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Building Infrastructure Capacity for Electronic Commerce

LEASED LINE DEVELOPMENTS AND PRICING

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BUILDING INFRASTRUCTURE CAPACITY FOR ELECTRONIC COMMERCE

LEASED LINE DEVELOPMENTS AND PRICING

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FOREWORD

In April 1999, this report was presented to the Working Party on Telecommunications and Information Services Policy (TISP) and was recommended to be made public by the Committee for Information, Computer and Communications Policy (ICCP).

The report was prepared by Dr. Sam Paltridge of the OECD's Directorate for Science, Technology and Industry. It is published on the responsibility of the Secretary-General of the OECD.

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This paper focuses on the capacity requirements and price development for telecommunication infrastructure for business-to-business electronic commerce. The emphasis in the paper is on leased circuit capacity, which provide the building blocks for business-to-business electronic commerce. The paper builds on the work for the Ottawa Ministerial Conference on Electronic Commerce in the area of access to infrastructures[1]. In Ottawa, Ministers concluded that "Effective competition in telecommunications markets can ensure a sustained, long-term trend towards lower costs, increased quality and, thus, expanded access to information infrastructures and services".[2] In the background report for the Ottawa Ministerial it was stressed that those countries with a communication regulatory environment, which facilitate abundant capacity at reasonable rates, will be able to launch electronic economies much faster than countries that constrain such developments. The Ottawa background report also stressed that business will not be competitive if it cannot get a connection with a high quality of service, in the quantities it needs, and at prices comparable to its competitors.

The conclusion from the analysis in this paper is that such competition is beginning to emerge and will likely increase over the next several years, especially for long distance and trans-border infrastructures. The evidence shows that the market is developing not only new ways for users to buy and sell telecommunication capacity but also rapidly increasing the amount of capacity to meet expected demand based on current market signals. There is, however, still important scope for improvement, and a particular requirement for more competition and lower prices in the provision of short distance leased circuit capacity.

The present paper stresses that, in the new electronic commerce environment, the customers and suppliers of any business are only as close as the performance of the network allows. Performance is tied to the availability and price of the underlying capacity. Accordingly, the notion that the Internet gives access to a global marketplace for any business that connects to the growing network of networks needs to be qualified by the quality, availability and price of service. As a result of legal monopolies in some countries, or from the significant market power of former monopolies in recently liberalised markets, leased line capacity is sometimes unavailable in a form users require or in a timely fashion.[3] Moreover, the pricing of available capacity for businesses building electronic commerce services is exorbitant in many of these countries. Business-to-business electronic commerce, whether transacted over the public Internet or private Intranets, in the main part uses leased lines.

In this context, the pricing of national and local access leased lines, where alternative infrastructures will take longer to roll out, could prove the major barrier to electronic commerce over the next several years. Regulators need to increase competition by encouraging efficient interconnection between the new pan-regional networks and national/local networks. Where monopolies remain in place, for even a short time into the future, they will impose higher than necessary costs for companies from these countries engaging in electronic commerce in world markets.

Where dominant positions are still entrenched, which is the case for many OECD countries, the evidence examined in this report shows that leased lines are still being sold at excessive prices. On a route where competition is not yet permitted at both ends a leased line can be sold for 14 times the best available price in liberal markets. Yet even paying these multiples will not always guarantee a business user can obtain capacity for electronic commerce.

Several fundamental trends are impacting on the telecommunication infrastructure markets used for business-to-business electronic commerce. First, technological developments, and particularly advances in fibre optic technologies, are enabling cables to be installed with huge increases in capacity and at relatively low prices when measured in terms of units of capacity. Moreover, on many of these routes, numerous cables are being installed leading to a further multiplication of available capacity. Second, the multiple cables are due to new entities being able to enter markets for the first time on an end-to-end basis. While a number of countries have more than a decade of experience with competition it was often the case that only one end of an international cable was in a liberal market. Indeed, the incentive to build international cables increases in proportion to the number of countries into which an infrastructure provider can sell capacity (i.e. pan-regional networks). Third, due to the Internet, traffic and capacity sales are increasing at unprecedented rates. Private circuit capacity, between the United States and the rest of the OECD, had a compound increase of 172% between 1995 and 1997. Significantly, this was the first year in which private capacity surpassed that which is allocated to international message services (e.g. public switched telecommunication services). Fourth, and less well understood, the market structure for selling capacity is undergoing a radical change due to a combination of the factors outline above. This includes market actors making decisions on buying and selling capacity that are coming to resemble the decisions which are made in more traditional commodity markets. These factors mean that infrastructure development for electronic commerce in liberal markets will increasingly be driven, as it should, by the demands of the market.

BUILDING INFRASTRUCTURE CAPACITY FOR ELECTRONIC COMMERCE – LEASED LINE DEVELOPMENTS AND PRICING

Introduction

Leased lines are the building blocks for electronic commerce networks. In simple terms a leased line is a defined amount of capacity, which has been allocated by a telecommunication infrastructure provider, between two points.[4] The public Internet is made up of a myriad of leased lines woven together by a common protocol (TCI/IP). At the same time business users' Intranets employ this protocol over leased lines to make up private networks. Public telecommunication operators (PTOs) provide virtually all of this capacity.[5] They do so over public switched telecommunication networks (PSTN). That being said, a new type of infrastructure provider is emerging, which aims to specialise in the construction and sale of wholesale capacity. These entities are sometimes referred to as carrier's carriers.

Business-to-business electronic commerce, whether transacted over the public Internet or private Intranets, in the main part uses leased lines. This can be the capacity that forms a company's private backbone network, or simply a dedicated line between that company's business premises and their Internet Service Provider (ISP) or Web hosting service. In other words even if a business buys network services, such as a virtual private network from an ISP, the underlying capacity is in most cases provided by lines leased from PTOs. Due to the continuance in some countries of legal monopolies, or more likely today dominant market power, leased line capacity is sometimes unavailable in a form users require or in a timely fashion. Moreover, the pricing of available capacity for businesses building electronic commerce services is exorbitant in many countries.

Leased line pricing and availability have long been the source of criticism and frustration for business users, with no choice of service supplier other than PTOs. Another criticism was that capacity was being rationed by PTOs, lest the purchaser compete with the monopoly incumbent by reselling this capacity or by using it to create value-added services. Analysis has shown, in most cases, that there is much weight to these criticisms. The evidence marshalled in this report, for example, shows that leased lines are priced at excessive amounts due to infrastructure providers, with legal monopolies or dominant market power, extracting monopoly rents. Policy makers that see these comparisons as all too familiar, and are perhaps fatigued by them, can not afford to ignore their impact on electronic commerce.

The growing ubiquity of the Internet protocol has enabled an increased pace of restructuring in the global economies. Those countries with a communication regulatory environment, which facilitates abundant capacity at reasonable rates, will launch electronic economies much faster than countries that constrain such developments. It is often said that the Internet gives access to a global market place for any business that connects to the growing network of networks. On the other hand, this needs to be qualified by the fact that a business will not be competitive if it cannot get connections with a high quality of service, in the quantities it needs, and at prices comparable to its competitors. In the new environment customers are only as close as the performance of the network enables, and that performance is tied to the availability and price of the underlying capacity.

A growing number of OECD Governments have identified bandwidth availability and pricing as an issue worthy of examination in relation to electronic commerce. In December 1998 the Australian

Government initiated a “National Bandwidth Inquiry”, with terms of reference raising questions in regard to the drivers of demand for bandwidth; bandwidth availability and pricing within Australia, and to and from Australia and key overseas markets; and the relevant commercial and regulatory issues.[6] The inquiry will look at local access bandwidth issues (i.e. should there be a minimum digital data capability of 64 kbit/s available under carriers’ universal service obligations) and issues in relation to backbone telecommunication networks. In response to this inquiry business users in Australia have commented that it is the need for affordable bandwidth which is their highest priority.[7]

The present report focuses on leased lines as the evidence shows they are the key building blocks for business-to-business electronic commerce. They are, of course, not the only network components necessary for “electronic economies” to flourish. All types of business and consumers use other network elements to participate in electronic commerce. For example, virtual private network (VPN) technologies enable users to log on from remote locations using all types of access connections (e.g. dial-up, cable modems, xDSL and ISDN lines). VPNs aim to provide users with a secure and reliable platform for business-to-business electronic commerce. They can support up to 20 000 concurrent user sessions.[8] Accordingly, the efficiency of access networks and pricing are also extremely important for business-to-business electronic commerce. This report, however, is primarily aimed at discussing leased lines, the underlying infrastructure most commonly used for business-to-business electronic commerce.

To describe what is happening in this market segment several fundamental trends need to be outlined. First, is that technological development, and particularly advances in fibre optic technologies, are enabling cables to be installed with huge increases in capacity. Moreover on many of these routes multiple cables are being installed leading to a further expansion of available capacity. Second, the multiple cables are due to new entities being able to enter markets for the first time on an end-to-end basis. While a number of countries have more than a decade of experience with competition it was often the case that only one end of an international cable was in a liberal market. Indeed, the incentive to build international cables increases in proportion to the number of countries into which an infrastructure provider can sell capacity (i.e. pan-regional networks). Third, due to the Internet and burgeoning electronic commerce markets, traffic and capacity sales are increasing at unprecedented rates. The number of activated 64 Kbit/s equivalent circuits at year-end 1997, between the United States and the rest of the OECD, had a compound increase of 172% between 1995 and 1997. Significantly, 1997 was the first year in which private capacity surpassed that which is allocated to international message services (e.g. public switched telecommunication services). Fourth, and less well understood, the market structure for selling capacity is undergoing a radical change due to a combination of the factors outlined above. This includes market actors making decisions on buying and selling capacity that are coming to resemble the decisions which are made in more traditional commodity markets.

Whereas in monopoly markets only incumbents could build and operate infrastructure, the opening of markets has attracted a massive amount of investment funds. Traditional carriers and new entrants are constructing broadband networks at a rapid rate across both the Atlantic and Pacific. These networks are being integrated on an end-to-end basis with pan-regional networks in North America and Europe. This is also occurring on an intra Asia-Pacific basis but appears to be at a slower pace. The corollary is that users, whether they be other service network providers or business users, can now purchase rather than lease capacity and buy this capacity at wholesale rates. Both these developments are a radical departure from traditional market structures and this document describes some of the new market mechanisms emerging to trade bandwidth.

For infrastructure providers making pricing decisions, and for purchasers of capacity, the types of contracts entered into must now factor in future pricing and capacity changes. In February 1999, as a result of new competitive networks coming on stream between Paris and London the price of a 2 Mbit/s link, at Band-X one of the new online bandwidth trading markets, plunged to 35% of what it had been in

October 1998. Network pricing managers and business users know this trend will continue as other European cities are connected for the first time to the networks of new market entrants and this is already having an impact on the “forward pricing” of bandwidth.

Where liberalisation has enabled the rollout of competitive infrastructure, and new structures for supplying capacity aimed at market demand, some dramatic improvements are already evident. A little more than one year on from widespread liberalisation of European telecommunication markets it is worth considering three examples of business, social and national developments. One example is from a company engaging in business-to-business electronic commerce. The second example is from a network assembled for academia. The third example is from a country rapidly becoming the “hub” for its region.

