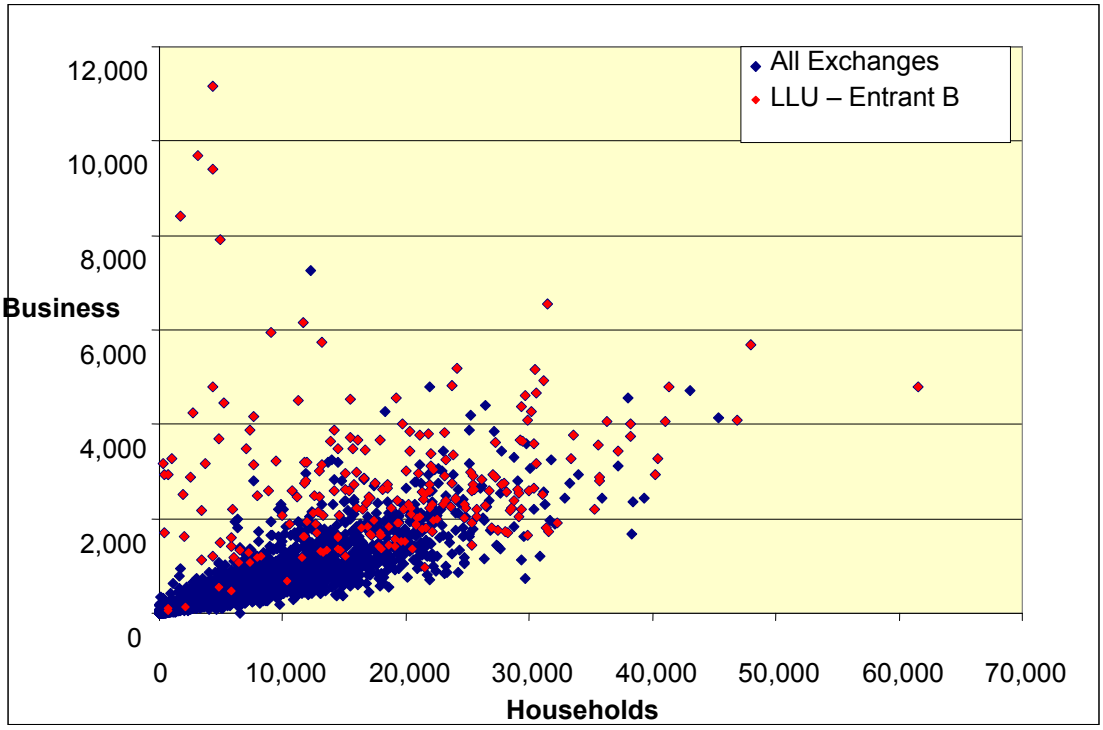
This diagram plots all of BT's exchanges and those in red are where a particular entrant is present. There are many exchanges with considerable number of businesses which are not being targeted.

Another operator, 'Entrant B', departed from the more common approach of targeting mainly residential populations. Its strategy had been to provide ADSL and SDSL connectivity to business customers, mainly in the SME sector, which will by definition exclude many of the business sites requiring multi-site connectivity. This is the only well known LLU operator which entered the industry in this fashion in the UK and which achieved some scale in this manner. This is shown in Figure 12 below.

It is likely however, that this entrant's strategy will change following its acquisition by another group which is exclusively oriented to mass market services and it is very unclear whether they will continue with their business services.

Figure 12

Presence in Local Exchanges of an LLU Entrant in the UK



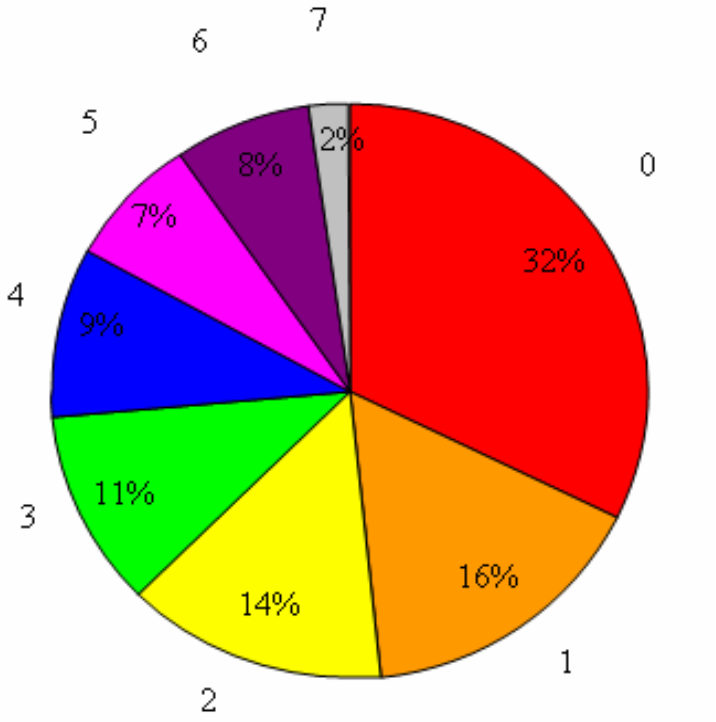
Source: BT based on public information

This is another LLU entrant which was specifically targeting businesses and again it is apparent that many businesses would not be covered.

Figure 13 shows businesses that are potentially covered by LLU. With only 38% of the market able to access 3 or more operators other than the incumbent, it suggests that access to a LLU operator and thus services is highly concentrated.

Figure 13

Number of Businesses Sited in Areas Where LLU Operators Present in the UK



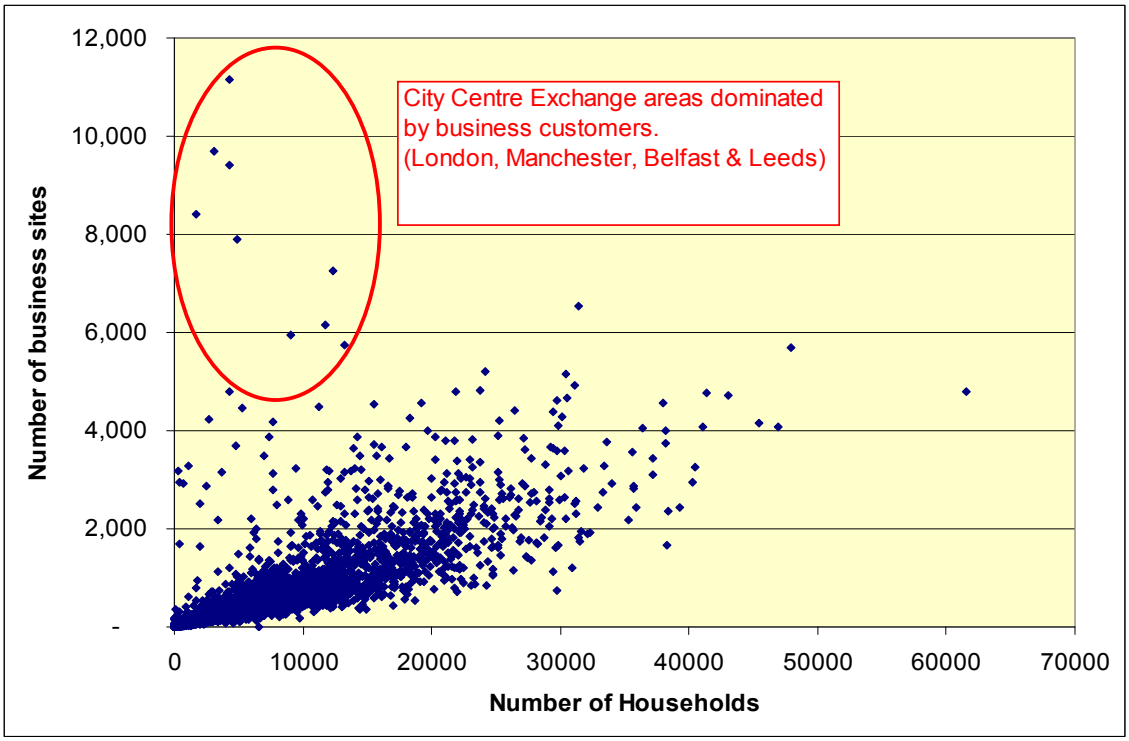
Source: BT based on public information

This diagram shows the number of LLU operators with presence in exchanges serving businesses. For 32% of businesses lines there are no LLU operators present at all and for 16% of businesses, only one LLU operator apart from the incumbent, and the latter may not actually serve business customers.

Figure 14 below maps the number of business customers against residential customers. It suggests that areas where there is sufficient density in business customers alone potentially to warrant the roll out of LLU, are also areas in which fibre networks would already be available (London, Leeds, Belfast Leeds). Thus, the use of LLU would be limited as businesses would be more likely to make use of the higher bandwidth infrastructure from fibre.

Figure 14

Location of Dense Business Exchanges (UK)



Source: BT based on public information

This diagram highlights the location of a cluster of exchanges which have a high proportion of businesses. They are all in city centres where alternative fibre networks are likely to be present.

The evidence and modelling suggests that broadly similar entry conditions are needed for an LLU operator to take a fully unbundled loop (or multiple loops) to replicate a symmetric service and offer the sort of service level associated with business critical applications for which leased lines are provided.[19]

This analysis indicates that equivalently high densities are still required to make use of the economies of backhaul to offer higher bandwidth with services across copper loops.

LLU operators which are oriented to mass market may not be interested in offering these sorts of services; the difference between a fully unbundled loop (or loops) and a shared metallic path is not just one of rental costs but a more significant strategic decision with commercial and operational consequences.

There are three substantive reasons why LLU operators may not wish to engage in wholesaling access services:

[19] Clearly not all applications associated with leased lines require high resilience and some can be provided across bitstream access service which is primarily intended for Internet access for residential customers.

- **The costs in terms of systems and networks**. Traffic originating from the end-customer would need to be groomed and sent to the interconnecting party. While the costs of basic transmission are comparatively low, the costs of interfaces are now comparatively high. For relatively small volumes of traffic this could easily be prohibitive.[20] Put another way, wholesale supply involves three parties on the investment ladder (the incumbent, LLU operator and the business services provider) and there may not be room for that number. The commercial case weakens when the costs of multiple contracting are taken into account.
- **The revenue potential is limited to access**. Wholesaling by definition implies that there will be less chance of acquiring downstream profits in the retail markets. LLU operators and their network-based customers seeking access to their end-users, will be competing against the integrated incumbent which will have already set up the systems and processes to link multi-site customers using a variety of access technologies.

Given these factors, the LLU operator may decide to concentrate on their core business strategy which will usually be mass market focussed on a portfolio of retail applications.

This is not to say that wholesaling to business service providers on the basis of LLU never arises, but evidence to date is that it is fragmented within Member States where it exists at all. LLU entry may be more viable in circumscribed and localised geographies where there is a concentration of businesses which are insufficient to justify an alternative fibre network but the alternative benchmark is a retail product which is not highly regulated. In these circumstances entry becomes more viable.

Even where wholesale services are provided by an operator engaged in unbundling, the service may actually come from re-sale of the (mandatory) bitstream service provided by the incumbent operator rather than the LLU operator's own network. Where the latter, this strengthens the case outlined above that bitstream is usually not viable across LLU.

3.4 Some Comparative Statistics on LLU

This section is included to demonstrate that the geographical focus of LLU operators is less than universal and often from a shared loop indicating that the service will be asymmetric. Table 1 below presents recently available statistics on LLU and broadband lines for France, Germany, Italy, Spain and UK.

[20] For more detail on this issue see 'Economic Features Of A Converging Environment', BT response to Ofcom Strategic Review Phase 2 consultation document, February 2005, available on the BT website.

Table 1

Broadband and LLU Statistics 2006

(millions)

	France		Germany	Italy	Spain	UK	
	Q1	**Q2**	**Q1**	**Q1**	**Q1**	**Q1**	**Q3**
DSL Lines	9.9	10.5	11.5	7.1	4.5	8.0	8.9
Cable Lines	0.6	0.6	0.3	0	1.2	2.8	2.9
All LLU	3.0	3.4	3.6	1.6	0.5	0.4	0.9
Full LLU	0.6	N/A	3.6	1.5	0.2	0.1	0.4
Shared LLU	2.4	N/A	0.0	0.2	0.3	0.2	0.5
LLU as % DSL	30	33	32	23	11	3	10
Shared % All LLU	79	N/A	0	11	64	60	60

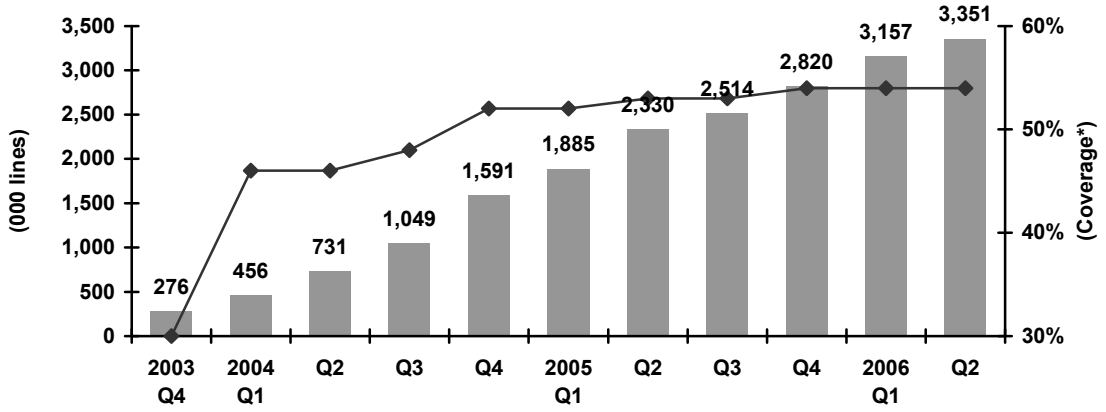
Source: Analysys May 2006, Enders Analysis Sept 2006, BT

In France, according to Enders Analysis, 'The coverage of LLU has been stable since mid-2005 at about 54% of FT telephone access lines … Neuf Cegetel, the main unbundler and Altnet in France, has quietly dropped its earlier target to attain LLU coverage of 70% in 2006'.[21]

[21] 'Iliad's Destiny', September 2006, Enders Analysis.

Figure 15

LLU Lines and Coverage in France



* Coverage is share of residential and business FT lines in unbundled exchanges, including lines too far from the exchange to be connected to DSL.

Source: Enders Analysis from Arcep and France Télécom.

This diagram shows that the coverage of LLU operators (line with bullets) has stabilised at just over 50% of the population even though the absolute number of customers taking LLU (bars) has grown in France.

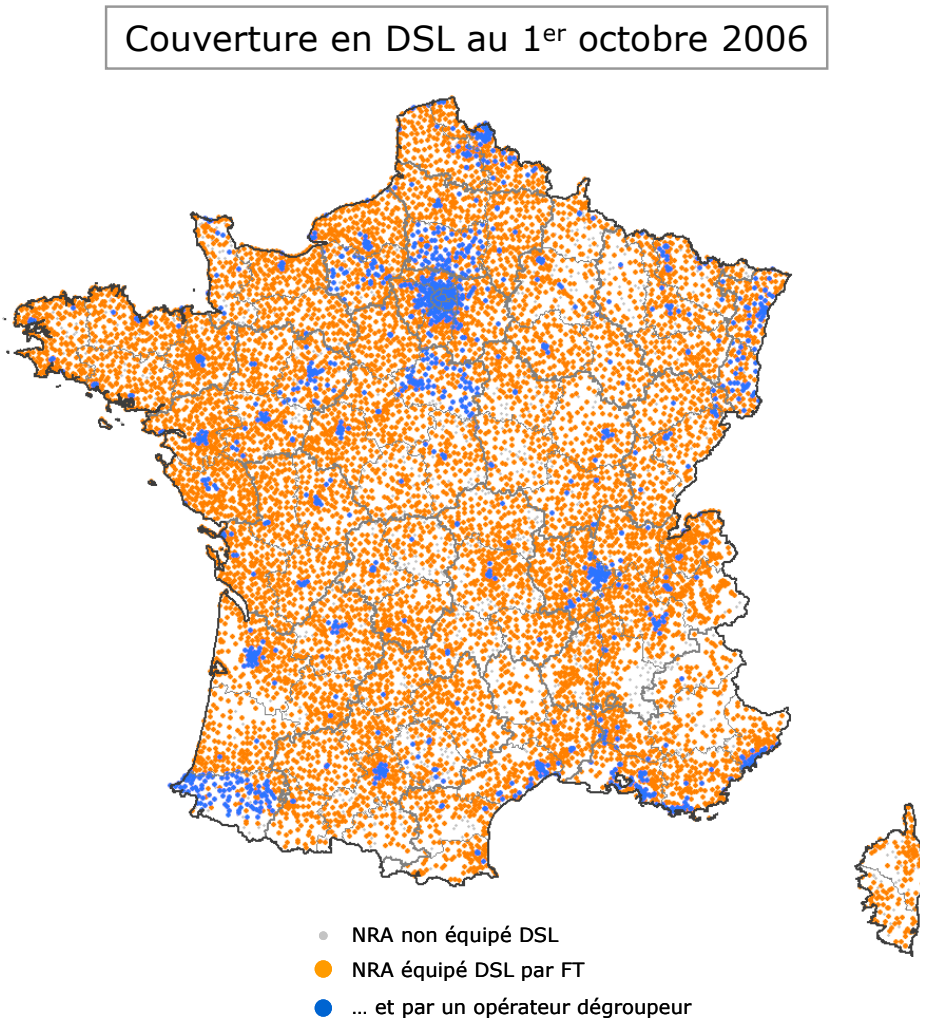
Outside the LLU areas, Enders states that – 'France Telecom has continued to enable exchanges for broadband and reached 96% line coverage at the end of 2005'.

The situation in France of partial geographic coverage is shown in a recently published map by ARCEP:[22]

[22]Available at – http://www.art-telecom.fr/index.php?id=8994http://www.ortel.fr/

Figure 16

Geographic Coverage of LLU in France



Source: Arcep

This diagram shows which exchanges have broadband either by the incumbent and/or by an entrant (blue). The large amounts of orange show that much of the country is supplied by the incumbent alone.

It can be seen from this map that considerable geographic areas of France are not covered by any operator other than the incumbent.

In Germany, the BNetza Annual Report[23] indicates that fully unbundled copper loops (3.2m end of 2005) were mainly used by Altnets to sell two channel ISDN services (2.5m.) possibly combined with DSL or analogue retail PSTN services to residential customers. BT understands from its own market knowledge that only a very small fraction of the unbundled loops are used by Altnets to emulate leased line services, particularly over SDSL technology.

[23] Cited above.

In terms of coverage of residential population, the Report (page 41) indicates that competitors are present in the local exchanges which account for about 56% of all telephone lines. As discussed below, this is a figure similar to both France and the UK, although coverage in the UK is expected to rise above this level over the coming years.[24]

In Italy and Spain the volumes of LLU are comparatively low and in the case of the latter, the predominant access is via shared LLU which will rule out the possibility of supplying symmetric services at reasonable bandwidth to businesses.