- In October 1998 if Reuters leased a 2Mbit/s circuit at the standard published rate of BT and France Telecom, between their premises in Paris and London, it would cost USD 40 000 per month. Being Reuters and a large customer, a substantial discount, would have brought this down to around USD 20 000 per month. The company might also lease this capacity from a new pan-European network provider at a discounted rate of around USD 13 000 per month. In February 1999, more radically Reuters could have leased this capacity from a bandwidth exchange for around USD 3 000 to USD 4 000 (the latter price including leased line tails, the local links to the business user’s premises from the PTO’s point of presence). Furthermore they could purchase, and own, the capacity for around USD 400 per month (the latter price excluding tails but around USD 1 000 with tails).

- In September 1998 Europe's academic network DANTE boosted its 10-country, 34-Mbit/s links to 155 Mbit/s in 18 countries. The upgraded network costs about the same as the one it replaced.[9] (Box 1)

- Between 1995 and 1997, Sweden went from having 12.5% of the leased line capacity between Scandinavia and the United States to 87.5%. The International Telecommunications User Group (INTUG) reports 2Mbit/s leased lines to neighbouring countries fell by 62% between 1997 and 1998.

Box 1. Prices of upgrading networks to high speeds in Europe

Pan-European research networking evolved from 64 kbit/s in 1991 to 155 Mbit/s in 1998. The experience gained in establishing these networks is relevant to the electronic commerce applications, as businesses upgrade their networks to higher speed connections.

DANTE is a company that plans, builds and manages advanced network services for the European research community. Since its launch, in July 1993, DANTE has aimed to take advantage of economies of scale in the establishment of a high-quality computer network infrastructure. In 1998 DANTE upgraded its Pan-European network from 34 Mbit/s to 155 Mbit/s. During the tending process the company received 16 proposals which included 87 individual price offerings for multiple connections and links. DANTE concluded, after analysing the data received in the tendering process, that in European countries where competition was beginning to flourish the tender prices were dramatically lower than those previously on offer. Notwithstanding this positive trend DANTE also noted extremely wide variations in tender prices across Europe and the unavailability of capacity at higher speeds in some countries. The company also noted price rises in certain markets without competition.

In the data below, DANTE has grouped countries under different cost categories according to the price and speed of the offers received in 1998.

While the prices within these benchmarks varied considerably, with some being much higher, they give a good indication of the current transition in the market for capacity across different European markets.

	Speed Mbit/s		
Countries	155	45	34
Cost Group A (France, Germany, Great Britain, Netherlands, Sweden, Switzerland)	25	--	--
Cost Group B (Austria, Belgium, Italy, Luxembourg, Spain)	36	57	--
Cost Group C (Czech Republic, Greece, Hungary, Slovenia)	--	--	62

Note: All costs are in USD 000/Mbit.Year.

Source: DANTE (http://www.dante.net/).

The examples highlight several important trends. Telecommunication carriers are competing in global markets in terms of “hubbing” traffic and those which are successful will be at the forefront of offering improved services to business users at lower costs.[10] Those countries that delay reform, and take insufficient action to stimulate competition, are holding back not only electronic commerce but also their national PTOs which will find it harder to compete against carriers with several years experience in competitive markets. At the same time, PTOs can no longer ration the supply of capacity through various means from construction schedules, delivery times and through to pricing. While Reuters may not want to buy wholesale capacity, the fact that their network suppliers can do this, is placing tremendous pressure on prices. On the other hand some entities may be prepared to pay the same amount for a dramatic increase in network capabilities and performance, as per DANTE’s experience.

While the trends described are extremely propitious a word of caution must also be sounded. The dramatic falls in leased line pricing are only evident in those market segments where infrastructure competition exists. While the prices between Paris and London or New York to Frankfurt are tumbling this only occurs in line with the availability of infrastructure from new market entrants. A business that needs to connect regional sites will still have a limited range of choice in most OECD countries. Moreover the evidence shows, that on average, a 2Mbit/s leased line at two kilometres cost more in 1998 than it did in 1992. This fact is critical because short distance leased lines are the most numerous part of the market and form the “arteries” of electronic commerce. These are the network components most businesses use to connect to the public Internet, the networks of Web hosting services and to their private Intranet backbones.

For policy makers wanting to foster the growth of electronic commerce, and particularly business-to-business trading as the initial driver in more widespread electronic commerce, the need to bring forward liberalisation and to provide incentives to competitive forces in newly liberalised markets is paramount. In those markets where competitive infrastructure is now available the benefits for electronic commerce are compelling. The challenge now is to maintain and increase this momentum in other market segments.

Building capacity for electronic commerce

For electronic commerce to meet its potential in the next several years, it is going to require greater amounts of bandwidth both in backbone networks and in local access connections to users. This document primarily focuses on the capacity available for business-to-business rather than business to consumer electronic commerce. This raises the question of how to draw a distinction between the two. The best starting point is to identify the infrastructure product most employed by business users to build networking capabilities. The most common building blocks used to construct or permanently connect to electronic commerce networks (e.g. Internet, Intranets etc.) are private lines which are leased from telecommunication carriers (i.e. leased lines).

Leased line services come in various defined amounts of bandwidths. Both acronyms and amounts of bandwidth are commonly used refer to these services (Table 1). For example, an E1 is a leased line at 2Mbit/s. Indicative speeds for how long it would take to download a Megabyte are also shown in Table 1. An alternative way to visualise how long it takes to download content at various speeds might be to take this document as an example. Using a 14.4 kbit/s modem it would take around three minutes to download this document which is around 321 000 bytes (2.6 Mbit/s). A 56 kbit/s modem would take 46 seconds and a 64 kbit/s ISDN line around 40 seconds. Using a leased line at higher much higher speeds than this would result in a virtually instantaneous download time.

Leased lines are also categorised by telecommunication carriers by distance and geography. For the purpose of this document a local, or short distance, leased line is taken to be at two kilometres. These leased lines are used to connect business premises with the infrastructure of communication service providers (e.g. telecommunication carriers, ISPs), public traffic exchange points (e.g. Internet exchanges), or to provide the local tails for longer distance leased lines. Dedicated lines over longer distances are categorised as national leased lines when they do not cross a border. They are international leased lines in those cases where they do cross a border.

It is true that business users employ a range of other products to transact electronic commerce. Aside from leased lines there are a range of other ways a business user might connect to the Internet such as xDSL, ISDN, Internet services over cable television networks and so forth. These products tend to be used by smaller business enterprises, and increasingly consumers, to access the public Internet rather than provide services to others. In reality, of course, there is no rigid division as many small businesses are generating electronic commerce via these connections. For example, for these users, another party (e.g. an ISP or specialist Web hosting company) may host a business service. In this case a business user could access their Web site to upload content or retrieve communications via a range of different technologies. Business users, and their business customers, also access virtual private networks over local access networks. However to give this document a manageable scope only the major building block for electronic commerce networks -- leased lines -- are examined. Future work could be undertaken on the infrastructure used for small business and consumers to participate in electronic commerce, as the issues raised are equally important for the consideration of policy makers.

Increasing demand

The *Communications Outlook 1999* demonstrated evidence of growing demand for national and international leased lines throughout the OECD area. While not seeking to repeat that work, it is worth considering some indicators of growth in this segment of the market. One option is to look at growth in sales for individual companies, such as France Telecom, which demonstrate rapidly increasing demand for capacity generated by the Internet and electronic commerce (Box 2). A more systematic approach is to look at data, gathered by the Federal Communications Commission (FCC), where it is possible to see the trends in the international private line market for transatlantic and trans-Pacific traffic. There are several reasons for selecting this indicator but the most important is that the United States is world's largest Internet and electronic commerce hub.

The period from 1995 through 1997 captures the first substantial commercial use of the Internet in the United States and elsewhere. Prior to this time very few businesses used the emerging public Internet (or private Intranets) and dial-up access was not widely available to the public. Prior to 1995 most of the international Internet infrastructure (i.e. leased lines) then in place linked universities and research institutions to the United States National Science Foundation backbone. It was then mostly the case that traffic between users would most likely traverse the United States even if they were located in the same country. Internet communications between users in different countries would almost certainly have passed through a backbone network in the United States. Since that time, however, greater regional infrastructure has begun to be deployed including a growing number of Internet traffic exchange points outside the United States.[11] Although this trend accelerated in 1998, it is true to say that in prior years the vast bulk of international Internet traffic was hubbed via the United States.

Set against this background the growth in leased lines, between the United States and the rest of the OECD area, is the best available indicator of demand for capacity to support electronic commerce between 1995 and 1997. During this period the amount of private line capacity between the United States and other OECD countries increased at an annual rate of 172.6% (Table 2). This compares to an increase in the capacity used for international message telecommunication service (i.e. PSTN traffic) of 18.7%.

This is not to argue that growth in the use of leased lines has only received stimulus from the Internet. Liberalisation in telecommunication services has opened the way for a number of new developments during this time, such as the refile of traffic using leased lines.[12] Alternative calling practices also need to be taken into account. Nevertheless these data show in great detail how quickly international telecommunication is being transformed by several factors of which the Internet is the single most important. Consider, for example, that in 1995 leased lines accounted for only 17% of active capacity between the United States and other OECD countries. In 1996 this grew to 43.1% and in 1997 increased to 51.8%.

It is also interesting to note the rate at which capacity increased between different countries. Whereas historically the United Kingdom-United States route was the largest international private line market, both the Canada-United States and Mexico-United States routes have now surpassed it. While there are a number of factors at work, due to liberalisation in North America, it is likely that Canada and Mexico are also acting as “Internet gateways” to the entire continent. For example, in 1997 nearly half Singapore’s Internet connectivity was linked to Vancouver and less than a quarter direct to the West Coast of the United States. Teleglobe which, in a very short period of time, has emerged as one of the largest carriers of Internet traffic, provides this capacity. To the extent that this causes infrastructure providers in Canada to increase their capacity across the border it shows up in the figures for the Canada-United States route.

For similar reasons the Sweden-United States route recorded the largest increase in capacity with an astronomical growth rate of 1 251% each year from 1995 through 1997. In this case the lower growth rates for Denmark, Finland, and Norway, in spite of their leading position in Internet development, suggests Sweden is acting as a regional gateway. Accordingly these data are good at showing capacity between countries hosting major Internet traffic exchange points and changing traffic patterns. In contrast Iceland, which also is among the leaders in terms of Internet development, has a similar growth rate to Sweden because it links directly to the United States. Both these Scandinavian countries have amongst the highest per capita leased line connectivity with the United States (Table 3) (Figure 1).

The vast increase in capacity between Sweden and the United States may be because Sweden hosted the initial, and largest, public Internet traffic exchange point in Scandinavia. Another factor would be that Sweden was the first country in Scandinavia to liberalise its PSTN market and obtain international simple resale agreements with other countries. This means new entrants have had longer to build alternative infrastructure than in other Scandinavian countries (particularly those that had either not opened their market, or had just opened it, by 1997). Competitive forces are clearly impacting on the pricing of leased lines in Sweden. According to the most recent INTUG survey, Sweden recorded a 70% reduction in 2Mbit/s national leased lines at 400 kilometres and a 62.5% fall in international half circuit prices to neighbouring countries between 1997 and 1998 (refer to the final section of this document).

Box 2. Extracts from France Telecom’s Annual Report, 1998 (http://www.francetelecomNA.com/)

Revenues from leased lines and data transmission products were USD 2.6 billion, a 14.5% increase excluding the effect of changes in consolidation and exchange rate fluctuations. The sustained increase in the number of high- and medium-speed digital leased lines was further amplified in 1998. The annual growth rate in the number of these types of leased lines reached 50% in 1998, compared to 42% in 1997. Growth in data transmission services also accelerated in 1998, led by the development of business services and Internet use. There was a fourfold increase in traffic volume for Internet applications in 1998. The Internet now accounts for nearly 70% of data transmission, compared to approximately 50% a year earlier.

Revenues from Teletel videotex and Audiotel audiotext services remained stable, while France Telecom's “Wanadoo” Internet service increased by more than four and one half times the number of subscribers over the 12-month period. At 31 December 1998 “Wanadoo” had 495 000 subscribers (compared with 106 000 a year earlier). This enabled “Wanadoo” to double its share of the market from 17% at the end of 1997 to 36% at the end of 1998.

The changes in Sweden graphically demonstrate how countries that liberalise early can become hubs for regional traffic. In 1995, Denmark, Finland and Norway collectively had seven times more direct leased line capacity than Sweden, between themselves and the United States. In 1997 Sweden had 11 times more leased line capacity direct to the United States than the combined total of its neighbours. Taking into account “gateway geography” (i.e. countries that are physically the closest undersea cable landing point for a particular region) an examination of leased line capacity between the United States and the rest of the OECD area shows:

- The countries that liberalised early have among the highest private line capacity with the United States (Canada, United Kingdom, Sweden and Australia).
- The five countries with the least private line capacity links per capita in 1997 still have monopolies in 1999 (Czech Republic, Greece, Hungary, Poland, and Turkey). Portugal, the sixth country still retaining a monopoly, ranks higher but this may be due to gateway geography.
- Finland, Norway and Denmark rank far lower than expected, given their rapid Internet development, as Sweden is clearly acting as a commercial gateway for Scandinavia.
- Geography, to a greater or lesser extent, plays a bigger part in the ranking of Canada, Mexico, Iceland, Ireland and Portugal.
- Countries with the greatest private line capacity links per capita in 1997 have the greatest number of electronic commerce sites (as measured by Secure Socket Layer servers[13]).
- A commercial race is on for countries to become a hub for electronic commerce traffic. A competitive capacity market is the key to performing well in this race.

Capacity growth

Telecommunication carriers throughout the OECD area are scaling up infrastructure in response to a growing demand for bandwidth. Evidence of this is available from several sources. One source is data showing increased capital expenditure by telecommunication carriers in OECD countries. A second source, although not available for all countries, are data filed with regulatory authorities on cable or satellite deployment.

In the foregoing section it was noted that demand for capacity across the Atlantic and the Pacific is escalating at an unprecedented rate. This has, in turn, stimulated a great deal of new and planned undersea cable capacity (Figure 2). Using data filed by telecommunication carriers, the FCC calculates that the available capacity in place across the Atlantic will grow from just under 800 thousand 64 kbit/s circuits in 1998 to more than 10 million circuits by 2001 (Table 4). During the same period, growth for capacity across the Pacific is expected to exceed this growth rate and reach more than 12 million 64 kbit/s circuits by the end of 2000 (Table 5). Since these data were compiled further cables have been announced. For example, Global Crossing has announced plans to add new 2.5 Terabit-Per-Second Atlantic Cable with capacity coming on stream in the first quarter of 2001. The company says the single new cable features the world's highest undersea capacity and adds 25 times the capacity of all existing transatlantic cables.[14] The reason that was given for initiating the new cable is the explosion of Internet use in Europe, where Global Crossing expects bandwidth demand on the Atlantic route to grow at about 80% per year.

This data indicate that telecommunication carriers, operating in a far more liberal environment than in the past, are rapidly increasing the availability of intercontinental infrastructure. The market has provided signals, via increased demand for leased lines, and both new entities and traditional carriers are responding. A huge increase in pan-European capacity has also got underway since 1998, with much of it coming on stream in early 1999 (Table 6).

In the case of undersea cables, because of the availability of data, it is possible to get an indication of the ability of the infrastructure providers to keep pace with this growing demand for bandwidth. It is not, however, possible to forecast demand with any degree of certainty. Apart from entering a totally new environment for the provision of infrastructure (refer to the section below on liberalisation and new market structures) telecommunication carriers find themselves having to forecast demand for capacity generated by new services developed around the Internet and electronic commerce. Previously, patterns of telephony traffic could be predicted with a reasonable degree of certainty. PTOs had many years of experience and patterns of demand changed relatively slowly compared to the current environment. In addition telecommunication carriers controlled many of the factors responsible for change, such as the introduction of a new service based on technological change (e.g. international direct dial). By way of contrast for the Internet it has largely been ISPs, rather than telecommunication carriers, which have led technological innovation and the marketing of new services. Furthermore, the open nature of the Internet means the wider information technology and communications industry has much more influence over the introduction of new services (e.g. Internet telephony).

Further decisive factors which telecommunication carriers controlled previously were the pricing and marketing of services. As will be shown below, the future pricing and marketing of telecommunication capacity is likely to be radically different from the past. This means that telecommunication carriers can no longer manage supply (i.e. only placing a certain amount of available capacity on the market) and demand (i.e. by charging monopoly prices). In those markets where there are multiple suppliers, the buying and selling of telecommunication capacity is coming to resemble the market for any other commodity.

Notwithstanding the trend towards telecommunication capacity becoming a commodity, the nature of communication networks means this will occur faster in some market segments than others. As will be discussed “capacity commoditisation” is already occurring on major international routes and domestically, in those cases where liberalisation has been implemented long enough to have enabled competing infrastructure providers. Moreover the evidence shows that the market is developing not only new ways for users to buy and sell capacity but also rapidly increasing the amount of capacity to meet expected demand based on current market signals.

However, a discussion on the availability of capacity only makes sense within a certain context. For example, a question posed to a supplier on the availability of a leased line can only be answered in respect to a particular route. For a business user engaging in electronic commerce further questions then arise as to pricing, installation (i.e. set-up time), availability (i.e. the amount of capacity for sale and in reserve) quality of service (e.g. reliability) and product definition (i.e. the suitability of the quantity to a user’s requirements). To explore these issues it is necessary to briefly recount how capacity has been marketed in the past and current trends in liberal markets as they adapt to the needs of electronic commerce.

Leased line pricing

The original reason leased lines emerged as a telecommunication service was to provide a discount on PSTN prices for traffic flowing between two fixed points (i.e. a permanent connection rather than a switched service). For this reason they are termed private lines in some countries. In other words the telecommunication applications, enabled by the permanent connection, could not be used to provide public services (and initially could not be used to provide third party services or shared among users) but were instead restricted to private use. The term "leased lines" owes its name to the manner by which telecommunication carriers historically sold private lines.

Formerly, telecommunication monopolies existed in all OECD countries. This meant that only one designated carrier in each market segment could own and operate the physical network facilities. If users wanted to connect two separate points with communication services they would lease, rather than buy, the underlying network facilities. In theory users could, of course, build their own facilities to connect two points but in practice this was virtually always uneconomic compared with leasing capacity. This was not only because the widespread geographical reach of the PSTN meant facilities were already in place or because rights of way had to be secured. It was also the case that, in general, users only required a small amount of capacity relative to the overall capacity a carrier could put in place and the user's network requirements could change over time.

Due to the economies of scale, available only to infrastructure providers who could legally sell capacity, a telecommunication carrier could virtually always build and operate infrastructure more economically than a user could provision its own facilities. Notwithstanding the economies available to them, PTOs with monopolies faced no market discipline on the prices or levels of service offered to users. Inevitably this led to criticism from users that carriers charged excessive prices and delivered poor quality service in terms of the provision and maintenance of leased lines. These tensions increased as so-called value added service markets were gradually liberalised in OECD countries. Originally value added suppliers were prohibited from building and operating their own network facilities and had to rely on telecommunication carriers to provide their underlying infrastructure. Accordingly the value-added suppliers argued that PTOs, who were often their main competitors in these markets, would price or deliver services in an anti-competitive manner. Some PTOs also withheld capacity in the belief that resellers would undercut their "retail" leased line prices by dividing large amounts of bandwidth into small units of capacity.

At the same time business users often criticised PTOs for defining their needs rather than responding to them. In some cases PTOs would only sell services that were inappropriate for the needs of businesses. An historical example, albeit of diminished impact for today's reader, would be to only sell capacity in blocks that were larger than a user required. On the other hand some users complained that they could not get enough capacity. In addition there were tensions between PTOs and users in respect to where "intelligence" would be located in the network. From the PTO's perspective centralising intelligent functions in the core of the network generally meant they could charge users for these services. From the perspective of users, empowered by rapid advances in information technology, it was more desirable to locate intelligence functions at the periphery of the network so that they could configure and manage their own networks. In other words business users wanted PTOs to provide raw capacity, sometimes in the form of dark fibre optic cable, rather than integrated network services.

At the international level, the telecommunication monopolies in place in each country meant that two carriers would provide part of a leased line. For international undersea cables each carrier would provide a so called "half circuit" and charge a user for their provision of infrastructure from a theoretical mid point between the two countries. In practice, however PTOs owned gateway to gateway capacity in the form of Indefeasible Rights-of-Use (IRUs) or Minimum Investment Units (MIUs) in digital fibre optic cable systems. In a similar manner, with satellites, PTOs owned "investment shares" in Intelsat or other international satellite organisations. However telecommunication carriers relied on the foreign PTO to provide the remainder of the infrastructure with the mid-point being only used for financial settlements.

All of the foregoing raises the question of how leased lines have been traditionally priced and how this is changing in liberal markets. If a business user wanted to lease a permanent circuit between two cities in the same country, an installation fee and an ongoing monthly charge would generally be charged. In the case of an international leased line these same charges would apply. However in this case the combination of different operators meant that the total price of the leased line would be made up by the sum of the two half circuit prices from each operator. Additional charges could also be made (bundled or unbundled) for back-haul (the link from an undersea cable landing point or international satellite earth station to the PTO's point of presence in the city concerned) and tails (the local links to the business user's premises from the PTO's point of presence). In all these cases business users leased, rather than owned, the transmission capacity concerned.

Liberalisation and new market structures

By the beginning of 1999, all but six OECD countries (Czech Republic, Greece, Hungary, Poland, Portugal and Turkey) had liberalised their public switched telecommunication markets. Liberalisation has not only enabled new players to enter the market. Wherever alternative infrastructure has been deployed it has also encouraged the development of new ways of buying and selling capacity. Not only do users now have a choice of suppliers, in a growing number of markets, they also have the option of purchasing capacity (e.g. IRUs) rather than just leasing capacity. The new suppliers are also casting aside many of the traditional ways of segmenting network pricing. For example consider the following excerpts from two companies building pan-European networks and services which show differences in both network configuration, provision and pricing of service on an end-to-end basis:

> "Stephen E. Lovas, Executive vice president-sales and marketing for Pangea, said the system will differ from other fiber optic cable systems because its cable rings "will operate all the way through the 'POPs' [points of presence] in the respective cities." That will provide an integrated architecture and avoid the necessity of bringing together rings and back-haul infrastructure as separate components, he said."[15]

> "Services like Carrier 1's bypass the established method of connecting calls between telecommunication carriers in different countries, defined by the International Telecommunication Union's International Accounting Rate System. Under this system, telecommunication carriers such as BT and Deutsche Telekom swap roughly equal amounts of international traffic without charging each other. Carrier 1 doesn't have any such bilateral agreements, said Johansson. The company picks up a call in London and terminates it in Germany, bypassing international accounting rates. The system is going to disappear over time, Johansson said, "and it is companies like us that will contribute to its demise."[16]

Bandwidth exchanges

The liberalisation of communication markets has enabled the creation of new forums for trading capacity. There are several sites on the Internet where capacity has recently begun to be traded (Table 7). In this document these markets are called Telecommunication Capacity Markets (TCMs). To better understand how TCMs work it is worth trying to define some categories of products and their structure.