Data from Italy demonstrate why take-up of LLU by ECS providers serving business customers is limited. For example, there are more than 10,000 local exchanges but only 400 have more than 330 business sites connected.[25]

In summary, the evidence across a number of Member States shows a broadly similar pattern of limited entry focussed on dense areas of residences. Substantial parts of France and Germany will not be covered by LLU and to greater extents than in the UK which is geographically more clustered than both these countries.

3.5 Conclusions: The Limitations of LLU for Businesses

It is apparent from the above analysis that LLU is not generally suitable to meet the multi-site connectivity needs of business customers.

Nor is it likely that the fundamental economics of LLU will change significantly in the medium term. As there are a limited number of business customers in many locations, there is insufficient scale to support the use of LLU as the basis for business applications.

Those locations where there are sufficient numbers of business customers to support the use of LLU, are typically also locations in which customers have large corporate offices. They are also more likely to be the locations where there are competitive MANs, which provide much greater bandwidth than LLU and hence are more suitable for business applications.

[24] http://www.ofcom.org.uk/consult/condocs/wbamr/

[25] Based on BT's assessment using published information of the incumbent.

4 The Outlook for Infrastructure Competition

4.1 Fixed Infrastructure Competition

The preceding sections have highlighted current challenges associated with the competitive supply of ECS to the business market. This next section looks at probable future developments in fixed infrastructure competition and argues that these challenges will continue into the future.

There is little evidence from analysts' reports that there will be widespread new fixed infrastructure build in access networks in the foreseeable future.[26] The accompanying report ('The Use of Access Technologies') suggests that although incumbents and entrants are devoting some resources to developing wireless technologies for both residential and business customers, these technologies are much more likely to be used in a complementary fashion with fixed networks. This means that wireless technologies will not generally substitute for fixed platforms and where fibre networks exist, they will out-perform other access technologies.

The LLU footprint appears to be stable in France and Germany but to grow modestly in the UK but unlikely to rise above 70% of households. LLU rollout in most other countries also appears to be modest. But in all these countries, there is little sign as yet that the LLU operators will start to serve businesses with the sort of access services which are required for multi-site connectivity.

Localised MANs and PoPs focussing on business customers will continue to be built. However as the underlying economics of network build by fibre makes this a high risk venture, substantive new business-centric alternative networks are not likely to emerge over the next few years.

In order to reduce risks and costs some regulators are re-examining the issue of duct sharing, though at this stage focussed on the mass consumer market. For example, the French government and NRA have recently launched such a review and are now discussing with industry (operators, media, housing companies) and regional authorities, a possible roadmap that should make fibre deployment less costly and more attractive for all players.[27]

Various working groups have been set up in France and the constituents of this programme of relevance to this Report include the following:

- Study existing duct infrastructure across France. Includes the possibility of France Telecom to provide a commercial offer on sharing of existing network ducts with other operators.
- Extend Regional authorities' powers to oblige operators to share and provide extra duct capacity for newly built passive network infrastructure. Includes the possibility of Regional authorities providing ducts to operators.
- Make an agreement on shared and standardised fibre access points at housing premises to avoid duplication of cabling work. Includes the possibility of standard access points to be mandated for new houses/buildings.

[26] A different picture may be appropriate for core transmission. However, see for example 'Global Bandwidth 2006' Report by TeleGeography Research which states that in the context of meeting rising international bandwidth demand arising from Internet usage – 'To cope with strong levels of bandwidth demand growth, European bandwidth providers have begun to take significant steps to add capacity on their long-haul networks. Fortunately there is enough potential capacity available through dark fibres to preclude any need to lay new fibre for quite some time.' The authors of this Report are not aware of any evidence of intentions to build ubiquitous local access infrastructure.

[27] Available on the ARCEP website.

Elements 1, 2 and 3 are aimed at decreasing deployment costs as engineering works are estimated to make up to 70% of deployment costs. Element 3 would also eliminate possible new monopolies on housing developments.[28] However, the technical issues associated with duct sharing are significant and this is unlikely to be anything more than a limited remedy. For example, the matter of resilience in providing services to businesses is often important and sometimes separate ducts are needed. There are considerable operational difficulties in mandating duct sharing on a widescale such as ensuring that ducts have space in them, enabling access to ducts for operational purposes and so forth.

What is also apparent from this review is that it is focussed more at the residential consumer market than businesses, where the issue of density of demand will always be an important issue. This is illustrated in the analysis undertaken for this review; the costs of fibre deployment are depicted in Figure 26 (contained at Annex 4) which illustrates the pivotal role of density.[29] Hence even the cost of trenching (about half of overall costs) outside the very largest of the cities will remain potentially prohibitive for an entrant.

4.2 Potential Implications of NGAs

A number of incumbents are expected to begin extending fibre deeper into their access networks over the next few years. This will have a major impact on the ability of alternative operators to provide services to businesses.

As presented in Figure 27 (Annex 4), when extending the access network, there are three basic network topologies that arise. These are:

- A point to point fibre network.
- A hybrid network of copper and fibre such as with FTTC supplying VDSL.
- A shared fibre network such as from a PON system (Passive Optical Network).

The economics of fibre-based entry to supply point to point fibre have been discussed in outline in this Report and will not be elaborated on further.

FTTC has already formed the basis of a number of proposals that are being developed or advanced by incumbents in Denmark, the Netherlands, Germany and Ireland and this is the most likely development of NGAs.

The clearest exposition of the regulatory issues arising from FTTC is contained in the consultations prepared by OPTA and recently discussed by the Chairman of OPTA in relation to KPN's proposed network upgrade.[30] The key elements of the proposal are that KPN will be able to close its MDF sites and to phase out LLU at the local exchange altogether. This should be appreciated against the context of extensive cable competition and other operators supplying DSL services.

[28] Ofcom also argues that around 78% of deployment costs are incurred in civil works – see 'Regulatory challenges posed by next generation access networks', Public discussion document, 23 November 2006. Available at – www.ofcom.org.uk

[29] This is available in the ARCEP discussion Paper which can be found on the ARCEP website.

[30] See The Papers prepared by OPTA 'KPN's Next Generation Network: All-IP', Issue Paper of May 2006 and Position Paper of October 2006 available at – www.optaa.nl. See Professor Fonteijn's presentation to the ECTA 2006 Conference on this topic available at – www.ectaportal.be.

In the Netherlands it is noticeable that while KPN does not have to provide bitstream access for the supply of residential customers, it does have to supply such services to competitors serving business customers.[31]

The two possibilities which OPTA considered included sub-loop unbundling (SLU) and a 'voluntary commercial open wholesale model for service providers: national/regional wholesale broadband access'.[32]

BT understands that OPTA is now delaying the decision as to whether to permit this development, noting that their consultants were highly pessimistic as to the viability of SLU, including the following assessment:[33]

> 'Based on the current interconnect and wholesale offers from KPN, we have calculated that the use of SLU by an alternative operator is not economically viable as an alternative to continuing to use LLU except under certain conditions. We estimate that a business case for SLU with similar economic viability to that of continuing use of LLU for 60% of the population would require both:
>
> - A market share greater than 40% of all broadband lines (including cable) in areas served; and
> - Our highest estimate for incremental revenue (which assumes an increase in ARPU across all broadband users of EUR10 per month by 2016).'

As in France, it is noteworthy that the underlying competition assessment of OPTA is oriented to the mass market residential sector of a bundle of services (triple play).

While the economics of SLU may be viable in highly dense areas of customers it is highly unlikely that SLU will be appropriate for serving dispersed business sites.

[31] The conclusion of the M12 analysis is that KPN must meet reasonable requests for 'high quality' bitstream (meaning low contention bitstream) and associated facilities. Associated obligations apply: – non-discrimination (internal and external); publication of reference offer. The decision (in Dutch) is available at – http://www.opta.nl/asp/besluiten/besluitenenoordelen/document.asp?id=2027.

[32] See slides of Professor Fonteijn's ECTA presentation found at http://www.ectaportal.com/regulatory06/upload/File/SPEAKER_PRESENTATIONS_PDF/Chris_Fonteijn.pdf.

[33] Communication of OPTA dated 24 January reference OPTA/TN/2007/200044, available on the OPTA website www.opta.nl

An altogether more cautious assessment of SLU is given in Ofcom's NGA discussion document:

> Sub loop unbundling at the cabinet
>
> 4.79 Should a fibre-to-the-cabinet topography be chosen, competitive operators may have the opportunity to move active electronics from the exchange in local loop unbundling to the cabinet to unbundle the sub-loop.
>
> 4.80 Competition at this level in the network would represent a move up the ladder of investment for competitive operators; access network competition would move closer to the customer. This option would also preserve the scope for product innovation in the market by allowing competitors choice in their technology deployments.
>
> 4.81 However, sub loop unbundling may face economic and practical limitations:
>
> - The economics of sub-loop unbundling are uncertain. The minimum efficient scale, in terms of share of lines that a competitive operator may need to achieve within a particular cabinet to cover fixed investment costs and achieve sustainable competition, may be materially higher than the share of lines required for sustainable local loop unbundling competition; and
> - Sub-loop unbundling faces practical constraints also, including the availability of space and electricity supply at the cabinet for multiple sets of electronics.

In the UK, there is no indication that any entrants have shown any interest whatsoever in SLU. The number of potential customers from a cabinet in the street will be considerably less than that in an exchange which will contain the feeds from numerous cabinets.

If the economics of LLU to serve distributed business customers generally looks weak, for SLU it must be even less likely.

The economics of a PON system (FTTH) are similar in certain respects to a FTTC. In a recent study, Banerjee and Sirbu argue the following –

> '5.3.1 Facilities based Competition. Though clearly FTTH is a decreasing cost infrastructure, in the absence of a model for operations costs, it is difficult to say whether it is a natural monopoly industry or not. However looking at the capital cost curves it seems likely that it will be economically most efficient for one service provider to serve a particular community. Huge economies of scale and large fixed costs are likely to create significant barriers for a second entrant'.[34]

The researchers also highlight the difficulties of entering beyond direct access in providing backhaul ('second mile costs') and thus advocate infrastructure investment which is 'technologically and competitively neutral' enabling service-based competition at higher levels than the physical infrastructure itself.

While in many cases the principal driver of this investment may be oriented to the residential sector and the provision of IPTV, the impact of such an extension of fibre will inevitably spill over into related markets including the provision of services to businesses.

[34] 'Towards Technologically and Competitively Neutral Fiber to the Home (FTTH) Infrastructure', Anupam Banerjee, Marvin Sirbu, 2006. Available at – www.tprc.org

4.3 Conclusions

Three points in general can be made from this brief assessment:

- Although the primary driver for an NGA is for residential markets, it is likely that fibre access networks will be extended to more businesses even if this does not happen immediately. This general increase in capacity will make the provision of competing infrastructures more difficult.
- Unless the legacy copper network is retained, the relevant Point Of Interconnection will likely move from the local exchange to deeper into the core the network and this will apply whether the final link is copper or fibre.
- The increased capacity of NGAs will likely reduce incentives for alternative fixed infrastructure operators. Business focussed NGA investments will be much harder to justify than consumer focussed investments given the much lower density of business customers compared to target residential customers.

Annex 1

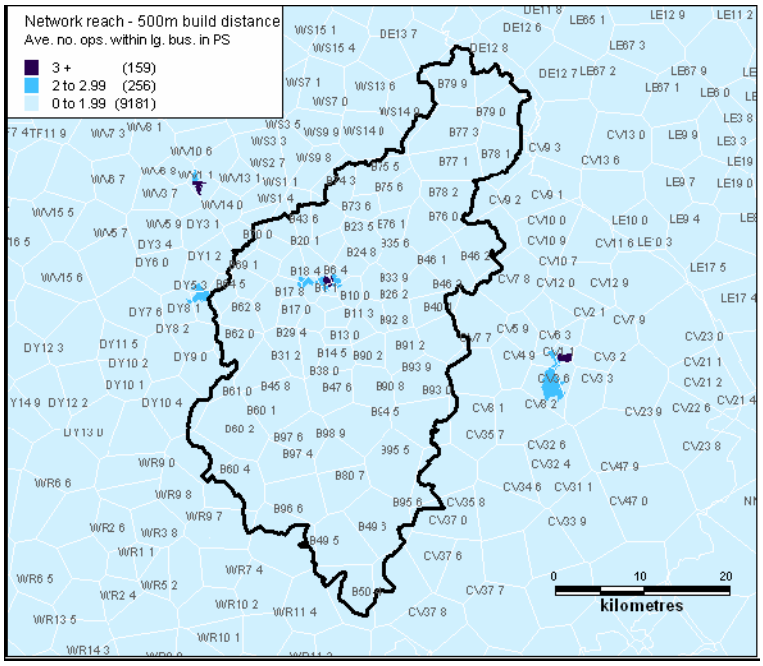
Number of Operators in UK Cities

(assuming 500m build distance)

The figures below indicate the average number of operators with fibre PoPs which are located within 500 metres of the business site.[35]

Figure 17

Number of Operators in Birmingham

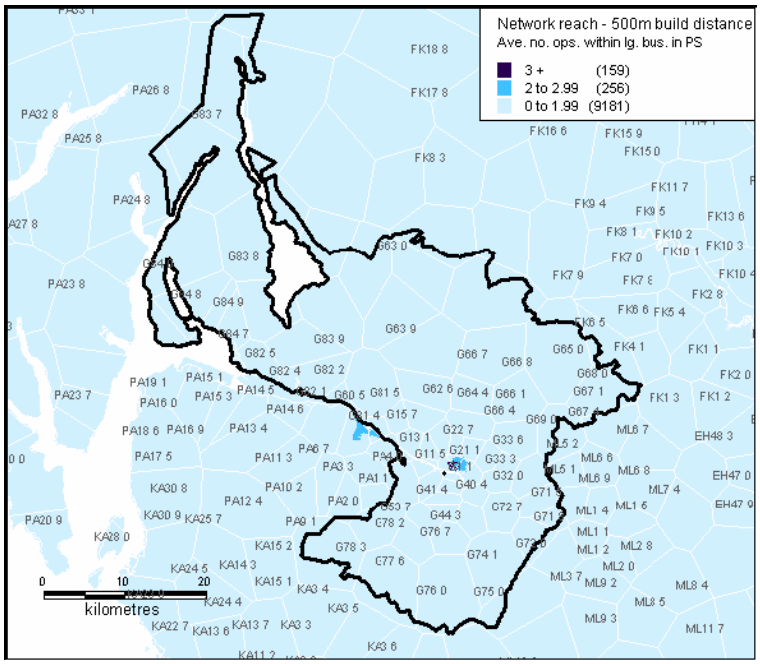


Source: Ofcom

[35] 'Disaggregated Markets', Discussion Document, Ofcom 28/3/06. Available at: http://www.ofcom.org.uk/consult/condocs/disagg/consultation.pdf

Figure 18

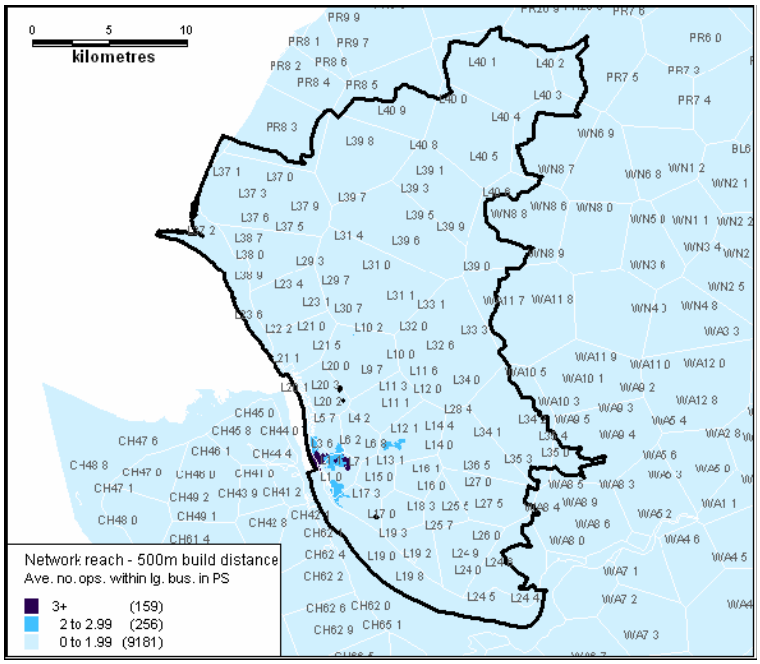
Number of Operators in Glasgow



Source: Ofcom

Figure 19

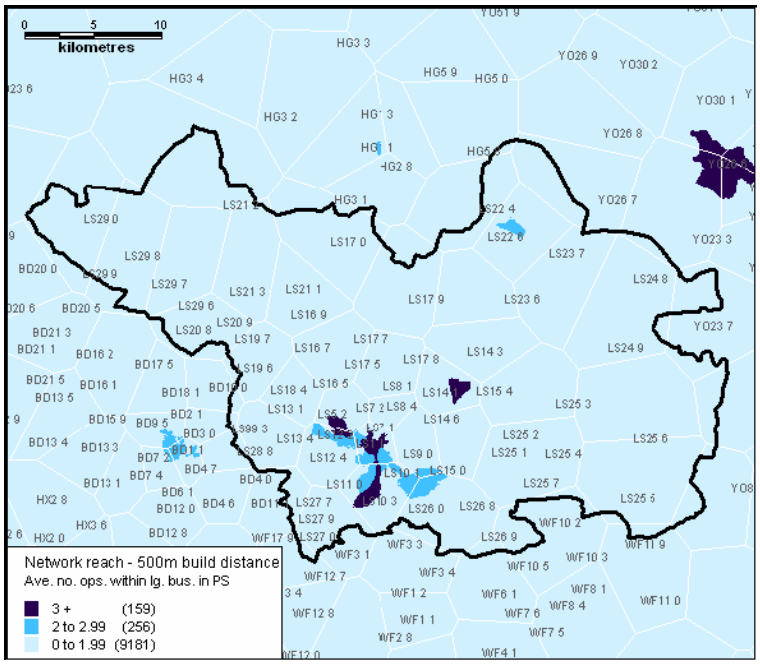
Number of Operators in Liverpool



Source: Ofcom

Figure 20

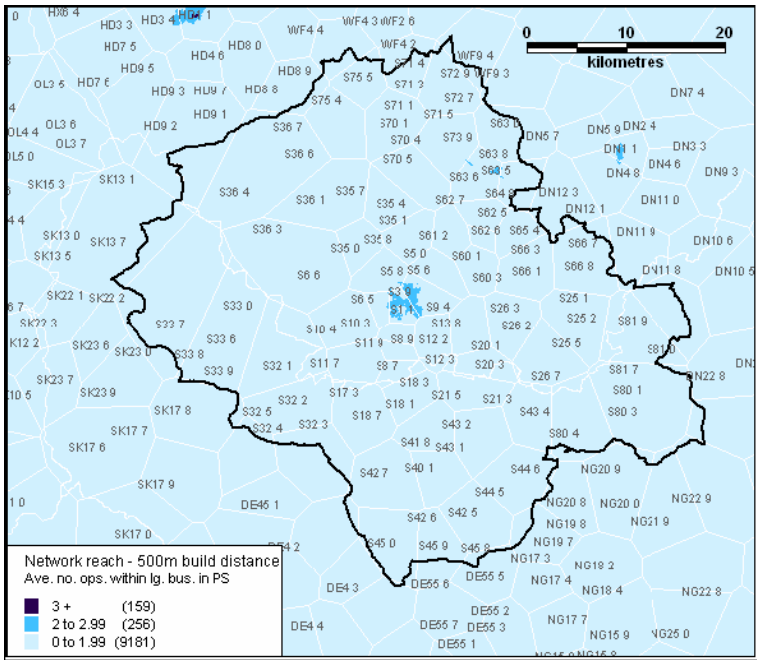
Number of Operators in Leeds



Source: Ofcom

Figure 21

Number of Operators in Sheffield



Source: Ofcom

Annex 2

Regulation of Access Services for the Provision of Business Services in the USA[36]

A2.1 Introduction

Although the impression is sometimes given by some protagonists in EU policy debates that there has been a complete deregulation of access inputs in the US[37], this is not accurate. De-regulation in the US has been more extensive with respect to broadband services for the supply of residential customers than with respect to inputs used to supply business services.