The sellers at TCMs can be infrastructure creators (i.e. carrier's carriers), market players with their own facilities wishing to augment their network sales and resellers. The buyers can be other facilities providers, resellers and business users building electronic commerce services. TCMs trade some or all of the following products -- minutes for communication traffic (PSTN and Internet), leased capacity between cities or countries, dark fibre, and IRUs on undersea cables. Another important product is co-location of facilities.

The market makers at TCMs also fall into several different categories and their modes of operation, while relatively short, are rapidly evolving. The first way TCMs make markets is by facilitating contact between buyers and sellers. For example a seller can place an offer at a TCM for a certain product. An interested purchaser will then contact the TCM and be put in contact with the seller. For this service the TCM receives a commission. At the same time a buyer could also make a bid for a particular product. In this case the seller would contact the TCM and be put in touch with the buyer.

The second way TCMs can function is to operate their own facilities (e.g. a telecommunication switch or an Internet traffic exchange point). In this case buyers and sellers connect their networks to the TCM's facilities. This enables the TCMs to offer a "spot market" for telecommunication capacity. Initially the TCMs operating spot markets only offered minutes of traffic but the product range has now been extended to include bandwidth.

One advantage of TCMs for all actors is their anonymity. Infrastructure providers can differentiate pricing without the knowledge of other users, partners in alliances or competitors. At the same time TCMs give major users the opportunity to resell capacity on a short or long-term basis. Another advantage, from the perspective of a new market entrant, could be with the opening of a new cable. As a way to generate immediate revenue from capacity, that would otherwise be idle, an infrastructure provider could market this capacity at a different rate than on the retail market.

Impact of telecommunication capacity markets

Indices tracking market prices

Several of the TCMs track prices for products in their markets via indices. Band-X commenced service in July 1997 and has two indexes, which track capacity sales. Band-X launched the Band-X United Kingdom Index to track minute prices in September 1997 and a United States equivalent in December 1997. The Band-X Bit Index, which tracks the price of wholesale bandwidth, was launched in October 1998. Between September 1997 and December 1998 the United Kingdom Index of wholesale minute rates has fallen by 35.6% (Table 8). Over a shorter period the United States Index has fallen by 21% (Table 9).

The Band-X Bit Index has been in operation for only a short period at the time of writing. Nevertheless, the falls in capacity prices are impressive. In the five months from October 1998 the Composite World Index declined by 16.6% and the European Index by 26.9% (Table 10). More spectacular gains were made on individual routes such as between New York - London and New York – Frankfurt where prices fell by 26% and 38% respectively. Within Europe the best gain was made on the London - Paris route where prices fell by a massive 65%.

The RateXchange TMC also publishes weekly indexes of prices for minutes and capacity. Between June 1998 and January 1999 the RateXminute Index has fallen by around 30% and the RateXmegabyte Index by just under 10%. The most spectacular gains have been for the RateXminute's European Index which has fallen by just over 40% during this time.

The utility of these indices, for policy makers, is that the benefits accruing from liberalisation can be seen on those routes where the first alternative infrastructure has become available. Other advantages are their timeliness, transparency and reflection of actual market prices. Over time their value should increase as the TCMs expand their coverage. However, for the present, these indices must be qualified by the fact that in the main their coverage, while growing quickly, is limited to the largest traffic routes and the volumes are still small. Where liberalisation has not yet been implemented or where new entrants have not had time to build networks, gains of the magnitude achieved by TCMs have not been realised. Indeed, as will be shown, prices have risen in some (see section below – a tail in two cities).

Placing TCM coverage to one side it is still undeniable that, where alternative infrastructure is available from different providers, they assist in bringing down the cost of the communication infrastructure underpinning electronic commerce. Their true value on competitive routes is somewhat obscured because they only show gains made against initial TCM prices. This can be demonstrated by comparing the standard published prices, listed by telecommunication carriers, and the actual prices on offer at TCMs. At the same time the transparency brought to the arcane world of IRU pricing gives an indication of the potential benefits in the near term for electronic commerce as wholesale rates for capacity become available to a greater number of network service suppliers.

Market prices versus list prices

In October 1998 the Global Communications Director for Reuters said, at a Telecommunication Managers Association workshop, that the best available price their company could obtain from BT and France Telecom for a 2Mbit/s circuit price between London and Paris, including tails, was USD 20 000.[17] By way of contrast the speaker pointed to the cost of purchasing capacity from Viatel's new European network (CIRCE) in which the quoted the cost of a 2Mbit/s circuit at the STM-1 rate was USD 587 (for an overall cost of USD 1 022 including tail circuits from Colt) (Figure 3). The main point, for Reuters as a major user of capacity supporting electronic commerce, was that telecommunication carriers were charging users 20 times the wholesale cost of the underlying infrastructure. For a company that spends USD 330 million annually on communication services the potential for savings are considerable.[18]

In the evolving market for telecommunication capacity there are at least five layers of pricing for international leased lines:

- The standard list or retail price from a telecommunication carrier. This is the list price published by the telecommunication carrier for a circuit or half circuit. Few, if any, users would pay this rate in markets open to competitive infrastructure provision. In October 1998 the combined standard list price from BT and France Telecom for a 2Mbit/s circuit between London and Paris was more than USD 40 000 (the actual list price would depend on local tail prices which in turn can depend on a user's locations).

- The discounted list or retail price. This is the price a user, such as Reuters, can negotiate with BT and France Telecom. The range of available discounts in OECD markets varies enormously. In this case Reuters have indicated that a discount of around 50% was on offer for a leased circuit between London and Paris. Accordingly the discounted list price is in the order of USD 20 000.

- The discount prices from new market entrants competing with incumbent carriers. In the Reuters example, prices were on offer between London and Paris from Hermes for USD 14 000.

- The TCM market price for leased capacity. In February 1999 the best available price for a 2Mbit/s of capacity between London (Telehouse) and Paris (Telehouse) from Band-X was USD 3 190 (excluding tails). A less expensive 2Mbit/s link was offered for April 1999 at USD 2 970.

- The wholesale IRU price from a TCM or direct from the infrastructure provider. To connect Reuters electronic commerce premises between London and Paris with a 2Mbit/s link would cost USD 1 022 per month from Viatel and Colt.

The large difference between retail discount prices and wholesale rates means prices will fall as competing infrastructure is deployed.

IRUs: cable costs and market prices

In a world of national monopolies over telecommunication infrastructure the only entities able to own and operate international PSTN infrastructure were incumbent carriers. The two main infrastructures utilised for intercontinental telecommunication are satellites and undersea cables. In the case of satellites, most capacity was owned and operated by International Satellite Organisations (ISOs). Incumbent telecommunication carriers initiated consortiums to build and operate undersea cables. For both satellite and undersea cables the allocation of capacity was dependent on the share of investment made by a PTO. In both cases either formal or informal barriers applied to participation by new market entrants or users. In fact users were prohibited from dealing directly with entities responsible for managing and operating systems (e.g. the ISOs or Cable Consortiums) but rather leased capacity from “Signatories” (i.e. carriers holding investment shares in these entities). Accordingly, “wholesale rates” for international capacity were very rarely available to new entrants or users, and they had to negotiate with multiple carriers for end-to-end circuits at retail rates.

The first challenge to these arrangements came in the form of private satellite systems, which offered services in competition with the ISOs. However private satellite systems generally sought to compete in the retail market rather than open the underlying infrastructure to users and resellers at wholesale rates. In the same manner the first pan-European networks, such as Hermes, have initially sought to compete at the retail pricing level. Accordingly, while prices declined many users felt they were still not receiving the full benefits that would be brought about by more widespread international liberalisation.

Even in liberal markets it was still difficult for smaller entrants to participate in cable construction and ownership. One reason was that liberalisation may have occurred at only one end of a cable and any new consortium would need to secure the rights for landing and service provision at both ends. Second, incumbent carriers owned the cable laying ships having, in many cases, preferred to carry this work out “in-house” rather than sub-contract cable installation (more recently carriers have sold these ships preferring to outsource cable construction, making it easier for new entrants to find contractors to install and maintain cables). Third, the initial cost of undersea cables (which are more expensive than land based counterparts) meant that the participation of major carriers, with sufficient traffic to warrant the investment, was essential. There are other reasons, but before describing why the situation has radically changed, it is worth noting the former obstacles as described by a new entrant now building a global network:

> “Under the traditional system of carrying cross-border telecommunications traffic in Europe, no ITO [International Telecommunication Operator] developed end-to-end cross-border circuits. Instead, an international call is carried by the ITO in the country where the call originates and is passed off to the ITO in the country in which the call terminates pursuant to bilateral agreements. Cable systems have historically been built by consortia of ITOs and certain other carriers under the "Club" system. The Club system has traditionally had no incentive to (i) upgrade capacity to provide access to new carriers since their respective needs were met, or (ii) sell capacity on a cost-effective basis to other carriers. In addition, landing stations associated with these Club

systems have traditionally been controlled by the ITO members and, in instances where capacity is sold, other carriers have been required to negotiate "back haul" arrangements in order to achieve access to the Club systems. The Company believes the system of bilateralism and the construction of cable systems by the "Club" has resulted in a serious shortage of cross-border capacity in Europe."[19]

The use of words such as "clubs", or "cartels" in other texts, are not necessary to explain how the world's undersea cable networks were developed in a closed market. The real barrier to new entrants was due to government mandated monopolies. It could be argued that, even with liberalisation, this situation might have changed much more slowly without the advent of the Internet. In times past some analysts argued that incumbent carriers could engage in "predatory investment" in excess capacity to deter new entrants in liberal markets.[20] At a time when traffic and demand for capacity increased relatively slowly, compared to the current environment, the supposed threat was that incumbents could "dump" capacity onto the market.[21] Any such concerns have certainly diminished in the current environment. The Internet, and more particularly the demand it has generated for capacity, has vastly increased the incentive for new entrants to build new infrastructure.

As new market entrants are not encumbered by the past rules governing international satellite organisations and are free to participate in cable consortiums initiated by new players, IRUs have come to be publicly traded for the first time at TCMs. Cable capacity can now be bought and sold by all actors in the market -- including users. That being said, most users do not wish to be in the communications business but instead need efficient communications to be in business. The main point is that freeing the wholesale market for communications is demonstrating itself as the single best way to bring down the cost of infrastructure for electronic commerce. While, as is the case for leased lines sold at TCMs, the initial effectiveness of IRUs sales is to bring down prices along specific routes they also have a wider influence. In respect to Internet and Intranets the markets which are connected via wholesale IRU sales are already acting as global and regional hubs. If the market players in other countries do not respond they will increasingly find themselves unable to compete on direct traffic routes. Rather users will increasingly hub traffic via cities such as Amsterdam, London, New York or Stockholm. The availability of wholesale rates on competitive routes will add to the momentum on leased line sales to key hubs already evident in the data published by the FCC.

The factors for why the trends wrought by IRU sales will be so compelling are evident in the initial trading prices (Table 11). There are two factors that are immediately striking. First is that the speeds on offer, such as the IRU for a 622 Mbit/s link between Paris and London, have not been previously available to any players except members of cable consortiums making the original investment. Indeed, a common criticism from larger users was that they could not obtain quotes from telecommunication carriers between countries for bandwidth of 34 Mbit/s and above. The second important aspect, which is even more striking, is the wholesale prices on offer at TCMs. While the differences between TCM prices for leased capacity and the list prices for telecommunication carriers are very large, they lose their glint compared to wholesale rates. Consider the following examples:

- An IRU between Paris and London for 622 Mbit/s can be purchased for USD 5.4 million. If this capacity was fully marketed at 2 Mbit/s speeds (at the lowest available TCM prices for this route) it would return, to the reseller, revenues of just under USD 1 million per annum. Fully marketed, at the discounted retail rate from the incumbent carriers on this route (i.e. USD 20 000 per month), the capacity would pay for itself within one year.

- An IRU for 155 Mbit/s link between London and New York can be purchased for USD 7.4 million as opposed to a leased line at this speed of USD 190 000 per month. In other words, the wholesale rate for purchasing the IRU in perpetuity (i.e. in this case a 25-

year lifetime) is the equivalent of only three years rental at current TCM prices. That is before consideration of other costs (e.g. cost of capital or any difference in operation and maintenance costs).

- An IRU for a 45 Mbit/s link between London and New York can be purchased for as little as USD 3.6 million as opposed to monthly rental ranging from USD 70 000 to over USD 100 000 on this route. In other words the wholesale rate is equivalent to around four years rental before consideration of other costs.

The main point is that there are large margins available from the initial wholesale rates and best available TCM prices. In turn, the best available TCM prices represent huge reductions on discounted retail prices from traditional carriers. As wholesale rates decline, as more capacity is brought to the market by new entrants, greater downward pressure will be placed on TCM prices and the retail rates charged by telecommunication carriers.

Transatlantic, Trans-Pacific, North American, and European Pricing at TCMs

The prices available at TCMs give a good indication of the level of competition in different markets. The prices available in North America, and in particular the United States, are far less expensive than prices in the European market (Table 12) (Figure 4 and Figure 5). There are, of course, well known difficulties in comparing leased line prices. Notwithstanding these caveats, the differences between North America and Europe are compelling. A selection of leased line prices from Band-X shows North American pricing of 1Mbit/s capacity between selected major cities, sometimes covering vast distances, to be in the order of USD 2 000 whereas the equivalent price between major cities in Europe is around USD 10 000. Notwithstanding this rough average for major cities the pricing on some routes is, at the least, extreme. For example, the monthly price of 1 Mbit/s of capacity between the financial centres of Frankfurt and Zurich (two cities 297 kilometres apart) is 13.5 times higher than between New York and Chicago (two cities 1 158 kilometres apart). By the end of 1999, these prices should incur massive falls as new competing infrastructure comes on line. In the mean time the lack of infrastructure competition is clearly adding a huge price to doing business-to-business electronic commerce in Europe.

The European prices at Band-X represent the best available prices in February 1999. Between those cities and regions where bandwidth is not traded at TCMs users must pay the list price, albeit with any applicable discount. Indeed, absence from TCMs is a sign that the underlying infrastructure has moved out of the hands of incumbent PTOs marketing at retail prices. While the Band-X prices shown are offers from infrastructure providers, users can also make bids. For example, a bid for a 2 Mbit/s leased line between Frankfurt and Warsaw was placed for USD 25 000 per month. In other words, while a user was prepared to pay more than 14 times what an equivalent circuit in the United States would cost, they could not find a supplier at this price. At the same time, a user’s bid for a 2Mbit/s link between Marseilles and New York went unanswered because routes such as these are not yet linked with competitive infrastructure.

An observation worth making for the major TCMs, in early 1999, was the very low number of offers for capacity across the Pacific compared to the Atlantic. In addition offers were mostly for United States half circuits rather than end-to-end circuits. In addition there was a total absence of offers on a North-South basis between Asian-Pacific countries. At the same time, a user’s bid of USD 60 000 per month for a 2Mbit/s link between Los Angeles and Beijing was unanswered at the time of writing. This evidence suggests that where end-to-end circuits are not yet available from new market entrants, incumbent operators are not prepared to sell outside retail pricing levels. In 1999, the new capacity coming on stream across the Pacific should act to rapidly bring down prices once it becomes available to the market. In the mean time high prices, and the lack of capacity between Asia-Pacific countries available in the market, are acting as a barrier to electronic commerce.

Internet access

While most of the analysis in this report focuses on capacity for building backbone networks, Internet connections are also a fundamental building block for electronic commerce. A survey released by the Commercial Internet Exchange (CIX), in 1997, showed large ISPs serving the business community used leased lines to a much greater extent than other high speed connections such as ISDN and frame relay (Table 13). The CIX survey also showed that business users, like residential users, use dial-up Internet access. As this report is primarily concerned with the infrastructure used for business-to-business electronic commerce it does not examine dial-up prices and access technologies. This is not because this area of pricing is not critical to the success of electronic commerce.[22] The employees of even the largest business users will employ dial-up access when they are mobile, working from home or accessing VPNs. At the same time small business to large business electronic commerce uses dial-up connections. However, given the focus of this document, this subject would be better treated in future work on infrastructure pricing for business to consumer electronic commerce and small business to large business electronic commerce. For the purpose of this document the focus in the following section is on the pricing of the short distance leased lines used to connect businesses to their ISPs and to provide connectivity from business premises to points of presence.

A tail in two cities: leased line rebalancing

The first impact of market liberalisation has been to reduce the prices for capacity between major cities. That being said a user may still need to purchase additional connections between their business premises and the points or presence for cable or satellite gateways in different cities. Sometimes these connections are referred to as “tails” or (somewhat confusingly as) “local loop” connections. At the same time, short distance leased lines have taken on an added significance for business users in terms of electronic commerce. Leased lines are the most common way in which larger businesses link their premises to the networks of ISPs if they want to establish a permanent connection. In many cases the leased line will only be over a relatively short distance.

To construct the OECD/Eurodata Baskets of Leased Lines, prices are collected for different speeds and distances. This enables a time series to be examined for 2 Mbit/s national leased lines and comparisons made between the pricing trends for short distance leased lines, such as those used for tails, and pricing trends over longer distances (Table 14). This analysis shows that many PTOs have been rebalancing leased line charges by raising short distance prices while lowering long distance charges. This is evident in the rising price of 9.6 kbit/s circuits -- the low speed circuits still used by many businesses for local permanent connections -- compared to higher speed leased lines (Figure 6).

Between 1992 and 1998 the average list price for a 2 Mbit/s leased line at distances beyond 50 kilometres was reduced by nearly 30%. On the other hand the list prices for the same leased lines at two kilometres actually rose in price and reached a peak in 1996 (Figure 7). Since that time there has been a progressive easing in the average prices for short distance leased lines, yet in 1998 users faced prices that were greater than in 1992. These data bear out the fact that competition is greater in the long distance capacity market than the short distance market. What is encouraging from these data is that they capture the growing benefits of liberalisation. The steeper declines in long distance prices in 1997 and 1998 reflect liberalisation in Europe during this period. At the same time the first declines in short distance prices in these years reflect the first impact of liberalisation on local access markets in countries which liberalised their markets at an early stage. Nevertheless the local access leased line market has the potential to be a bottleneck for business-to-business electronic commerce.

International and national leased line pricing

In November 1995 BTG, the Dutch association of large business telecommunication users, questioned the high ratio between the tariffs for international and equivalent national leased lines in the Netherlands, and whether cost-orientation had been applied to the tariffs for international leased lines.[23] This led to the first INTUG survey on tariffs for leased lines in Europe, requested by the European Commission. According to INTUG this survey, and subsequent surveys, have revealed that cost orientation in the tariffs for leased lines is not evident (Table 15) (Figure 8). The INTUG methodology is to compare a national leased line price with an international leased line price over the same distance. The international leased line is to a neighbouring country. INTUG, deliberately, does not convert the prices from national currencies because, in this case, they do not want to focus on the differences between countries. Rather INTUG want to highlight the differences between the pricing of two products, which have similar characteristics with the exception that one is national and the other international.

In responding to the INTUG surveys, a number of PTOs have raised points as to why international leased line prices are higher than their national equivalents (Box 3). Notwithstanding these points, which INTUG readily acknowledges may justify a mark-up of 30% (and perhaps 50% in extreme cases), business users strongly question prices well in excess of these benchmarks. The most recent data, for January 1999, show the mark-up on international leased line prices can be as high as six times those of national leased lines. Mark-ups in the order of 200 to 400% are common.

The INTUG comparisons are extremely effective in demonstrating the additional costs imposed on businesses engaging in electronic commerce across national borders. This has led some PTOs to question whether the principle of "cost orientation" is applicable in markets that have now been liberalised. This is a point worth consideration by policy makers. It is undeniable that the most recent INTUG survey reveals pricing of international leased lines which is far from being cost oriented (even assuming national leased line prices were cost orientated which they are not in virtually all cases). Notwithstanding this fact, in liberal markets, regulatory authorities should look to increased infrastructure competition rather than price control mechanisms.

The new pan-European networks coming on stream in 1999 should boost competition in those markets which have been liberalised and bring the price of international circuits down very quickly. INTUG's survey already reveals substantial price reductions in Denmark and Sweden (Table 16). It is almost certainly the case that the new pan-European networks will sweep away the caveats raised by incumbent PTOs as to why international circuits have a higher cost to provide. Issues of scale, standards, settlements and so forth will be less, or no longer, relevant where pan-regional networks are in place and end-to-end service is provided by the same company.

Box 3. Extract from INTUG's leased line survey: national vs. international cost

INTUG reports some telecommunication operators gave the following reasons for why international leased line prices are higher than equivalent national circuits:

1. **Economy of scale**: It was argued that the volume of international circuits leased in relation to national circuits leased is very low (France Telecom: 1%), however they draw on joint resources and have proportionally higher cost. Network optimisation is therefore more difficult for certain international circuits.

2. **Interconnecting related problems:**

-- To guarantee quality levels by working with different technical standards.

-- Initial settlements between operators, management and interworking.

-- Bilingual staffing.

3. **Capacity related problems:**

-- According to telecommunication operators there is a European Operating Rule (CEPT originated) requiring a third of capacity in stand-by for security reasons (breakdown and fault management) and commercial reasons (to fulfil demands from other operators with a minimum delay).

-- For non English mother-tongue operators a permanent English-language hot-line must be provided.

-- The need to maintain spare capacity to enable leased lines to be available within an agreed time scale.

4. **Other reasons:**

-- Cost of laying and maintaining submarine cables.

-- Geographical particularities of a country.

Tying regulatory intervention to complicated assessments of current costs and prices would be quickly swept away by the growing availability of international capacity and competition in these markets. Rather the pricing of national and local access leased lines, where alternative infrastructures will take longer to roll out, could prove the major barrier to electronic commerce over the next several years. A valuable addition to the INTUG survey would be the market price of leased line at two kilometres in OECD countries. In the mean time regulatory intervention should be aimed at increasing competition by encouraging efficient interconnection between the new pan-regional networks and national/local networks. Where monopolies remain in place, for even a short time into the future, the INTUG results remain extremely relevant because they demonstrate the higher than necessary costs for companies from these countries engaging in electronic commerce in world markets.