The US rules for regulation or deregulation of access for business services are in theory based on the principle that there is variation in the degree of competitive entry in different exchange areas and that where there is insufficient evidence of collocation in the case of PPC deregulation and insufficient evidence of collocation and business lines in an exchange in the case of unbundling that access must be regulated.[38] There is however a debate in the US over whether the FCC's tests are predictive of effective competition warranting deregulation. BT takes the view that the tests applied have not correctly assessed the extent of effective competition and that this has damaged competition.

It seems inherently unlikely that the residential access deregulation has been a major determinant of productivity growth for US businesses thus far. By contrast, regulation (at least in the sense of mandated free local telephony) has proven an influential driver of US productivity growth, while deregulation has not. Deregulation, even of residential services, has been very recent and therefore is unlikely to be a strong candidate for explaining historical differences in productivity gains. The decision not to regulate new residential fibre roll out was only taken in 2003 and the decision not to regulate DSL was taken in 2005. Until 2000 the US telecoms market was arguably far more extensively regulated than any EU markets.

[36] Report prepared by Jonathan Cave, Department of Economics, University of Warwick and Senior Research Fellow at RAND, Europe. The views expressed in this Report are those of the authors and not necessarily the University of Warwick or RAND.

[37] ETNO Reflection Document (RD248) Position on the Commission Communication on a review of the EU Regulatory Framework for electronic communications networks and services, p.15.

[38] There are exceptions to this principle. For example, Verizon's fast packet services such as Ethernet and optical networking, hubbing and switching services were deregulated because a petition it filed for forbearance was deemed granted by operation of law. The FCC deadlocked, and after a year, because the time had expired for the FCC to rule on the matter, Verizon's petition was deemed granted. No FCC decision was ever issued. Verizon Telephone Companies' Petition for Forbearance from Title II and Computer Inquiry Rules with Respect to their Broadband Services Is Granted by Operation of Law, FCC News Release, March 20, 2006. Such departures from the principle, in BT's view, weaken effective competition.

As in the EU, the conditions of competition for supply of businesses in the US are different from the supply of residential services. By the end of the decade, 40% of residential customers in the US may have access to more than one broadband access provider.[39] Last mile access to business customers, however, outside of central business districts, is usually only possible from one incumbent supplier, i.e. to the vast bulk of sites. The United States Government Accountability Office (the equivalent of the UK's National Audit Office) recently found that competitors provide access service to 6% of business customer sites for services at 2 Mbit/s and 15 to 25% of sites for services at 45 MBit/s and above.[40] These figures are very comparable for the figures found in this study for EU Member States.[41]

A2.2 A history of the regulation of access inputs for serving business customers in the US

Access for providing services for business customers potentially falls under three categories: special access, unbundled loops and transport (i.e. equivalent of unbundled loops and transit in the EU) and merger conditions.

A2.2.1 Special Access

Special access includes local loops and backhaul (i.e. connection to the new entrant's point of presence) and the rules remain neutral as to technology i.e. they cover fibre as well as copper, packet as well as TDM-based technologies.[42] The 1996 Telecommunications Act required the FCC to deregulate where incumbent suppliers were subject to substantial competition. In 1999, the FCC adopted a policy to deregulate special access in metropolitan statistical areas ("MSAs") when certain "competitive triggers" were met. The principal trigger was the extent of collocation in local exchanges within the metropolitan areas which the FCC believed was predictive evidence of irreversible market entry.[43] Regulated products are required to meet a just and reasonable pricing standard. Where service is fully regulated it must be supplied at rates price-capped in 2003. Where deregulated, the degree of collocation determines the degree of pricing flexibility accorded to the incumbent operators. The policy began to be implemented in 2001 and full or partial pricing flexibility is currently applied in 215 of 369 MSAs in the US.[44] Deregulation was based on evidence of new entrant investment in the local exchange, and is being re-evaluated as a result of the mergers between incumbents and the main alternative investors in the exchanges such as AT&T and MCI.

[39] Telco fibre access roll out in the US is expected to pass 38% of households, the majority of households will have a single cable supplier. Dumb Pipe Paradox (Part II): Patchwork Pipes, Bernstein Research, Feb. 28, 2006.

[40] GAO 07-80 Telecommunications. FCC needs to improve its ability to monitor and determine the extent of competition in dedicated access services, p.20 (November, 2006).

[41] See section 2.2.

[42] Except that Verizon's, but not other incumbent operators', fast packet access services (e.g., ATM, Frame Relay and Ethernet) and optical networking, hubbing and transmission services have been deregulated. Supra at 3.

[43] *Access Charge Reform*, Fifth Report and Order and Further Notice of Proposed Rulemaking, 14 FCC Rcd 14221 (1999) (*Pricing Flexibility Order*), *aff'd WorldCom v. FCC*, 238 F3d 449 (DC Cir 2001).

[44] GAO, op. cit., p.6.

A2.2.2 Unbundling

Beginning in 1996, incumbent local exchange carriers were required to provide all inputs for service to other local exchange carriers providing service to both residential and business customers at total element long run incremental cost ("TELRIC"). Unbundling obligations have been radically scaled back affecting carriers providing service to residential customers the most.[45] Unbundling has also been scaled back with respect to supply to business customers. Removal with respect to the latter was also based on a co-location test and the number of business lines in an exchange.[46] The extent of the deregulation is being re-evaluated in the light of the mergers between AT&T and SBC and MCI and Verizon.

A2.2.3 Merger conditions

The merger decisions relating to the SBC/AT&T, Verizon/MCI and AT&T/Bellsouth mergers partially re-impose some amount of regulation on the merged entities. The following conditions were imposed on the SBC/AT&T and Verizon/MCI mergers:[47]

- Rates previously charged by AT&T and MCI for 1.5 and 45 MBit/s PPC access are available to other carriers in SBC and Verizon territory respectively until 2008.
- Neither SBC nor Verizon can seek increases in their UNE (i.e. LLU and backhaul) rates.
- SBC and Verizon will file revised lists of where their UNEs will be made available because of the reduction in local competition from their acquisitions of AT&T and MCI respectively.
- The post-merger entities AT&T and Verizon will file KPI with the FCC demonstrating whether there is a difference in ordering, provisioning and maintenance of access services as provided by the incumbents to its downstream affiliates versus to OLOs and others.
- The post-merger AT&T must continue to make available the rates offered by the pre-merger AT&T for 1.5 and 45 MBit/s services in SBC territory. Likewise for Verizon and MCI.
- The incumbent arm of AT&T shall not offer an affiliate a deal for access unless a third party (other than Verizon) has signed up for the offer.
- SBC and Verizon may not increase special access rates in their regions.
- SBC and Verizon must offer naked DSL in-region.
- SBC and Verizon must peer with as many US backbone providers as they did at the time of their acquisitions of AT&T and MCI were approved and publicly post their peering policies.

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[45] For example, new entrants serving residential customers based their business plans on the availability of a combination called UNE-P that consisted of the unbundled loop, unbundled switching and unbundled backhaul priced at TELRIC but beginning in 2004 this combination ceased to be available. The carriers providing DSL services relied on the availability for lease of the upper frequencies of a copper loop at TELRIC. This was also phased out. See Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers; Implementation of the Local Competition Provisions of the Telecommunications Act of 1996; Deployment of Wireline Services Offering Advanced Telecommunications Capability, Report and Order and Order on Remand and Further Notice of Proposed Rulemaking, 18 FCC Rcd 16978 (2003) (Triennial Review Order), *corrected by* Errata, 18 FCC Rcd 19020 (2003) (Triennial Review Order Errata), *vacated and remanded in part, affirmed in part,* United States Telecom Ass'n v. FCC, 359 F3d 554 (DC Cir 2004) (*USTA II*) *cert. denied*, 125 S Ct 313, 316, 345 (2004).

[46] For example, the incumbent local exchange carrier need not lease to competitors 1.5 Mbps loops at TELRIC rates in any location within the service area of an exchange containing at least 60,000 business lines and four or more fibre-based collocators. See Triennial Remand Review Order: In re Unbundled Access to Network Elements, Order on Remand, 2005 WL 289015 (2005).

[47] In re Application of SBC Commc'ns Inc. & AT&T Corp., Memorandum Opinion and Order, WC Dkt. No. WC Dkt. No. 05-65, FCC 05-183 (Nov. 17, 2005); VZC/MCI Merger Order: In re Application of Verizon Commc'ns Inc. & MCI Inc., Memorandum Opinion and Order, WC Dkt. No. 05-75, FCC 05-184 (Nov. 17, 2005).

- Most of the merger conditions sunset in the period between November 2007 and November 2008.

Conditions applicable to the AT&T/BellSouth merger include the following:[48]

- For a period of 48 months:
  - (i) AT&T will report specified special access performance metrics to the FCC;
  - (ii) AT&T will not provide special access services to its fixed affiliates that are not available to other similarly situated special access customers on the same terms and conditions;
  - (iii) For newly negotiated contracts, where AT&T/BLS have obtained Phase II pricing flexibility, they will offer 1.5 and 45 Mbps channel termination and mileage services, and Ethernet services, at rates that are no higher than, and on the same terms and conditions as, offered where it has not received Phase II pricing flexibility; they will also reduce by 15% the rates for interstate Ethernet services not subject to price caps;[49]
  - (iv) Not include in new contracts/tariffs ratio terms which limit the extent to which customers may obtain transmission services as UNEs rather than special access services; and
  - (v) Will make available 1.5 and 45 Mbps and Ethernet services at "reasonable" volume and term discounts without minimum annual revenue commitments per year (MARCs) or growth discounts.[50]

In addition, AT&T/BellSouth shall continue to offer unbundled loops and backhaul and shall not seek increases in rates. The newly merged entity shall recalculate the availability of unbundled loops and backhaul based on the removal of AT&T as a competitor in BellSouth's territory. AT&T/BellSouth shall permit a competitive carrier to extend its interconnection agreement for three years and will sell a naked DSL service of speeds up to 768 kbps. On net neutrality, AT&T/BellSouth are required to offer neutral network and neutral routing in its wireline broadband Internet access service. It may not sell prioritized service to any Internet application, content or service provider including affiliates except that AT&T/BellSouth's enterprise and IPTV services are carved out. This neutrality condition terminates in 2008.

[48] See commitments appended to the FCC's Announcement of its Approval of the AT&T/BellSouth merger. FCC Approves Merger of AT&T, Inc. and BellSouth Corp., FCC News Release, Dec. 29, 2006. Note that a formal order has not issued yet.

[49] This does not apply to services provided to other price capped ILECs unless they do the same ("reciprocal services") Verizon and Qwest have already challenged this aspect of the conditions as illegal.

[50] If they file a discount tariff with a varying MARC they will offer the same for a fixed MARC. If they propose a MARC during negotiations, AT&T will also offer the option of a discount without a MARC or if a varying MARC is offered, they will also offer a fixed MARC. Finally, customers with varying MARCs today will have option to freeze the MARC as of the closing date if they also agree to freeze the discount rate as of the closing date. Other special access conditions include: (i) AT&T will freeze rates for former AT&Ts local access unit (TCG) tariffed services, but as noted infra, AT&T has for the past year been phasing out/retiring those TCG's facilities; (ii) AT&T/BLS will not to oppose mediation or placing complaints on the accelerated docket.

Annex 3

The Economics of Serving Customers by LLU

1. The purpose of this note is to explain the underlying economics of using LLU using shared metallic path rather than full LLU. The alternative of using multiple bonded pairs to provide symmetric services is outside the scope of this analysis but evidence to date is that entry in most countries using bonded copper pairs is very limited at the current point in time.

2. While the results of this work are based on detailed calculations using the UK as the benchmark, a number of analyses in other countries including France, Germany and Italy show fairly similar results. Entry starts to become viable when: (a) there is efficient utilisation of the relevant network components which are sensitive to volume, and (b) this efficiency can be sufficient to be competitive against the alternative of a wholesale service (where provided) or the incumbent's retail service if a wholesale service is not provided. Both absolute costs and relative costs are thus important.

3. The following illustrations uses a spreadsheet-based model of entry which uses inputs and assumptions based on information placed in the public domain, including published prices which are regulated and studies by industry analysts and network operators.

4. This modelling work is predicated against an entrant deciding to provide services primarily to mass market consumers in the first instance and able to acquire 20% of the customers who currently take broadband service on an exchange.

5. The essence of this model is to emulate the likely costs of such an entrant purchasing network components or equipment at competitive rates or at regulated prices. This benchmark set of costs can then be compared against a hypothetical wholesale tariff for bitstream access which is assumed to be uniformly priced across all exchange areas.[51] The entry decision is that of 'make or buy' in that the presumption of entry is whether or not it is cheaper to self-supply rather than to purchase an aggregation service from the incumbent.

6. The underlying mechanics of the modelling is to build up a cost profile of entry which specifically permits the following factors to be taken into account:

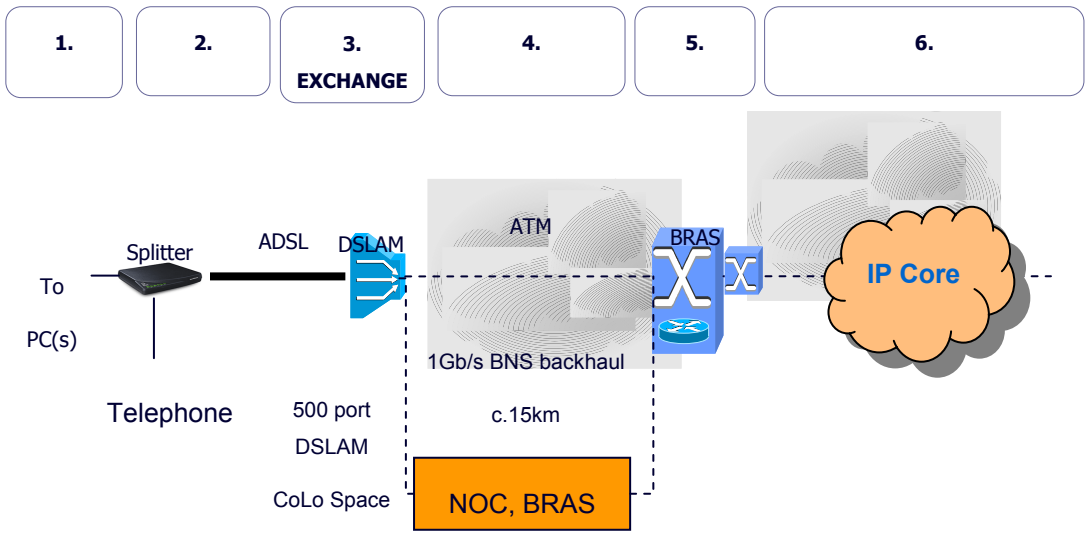
- Actual penetration of broadband users at each exchange.
- Potential market share of an LLU operator using plausible growth rates.
- A fair period of amortisation of capital charges, achieved level of utilisation and an appropriate cost of capital.
- The cost of backhaul services on the marketplace including the possibility of self-provision taking into account the average length of backhaul required on an exchange basis (where exchanges are grouped as discussed below).
- The costs of other network and service components required to deliver an end to end service at the network layer

[51] In some Member States regional tariffs may be offered but this does not affect the conclusions drawn materially.

7. Figure 22 gives a representation of the scope of the relevant costs which are from the MDF to the core IP network. From thereon, the path of traffic to the Internet is (reasonably) assumed to be competitively supplied and the entry decision is not dependent upon assumptions thereafter. The costs of LLU and any connection or cessation charges are excluded as being a common input irrespective of the particular operator as they will be at regulated rates.

Figure 22

The Network Activities in LLU Costing



Source: BT

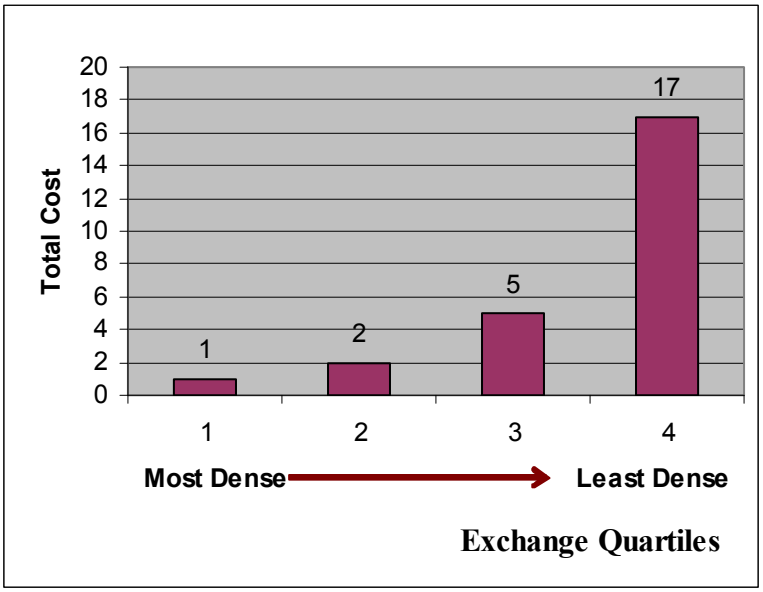
This diagram show the key constituents of network activity which are used to assess the economics of LLU. They start at the end-users in the access network and extend into the shared core network on the far right.

8. As noted above, what matters for the entrant is not necessarily the absolute level of costs but rather: (a) the level of costs to an alternative regulated price (assuming such a service exists); and (b) the sensitivity of the cost benchmark to the potential for growth in customer numbers (and revenue) to acquire the full benefits of scale.

9. To answer the first of these questions, Figure 23 shows the relative cost of serving customers located in the quartiles of the exchanges in the UK which are ranked in terms of density of end-users (least dense first). It is seen that for the UK at least, the range in costs is from a factor of 1 to 17.