Table 1. Telecommunication capacity terminology

	Acronym	Capacity	
DS-1	T1	1.544	Mbit/s
	E1	2	Mbit/s
DS-2	T2	6.3	Mbit/s
	E3	34	Mbit/s
DS-3	T3	45	Mbit/s
	OC-3 or STM-1	150	Mbit/s
	STM-1	155	Mbit/s
ds-4		274	Mbit/s
	OC-12	600	Mbit/s
	OC-12 or STM-4	622	Mbit/s
	OC-48 orSTM-16	2.4	Gbit/s
	OC-192 or STM 64	10	Gbit/s
Connection Type	Bits per Second	Bytes per Second	Download time of 5 Megabytes
14.4 Modem	14 400	1 600	52 minutes
28.8 Modem	28 800	3 200	26 minutes
33.6 Modem	33 600	3 800	22 minutes
56k Line	57 600	7 168	12 minutes
64k 1 ISDN B channel	65 535	8 192	10 minutes
128k 2 ISDN B channels	131 072	16 384	5 minutes
T1/DS1	1 536 000	192 000	43 seconds
T2/DS2	6 144 000	768 000	7 seconds
T3/DS3	46 080 000	5 760 000	1 second
T4/DS4	276 480 000	34 560 000	0.2 seconds
Sonet/OC1	51 000 000	6 380 000	0.9 seconds
Sonet/OC3	155 000 000	19 370 000	0.5 seconds
Sonet/OC12	600 000 000	75 000 000	0.15 seconds
Sonet/OC48	2 400 000 000	300 000 000	Instantaneous

Source : OECD and Dennis Cox, “Explaining Bandwidth”, http://puzzlesol.com/html/bande_passante.html

Table 2. Leased line growth between the United States and OECD area

	Number of Leased Lines (64bit/s equivalents)			Leased Line Growth (CAGR)	IMTS growth (CAGR)	Leased lines share of total active circuits			Idle circuits share of reported total circuits		
	1 995	1996	1997	1995-1997	1995-1997	1995	1996	1997	1995	1996	1997
Canada	5 555	29 715	71 449	258.6	6.7	10.6	39.4	56.5	3.8	1.3	1.1
Mexico	1 667	13 321	23 525	275.7	26.1	6.7	32.4	38.8	3.5	3.4	1.9
United Kingdom	6 445	18 993	23 208	89.8	46.1	39.8	58.5	55.6	63.1	25.4	35.0
Japan	2 277	7 683	10 097	110.6	16.0	29.1	55.0	58.2	67.7	56.0	50.0
Germany	1 271	4 636	8 028	151.3	37.6	31.9	54.4	60.6	62.7	45.3	39.2
Australia	848	2 450	4 289	124.9	34.4	26.8	52.1	50.6	25.7	28.0	11.0
Korea	494	1 521	3 788	176.9	40.2	30.1	50.4	62.7	68.6	57.1	39.4
Sweden	19	1 375	3 468	1 251.0	23.1	2.7	61.2	74.2	78.5	33.3	27.9
France	766	2 830	3 314	108.0	21.1	26.2	49.7	49.8	59.7	41.9	45.4
Netherlands	666	1 903	2 028	74.5	-1.9	35.1	62.8	62.0	54.2	35.8	47.9
Switzerland	404	716	1 111	65.8	15.5	30.3	42.9	47.3	55.0	47.7	45.0
Spain	76	201	1 041	270.1	24.0	6.3	13.8	37.1	76.8	58.5	37.8
Italy	165	756	813	122.0	4.9	9.6	29.4	31.8	52.7	32.4	34.7
Belgium	226	587	809	89.2	25.4	20.8	38.4	36.7	48.6	38.8	24.7
Ireland	216	462	620	69.4	24.7	18.9	25.8	29.2	66.1	34.3	28.7
Portugal	46	90	416	200.7	13.4	11.4	16.5	45.3	37.5	16.0	3.9
New Zealand	54	395	390	168.7	24.7	10.4	44.7	35.1	32.8	22.6	7.0
Iceland	1	19	182	1 249.1	3.3	0.8	13.4	58.9	0.0	11.3	1.9
Turkey	49	151	149	74.4	26.3	21.4	35.4	31.1	48.4	42.7	37.8
Austria	30	67	138	114.5	5.3	10.5	19.0	32.6	50.6	46.0	41.3
Finland	94	76	133	18.9	12.8	26.8	17.5	28.9	30.1	35.4	28.3
Greece	25	106	126	124.5	13.4	7.4	22.1	22.0	3.7	24.2	7.0
Poland	17	52	114	159.0	17.1	3.0	6.2	12.4	56.0	45.3	40.7
Denmark	27	73	94	86.6	12.1	5.8	11.6	13.7	27.8	26.3	26.2
Norway	11	74	86	179.6	22.3	3.1	12.3	13.4	49.6	10.8	35.8
Luxembourg	6	8	39	155.0	6.5	4.7	5.6	22.2	39.5	41.9	35.8
Hungary	0	35	31	n.a.	16.0	0.0	15.4	11.2	44.4	37.9	27.0
Czech Republic	2	8	8	100.0	-20.2	1.2	3.8	5.1	47.2	29.2	48.3
OECD	21 457	88 303	159 494	172.6	18.7	17.0	43.1	51.8	39.1	22.8	19.8
Rest of World	6 623	15 594	26 478	99.9	14.1	17.4	30.7	22.1	33.9	24.3	23.1
Total	28 080	103 897	185 972	157.4	17.7	17.1	40.6	27.5	38.0	23.1	20.3

1. Data for Hawaii is counted under Rest of World.

Source : FCC.

Table 3. Leased line capacity per capita between United States and OECD area

64kbits/ circuits per 100000 inhabitants

Between US and:	1995	1996	1997
Canada	18.89	100.12	238.62
Iceland	0.37	7.01	66.42
United Kingdom	11.10	32.67	39.88
Sweden	0.22	15.59	39.21
Mexico	1.83	14.37	24.95
Australia	4.75	13.57	23.50
Ireland	6.09	13.00	17.42
Switzerland	5.64	9.91	15.27
Netherlands	4.30	12.22	12.95
New Zealand	1.52	10.97	10.71
Germany	1.56	5.66	9.77
Luxembourg	1.47	1.94	9.35
Korea	1.10	3.36	8.29
Japan	1.82	6.13	8.04
Belgium	2.23	5.78	7.94
France	1.32	4.85	5.66
Portugal	0.47	0.92	4.24
Spain	0.19	0.51	2.62
Finland	1.84	1.48	2.59
Norway	0.25	1.70	1.97
Denmark	0.52	1.39	1.79
Austria	0.37	0.83	1.69
Italy	0.29	1.32	1.42
Greece	0.24	1.01	1.20
Hungary	0.00	0.35	0.31
Poland	0.04	0.13	0.30
Turkey	0.08	0.24	0.24
Czech Republic	0.02	0.08	0.08

1. Only the population of the corresponding country is used to weight this indicator.

Source : FCC, OECD.

Table 4. Transatlantic cable capacity

64 kbit/s circuit equivalents

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999 Est.	2000 Est.	2001 Est.
Operational:														
CANTAT-3 (1)							60 480	60 480	60 480	60 480	60480	60 480	60480	60480
CANUS-1	0	0	0	0	0	0	0	30 240	30 240	30 240	30 240	30 240	30240	30240
Columbus II (2)	0	0	0	0	0	0	15 120	15 120	15 120	15 120	15 120	15 120	15120	15120
PTAT 1	0	17 010	17 010	17 010	17 010	17 010	17 010	17 010	17 010	17 010	17 010	17 010	17 010	17 010
TAT 8	7 560	7 560	7 560	7 560	7 560	7 560	7 560	7 560	7 560	7 560	7 560	7 560	7 560	7 560
TAT 9	0	0	0	0	15 120	15 120	15 120	15 120	15 120	15 120	15 120	15 120	15 120	15 120
TAT 10	0	0	0	0	22 680	22 680	22 680	22 680	22 680	22 680	22 680	22 680	22 680	22 680
TAT 11	0	0	0	0	0	22 680	22 680	22 680	22 680	22 680	22 680	22 680	22 680	22 680
TAT 12/TAT-13	0	0	0	0	0	0	0	60480	120960	120960	241920	362 880	362 880	362 880
Gemini										60 480	120 960	362 880	362 880	362 880
Atlantic Crossing (AC-1)											241 920	483 840	967 680	967 680
Planned														
Columbus III												120 960	120 960	483 840
OXYGEN (USA)													7 741 440	7 741 440
Total	7 560	24 570	24 570	24 570	62 370	85 050	160 650	251 370	311 850	372 330	795 690	1 521 450	9 746 730	10 109 610

1. FCC Report No. IN 99-4.
2. Another announced project - TAT-14, with potential capacity of 640 Gbps in 2000 has not filed its landing license with the FCC and therefore is not included.

Source : FCC.

Table 5. Trans-Pacific cable capacity

64 kbit/s circuit equivalents

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999 Est.	2000 Est.	2001 Est.
Operational:														
HAW 4/TPC 3	0	7560	7560	7560	7560	7560	7560	7560	7560	7560	7560	7560	7560	7560
NPC	0	0	0	17010	17010	17010	17010	17010	17010	17010	17010	17010	17010	17010
TPC 4	0	0	0	0	15120	15120	15120	15120	15120	15120	15120	15120	15120	15120
HAW-5						15120	15120	15120	15120	15120	15120	15120	15120	15120
PacRimEast						7560	7560	7560	7560	7560	7560	7560	7560	7560
PacRimWest								7560	7560	7560	7560	7560	7560	7560
TPC 5	0	0	0	0	0	0	0	0	120960	120960	241920	241920	241920	241920
Planned:														
China - U.S. Cable Network												967680	967680	967680
PC-1													967680	967680
Japan - U.S. Cable Network													967680	967680
Southern Cross												483840	967680	967680
Guam-Philippines													120960	120960
OXYGEN (USA)													7741440	7741440
Total	0	7560	7560	24570	39690	62370	62370	69930	190890	190890	311850	1763370	12044970	12044970

1. FCC Report No. IN 99-4.

Source : FCC.

Table 6. Building new bandwidth in Europe

Consortium/ Company	Coverage	Capacity	Date	URL
BT	BT and its European partners pan-European communications network announced in June 1998 was undergoing final testing in early 1999 before going live, on schedule, by the end of March. In less than eight months, BT and its partners have implemented more than 5 000 km of fibre, connecting the 27 000 km of fibre within the networks of BT's family of operating alliances. This network will be extended by a further 4 000 km of fibre by the summer to create Europe's largest pan-European high-speed network. Ultimately the network will provide access to 36000 km of fibre and have Europe's greatest reach with points-of-presence in more than 200 cities. BT, Albacom, BT Belgium, Sunrise, Telfort, Viag Interkom and Cegetel/TD (Telecom Developpement) have inter-linked their networks, linking the UK, Italy, Belgium, Switzerland, the Netherlands, Germany and France.	The pan-European network and BeTaNet (BT's UK equivalent) will be optimised to support 160 Gbit/s of capacity per fibre pair with the ability to increase transmission to 320 Gbit/s in the future. Both networks are based on leading-edge Synchronous Digital Hierarchy (SDH) and dense wave division multiplexing (DWDM) Technologies.	Opened 11 March 1999.	www.bt.com
Cable and Wireless	As an initial step Cable & Wireless will provide ATM transmission capacity across mainland Europe to ensure that the network provides comprehensive coverage of all key European business centres. The principal supplier of this new capacity will be Hermes Europe Railtel (HER). As part of this expansion Cable & Wireless will also start new operations in both Frankfurt and Düsseldorf this year to provide	In November 1998 Cable & Wireless announced a two year development of a pan-European high-capacity fibre-optic network linking 18 cities. Sourced as a dark fibre purchase from Global Crossing's European network, Pan European Crossing (PEC), the Cable & Wireless European network will provide ultra high capacity, self-healing fibre networks to connect the major commercial centres of Europe. This acquisition	In operation and being upgraded in 1999 and 2000.	www.cwplc.com

Table 6. Building new bandwidth in Europe (*continued*)

Consortium/ Company	Coverage	Capacity	Date	URL
	voice and data services to the German market over the network. HER has also agreed to purchase capacity on Gemini's transatlantic cable. There are currently operations in Belgium, France, Ireland Italy, Spain and Switzerland, and these will expand to include Germany and the Netherlands during the first half of 1999. The complete Cable & Wireless European network will provide a range of high-speed integrated communication services to over 40 cities in 13 countries. These include: Vienna: Antwerp, Brussels, Copenhagen, Lille, Lyon, Paris, Marseilles, Strasbourg, Berlin, Cologne, Dusseldorf, Frankfurt, Hamburg, Hanover, Munich, Stuttgart, Amsterdam, Rotterdam, Cork, Dublin, Bologna, Florence, Genoa, Milan, Rome, Turin, Venice, Luxembourg, Lisbon, Barcelona, Madrid, Geneva, Zurich, Birmingham, Cardiff, Edinburgh, Glasgow, Leeds, Liverpool, London, Manchester, Newcastle.	will give the company a 7 200 kilometre terrestrial network capable of handling the equivalent of around 5 million simultaneous telephone calls.		
Carrier 1	In September 1998, Carrier 1 announced a partnership with two U.S. network operators - Viatel and Metromedia - to build a fibre-optic telecom network in Germany. The 2 300 km network will span 12 cities Carrier 1 said it plans to extend its network across Europe, offering voice, data, and eventually IP-based voice services. Previously, in July 1998, Carrier 1 announced that it had contracted with Hermes Europe Railtel (HER) for an SDH ring based transmission service, connecting London, Paris, Geneva, Frankfurt and Amsterdam.	The service is based on a 155 megabit-per-second SDH (Synchronous Digital Hierarchy) ring, linking London, Amsterdam, Frankfurt, Geneva and Paris, provided by Hermes and 155-Mbps SDH transatlantic capacity to New York.	German network scheduled to open late in 1999.	www.carrier1.com

Table 6. Building new bandwidth in Europe (*continued*)

Consortium/ Company	Coverage	Capacity	Date	URL
Global Crossing	Announced 1 October, 1998, Pan European Crossing (PEC) is a fibre optic network directly linking 18 of the major European commercial centres with the United States, Asia and Latin America. This USD 700 million high-capacity terrestrial telecommunications network will link with Global Crossing's four other undersea systems that, once completed, will create a direct city-to-city network connecting 100 of the world's largest metropolitan areas. PEC is a critical link in the Global Crossing Network, and positions the company for further regional expansion in areas such as Central and Eastern Europe, Russia and the Baltic regions. PEC's point-of-presence will be in: Paris: Hamburg, Strasbourg, Brussels, Hanover, Zurich, Milan, Antwerp, Dusseldorf, Lyon, Copenhagen, Rotterdam, Cologne, Marseilles, London, Amsterdam, Frankfurt, Turin.	PEC will use the latest Synchronous Digital Hierarchy (SDH) and Dense Wavelength Division Multiplexing (DWDM) technologies from leading suppliers to provide ultra-high capacity, self-healing fibre networks. PEC's terrestrial network will span approximately 7 200 route kilometres and have a fully deployed capacity of 24 fibre pairs, or 500 000 fibre kilometres. Based on fibres per kilometres, PEC is by far the highest capacity independent European network.	PEC will be developed in several phases. The first phase, scheduled for completion in 1999, will connect 13 cities: London, Paris, Amsterdam, Rotterdam, Antwerp, Brussels, Hamburg, Hanover, Dusseldorf, Cologne, Frankfurt, Strasbourg and Copenhagen. Planned extensions to the network will connect Lyon, Marseilles, Turin, Milan and Zurich, which will be completed in 2000.	www.globalcrossing.bm/ pan-european.html
GlobalOne	Global ATM operates on one of the world's largest and most advanced ATM-based networks, which will be deployed in more than 200 cities in over 46 countries by the end of 1998. The first 13 countries connected were Belgium, Denmark, France, Germany, Ireland, the Netherlands, Sweden, Switzerland, the United Kingdom, Canada, Japan, Israel and the United States.	Global ATM has the capacity to operate at extremely high switching speeds of up to 155 Mbit/s rates. Lower speeds, starting from T-1 (1.544 Mbit/s) can be tailored to specific customer needs.	In operation.	www.gip.net

Table 6. Building new bandwidth in Europe (*continued*)

Consortium/ Company	Coverage	Capacity	Date	URL
GTS Trans-European Network	As of December 1998, the Hermes operational network connects 17 cities in nine European countries. The full network will be built on 20 000 kilometres of pan-European high capacity fibre-optic network designed to interconnect points of presence in over 33 cities in 15 countries.		In operation.	www.her.com
Jazztel	Jazztel is initially building a network in Spain and primarily concentrating on that market but expects to have completed 4 627 kilometres of fibre cable and an undersea link of 780 kilometres of undersea cable to the UK by 2003.	The E14U cable is initial 20 Gbit/s upgradeable to 320 Gbit/s. The network will employ DWDM, ATM and SDH technologies.	1999.	www.jazztel.es
KPNQwest	KPNQwest's pan-European high-capacity fibre optic network consists of bi-directional self-healing "EuroRings" for uninterrupted service. The partners in the joint venture recently announced the completion of the first EuroRing, linking Antwerp, Brussels, Dusseldorf, Frankfurt, Paris, Rotterdam and Strasbourg. By the year 2000, KPNQwest plans to construct five additional rings connecting up to 40 major western, central and eastern European cities. Through KPNQwest's high bandwidth transatlantic connections, the EuroRing network can seamlessly be linked to Qwest's technologically advanced 18 500-mile North American fibre optic network for the delivery of advanced IP-based data, video and voice services on a global scale.	Designed to transmit capacity at up to two terabits per second, the KPNQwest network can carry more information faster than any other communications network in Europe.	Completed the first of six EuroRingsTM in January 1999 and is now providing service to Amsterdam, Antwerp, Brussels, Dusseldorf, Frankfurt, Paris, Rotterdam and Strasbourg.	http://jv.eu.net/

Table 6. Building new bandwidth in Europe (*continued*)

Consortium/ Company	Coverage	Capacity	Date	URL
Level3	Following the launch of services in London in January 1999, Level3 plans to offer services between Paris, Amsterdam and Frankfurt and two other cities in late 1999. The first cities will be connected by a 2 000-mile Pan European Network. Level 3 has been granted full PTO licences in the UK, France, Germany and the Netherlands. National and international facilities licences have also been granted in Belgium.	The company has negotiated 7 Gbit/s of Transatlantic capacity to connect to its inter-city network in the United States.	1999.	www.level3.com
MCI Worldcom	In Europe, MCI WorldCorn has full service, facilities-based local telecommunications subsidiaries in Belgium, France, Germany, Italy, the Netherlands, Sweden, Switzerland and the UK. It has built and operates local networks in Brussels, Paris, Frankfurt, London, Amsterdam, Rotterdam, Stockholm and Zurich. In 1998 the company announced plans to triple the size and scope of its pan-European long distance network that connects these city networks.	The transmission network is delivering a new class of product for Europe - notably full service international ATM and high speed (up to 155Mbps) building-to-building circuits.	In operation.	www.mciworldcom.com
Pangea	Start-up Pangea Ltd., plans to build a USD 400 million submarine fiber optic cable linking countries that ring the North and Baltic Seas: the United Kingdom, the Netherlands, Germany, Denmark, Norway, Sweden, and Finland.	The planned Pangea-1 system will provide 640 gigabits per second of capacity on a 32-wavelength system	Planned.	

Table 6. Building new bandwidth in Europe (*continued*)

Consortium/ Company	Coverage	Capacity	Date	URL
Telemonde	Titan network. Telemonde, a new telecommunication carrier which sells and leases bandwidth exclusively to other carriers. Telemonde is currently the largest independent owner of available bandwidth on the Gemini and Atlantic Crossing transatlantic cables.	Telemonde's Transatlantic capacity includes a 2.4 gigabits per second link on Gemini and capacity on Global Crossing's cable.	Phase One: London, Paris, Brussels, Amsterdam, Dusseldorf, Frankfurt (Q1 1999) Phase Two: Lyons, Geneva, Zurich, Munich, Berlin, Hamburg (Q2 1999) Phase Three: Bordeaux, Barcelona, Madrid, Milan (Q3-Q4 1999)	www.telemonde.com
Telia	In November 1998 Telia approved an investment to install new fibre optic cable links between London and Paris, and Paris and Frankfurt and Main. As a result of the decision, Telia can link together previous cable investments in Europe into a loop called "The Viking Ring". Telia are currently extending a submarine cable from Oslo to the U.K. over the Ekofisk field in the North Sea. Previous cable investment is also being implemented today between Stockholm and Oslo, and Stockholm, Copenhagen and Hamburg. The Copenhagen-Hamburg cable link will soon be placed in service.	An optical cable containing 192 fibres will be installed throughout Europe and laid across the English Channel either through the Euro Tunnel or as a submarine cable. For deployment in France, the cable will be laid in waterways and canals for most of the distance.	1999.	www.telia.se

Table 6. Building new bandwidth in Europe (*continued*)

Consortium/ Company	Coverage	Capacity	Date	URL
Viatel	The first phase of Viatel's Circe Pan-European Network is an 1 850 route kilometre ring that links London in the United Kingdom; Amsterdam and Rotterdam in The Netherlands; Antwerp and Brussels in Belgium; and Paris and Amiens in France. The ring includes 312 kilometres of submarine cables that cross the Channel and the North Sea. Circe's Ring One is part of a larger, three-ring, 5 200 route kilometre, broadband infrastructure that will link over 30 major European cities in the United Kingdom, Belgium, France, Germany and The Netherlands. The first network ring, like its sister rings, is a high capacity, bi-directional and self-healing network and, as such, is capable of supporting data services (i.e. ATM, IP, and frame relay), multimedia and e-commerce applications, and voice telephony.	Initial pair is 20 Gbit/s.	In February 1999 Viatel announced that construction of the first ring of "Circe," its Pan-European broadband network, was completed. The Company further announced that Ring One of the Circe Pan-European Network would be ready for commercial service in March 1999.	www.viatel.com

Source : OECD.