Figure 23

Relative Costs for an LLU Operator by Exchange Density



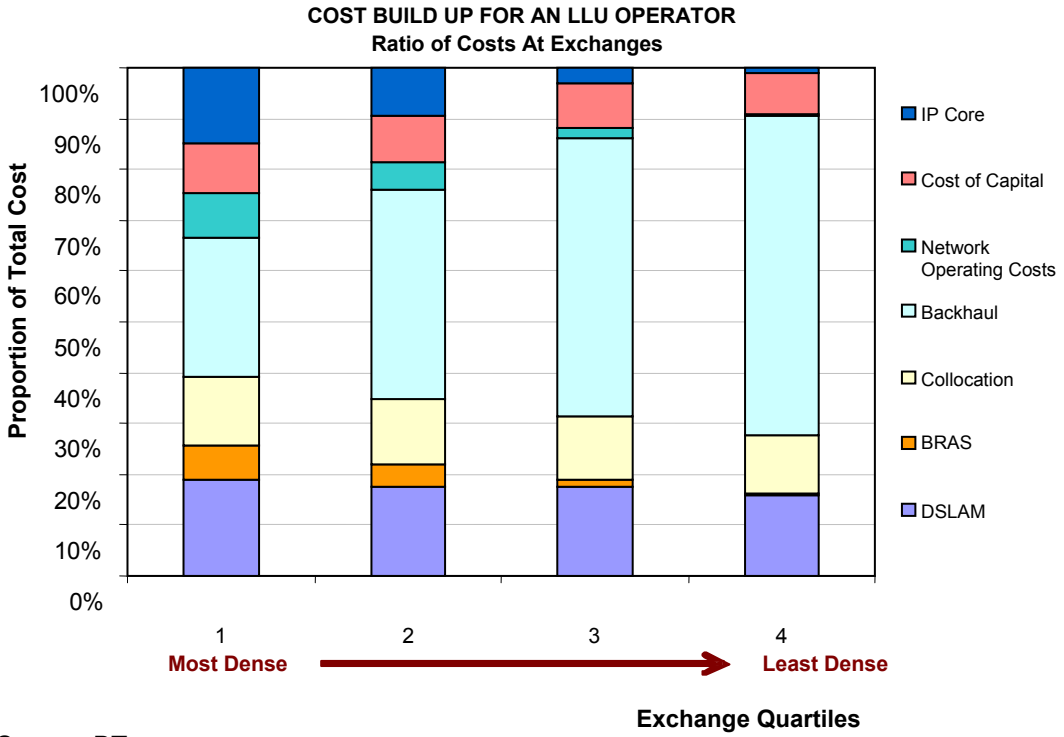
Source: BT

This chart shows the relative cost of supplying customers in the exchanges which are in the most densely populated areas with those which serve small dispersed populations.

10. Figure 24 shows the composition of the four cost stacks corresponding to these quartiles. The cost stacks assume that the entrant can acquire 20% of the actual broadband consumers at those exchanges. The costs of SMPF are not shown as common to all operators and all exchange areas. For the first quartile group of exchanges, this would be about 20% of the cost stack shown.

Figure 24

The Cost Structure By Exchange Density



Source: BT

This diagram shows two principal features of the economics of LLU. The four bar charts show the composition of costs where exchanges are grouped into the most dense (left hand side) and least dense (right hand side) quartiles. On top of each bar chart and relative to the least expensive/most dense group of exchanges, it is evident that the other exchanges cost roughly 60%, 5 times and 17 times more per end user respectively. The composition of costs is shown by the different colours. It is seen that the cost of backhaul (light blue) becomes the predominant cost in the less dense exchanges.

11. The key features of these cost stacks are as follows:

- The largest component of the cost is actually backhaul and this cost is subject to very large economies of scale.
- At all volumes of end-users, the next largest component is that of equipment (DSLAM and nodal equipment) which has lesser economies of scale as volumes rise because these need to be replicated. However utilisation of this equipment is greater at the high dense areas of the network.
- The absolute cost at the first and second quartiles is modest but the costs of the extreme quartile is very high.

12. Some features tend to work together to explain why entrants will typically all go to the same exchanges:

- The larger exchanges in terms of end-users tend to have shorter copper loops as they will be more likely to be in urban areas and thus more clustered nearer to the exchange. This assists in the provision of higher bandwidth per end-user.
- The larger exchanges tend to be clustered in areas where there is proximity to serving nodes and backhaul is much shorter than in less urban areas.[52]
- The shorter lengths for backhaul are more likely to have fully competitive supply which obviates any need to rely on the incumbent for wholesale services.
- The areas of high density will likely have similar socio-demographic characteristics and consumer patterns of demand.

13. Economies of scale (and potentially of scope) are thus pivotal to entry, but so are the underlying features of any particular exchange including its position in the topology of the broader network infrastructure of the country, the number of end-users at the exchange and the general take-up of service. These factors do vary from one country to another for a variety of historic reasons, as do the features of the access network itself such as the length of copper loops and the price formula for LLU and shared loop access.[53]

14. The viability of an entrant versus an incumbent is affected by the ability of the entrant to match the economies of scale and scope particularly in backhaul, but also by the degree to which selective entry becomes viable based on uniform tariffs (which are not universal throughout the EU). The absolute cost for the entrant between the four quartiles of exchanges varies by a factor of 15 and although the absolute number of customers (business and residential) is much lower as a proportion of the total in the bottom three quartiles, nevertheless these would still jointly encompass 25% of customers. In fact, the maximum entry for mass market consumers anticipated in the UK is for 1200 exchanges or about 70% of consumers.

15. To answer the second question (viability of entry), Figure 25 shows a plausible relationship between the LLU benchmark cost against a regulated and hypothetical bitstream access product. These are plotted against the number of users per exchange; all calculations take as given the current distribution of customers in the network and the actual state of provision of the necessary inputs such as average length of backhaul.

16. This diagram suggests that a cut-off would be a little below 300 customers per exchange where this exchange would be located in the more favourable areas of the country with low backhaul costs and the like. Clearly over time and under technical progress some of these cost components would alter, for example the cost of backhaul and nodal equipment. The broad relationships may however not alter substantially.

17. For an entrant targeting exchanges in less dense areas, the cost curve would move vertically upwards such that it would eventually never be appropriate to enter using LLU against a notional average alternative price. The point at which this cross-over occurs would depend upon national circumstances but it seems likely that at least one third of exchanges would be outside a competitive footprint.[54]

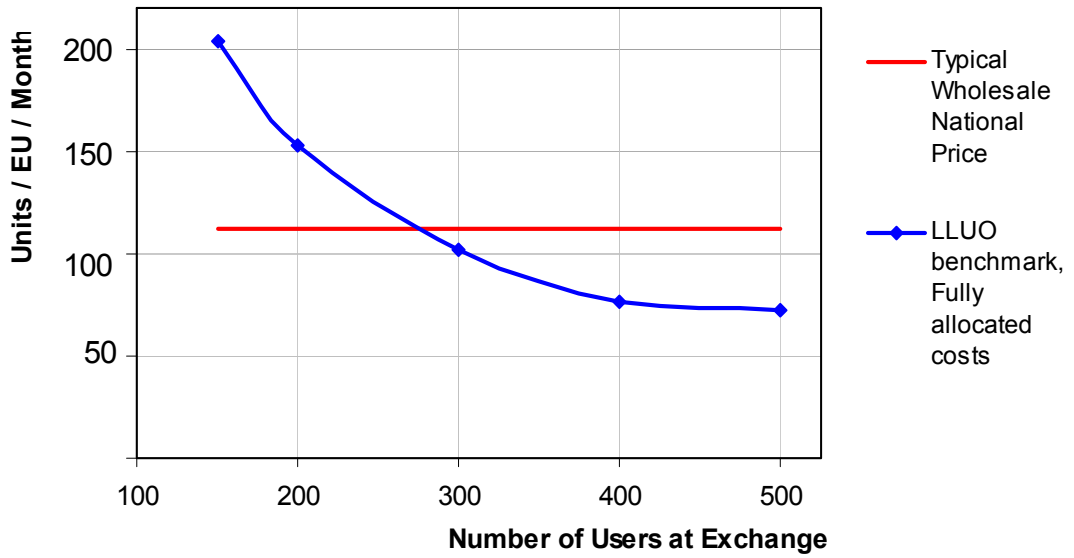
[52] Evidence in the UK suggests that a 10% increase in customers at an exchange is associated with a 19% reduction in length of backhaul.

[53] For a very dense country like much of Holland for example, backhaul costs are likely to be relatively smaller and entry may be easier for mass market consumers.

[54] This is obviously viewed in a static context as if there is selective entry, then the prices of the remaining exchanges would tend to rise on average.

Figure 25

The Minimum Size for an LLU Operator



Source: BT

This chart demonstrates the relative costs of serving users by exchange area. The red horizontal line shows the national average and the blue line how much the costs of exchanges of different density are likely to vary relative to the average. The low number of users (less than 200) will be twice as expensive as the average and the break-even point is a little below 300 users at an exchange.

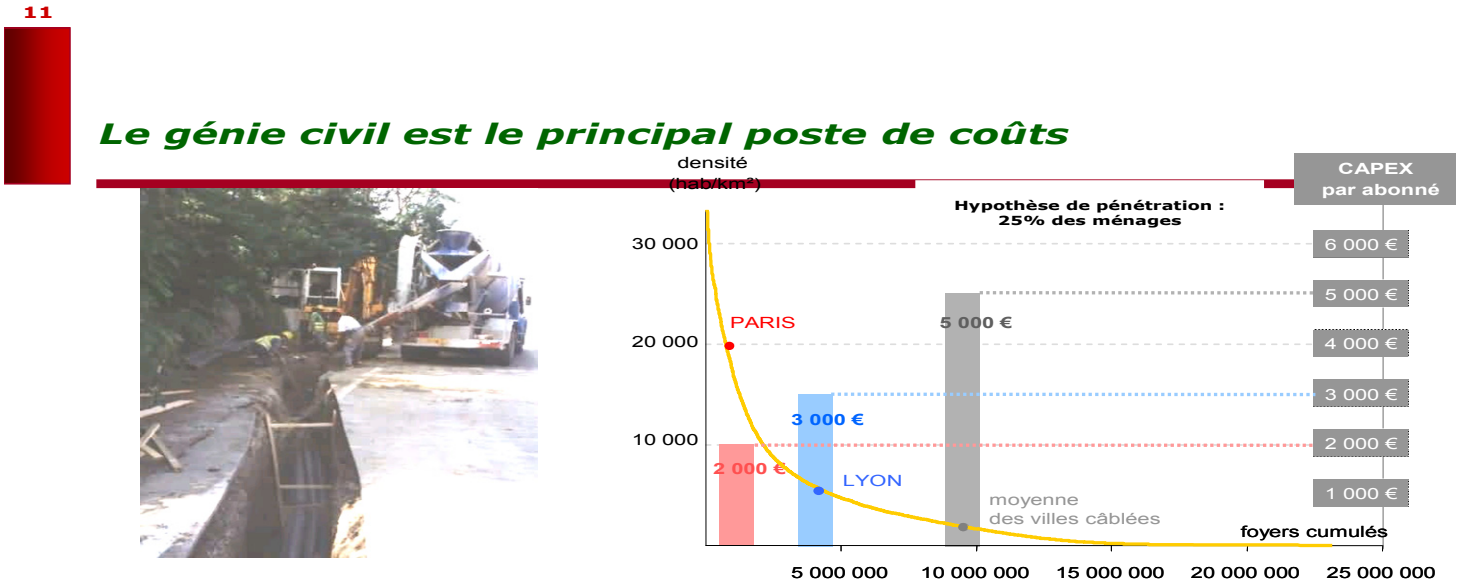
18. The provision of access services to emulate leased line circuit provision would generally be more expensive than for mass market requiring multiple copper pairs or alternatively higher guaranteed bandwidth across a bitstream access product. The benchmark regulated service (where it exists) would also be different. Again, broad comparisons indicate that typically 300+ such customers would be needed to acquire the economies of scale and scope in equipment and backhaul to be competitive against incumbent equivalent services across copper or fibre. However this will be subject to many factors.

Annex 4

Illustrations of the Economics of Access

Figure 26

The Costs of Laying Fibre in France

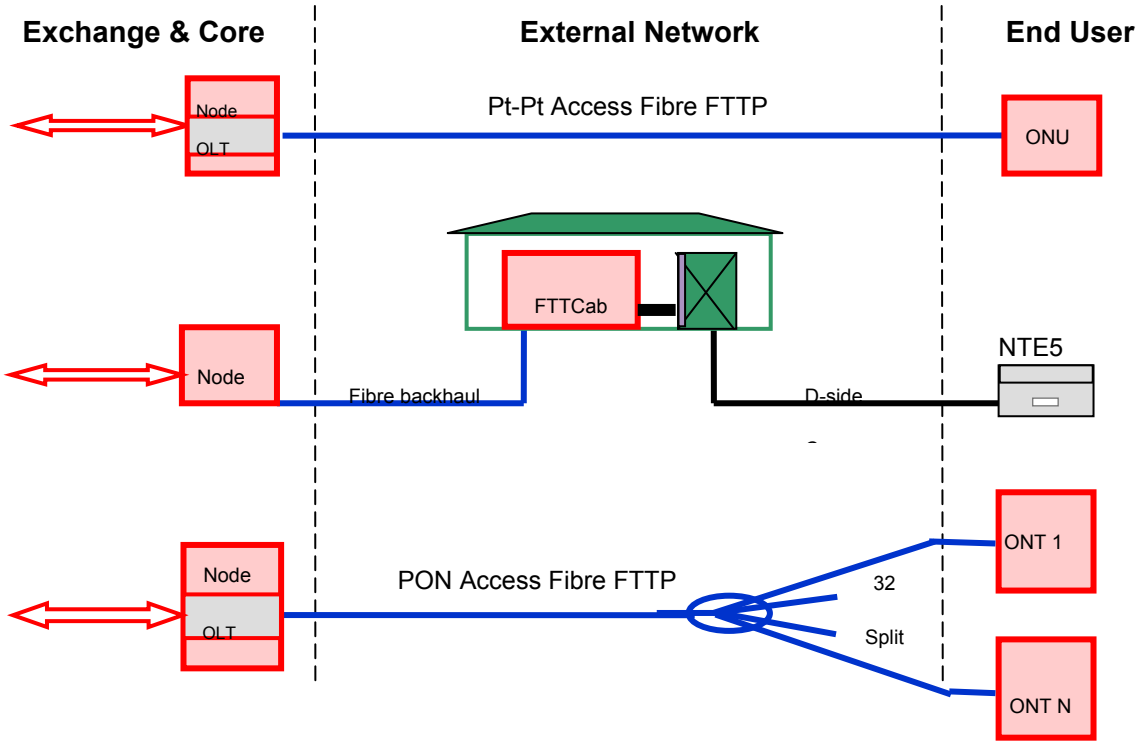


Source: www.arcep.fr

This diagram shows how the costs of fibre to the home increase sharply as the density of dwellings declines. The yellow curve plots the density of dwellings against the total cumulative number of such dwellings with the most dense on the left hand side. Paris for example is very dense but the dwellings in Lyon are less so and appear on the right of Paris. The costs are shown in the respective colours of the three points on the curve – as density falls they rise very quickly.

Figure 27

Models of Fibre Access Networks



Source: BT

These three charts show the schematics of fibre access using traditional leased lines (top), fibre and copper in a fibre to the cabinet/curb (middle) and a shared fibre access network (bottom).

The Application of Proportionate Regulation in the Electronic Communications Sector

A Report Prepared by BT

PURPOSE OF REPORT

Commissioner Reding recently stated the following:

> *'I also see a need to take a decisive step towards the completion of the internal market.* ***We need greater consistency and effectiveness in the application of remedies to repair the fragmentation of the internal market****.'*[1]

This Report provides evidence of the serious disparities between Member States in the effective implementation of remedies and suggests some necessary developments in the nature of remedies and institutional change.

[1] Speech by Vivian Reding to ECTA conference November 2006 available at: http://europa.eu/rapid/pressReleasesAction.do?reference=SPEECH/06/697&format=HTML&aged=0&language=EN&guiLanguage=fr

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Executive Summary

The provision of business services to multi-national multi-site customers is critically dependent on reasonably priced and fit for purpose access products. An access product for business services is fit for purpose if a range of key quality of service (or non price) elements are met. For example, the time taken to repair service threatening faults.

The EU Framework regulation is intended to empower national regulatory authorities to require that owners of monopoly access products make them available on a non-discriminatory, cost oriented basis so that they can be used, inter alia, to provide key business services to Europe's businesses. Provision is also required under the Directives to be on a transparent basis so that regulators and service providers can require compliance. Indeed, it may sometimes be the case that lack of regulatory transparency requirements means that the access provider (particularly if it is not very interested in serving this market itself) is not even aware at senior levels of its own success or failure in providing adequate service.

This Report addresses two fundamental issues. The first is whether NRAs have actually put in place adequate measures to ensure that the services provided under regulatory obligation are available on a transparent and non-discriminatory basis. The second issue it deals with is whether the actual quality and range of access services which have been mandated meets the needs of those putting together services for business customers.

The Report concludes that with respect to both issues that there is wide variation in the quality of implementation. As noted in the first paper in this report, the construction of multi-country business ICT systems suffers overall if there is poor implementation in individual Member States.

Two underlying factors would appear to contribute to the widespread variation in the quality of implementation.

First, the current set of regulatory powers does not necessarily create incentives for the incumbent operator to provide fit-for-purpose access products on a timely basis.

Second, the current institutional arrangements can make it difficult for NRAs to take into account the general interest in securing a functioning single European market in business services.

There are improvements that can be made in the implementation of the current set of regulatory powers and they are discussed in this Report.

However, we believe that in the coming NGN environment that it may become technically more difficult to police price and quality discrimination. As a consequence, it will become imperative that the owner of monopoly access products provides access on its own initiative, on a basis that does not favour one party over another, rather than being forced into doing so over time through the accumulation of evidence. Our view is that a requirement for real equivalence of input is vital to achieve this.

Real equivalence of input means that all downstream operations, whether that of the vertically integrated incumbent or other service providers, have the ability to use the same access products, systems and processes and that this must be demonstrably the case. This is likely to be easiest to deliver on the vertically integrated incumbent's side where the workforce, including the management, providing those access systems and processes is incentivised to provide all service providers on the same basis i.e. where their goals and objectives are differentiated from those of the workforce in other parts of the vertically integrated incumbent. This outcome can be achieved through functional separation.

BT also considers that there are major benefits to be gained from modification of the institutional arrangements both at European and national level such that national regulators are able to take the overall interests of European business into account.

1 Introduction

1.1 The Key Issues for Regulation

The assessment of the effectiveness of the Framework fundamentally comes down in practice to two pivotal issues:

- Whether or not NRAs have been able to put in place monitoring systems to ensure that the provision of wholesale services to third parties is on a non-discriminatory basis both with respect to price and service quality.
- Whether NRAs have implemented their powers to impose obligations and provide incentives for the provision of a range of access services of good service quality and at reasonable prices.

To address these two issues, this Report reviews progress on the implementation of the regime and is structured as follows.

This Section gives some background to the themes to be reviewed.

Section 2 reviews the current status of some of the key building blocks of regulation, including accounting separation and mechanisms for measuring comparative service quality in order to ensure the provision of wholesale products on a non-discriminatory basis otherwise known as Key Performance Indicators ("KPI"). There is a great deal of variation throughout the EU.

Section 3 looks at the specifics of wholesale access products in the context of best practice. While there are positive examples of effective implementation, the position is far from harmonised.

Section 4 identifies the priorities for regulatory attention in the context of the 2006 review. Equivalence of input as the basis of real non-discrimination.

Section 5 proposes harmonisation of European best practices through institutional reform.

1.2 The Key Goals of Sector Regulation

The fundamental purpose of the regulatory regime was recently re-iterated by the ERG as follows:[2]

> 'First, the nature of ex-ante regulation (as opposed to ex-post competition law intervention) needs to be recalled: for a market susceptible to ex-ante regulation, the risk of abuse of SMP is considered to be too great to be taken in a still "fragile" market situation. While the transition to general competition law is the ultimate aim, for the time being at least in those markets classified as markets susceptible to ex-ante regulation, the market failure can only be remedied with obligations imposed ex-ante.
>
> Therefore, if there are different markets identified as ex-ante markets along the broadband value chain and an operator is found to have SMP on most or all of them, obligations need to be imposed, at least one obligation on each market where SMP was found.
>
> This concept – SMP as the trigger for any regulatory intervention – at the same time also implies an "automatic" timeline for removal of obligations, i.e. when the market is found to be effectively competitive, according to Art. 16.3 FD obligations shall be withdrawn.'

[2] ERG (06) 19 May 2006, Revised ERG Common Position on Remedies Explanatory Memorandum. Available at www.erg.eu.int

The accompanying Reports to this study on Access ('Use of Access Technologies') fully endorse these principles.

For most business applications, the fixed and wireless platforms will be complementary to each other and not substitutable at least over the medium term. It is therefore appropriate to treat them as distinct in regulatory terms.

For some customer groups and applications it will be appropriate to rely on LLU alone (including backhaul services) to ensure effective competition. This is more likely in areas of high population density for mass market broadband. For other customer types and applications, LLU will not be adequate (see the accompanying Report 'The Extent of Competition in Serving Business Customers from Fixed Infrastructures'). The latter typically includes access connectivity for businesses to build their data transport networks. The ERG text is thus relevant and appropriate for services supplied to businesses.

1.3 Priorities for Regulatory Action

In BT's view, the key priorities for improving delivery of the current regime are the following:

First, to ensure that all Member States enforce a system of accounting separation on incumbent operators with sufficient transparency to ensure that all stakeholders (including the incumbent itself) can understand whether the vertically integrated incumbent is actually observing the principle of non-discrimination with respect to wholesale pricing.

Second, to promote the application of best practice in the provision of transparent and non-discriminatory wholesale access services in the key markets for business services of leased lines, bitstream access, WLR and MVNO services. Best practice requires reporting on comparative supply conditions, such as the availability in different geographic areas of an access product, the timeframe in which it could be made available, the timeframe within which service threatening faults are repaired, the office hours within which faults can be reported, the notice provided of service restricting maintenance and outages and the hours within which they take place (which should be outside peak use by the end user customer) and compensation clauses which incentivise the access provider to stick to his agreement.

Third, in order to improve the overall regime, BT considers that the principal of Equivalence of Input should be adopted. This can also be described as "enhanced" non-discrimination. This requires that all downstream operations (including those of the vertically integrated incumbent) use exactly the same products underpinned by the same systems and processes.

Currently, incumbents often provide a wholesale "equivalent" to a retail product over a separate technical system subject to different ordering processes and timescales. This could be considered an attempt at equivalence of output but can often turn out not to be very equivalent in practice.

Fourth, real equivalence of input is more likely to be delivered by the vertically integrated incumbent's side where the workforce, including the management, providing those access systems and processes is incentivised to provide all service providers on the same basis i.e. where their goals and objectives are differentiated from those of the workforce in other parts of the vertically integrated incumbent. This outcome can be achieved through functional separation.

Fifth, the overall regime is also likely to improve if institutional reform is undertaken at European level to spread best practice and to encourage NRAs to take the general European interest in delivering the single market into account.

2 Establishing Transparency and Non-Discrimination

2.1 Establishing Non-Discrimination in Practice

Non-discrimination obligations address two broad sets of issues, price and non-price. The non-price issues include aspects such as quality of service (ordering, provisioning and operation) and the technical specification of the relevant service. The obligation should prohibit the SMP operator from offering different quality of service or technical specifications for service than they offer their downstream divisions unless there are objective grounds for doing so e.g. reflected in the price charged.

The price obligation means that the SMP operator charges its wholesale customers broadly the same as the internal transfer charge it notionally prices to itself for the same service. Differences in prices should be objectively justified.

The results of the 2006 ECTA Scorecard on whether the principles (not the enforcement) of non-discrimination and margin squeeze have been addressed are shown in Table 1. Only two countries score above 10 out of a maximum of 20 and six countries have a score of 5 or less.

2.2 Systems of Accounting Separation (AS)

Where there is little prospect of competitive supply, cost orientation is required for two reasons. First, it provides some protection against price squeeze by preventing the SMP operator insulating itself from price competition by manipulating its tariffs. Second, by setting price as close as possible to incremental cost (plus a mark-up for the recovery of common costs) it allows an efficient relationship in the marketplace between supply and demand.

Cost orientation necessarily requires some form of accounting system. The bedrock of cost orientation is a system of accounting separation and attribution of costs to activities and services on an economically justifiable basis. These are needed to align individual services to a requirement of cost orientation and ensure that internal transfer charging is performed on a fair basis.

The absence of cost orientation from a remedy will increase the risk of a margin squeeze. Simply incorporating a requirement not to excessively price at the wholesale level is insufficient. It means that the external charge may only limit the *maximum* extent to which the charge will be greater than the underlying incremental costs – and therefore the implicit internal transfer charge which the company will use for its own downstream pricing.

Table 1

ECTA Scorecard on Margin Squeeze

Non-Discrimination and Margin Squeeze

Section	Sub-section	Question	Question	Weight	AT	BE	CZ	DK	FI	FR	DE	EL	HU	IE	IT	NL	PL	PT	ES	SE	UK
B	3	38	Are there clear rules for non-discrimination in an *ex ante* context	5	2.5	2.5	0	2.5	2.5	2.5	0	2.5	2.5	2.5	5	2.5	0	0	2.5	0	5
		39	Clear rules for price squeeze test	5	2.5	2.5	0	0	0	5	0	2.5	0	2.5	5	5	0	0	2.5	2.5	2.5
		40	Have rules for price squeeze test been published	5	0	0	0	2.5	0	5	0	2.5	0	2.5	5	5	0	0	2.5	0	2.5
		41	Does NRA have provisions for non-price discrimination	5	5	5	0	2.5	2.5	5	0	2.5	0	2.5	0	0	5	2.5	2.5	2.5	5
			TOTAL	20	10	10	0	7.5	5	17.5	0	10	2.5	10	15	12.5	5	2.5	10	5	15

Source: ECTA 2006

Many relevant documents have been issued by the Commission, the ERG and their consultants reinforcing the critical requirements of this work.[3] For example, EC Recommendation on Preparation and Publication of Information (2005/698/EC) proposes that the following should be prepared:

- Profit and loss statements.
- Capital employed statements.
- Consolidation and reconciliation with statutory accounts.
- Description of costing methodologies including reference to cost base and standards, allocation and valuation methodologies, identification and treatment of indirect costs.
- Non discrimination notes (detailed transfer charges).
- Audit opinion.
- Description of accounting policies and regulatory accounting principles.

The telecommunications sector is highly dynamic and it is commonly recognised that valuations of assets can be as much an art as a science, as indeed are many financial assessments.

However, this observation does not detract from the real feasibility of constructing a workable and useful system which can make a reasonable attempt at cost apportionment which has consistency and transparency, recognising that perfection is not going to be possible. The absence of *any* such system means that there can be no confidence in the industry that the regime will be implemented properly at all.

The ECTA 2005 Report put the position as follows:

> 'Most national legislation contains some sort of cost accounting separation obligation. However, in many countries, such legislation is unclear and in a few cases is non-existent. Alternatively, the mechanisms used are not transparent, preventing third parties from taking effective action to secure the regulatory commitments made by the SMP operator or from identifying anti-competitive activities. Generally, the majority of Member States have done very little to actually enforce cost accounting obligations under the old regulatory framework.'[4]

The precise nature of cost accounting systems is not clear in many countries; the outcomes of the ECTA Scorecard for 2006 are shown in Table 2. Of the seventeen Member States identified, thirteen were attributed scores of 10 or less out of a maximum of 20. The current position appears to be that still only Ireland and the UK have implemented in full the Commission's Recommendations.

In comparison with the scores for 2005 (see Table 2), progress is being made to varying degrees in a number of countries. Figure 1 provides a picture based on BT research which supports this conclusion but also indicates that in at least half of the European Union, it is simply unclear to industry what is happening in practice. This is in spite of the majority of market reviews having being completed and that most NRAs have included an AS obligation as part of their remedies in SMP markets.

[3] These include the Commission Recommendation of 19 September 2005 and the ERG Common Position ERG (05) 29.

[4] See the Andersen Business Consulting Study prepared for DG InfoSoc "Study on the implementation of cost accounting methodologies and accounting separation by telecommunications operators with significant market power" (July 2002).

Table 2

ECTA Scorecard on Accounting Separation

Accounting Separation (Art 11 AD)

Section	Sub-section	Question	Question	Weight	AT	BE	CZ	DK	FI	FR	DE	EL	HU	IE	IT	NL	PL	PT	ES	SE	UK
B	2	34	Does cost accounting separation accompany non-discrimination	5	5	5	5	5	5	5	0	5	5	5	5	2.5	5	5	5	5	5
		35	Is cost accounting separation methodology clearly specified	5	0	0	5	5	0	5	0	0	2.5	5	2.5	5	0	5	5	0	5
		36	Are accounting separation accounts published	5	0	0	0	0	0	0	0	0	0	5	0	2.5	0	0	0	0	5
		37	Do separated accounts show transfer charging	5	0	0	0	0	0	0	0	0	0	5	5	2.5	0	0	0	0	5
			TOTAL	**20**	**5**	**5**	**10**	**10**	**5**	**10**	**0**	**5**	**7.5**	**20**	**12.5**	**12.5**	**5**	**10**	**10**	**5**	**20**
			TOTAL 2005		**5**	**0**	**7.5**	**0**	**n/a**	**2.5**	**0**	**5**	**5**	**17.5**	**7.5**	**0**	**2.5**	**5**	**5**	**5**	**20**

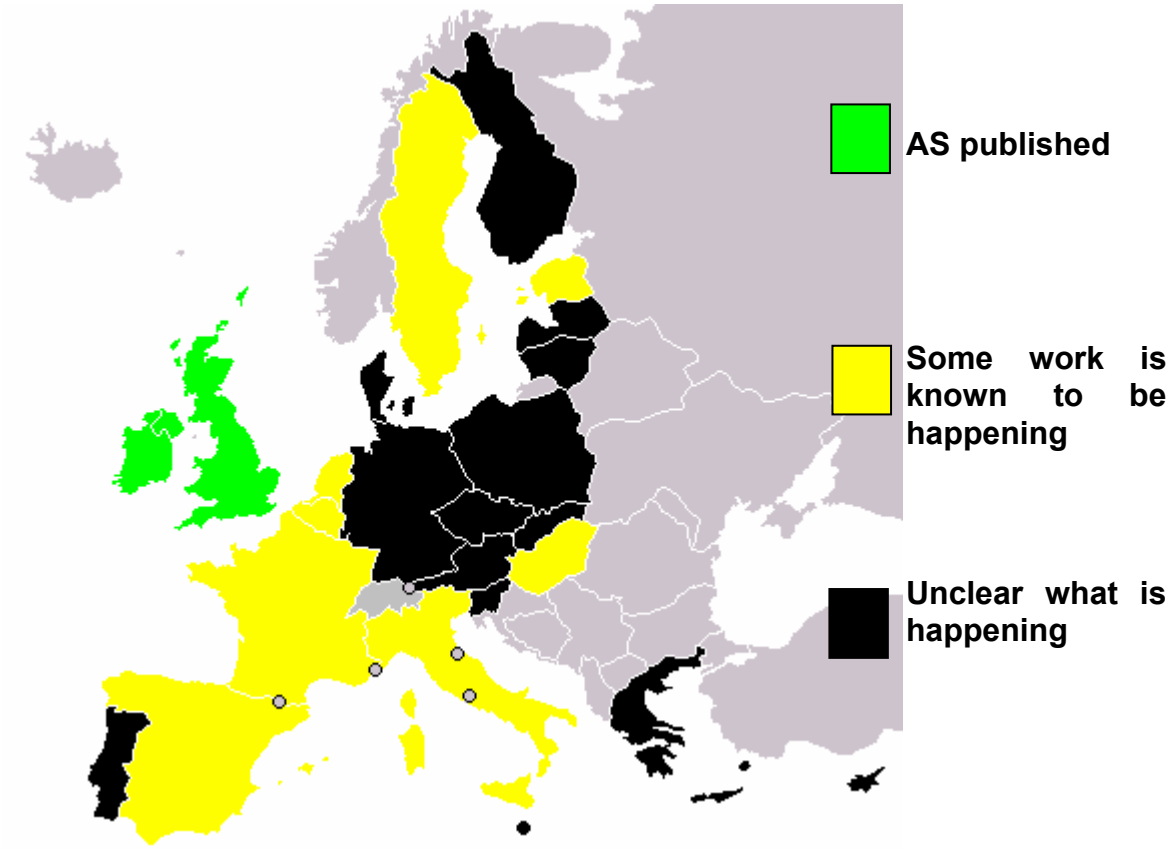
Source: ECTA

We note that the current rules on Accounting Separation are potentially mutually contradictory. Article 10(1) and 10(2) of the Access and Interconnection Directive allows (but does not require) a national regulator to require accounting separation and transparency. However, Article 10(2) allows this harmonisation requirement to be undermined by allowing it to be overruled by national rules on commercial confidentiality. A number of national regulators claim that they cannot observe the EU requirements on accounting separation and transparency because national rules prevent them.

It may also be the case that as incumbents adopt next generation networks that new pricing models are necessary. This may have implications for the ability of accounting separation models to track non-discrimination. However, this provides no excuse for not adopting accounting separation in the short to medium term. Adopting such a system, where it is being done with any seriousness, takes 6-12 months. Most incumbents are unlikely to have switched to a full NGN network for at least another ten years.

Figure 1

Status of Cost Accounting in the EU



Source: BT

This diagram shows the status of known accounting separation in the EU.

2.2.1 Preventing Margin Squeeze in Prices

The underlying principle of margin squeeze is an attempt to manipulate input and output prices to disadvantage rivals in downstream market making their business case untenable. A proper accounting separation regime helps to prevents this.

A transparent price-squeeze test is sometimes called a 'retail cost stack'. It consists of building the retail price of an incumbent by adding the incremental retail costs of provision and a share of retail common costs on to the wholesale prices (themselves constructed from incremental and common costs). Absent this, even when operating under a cost-orientation condition, an SMP operator might still have considerable scope to transfer its common costs away from retail services in the areas where the competitive threat is the greatest and conversely to load them onto those wholesale services which are separate and dedicated to new entrants.

It is also desirable and in principle feasible to link such regulation to regulatory accounts and for third parties to see with transparency what the internal transfer charges have been from published accounts. However, the generally poor state of AS implementation means that in practice very few NRAs are actually able to do this.

2.3 Key Performance Indicators (KPIs)

All stakeholders (including the vertically-integrated incumbent) industry need the ability to assess whether monopoly access products are actually being supplied on a non-discriminatory basis. Sometimes SMP operators have been known to offer a reasonably weak Service Level Agreement ("SLA") but gain a reputation for offering better service to their own end users. One way to address this is via a requirement for the SMP operator to compile and publish Key Performance Indicators ("KPI"s), separating out performance offered to their wholesale arm (or where that is not yet technically possible to their own retail customers) and wholesale customers.

KPIs are in fact seldom imposed as part of remedies. Sometimes where they are mandated, there may only be a requirement to publish them to the national regulatory authority and they may not in fact cover all the key elements. KPIs must cover a number of areas including: order fulfilment, order priority, provisioning times, repairs etc.

BT research into the regulatory requirement to publish KPIs with respect to some key access products for business services in 13 Member States: Belgium, Czech Republic, Denmark, France, Germany, Hungary, Ireland, Italy, Netherlands, Poland, Spain, Sweden and the UK, reveals the following:

Product	Publication of KPIs	Publication of KPIs to NRA only
Traditional PPC	3 Member States	1 Member State
Ethernet PPC	4 Member States	1 Member State
ATM Bitstream	3 Member States	1 Member State (a different Member State from the one above)

While KPIs have been applied for some years in the UK, it is only comparatively recently that formal statistical analysis and widespread reporting have been undertaken even there.

The product equivalence KPIs published in the UK show how BT's performance in the supply of wholesale services to other communications providers (CPs) compares to that it provides to its own downstream divisions. Where the supply is not yet required to be provided equivalently then a comparison is made between the service BT provides to other CPs and its own retail service[5]. Whilst this is less accurate, it does offer a degree of assurance whilst fully equivalent systems and processes are being introduced.

The range of services covered by KPIs in the UK is shown in Table 3.

Table 3

BT Products Covered By KPIs

Wholesale Input Product	BT Retail Comparator
Unbundled Local Loop – MPF and SMPF Provision and Repair	MPF and SMPF as supplied to BT Downstream Units (comparison under development)
Wholesale Ethernet Service and Backhaul Ethernet Service – Provision and Repair	Local Ethernet Service
IPstream and Datastream, Provision and Repair	IPstream and Datastream provided to BT Downstream Units
Partial Private Circuit Provision and Repair	Retail Private Circuits
Wholesale Line Rental Analogue Provision, Transfer and Repair – Consumer. Repair analysed by Care level.	PSTN Line Rental Provision, Transfer and Repair – Consumer. Repair analysed by Care level.
Wholesale Line Rental Analogue Provision, Transfer and Repair – Business. Repair analysed by Care level.	PSTN Line Rental Provision, Transfer and Repair – Business. Repair analysed by Care level.
Wholesale Line Rental Digital Provision Transfer and Repair – Consumer. Repair analysed by Care level.	ISDN Line rental Provision, Transfer and Repair – Consumer. Repair analysed by Care level.
Wholesale Line Rental Digital Provision, Transfer and Repair – Business. Repair analysed by Care level.	ISDN Line Rental Provision, Transfer and Repair – Business. Repair analysed by Care level.
Wholesale Line Rental 30 Channel Digital Provision, Transfer and Repair – Business. Repair analysed by Care level.	ISDN30 Line Rental Provision, Transfer and Repair – Business. Repair analysed by Care level.

Source: BT

[5] With respect to some products in the UK there is a transition period to full equivalence.

3 Evidence on the Range and Quality of Access Services

3.1 Non-Price Factors and Service Delivery

3.1.1 The Importance of Service Quality

As noted above, non-price aspects of non-discrimination obligations include both the technical specification of the product and the associated service delivery, assurance, and other processes.

The non-price quality aspects of a service are as important to the consumer as the price – particularly to a business where a mission critical IT application may be dependent on the associated communications service. Business users typically require prompt and certain installation lead-times, high availability of the service and speedy repair times.

These issues are examined below.

3.1.2 Time to Supply

Long lead-times for supplying access often prevent customers from choosing an alternative to the incumbent. The ERG states the following[6]:

> 'Another issue may arise where the SMP player is already selling a retail service but no wholesale equivalent. Where the wholesale equivalent is covered by a general obligation to supply (or where the NRA determines that the SMP player should supply a defined wholesale service) the SMP player needs to be given incentives to supply the wholesale service quickly, once it has been requested.
>
> In such circumstances, the NRA may consider imposing a deadline for supply. If the SMP player misses the deadline, it would be liable not only for compensation (as described in the previous paragraph) but also to a prohibition on providing any relevant wholesale input to itself until such time as the requested wholesale service had been made available to others. This would mean that it would not be able to obtain a "first mover advantage" by supplying its retail product while denying others the ability to compete by withholding the necessary network inputs.'

The incumbent European supplier to BT which has the longest contractual supply time for the provision of a PPC takes 95 days to deliver (the company is based in Western Europe). BT's most rapid supplier is an incumbent (also based in Western Europe) which takes 15-22 days. It is reasonable to be sceptical that the first supplier takes 95 days to supply end-users with end-to-end leased lines.

4.1.3. Service Level Agreement (SLA)

Service quality is usually specified by the customer's supplier in a SLA. When an SMP supplier offers a retail SLA, this is naturally underpinned by an implicit quality of service delivery from the upstream operation. Access seekers dependent on the SMP supplier for wholesale services input need to ensure there is an appropriate wholesale supply SLA in place to underpin their own retail SLA commitments.

The nature of the Quality which is ensured through an SLA that is in two parts:

- Designing and agreeing a level of quality of service at least comparable to that which is supplied by the access provider to its own downstream business; and

[6] Revised Common Position on Remedies, ERG (06) 33 available on ERG website www.erg.be

- Actually delivering the agreed quality on a transparently measured basis.

In this context, the ERG states the following:

> 'Even where there is an established reference offer for a product, SMP players often prefer not to be committed to supplying that product according to a particular time-scale or quality or to be committed to repairing faults within an agreed time-scale. Commitments of this kind would be normal commercial practice and it is entirely legitimate – and may be necessary for proper functioning of the market – for the NRA to require the SMP player to make reasonable commitments of that nature. What is 'reasonable' will depend on the individual characteristics of the product.'

Two examples that BT can provide of this:

One incumbent's standard offer for PPC and leased line repair for service threatening faults is 45 hours. Industry best practice is 3 hours. Another offers 5 hours but with no provisions at all compensating for any failure to repair within that (or any) time frame.

3.1.3 Efficient Migration Processes

An aspect of service delivery that is particularly problematic in a competitive environment dominated by an SMP provider is the migration of a customer's service between competing service providers. In this context initially all customers are with the incumbent SMP provider and have to have their services 'moved' from that provider to the competitor entrant. This can constitute a barrier to switching and a barrier to entry.

In due course, customers may wish to switch between operators where there is no SMP at all and competition is effective. Under these circumstances, it is appropriate for the industry to agree processes which are both efficient and fair to all parties involved. Wholesale services need to be defined with reasonable terms for acquisition and cessation with a seamless transfer where appropriate.

The ERG states the following:

> 'The other crucial condition besides consistent pricing to maximise efficiency of investment and effectiveness of competition is the availability of well-functioning and cost-effective network migration processes (see below point 5.2.2.3). These will be needed either to allow the entrant to serve its existing customers via its own additional infrastructure (corresponding to a climb of the ladder) or to serve customers who have been attracted from another provider using a different infrastructure configuration.
>
> SMP players have commercial incentives to delay and degrade such processes, in order to make it more difficult for entrants to justify infrastructure investments and to win customers from other providers. For business customers, who are generally extremely sensitive to quality of service, the functioning of migration processes is crucial for the choice of an operator.'

The development of a suite of wholesale products has necessitated something of a learning process on migrations between different service providers and SMP operators. It is fair to say that even though the basic principles of rights of customers to switch between different providers was fully anticipated in the regulatory framework – as a sign of a competitive marketplace – the practical issues arising were left to be dealt with by NRAs. Some have been more successful than others in dealing with them.

Migration processes are complex and the regime has involved a significant learning requirement for the industry. Annex 1, Case 1 sets out the history of migration for broadband products in Ireland. It is apparent that significant difficulties are still occurring two years after requests were made for migration processes to be offered and considerable disbenefits to consumers have arisen.

NRAs and operators are however becoming considerably more experienced at handling these matters and to a large degree the teething difficulties of migrations should in principle be a 'one-off' problem, unless inadequate regulatory intervention permits stalling of efficient processes being put into place.

3.1.5. Service Specification and Commercialisation

The precise amount of time which it is reasonable to allow for the introduction of a wholesale service will depend upon a number of factors including the complexity of the service itself; the requirements of systems and processes to manage the introduction of the service and whether any other services are affected by its introduction, such as requirements to migrate between other possibly pre-existing services and so forth.

Regulators therefore need to act proportionately recognising that *some* new services can be difficult to introduce for the first time and all parties may need to undergo a learning process to ensure reasonable efficiency. No hard and fast rule is therefore likely to be universally applicable, but in general it should be expected that most products should be available within 6-12 months.

In some cases, the product may be introduced using processes which are designed for relatively small volumes (manual processes) and at a later stage when demand is more established, more streamlined processes can be more effective i.e. the product becomes 'industrialised'. This has been the procedure for example with LLU in a number of Member States.

There is a tension in the need to bring a new wholesale product to market as rapidly as possible, particularly after a lengthy period of regulatory market review, and the need for the quality of the product and its accompanying provisioning and assurance process to be fit for purpose as often the SMP access provider has already launched a retail product into the market.

There are two aspects to mitigating this conflict:

- Ensuring the shortest feasible period between imposition of the regulatory obligation and delivery of a non-discriminatory fit for purpose product with associated processes; and
- Ensuring that during the intervening transition to fit-for-purpose, the access provider provides sufficient resources in order to make up for any product/service shortfalls.

Appropriate incentives need to be included with any regulatory remedy that address the above two dimensions.

One researcher identified systematic delaying tactics in the past in one Member State which had the effect that there was a significant time difference between a product being formally required and something actually useable being supplied: Reference Interconnection Offer (12-20 months for application); LLU (30 months for restoration of equality); Partial Private Circuit (33 months for basic provision); DSL (42 months for pricing provisions). These statistics are set out in Annex 1, Case 2.

Clearly this particular situation should not be taken as typical or necessarily the prevailing situation. However, it does highlight that delays – which Commissioner Reding mentions are damaging – can arise from many sources.

3.2 The Actual Standards of Access Services

3.2.1 Overview

It has been argued in the associated Reports that to provide services to businesses requires wholesale services at multiple levels and of many types, including: partial private circuits (traditional and Ethernet interface) and DSL bitstream access (IP and ATM interface). As IP networks develop, new interfaces and wholesale products will also be required. These changes are to be expected as a consequence of technical progress which features in competitive markets.

It is well understood that supplying functional, high quality wholesale products involves a potential conflict of interest for the SMP operator as doing so facilitates greater competition in retail business and loss of downstream profits. Because of this, it is common to observe 'deal killers' in the product specification or terms and conditions (often both). It is the NRA's responsibility, in conjunction with operators, to specify the product and terms and conditions sufficiently tightly to prevent this from happening.

Some NRAs have performed better than others in adequately defining the necessary detail for service provision parameters

3.2.2 Supply of Bitstream Services

Table 5 examines the comparative supply of regulated bitstream services across a number of Member States. Bitstream has been identified as a key service in the competitive supply of business to business services. Yet, even allowing for differences between Member States as regards the level of competition in the relevant market, there is a remarkable fragmentation across Member States, both in the supply of the three common forms of ATM and IP bitstream service, and also in the price regulation deemed appropriate.

In most cases, where bitstream services are not provided, this is not that they have been required as a remedy in the past and have been withdrawn because the relevant market has become competitive, but they have never been provided at all.

Table 6 examines in more detail the characteristics of the bitstream services as supplied in Germany and France. Germany is a market in transition: there has never been a serviceable bitstream product in the German market, though the regulator, BNetzA has recently mandated its provision by the incumbent.

In France there has been an obligation on the incumbent to provide a bitstream service for some time. The differences between the two markets are clearly shown in the market share outcomes.

Table 4

Provision of Bitstream Services

Country	Parent ATM	Distant ATM	IP Handover	Price regulation	KPIs Published
Austria	No	Yes	Yes	Retail minus	No
Belgium	No	Yes	No	Cost plus + Price squeeze test	ATM – Yes IP – No
Denmark	Yes	Yes	Yes	Cost orientation	Not formally mandated but part of service.
Finland	Yes	Yes	No	None	No
France	No	Yes	Yes	Reasonably efficient entrant test	Yes
Germany	Under review	Under review	Not available yet	None	No
Greece	No	Yes	Yes	Retail minus	ATM – No IP – Yes
Ireland	No	Yes	Yes	Retail minus	No
Italy	Yes	Yes	Yes	Cost orientation	To NRA only
Luxembourg	No	No	Yes	None	No
Netherlands	No	Yes	No	None	Yes
Portugal	No	Yes	Yes	Retail minus	No
Spain	Yes	Yes	Yes	Retail minus pending CO	No
Sweden	No	No	Yes	Retail minus	No
UK	Yes	Yes	Yes	Price squeeze test	Yes

Source: BT, Information as at February 2007.

Table 5

Bitstream Access Remedies in France and Germany

	Germany	**France**
Remedies applied and timescales	ATM and IP bitstream defined as separate markets, with DTAG having SMP on both. IP Bitstream: • Not available yet and not mandated yet. ATM Bitstream: • BNetzA are now proposing to remedy DT's refusal to supply through an access obligation; and • BNetzA are also proposing obligations: ▪ To publish a reference offer; ▪ Non-discrimination; ▪ Accounting separation; and ▪ To apply an ex post excessive pricing test to DT's rates (the European Commission has recommended an ex ante cost orientation obligation).	Wholesale broadband access delivered at a regional level. Decision dated 19 May 2005, valid until May 2008: FT must respect the following obligations: • Obligation to provide access (IP or ATM); and • Obligation to maintain their previous wholesale offers. And to add them to the reference offer: • Non discrimination; • Transparency; • Publish a reference offer; • QoS commitments; • Non eviction tariffs; • Cost orientation; • Accounting separation.
Price of Access	IP Bitstream: • Not available yet and not mandated yet. ATM Bitstream: • Not available yet. • Commercial ATM network offer from DT is an estimated 300% above cost, but no cost orientation mandated.	http://www.francetelecom.com/fr/groupe/initiatives/saviorplus.documentation/offres/att00022719/ODR_DSL_13_10_2006.pdf Tariffs 5 pages long. 1 example: • DSI Access subscription: €49. • DSI collect ATM: when the OLO POP is not connected to FT: €4500 subscription + €2400/month if distance <10km. • Backhaul price depends upon SLAs from €57 per Mbit/s for 'best efforts' to €137 per Mbit/s for 'premium' SLA.
SLAs	None or below retail.	Several SLAs in FT's offer.
KPIs published	No	Yes
Margin Squeeze	None Mandated.	No margin squeeze test published but the regulator stated that FT's

	Germany	**France**
Test		wholesale broadband regional access offer cannot squeeze LLU rates nor local access offers.
Take-up of Bitstream	None.	44.1% growth from 12/2004 to 12/2005 of the retail market.
Incumbent Market Share	Retail: 80% (remainder is ~10% LLU and ~10% simple resale of DT product by ISPs).	Wanadoo (FT): 50% retail market share on Q2 2006 Free (2nd ISP in France): 18.2% on Q2 2006 Neuf (3rd ISP): 14% on Q2 2006
Penetration	~10M retail ccts installed.	On Q3 2006, 11.1M DSL subscriptions in France.
Retail Offers	ADSL 6000 for 19.99 but only on top of PSTN service.	Wanadoo: 8 Mbit/s + TV + phone for €29.90 Free: Up to 28 Mbit/s + TV + phone for €29.99/month

Source: NRA websites

3.2.3 Wholesale Ethernet Services

Regulation is defined by market and not by specific technology. Retaining a technology-neutral approach is particularly important in the dynamic market of communications. However, if a particular technology is not explicitly included in regulation, the SMP provider may try to argue that a specific technological variant of a service is either not included in the market, or that it is a 'new' service and hence should not be regulated. A good example of where such issues may arise in a number of EU countries, is Ethernet which is a data service with an alternate interface to the traditional SDH interface.

Ethernet has the advantage of being significantly cheaper than traditional interface leased lines and many incumbent operators use Ethernet to supply their own retail customers. This has resulted in some NRAs mandating the SMP operator to provide wholesale Ethernet services, but not all have done so.

Table 7 below gives a summary of the current state of the commercial deployment of Ethernet services in a number of major markets. The Table once again indicates a very patchy and unharmonised approach across Member States.

Annex 1, Case 3 contains an example which illustrates the issue of potential margin squeeze arising from launch of a retail service absent a wholesale equivalent. It concerns the introduction of Ethernet services in Spain where initially, the NRA did not at first impose a wholesale obligation with remedies. This enabled the incumbent to launch a service with clear exclusionary capability. In this instance, regulatory action was taken which mitigated the potential impact of this development and the problem has been resolved.

Table 6

Provision of Wholesale Ethernet Services in a range of Member States

Country	Regulated Access Offer	Price regulation	KPIs published
Belgium	Yes	Regulated – no cost orientation obligation.	Yes
Czech	No	No	No
Denmark	No	Not regulated	No
Finland	No	Not regulated	No
France	Yes	Regulated – no cost orientation obligation.	Yes
Germany	Under review	Not regulated	No
Hungary	No	Not regulated	No
Ireland	No	Not regulated	No
Italy	Yes, but RIO offer not yet specified.	Not regulated	In theory, published to regulator.
Netherlands	No	Not regulated	No
Poland	No	Not regulated	No
Spain	Yes	Being implemented	Yes
Sweden	Yes	Cost orientation/commercial offer depending on bandwidth.	No
UK	Yes	Cost orientation	Yes

Source: BT, Information as at February 2007.

4 Remedies for Current Shortcomings

4.1 Introduction

European Union legislators should take the opportunity in the 2006 review to improve the possibilities for regulators to require efficient regulation in practice.

4.2 Equivalence of Input ("EoI")

Adopting EoI would require that incumbents provide the key monopolised access and backhaul products on the following and demonstrable bases to their downstream arms and to their competitors:

- Same products;
- Same supply time scales, terms and conditions, including price and service levels;
- Use of the same systems and processes;
- Same service, system, and process reliability and performance; and
- Same controlled access to and sharing of commercial information relating to product, service, systems, process, network coverage and capabilities.

The effect of this would be to create an incentive for the incumbent to create fit for purpose products since the incumbent could only use the same ones itself. Currently, incumbents usually provide separate wholesale services to their competitors which are different from those which they in fact supply to themselves.

It may be even more difficult to police non-discrimination in an NGN future than it is currently. This is because many services are currently provided over individual unique platforms. It may therefore be comparatively easy to construct the individual incremental cost of provision. It is also easy to see that the quality of service supplied over a unique piece of equipment should be the same for all users.

In an NGN environment, all services will eventually be supplied over a single network and will potentially be capable of being differentiated to the unique demands of each customer. Attributing cost and assessing discrimination will become more difficult. Consequently, it would appear to be vital to ensure that the interests of the access provider are to supply all purchasers of access without any interest in the outcomes at the service level. This would appear only to be achievable with functional separation.

4.3 Functional Separation

Functional separation requires the following:

(i) An upstream business unit (clearly separate from the incumbent's other business units) with:

- Transparent, forceful obligations – public, published, monitored and reported targets;
- Separate staff, management, and remuneration incentives;
- Specific obligations with respect to commercial and customer information confidentiality;
- Monitoring and oversight by an independent Equality of Access Board; and
- Governed by an independent management Board.

(ii) Effective regulation to ensure enforcement, including:

- Open to directions from the NRA and/or court enforcement;
- Potential threat of competition law action; and
- Third party actions for damages.

4.4 EOI, Functional Separation and the 2006 review

4.4.1 EoI

EoI could best be delivered in the 2006 Review by redrafting Article 10 of the Access and Interconnection Directive to include requirements concerning the ways in which operators with market power in upstream services trade on an identical basis with their wholesale customers and downstream arms. Article 10 should specify that non-discrimination requirements apply to:

- Prices, terms & conditions;
- Ordering systems;
- Services;
- Performance (and it should specifically be stated that this should be measured against key performance indicators); and
- Access to commercial information (which should either be or not be available on the same basis).

4.4.2 Functional Separation

Functional separation is now under consideration in the 2006 review:

- The IRG/ERG, in their submission to the Commission have noted that they "would welcome the ability for NRAs to impose a remedy of functional separation on SMP operators, where appropriate".[7]
- ECTA also included in their submission a call for functional separation as a possible remedy available to NRAs, noting: "The power to apply functional separation could provide a valuable threat to aid compliance, and the means, where implemented, to address the incentives for this behaviour at their very core."[8]

Commissioner Reading has specifically addressed the desirability of functional separation, confirming that she believed it could help to make competition more effective in circumstances where infrastructure competition could not expected in reasonable timeframe.[9]

[7] IRG/ERG Response to the Review of the EU Regulatory Framework for electronic communications network and services 27 October 2006
http://erg.eu.int/doc/whatsnew/irg_erg_resp_review_rf_final271006.pdf

[8] ECTA Response to the Commission's consultation on the revision of the telecommunications framework (in 3 parts) 30 October 2006
http://www.ectaportal.com/en/basic522.html

[9] Commissioner Reading speech, ECTA Conference 16 November 2006
http://europa.eu.int/rapid/pressReleasesAction.do?reference=SPEECH/06/697&format=HTML&aged=0&language=EN&guiLanguage=en

BT recommends that if, after review, the market for access is generally found not likely to be effectively competitive in the long run, then the NRA should have a new power under the Framework to require functional separation. This would imply the following:

- Formally require a telecommunications network operator with SMP to reorganise its business into separate functional units, in order to provide greater transparency and demonstrable delivery of equivalence of access;
- Set the detailed terms of such functional separation after public/industry consultation;
- After review, determine what products and services should be the domain of the functionally separate unit and establish the initial set with additional services being potentially added to the basic set at a later stage; and
- Ensure that there is a robust ongoing reporting and oversight regime as part of the operation of the separate unit.

5 Institutional Reform

5.1 Introduction

The principal institutions selected by the 2003 Framework to deliver the single market objectives set out in Article 8(3) of the Framework Directive are the national regulatory authorities. While there are examples of individual NRAs delivering best practice remedies to ensure competition in the provision of the access inputs used to provide business services, this is not the common pattern as can be seen for example from the extent to which NRAs have not actually dealt with either accounting separation or KPIs.

5.2 NRAs and Remedies

When NRAs have come together at European level, they have recognised that both accounting separation and KPIs matter. The ERG Common Position on remedies, dating back to 2003, has recognised the importance of both.[10] However, this does not appear to translate into very much activity at national level.

Our view is that ERG Common Positions are unlikely to be of practical significance unless:

- ERG common positions are more detailed and prescriptive than they have been in the past;
- ERG members give credible voluntary commitments to adhere to such common positions;
- "National circumstances" are used as a reason to depart from common positions only rarely, and only after an in-depth market analysis accompanied by a detailed explanation of why the remedy proposed by the common position is inappropriate in that particular national context; and
- There is commitment to co-operation for better regulation via benchmarking of market results coupled with frequent constructive criticism between ERG members.

To take a concrete example of the guidance on bitstream in the ERG remedies Paper ERG (06) 19. This is fairly abstract and tends to result in the imposition of obligations which lack the necessary level of technical detail. This in turn leads to lengthy disputes outside the remedies process.

The ERG should therefore for example try to define with respect to bitstream:

- Some commonality around key technical parameters of the products including:
  - How many interconnect points and in what circumstances should be made available to access seekers and at which level (Ethernet, ATM, IP aggregation, IP concentration);
  - How QoS should be made available to access seekers (e.g. constant bit rate, real-time variable bit rate, unspecified bit rate);
- The essential parameters of links (including latency, jitter and packet loss);
- The specification of the xDSL end-customer link to be offered and whether 'naked DSL' should be made available; and
- Which KPIs should be measured.

[10] The 2006 ERG Report on remedies is available at: http://www.erg.eu.int/documents/index_en.htm. The issue of accounting separation is addressed at section 3.2.2 and KPIs at section 5.2.5.4.

There is considerable scope for the promulgation of best practice through the ERG but only if it is to have a more focussed approach and commitment from its members to carry through its recommendations.

5.3 Explanations for ERG Members not Delivering on Their Own Recommendations

There are likely to be a number of explanations for this collective failure.

Perhaps the major explanation is that in overall terms a regime has been constructed where NRAs require enormous efforts to deliver on the ostensible basics of regulation. This is because the incentives on the regulated entities are not to cooperate. Currently, they can usually begin providing retail services years before provision is forced from them of a workable wholesale product to their competitors. Therefore, resistance is likely to maximise their profits.

The close involvement of Ministries in many countries makes the process all the more arduous for the regulator. Contrary to popular opinion, EU Directives never made them free from Ministerial instruction or potential national legislative change to either return decision-making to the Ministry, or to set new policy direction. In fact, they only required that they be independent of the incumbent operators.

Consequently, some Ministries continue to be swayed by the perceived short-terms interests of a “national champion” versus the more diffuse interests of the internal market and end-user business customers. This tends to be particularly marked in those countries where there continues to be state ownership in the incumbent. Those Ministers which are in favour of competition, tend only to be focussed on the residential consumer services market. Obtaining Ministerial consent in a situation of semi or full dependency can also significantly deplete regulators’ resources of time, political capital and will.

Once the regulator has navigated around the Ministry, he or she must also then overcome the Courts. The application of the 2002 Framework has proved to be highly litigious in some Member States and dealing with constant challenge can represent a further significant absorbent of NRA resources.

A further explanation is that NRAs themselves may not be fully appraised of the significance of the business services market for delivering the single market in general. Part of the problem may lie in the fact that the Commission’s Guidelines on market analysis for NRAs dealt fairly cursorily with the difference between business and residential markets and in practice the recommendation tried to deal with the issue by identifying relevant product markets that appeared at the time of drafting to be predominantly linked with one of either of the two customer groups.[11]

The existing Guidelines do deal at greater length with the geographic market issue and there will likely be further material in the revised guidelines. A similar approach should be adopted for examining the differences between residential and business demand and the Recommendation should be revised appropriately. Indeed, if NRAs are advised to analyse disaggregated markets on a geographic basis there will in fact be a greater need to examine the differences between residential and business supply and demand. Otherwise, there will be a severe risk of premature deregulation of access markets for the provision of business services.

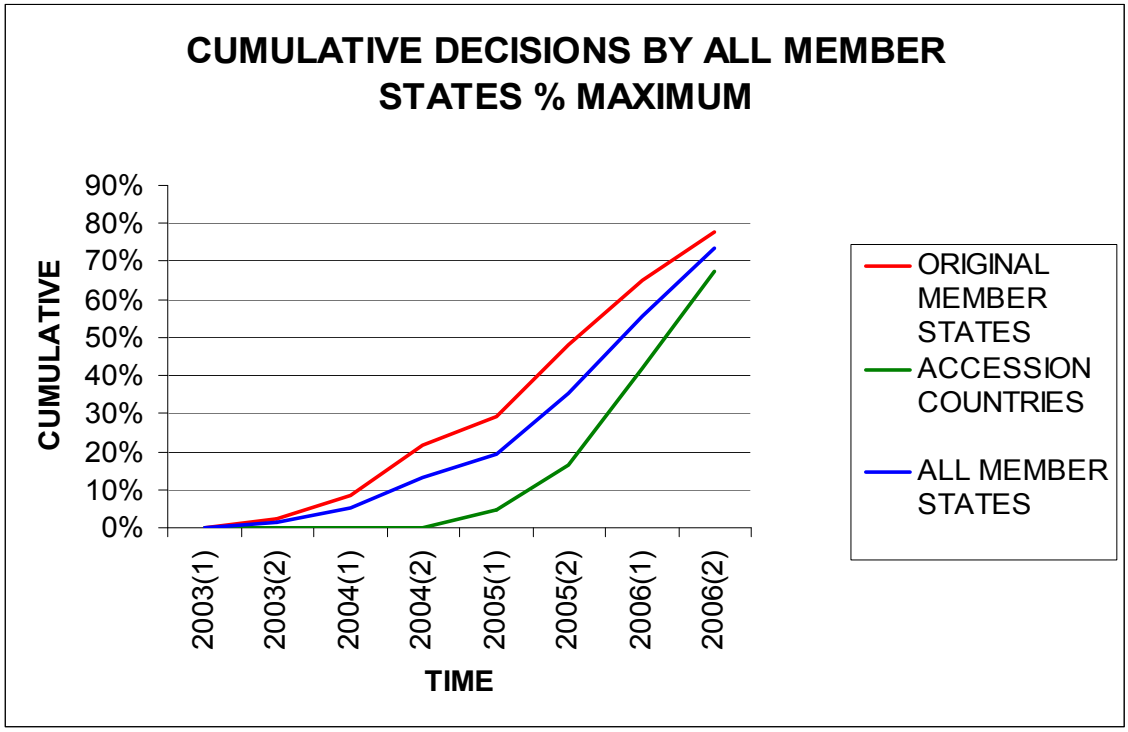
[11] Commission Guidelines on market analysis and the assessment of significant market power, 2002/C 165/03, Para 46.

The barriers currently faced by the NRAs are indicated by the slow speed with which notifications of the market reviews have been made to the European Commission. Notifications do not themselves imply that the proposed measures have been actually put in place. There are a number of reasons for this: (i) a high proportion of proposals are appealed sometimes with suspensory effect; (ii) decisions have to be put into effect by specific regulatory orders; (iii) regulations may take time to be implemented and, if necessary, to be enforced; and, (iv) the market takes time to react to the existence of new products.

Figure 2 shows the cumulative notifications of wholesale markets relative to the maximum possible of all eleven wholesale markets (100% if all market reviews were completed).

Figure 2

Cumulative Notifications by All Member States



Source: Cullen International

These graphs show the cumulative number of Notifications on wholesale market reviews taken by NRAs as a percentage of the maximum possible of 100% when all market reviews will be completed.

5.4 Independence

Member States are not required by the existing Directives to truly grant their national regulatory authorities independence. This is not because the issue was not raised at the time of the negotiation of the 2002 Directives. Both the Commission and the Independent Regulators' Group proposed that provisions guaranteeing independence be adopted.

The Commission's initial proposals contained the following text for a draft Directive:

> "Member States shall ensure that national regulatory authorities are able to act freely, without further authorization or control from any other agency or body…"[12]

The IRG's suggestion was:

> "Member States shall ensure that national regulatory authorities exercise their powers impartially and transparently. Governments shall be prevented from giving instructions to a national regulatory authority regarding a regulatory decision (including a dispute resolution) arising from a Directive."[13]

Neither was accepted by the Council Working Group.

It would seem appropriate that in 2009 or 2010 that such independence should finally be guaranteed. Independence (in terms of not taking instruction) is already granted under the Treaty to national central banks when they exercise their tasks under the Treaty and the Statutes of the ESCB.[14]

5.5 Appeals

In the context of a regulatory regime where delay offers benefit, it is likely that regulated operators will make frequent access to the courts even if there is little real merit in the appeal. Design of appeal regimes will therefore be important to ensure that delay is not a systematic feature and/or whether functional separation may also change the incentives of the incumbent regarding appeals relating to access regulation.

In the 11th Implementation Report, the Commission identified the following concerns with national appeal processes:[15]

- The length of the procedure (17 Member States).
- The practice of systematic appeals (10 Member States).
- The suspensory effect of appeals and/or suspensions on a regular basis (8 Member States).
- No right of intervention for third parties on appeal (1 Member State).

Some examples and evidence illustrate the potential magnitude of these problems.

Sweden conducted a number of market reviews relatively early in the process during 2004 but many decisions have not been fully implemented as they have been subject to appeal. The complexity of the appeals process in Sweden has been well documented and BT's understanding of the position for the key wholesale markets is shown in Table 8.[16]

The proliferation of multiple appeals on a large number of access markets greatly hinders the efficient planning by entrants to provide integrated solutions to their customers.

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[12] Unofficial working document listing the positions of all the institutions 19 November 2001, Presidency page 6.

[13] Independent Regulators Group (2000) IRG Common Position on Commission Working Documents of 27 April 2000, Annex A.

[14] Articles 108, 237 (d) EC and Article 35.6 of the Statute of the ECB. See Ziloli, C and Selmayr, M. The European Central Bank: an independent specialised organisation of Community law, Common Market Law Review, 37, 2000, page 627.

[15] Available on Commission website: http://ec.europa.eu/information_society/policy/ecomm/implementation_enforcement/annualreports/11threport/index_en.htm

[16] This table does not record the extent of suspensionary appeals which have had a significant additional impact. As at June 2006, BT understands that there were more than 80 court cases pending.

There are many other examples which can be cited. In Germany, the NRA adopted its decision for bitstream access following the market review somewhat late in September 2006, only for the incumbent to appeal all aspects of market definition, SMP and remedies.[17]

Table 7

Overview of Appeals in Sweden

Market	Status Of Appeal
8. Call origination	SMP decision not subject to appeal. Incumbent did however appeal the implementation of decision, specifically the LRIC modelling which drives the prices.
9. Call termination	SMP decision not subject to appeal. Incumbent did however appeal the implementation, specifically the LRIC modelling which drives the prices.
10. Call transit	SMP decision not subject to appeal. Incumbent did however appeal the implementation specifically, the LRIC modelling which drives the prices.
11. LLU	Numerous issues. LRIC appeal as above + other implementation appeals.
12. Bitstream	Numerous appeals. Lower court ruled in NRA favour; mid court did not grant leave to appeal; supreme court granted leave to appeal on the earlier refusal to grant leave (still not implemented).
13. Terminating Segment Leased Lines	Incumbent did appeal but subsequently withdrew appeal. Still not implemented by NRA (despite more than a year passing).
14. Trunk Segment Leased Lines	NRA withdrew regulation despite finding incumbent to hold +70% market share.
15. Mobile origination	No SMP finding.
16. Mobile termination	Numerous appeals. Amongst others: NRA imposed SMP decision on some wrong legal entities which means that some SMP operators did not become subject to *ex ante* regulation. Went all the way to Supreme Court.
17. International roaming	No SMP finding.

Source: BT, January 2006

If the decision is to adjust incentives only through modification of appeal systems then the appropriate reforms include time limits on national courts decision-making and/or tightening the rules on interim injunctions pending a decision.

5.6 Taking into Account the Single Market

If some NRAs remain subject to potential (or actual) national override by Ministries, then their individual priorities may be pursuit of outcomes that differ from those informed by a single market objective.

[17] http://www.bundesnetzagentur.de/media/archive/7381.pdf

There is discussion in the context of the 2006 Review for the power to review national regulatory remedies (or lack thereof) to be given either to the NRAs collectively in the ERG or to the European Commission.

From the perspective of a provider pan-European business services, either seems preferable in principle to the status quo and in any event likely to be of benefit even where NRAs are independent.

Given potential legal doubts around the possibility of the ERG exercising formal powers of review, the best solution would seem to be a Commission veto on remedies and a power to remedy a failure to act but for these to be exercised subsequent to a formal opinion of the ERG.

5.7 Recommendations for Delivering Effective Remedies for Underpinning a Competitive Market in Business Services

(i) Proper implementation of accounting separation (price discrimination) and KPIs (non price discrimination) under the existing regime. Amendment of the accounting separation rules in the Access and Interconnection Directive so that transparency requirements cannot be overridden by national rules on commercial confidentiality;

(ii) Adoption of true EoI;

(iii) Supported by functional separation;

(iv) Market analysis needs to take into account the nature of demand and supply of products with respect to business users;

(v) Reforming the appeals procedure through time limits on national court decision-making and/or tightening the rules on interim injunctions suspending regulatory decisions pending court decisions;

(vi) NRAs should be made independent of national ministries;

(vii) ERG best practice recommendations should be made more detailed and NRAs should explain in detail when they decide not to adopt the recommendations;

(viii) A veto on remedies/a power to direct an NRA to adopt remedies should be conferred to the Commission only after receipt of an opinion from the ERG.

Annex 1

Case Examples of Problematic Regulation

CASE 1 THE PROBLEM OF MIGRATIONS FOR ENTRANTS

CASE 2 DELAY IN PROVISION OF WHOLESALE PRODUCTS

CASE 3 INTRODUCTION OF RETAIL SERVICE WITH NO WHOLESALE EQUIVALENT

Case 1 (1 of 8)

The Problem of Migrations for Entrants

Summary

The absence of appropriate migration products in the Republic of Ireland (ROI) is severely limiting the prospect of a viable LLU-based broadband alternative to the incumbent. The latter has taken the position that regulation only applies within each of the regulated markets, and as migrations effectively bridges regulated markets, *no* regulation therefore applies.

The outcome of this situation is that customers will lose service for considerable periods of time (minimum 10 days) if they wish to transfer Internet access from the incumbent to an entrant using line sharing. Additionally, the absence of bulk migration facilities means that moving to an LLU-based solution is impractical and not commercially viable.

Very recently the incumbent has offered – although no such service is yet available – to provide inter-operator migrations where customers can migrate between operators (including back to the incumbent) without the need to cease and re-provide services. If and when this is implemented, it would solve the problem described in Scenario 1 below. However, the incumbent continues not to permit intra-operator migrations (addressed in Scenario 2 below). This means that operators with customers supplied on the incumbents' wholesale services are not permitted to migrate to LLU platforms, and move to potentially enhanced LLU-based services with their existing operator except by the cumbersome processes of 'cease and provide' . These necessitate loss in service.

The success of LLU in the ROI is completely dependent in resolving these issues.

C1.1 History

Although migrations were originally requested in December 2004, the NRA advised operators to re-submit their request for migration products in September 2006. The timeline of negotiations is set out in Table C1.1. The industry is still waiting for migration products to be available.

Case 1 (2 of 8)

The Problem of Migrations for Entrants

Table C1.1

History of Migration Negotiations in ROI

Dec 2004	Industry Issued Market requirements document for LLU including request for single and bulk migrations. (Ref: 0504)
Jan 2005	Regulator issued direction to the incumbent to respond to industries request for LLU services including migrations. The incumbent appealed the direction on the technicality of not having a right to appeal and took NRA to the high court and won on the technicality. No progress on LLU whilst this was happening. (Ref 0504)
Sept 2005	Regulator withdraws direction against the incumbent. (Ref 0571)
Oct 2005	The incumbent issued response to the industry that accepted obligation to provide number portability with LLU, but did not accept any obligation to offer migration products. (Ref 0581)
Nov/Dec 2005	Industry discussions commence on adding number portability to the fully unbundled solution however no discussion or progress on migrations.
May 2006	Following a major break in LLU discussions due to slow progress, the regulator agreed to issue monthly progress reports. (Ref 0621)
Aug 2006	The NRA requested that given the passage of time since December 2004 and that the strategies of LLU operators may have altered, they should submit updated versions of their request for migration products to the incumbent by the 7th September 2006. (Ref 0638)
Sept 2006	Three operators submitted updated SORs for migrations and attempted to reach commercial agreement. This completely failed and matter referred to NRA.
October to December 2006	No progress to report although it is understood that incumbent and NRA are holding bi-lateral discussions on the matter. (Refs. 0650, 0656, 0661 and 0671)
January/February 2007	Incumbent offered to make available inter-operator migration services. No migration services are yet available and no details of service processes have been made available. The incumbent has made it clear that it will not be offering intra-operator migration products. Intra-operator migrations would have allowed new entrants to migrate their existing customers to new LLU based services and additionally would have supported customer requests for their existing providers to move them to potentially higher specification LLU based services where such services are available.

Source: BT

Case 1 (3 of 8)

The Problem of Migrations for Entrants

C1.2 Impact of Absence of Migration Scenario 1: Bitstream Transfer

In this scenario, a customer is with the incumbent's Internet access but wishes to move to an entrant which provides bitstream access across line sharing.

Figure C1.1 shows Scenario 1a and sets out the stages in the current process which are numerous (six in total) which effectively involve two separate and disjoint processes of 'cease and provide'. They mean that the end-customer will actually have no broadband service at all for a minimum of 10 working days. In practice this could be longer if there are problems at any of the stages of ceasing and providing service.

There is no need for such an outcome. Figure C1.2 in Scenario 1b sets out what would happen with an efficient migration process which effectively means that the customer would continue with its existing provider up until the point of hand-over, so any loss in service could be in minutes and not days. The same would apply to a reverse move or between two non-SMP operators.

C1.3 Impact of Absence of Migration Scenario 2: Single and Bulk Migrations

Like a number of other entrants, BT Ireland continues to grow a significant consumer base using Wholesale Line Rental Product and the incumbent bitstream broadband wholesale product. Entrants may wish to seamlessly move their customers to a fully unbundled LLU product to utilise their own infrastructures.

However, the incumbent has refused to offer this facility (known as an 'All and Every' migration product) to migrate customers to LLU from existing wholesale services. The impact of intra-operator migrations of this kind being prohibited, is that the following impractical routes are the only way to move customers to LLU. It should be noted that these scenarios are presented as possibilities which exist in theory only because the incumbent refuses to offer migration services. In practice they are not viable.

The first is for the alternative provider to purchase a completely *new* fully unbundled line – which is *only* provided if copper is already available as the incumbent will not supply new lines. The second is to cease existing customers services, ask the customer to move to the incumbents PSTN line (without taking the incumbent broadband service) and then to move the customer to full LLU. The customer should be prepared to lose broadband for several weeks.

Scenario 2 details the difficulties associated with using the above two routes to move customers to LLU: Scenario 2a shows parallel provision; Scenario 2b shows the cease and provide route and Scenario 2c shows the process if migrations were permitted.

Case 1 (4 of 8)

The Problem of Migrations for Entrants

C1.4 Detailed Breakdown of the Scenarios

C1.4.1 Scenario 1 (a, b)

Scenario 1a is based on the fact that in Ireland the incumbent SMP operator does not permit an LLU order to be placed on a line where there is a competing service in place. Therefore the gaining provided would have to ask the customer to cease their existing broadband service with the losing operator. The 'cease' can take several days to process. The broadband service may be lost for a short time after the cease is initiated. Once the cease request has reached the incumbents wholesale division, the LLU Line Share service can be ordered and can take up to 10 working days to deliver. Once the line share is delivered and the provider has been notified by the incumbent, the gaining broadband service provider will enable their broadband service. The user should expect to be without broadband service for a minimum of 10 days.

Scenario 1b is based on using the incumbents existing bitstream-to-bitstream transfer process. The proposal adopts the existing consumer protection mechanisms within the bitstream process to ensure the migration is a genuine request and then simply triggers the transfer to take place. Service loss would be minimised to around 30 minutes whilst the Main Distribution frame jumpers are moved.

C1.4.2 Scenario 2 (a, b, c)

Figure C1.3 (Scenario 2a) shows what happens if a fully unbundled LLU is requested:

- The entrant would need to order a new fully unbundled LLU line.
- It can be difficult to get a second line installed due to the lack of existing copper lines hence there is a high probability of failure which would mean that service cannot be provided anyway.
- Address matching is problematic in Ireland as there is no postcode system hence the order is likely to take a few attempts.
- The entrant would have to pay the full cost of a new line which is a waste as customer already has a line.
- An engineer visit will be required to the customer premises, which is a wasted cost and not necessary if the existing pair was used.
- The entrant would then have to arrange number portability and to co-ordinate the transfer of the customer from their existing line to this new line, and re-apply the telephony and BB services.
- The existing line would then become spare and unused highlighting this as a total waste of valuable resource. The operator would then have to cease the old line.

Scenario 2b in Figure C1.4 shows that although there is a theoretical possibility of using the same line, it is totally impractical as BB services would be lost for several weeks. Further, it would be extremely expensive to do.

Case 1 (5 of 8)

The Problem of Migrations for Entrants

Originally the customer is assumed to be on the entrant's Voice (WLR) and BB (Bitstream) service. The entrant would have to get the customers agreement to cease their broadband potentially for several weeks (up to 6 weeks). Note LLU cannot be ordered on a line with bitstream service being provided and it can take several days for the 'cease' to be processed. Further, the entrant would also have to ask the customer to approach the incumbent's retail arm and request *their* PSTN service for the time being. In turn, this PSTN line would have to go through the move to LLU procedure. The whole process can take up to 6 weeks.

- Scenario 2c in Figure C1.5 shows the simplified procedures which would take place if migrations were permitted in an equivalent fashion. In a situation where a migration process was available, the following would be the process. The entrant would order a transfer of an existing customer's line to a fully unbundled LLU line.
- Problems of address matching are minimised if information on the existing CLI was made available.
- The incumbent would simply move the pair of wires in the exchange to the equipment of the entrant. Number portability is part of the LLU process.
- The entrant would then have to transfer the customer from their existing line to this new line and re-apply the telephony and broadband services.

This simplified process would have a timescale approximately 5 to 10 days with minimal loss in service of a few hours.

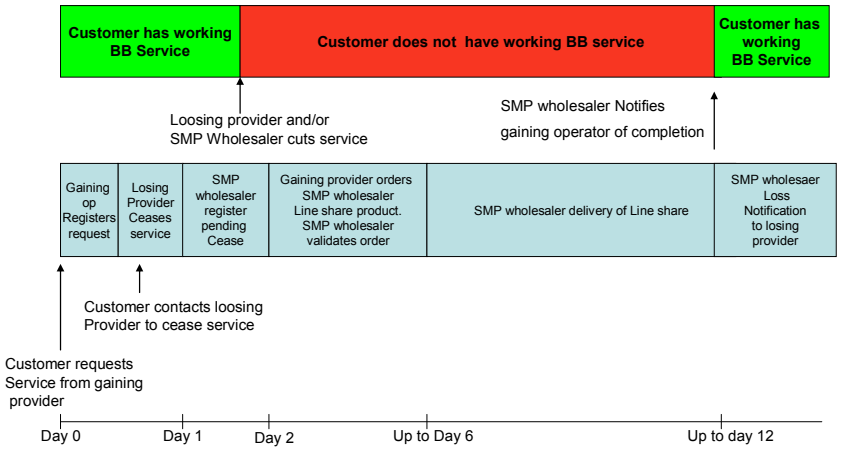
Case 1 (6 of 8)

The Problem of Migrations for Entrants

Figure C1.1

Scenario 1a: Incumbent Bitstream to LLU Line Share Bitstream

Existing 'Cease and Provide' Method

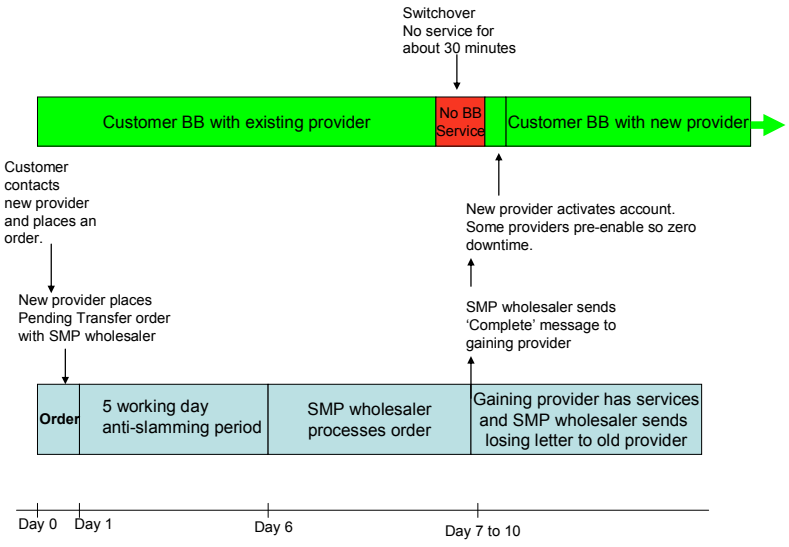


Source: BT

Figure C1.2

Scenario 1b: SMP Wholesaler Bitstream to LLU Line Share Bitstream

Example of Improvement if Process Were Made Equivalent to SMP Wholesaler Bitstream to Bitstream Service



Source: BT

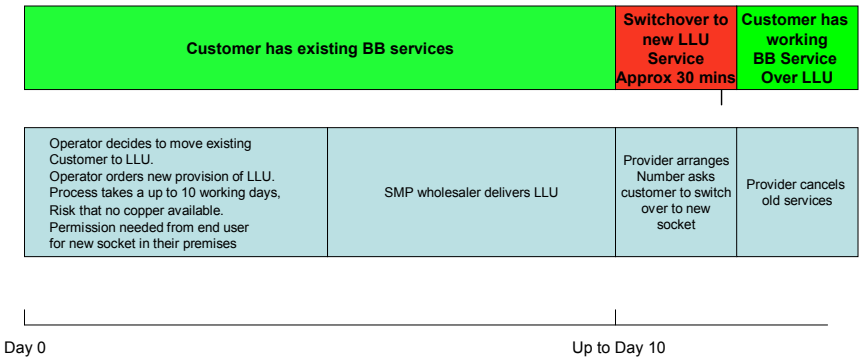
Case 1 (7 of 8)

The Problem of Migrations for Entrants

Figure C1.3

Scenario 2a: Same Operator Migrations

Existing: Parallel Provision



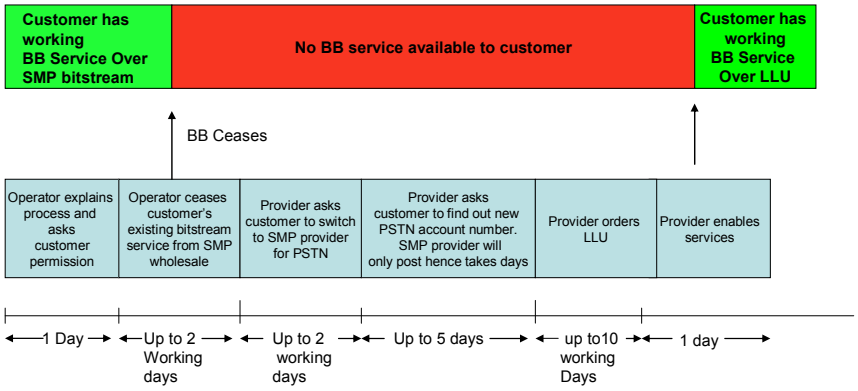
Source: BT

Figure C1.4

Scenario 2b: Same Operator Migrations

Existing: Keeping The Same Copper Pair

(Process Exists But Not Practical and Thus is Shown For Illustration)



Source: BT

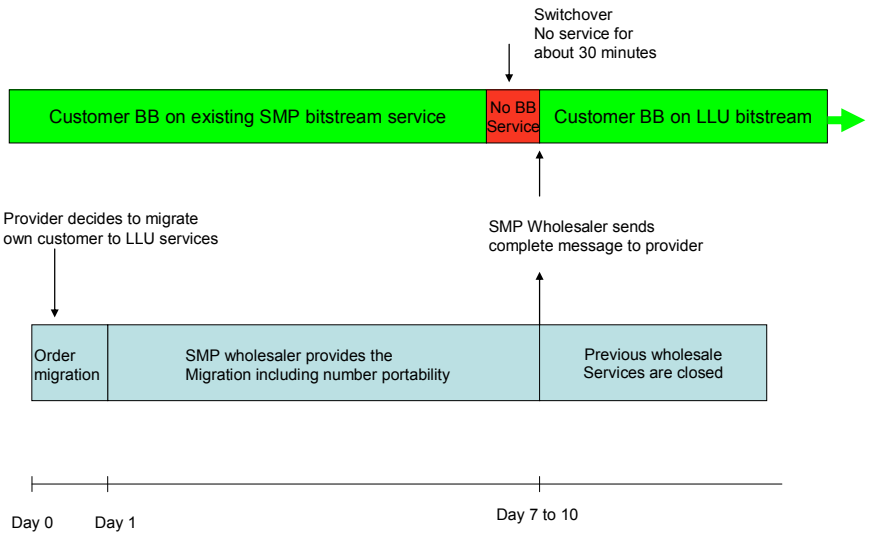
Case 1 (8 of 8)

The Problem of Migrations for Entrants

Figure C1.5

Scenario 2c: Same Operator Migrations

Example of Improvement if Process Were Made Equivalent to SMP Wholesaler Bitstream to Bitstream Service



Source: BT

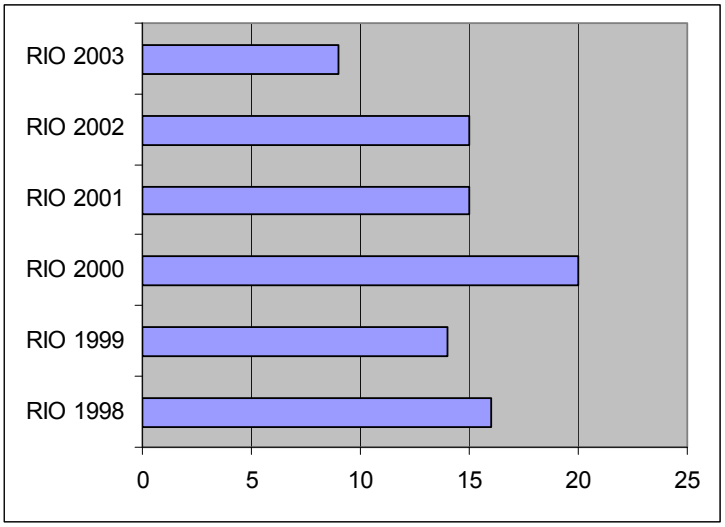
Case 2 (1 of 2)

Delay in Provision of Wholesale Products

The charts below indicate the results of research of the length of time taken to comply with regulatory obligations in practice in one European Member State.

Figure C2.1

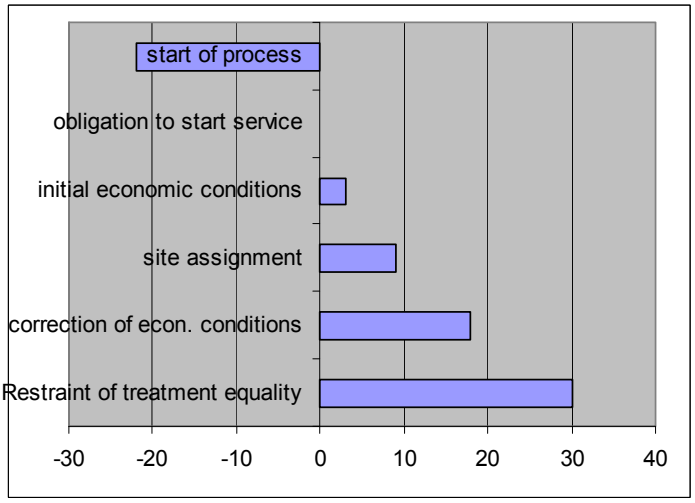
Delay between Publication of the Approved RIO and the Date of Application



Months of delay

Figure C2.2

LLU Implementation Times



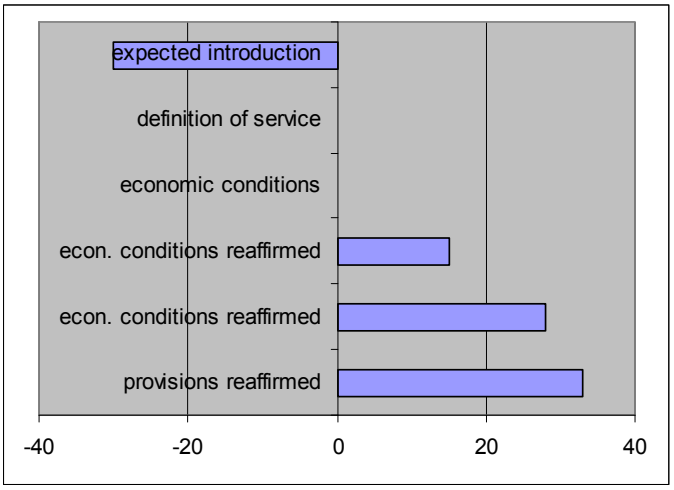
Months since obligation to start service (16/9/00)

Case 2 (2 of 2)

Delay in Provision of Wholesale Products

Figure C2.3

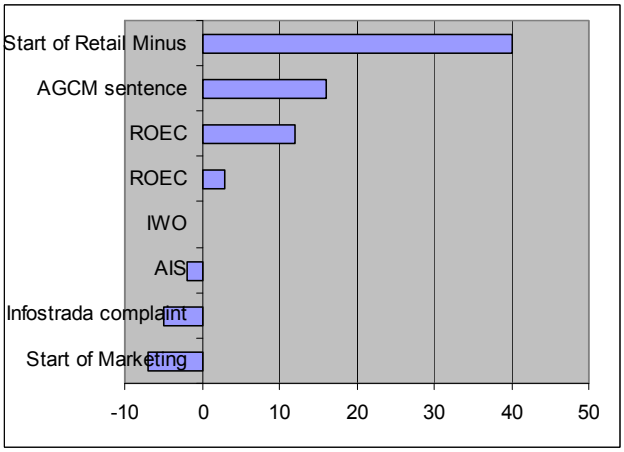
Times for Correct Use of the Partial Circuit Service



Months since definition of service

Figure C2.4

Times for Restoring a Competitive DSL Market



Months since introduction of wholesale offer

Glossary:

AIS – AGCM Investigation Started;
IAP – Investigation on anticompetitive practices;
IET – Investigation on equality of treatment;
IPT – Introduction of price test;
IWO – Introduction of Wholesale Offer;
ROEC – Reformulation of Economic Conditions;
TFPS – Operator fined for previous sentence;
TSAP – Operator sentenced for anticompetitive practices;

Source: See "La liberalizzazione zoppa. Il caso della telefonia fissa". Sandro Frova and Enzo Pontarollo. Publisher Vita e Pensiero, Milano, 2004.

Case 3 (1 of 3)

Introduction of Retail Service with No Wholesale Equivalent

Spain provides an example of where the absence of regulated wholesale Ethernet products resulted in margin squeeze as it enabled entrants buying SDH-based inputs to be undercut and excluded from the marketplace.

The NRA originally did consider Ethernet in the leased line market review but decided not to apply any remedies, the idea being that Ethernet was sufficiently new and emerging to justify non-intervention. This situation has now been rectified.

C3.1 Potential for Exclusion Consequential on No Regulation

Table C3.1 provides a comparison of retail Ethernet tariffs in Spain with published PPC wholesale charges and it shows the impossibility for alternative operators to compete at the retail level. For example, the price of a PPC at a typical distance of up to 50km, the *lowest* price of the PPC – is actually above the highest price of a retail Ethernet service which offers three times the bandwidth capacity.

The situation is actually more dramatic than these figures indicate; a true like-for-like comparison should take into account the fact that Ethernet tariffs are retail i.e. include relevant retail costs and retail profit margin and are not distance dependant, while PPC wholesale charges should not include these elements and increase with the length of the circuit.

This unbridgeable difference in fees is a result of a combination of the incumbent's low Ethernet retail tariffs and the relatively high prices of Spanish PPCs as shown below at Table C3.2.[18]

The price effect of divergence between the old and the new, is exacerbated by the fact that the retail customer base is increasingly moving away from the traditional SDH-based service:

A technologically neutral market definition should include Ethernet based services. Consumer demands drive a natural switch from older (and more expensive) presentation protocols to Ethernet and this arises from technical progress driven from outside the telecoms sector.[19] Many of the network elements remain the same and there is no inherent network rationale for finding that different protocols should place Ethernet services in a different relevant economic market to traditional leased line services.[20]

[18] Prices of high bandwidth PPCs are twice or three times more expensive in Spain than the EU average.

[19] The potential use of Ethernet as a transport technology as well as a service is something very different however.

[20] There are however some issues regarding the distance of Ethernet services compared with traditional leased lines and some other technical difference in service delivery.

Case 3 (2 of 3)

Introduction of Retail Service with No Wholesale Equivalent

Table C3.1

Ethernet Prices in Spain

	10 Mbit/s	100 Mbit/s
Ethernet retail	500 € to 700 €	800 € to 900 €
PPCs	34 Mbit/s	155 Mbit/s
(0 Km. to 50 Km.)	From 1,053 € to 5,587 €	From 2,211 € to 11,732 €

Source: BT

Table C3.2

PPC Prices in Spain

	34 Mbit/s			155 Mbit/s		
	Spain	EU	Dif (%)	Spain	EU	Dif (%)
2 Km.	1.424 €	892 €	160%	2.990 €	1.206 €	248%
5 Km.	1.915 €	963 €	199%	4.022 €	1.332 €	302%
15 Km.	3.713 €	1.597 €	232%	6.539 €	1.991 €	328%
50 Km.	7.959 €	2.539 €	313%	11.733 €	4.144 €	283%

Source: BT

Case 3 (3 of 3)

Introduction of Retail Service with No Wholesale Equivalent

C3.2 The Revision to Regulation

In November 2006, The Spanish NRA made very important changes to the regulation of Markets 13 and 14, the essence of which is that Ethernet is now regulated in Spain[21] and the SMP operator subject to the following conditions:

- Obligation on incumbent to offer Ethernet and Fast Ethernet.
- Wholesale prices based on retail minus formula.
- A transparency obligation.
- A non discrimination obligation.
- Accounting separation.
- KPIs.

This change in regulatory stance is critical since:

- It means retention of regulation of terminating leased lines of 155 Mbps (which initially were going to be deregulated).
- It mandates access for trunk segments (which initially were not included) and which will put additional competitive pressure on circuits for routes which are monopolised such as that between the mainland and the Canary Islands.[22]

[21] CMT Board decision of 23rd November 2006. It is nevertheless in the process of being implemented with respect to the provision of Ethernet.

[22] See the Access Report on this matter.

Offices worldwide

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