Table 7. Telecommunication capacity trading

Name	Products Traded	Description	URL
Arbinet	PSTN Minutes and IP telephony Minutes	The Arbinet Global Clearing Network (AGCN) allows large and small carriers to connect their traditional or emerging networks to over 50 world carriers. The AGCN provides real-time authentication, authorisation, least cost routing, call placement, and settlement, on a transaction-by-transaction basis, allowing carriers to access the best rates and routing options without having to negotiate and contract separately with each supplier. The AGCN members post for sale or purchase any capacity to any destination and attach specific parameters to define the conditions under which such trades will be authorised. The rest is performed automatically by the AGCN as it matches on a call-by-call basis any such available routes. The AGCN is presently clearing and settling minutes for all types of communications companies.	www.arbinet.com
Band-X	Capacity and PSTN Minutes	Members place details of capacity that they wish to buy, sell or lease on this Web site. Assets traded are leased circuits, IRUs and dark fibre. Carriers or resellers connect directly to the Band-X market switch to buy or sell minutes. All daily volumes, rates and a quality measurement are visible on these pages to interconnected carriers who can then buy or sell directly, anonymously and immediately through the London Telehouse based switch. Carriers contract with Band-X direct. Buyers and sellers receive daily statements of minutes traded.	www.band-x.com/index.cfm
Capesaffron	Capacity and Minutes		www.capesaffron.com
Clarent	The Clarent Clearinghouse programme, links carrier networks worldwide and enables large service providers and backbone operators to provide wholesale transit and termination for regional carriers.	Clarent Corporation is a provider of IP telephony technology to mainstream carriers and service providers. The clearing houses of AT&T and Telia clearing house use this technology.	www.clarent.com
InterXion	Capacity	In order to be able to facilitate the handling of the deals made via the Virtual Dealing Room InterXion offers switching facilities at it's location in Amsterdam. InterXion customers can physically connect at 2Mbit/s level. The location of InterXion is connected to the fibre rings in Amsterdam. Amsterdam was the first location of InterXion and locations in Brussels, Frankfurt, New York, London and Paris are currently in preparation.	www.interxion.com/services

Table 7. Telecommunication capacity trading (*continued)*

Name	Products Traded	Description	URL
Min-X	IP Telephony and PSTN Minutes	The Minutes Exchange is a "Relationship Broker" and "Market Maker" and earns commissions on completed trades. Min-X.com is not a carrier, or clearing house and does not compete with any company currently offering telephony services. The Minutes Exchange does not provide authorisation, accounting, routing and settlement services other then providing Settlement for our own Trades.	pulver.com/min-x
Executive Telecom	Facilities management of telecommunication networks; Facilities management of global switching; Telecom housing management; Minute trading	Paris based exchange trading minutes in France.	www.executive-tele.com
RateXchange	Capacity, Minutes and IP minutes.	The Real-Time Bandwidth eXchange (RTBX) is a switch-integrated exchange that services the entire transaction process. Carriers pre-interconnect to one of 12 switching hubs to trade anonymously with managed delivery and guaranteed payment.	www.ratexchange.com

Source : OECD from Web sites cited.

Table 8. Band-X index for the United Kingdom

Destination and volume weighting (%)		Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Destination and volume weighting(%)		Nov-98	Dec-98
Band-X UK Composite		**79.6**	**78.1**	**77.7**	**77.4**	**75.2**	**72.9**	**70.4**			**68.2**	**64.4**
USA	12.70	78.2	78.2	76.7	75.7	74.4	73.7	72.4	**USA**	17.6	70.4	67.6
Ireland	11.40	73.0	73.1	73.0	73.0	72.4	67.1	63.1	**Ireland**	14.7	61.4	59.5
France	8.70	85.9	80.6	84.1	84.1	79.5	76.9	73.4	**Germany**	10.9	68.5	64.8
Germany	8.70	80.4	77.7	81.0	81.7	76.7	74.7	71.5	**France**	10.9	66.7	60.3
Italy	4.70	76.8	76.0	72.2	72.2	69.1	68.0	66.1	**Spain**	6.0	64.2	59.7
Spain	4.70	81.1	79.5	76.3	74.9	73.9	68.4	67.0	**Italy**	5.5	63.6	61.2
Netherlands	3.80	69.2	65.1	63.2	63.6	62.9	65.1	62.4	**Netherlands**	5.1	56.5	52.9
Australia	3.00	75.4	74.8	78.8	78.5	74.5	68.9	67.5	**Australia**	3.9	65.3	61.1
Canada	2.70	78.1	77.0	75.2	74.4	71.5	70.0	66.4	**Canada**	3.5	63.1	60.6
Belgium	2.50	76.7	73.4	72.6	72.6	70.6	66.8	65.9	**Belgium**	3.3	64.7	58.7
Switzerland	2.20	87.3	86.1	79.6	78.4	77.2	76.1	71.5	**Switzerland**	3.3	68.1	58.9
Greece	1.80	90.1	89.2	88.7	88.7	87.6	86.5	85.8	**Greece**	2.1	84.7	79.1
Sweden	1.70	74.9	72.3	71.6	70.7	69.7	69.1	67.9	**Hong Kong**	2.0	65.1	57.7
India	1.60	100.9	100.9	100.0	100.0	98.9	95.5	93.0	**Turkey**	1.8	93.6	90.2
South Africa	1.50	93.9	93.0	92.5	93.0	92.4	89.9	86.8	**South Africa**	1.7	85.4	82.7
Denmark	1.40	80.4	80.5	76.9	75.9	72.4	71.8	69.7	**Sweden**	1.7	64.6	64.6
Portugal	1.40	85.5	85.8	85.0	85.0	84.2	83.1	82.1	**Poland**	1.6	100.0	99.0
Turkey	1.30	94.4	95.2	94.3	96.2	95.4	95.1	94.1	**India**	1.6	90.2	84.6
Hong Kong	1.30	73.7	71.8	68.7	69.3	66.3	65.1	64.0	**Denmark**	1.5	67.6	63.8
Pakistan	1.30	84.0	84.1	83.0	84.5	84.0	77.8	75.1	**Portugal**	1.2	80.0	75.0

Source : Band-X

Table 9. Band-X index for the United States

Destination and volume weighting (%)		Apr-98	May-98	Jun-98	Jul-98	Aug-98	Sep-98	Oct-98	Destination and volume weighting (%)		Nov-98	Dec-98
Band-X US Composite		**95.1**	**94.8**	**94.2**	**93.4**	**88.2**	**88.0**	**85.2**			**82.62**	**79.74**
Canada (Vancouver)	6.3	92.20	88.34	90.63	90.6	86.1	84.1	83.0	**Canada (Van.)**	4.33	81.8	77.8
Canada (Calgary)	6.3	99.73	95.50	98.08	98.2	94.1	93.3	92.4	**Canada (Calg.)**	4.33	91.8	87.9
Cananda (Toronto)	6.3	91.44	90.58	92.56	93.5	91.4	91.2	90.6	**Canada (Tor.)**	4.33	88.6	84.4
Canada (Montreal)	6.3	91.77	90.90	92.89	93.9	91.7	95.2	91.0	**Canada (Mon.)**	4.33	88.9	85.4
Mexico (Band 1)	5.9	101.21	104.49	103.49	99.7	84.5	84.2	83.5	**Mexico (Band 1)**	4.03	81.6	80.0
Mexico (Band 4)	5.9	105.91	108.75	107.55	107.7	97.2	97.1	96.6	**Mexico (Band 4)**	4.03	92.1	91.3
Mexico (Band 7)	5.9	98.27	99.93	94.73	95.7	87.6	87.1	86.8	**Mexico (Band 7)**	4.03	85.0	84.9
United Kingdom	9.0	93.77	95.92	91.27	92.1	87.3	87.7	78.7	**United Kingdom**	6.80	74.6	72.2
Germany	5.8	90.90	91.81	86.92	85.0	84.6	84.5	79.6	**Germany**	4.40	76.0	70.1
Japan	5.2	98.61	98.19	95.95	96.4	90.3	87.5	85.8	**Japan**	3.70	81.2	78.6
Hong Kong	3.9	92.24	96.02	89.99	89.3	81.0	82.3	76.3	**Hong Kong**	3.00	76.1	67.7
France	3.2	93.79	91.43	91.13	91.0	88.7	88.3	81.3	**India**	2.60	95.0	93.9
India	3.1	98.01	97.47	99.20	100.8	96.8	97.3	97.3	**France**	2.20	76.1	73.4
Korea	2.8	89.56	90.96	84.50	83.8	75.5	74.2	73.6	**Brazil**	2.20	82.8	81.8
Brazil	2.7	93.97	91.60	90.87	92.9	86.1	86.5	84.8	**Italy**	2.10	77.8	74.6
Dominican. Republic	2.7	93.54	93.45	91.32	91.0	92.9	93.1	93.2	**Korea**	1.90	71.8	70.0
Philippines	2.5	97.23	94.53	91.13	92.2	88.5	86.8	85.9	**Philippines**	1.80	84.3	79.4
Italy	2.4	93.07	93.17	89.30	88.7	83.4	83.6	80.5	**Dominican Rep.**	1.70	89.9	86.9
Taiwan	2.4	92.23	95.06	92.46	94.9	84.7	82.5	80.6	**China**	1.70	76.7	74.8
China	2.3	93.39	89.22	83.15	83.5	81.2	81.6	79.5	**Australia**	1.70	74.0	73.6
Australia	2.1	83.62	81.19	79.98	81.7	79.6	81.2	78.2	**Taiwan**	1.70	76.0	74.7
Colombia	2.1	105.72	103.42	101.18	103.6	102.4	100.0	88.6	**Jamaica**	1.20	90.1	89.5
Israel	1.8	78.27	70.68	66.35	68.0	64.5	66.4	65.8	**Columbia**	1.10	85.7	83.3
Argentina	1.7	99.26	98.94	96.90	98.0	90.9	93.4	91.8	**Argentina**	1.00	88.6	88.7
Jamaica	1.5	90.82	90.81	95.76	93.7	94.9	95.4	93.0	**Switzerland**	1.00	100.0	94.6

Source : Band-X.

Table 10. Band-X bit index

		October 1998 Index	November 1998 Index	December 1998 Index	January 1999 Index	February 1999 Index
Composite World		100.0	99.4	96.8	90.5	83.4
Composite European		100.0	98.5	96.4	85.5	73.1
Los Angeles	Tokyo	100.0	100.0	96.7	96.7	96.7
Los Angeles	Hong Kong	100.0	100.0	98.3	98.3	95.0
New York	Los Angeles	100.0	100.0	100.0	95.0	93.8
New York	Moscow	100.0	100.0	100.0	100.0	95.7
Los Angeles	Beijing	100.0	100.0	100.0	100.0	100.0
New York	London	100.0	100.0	85.0	80.0	73.5
New York	Frankfurt	100.0	100.0	93.3	80.0	62.2
London	Hong Kong	100.0	100.0	100.0	95.0	95.0
London	Sydney	100.0	100.0	100.0	100.0	100.0
London	Milan	100.0	95.7	95.7	91.3	91.3
London	Frankfurt	100.0	99.2	99.2	84.6	76.9
London	Amsterdam	100.0	96.2	92.3	84.6	76.9
London	Paris	100.0	100.0	95.0	75.0	35.0
London	Brussels	100.0	100.0	96.2	84.6	76.9
London	Madrid	100.0	100.0	100.0	92.6	81.5

Source : Band-X.

Table 11. The IRU market

Speed (Mbit/s)	Origin	Destination	Distance between Cities as the crow flies (km)	IRU Price (USD)	Installation (USD)	Price per Mbit/s (USD)	Price per Mbit/s per month over 15-year life (unless otherwise stated). (USD)	Other
622	Paris Telehouse	London, Telehouse	343	5 400 000	200 000	8 682	50	30 day delivery time, 99.99% availability
155	Aldeburgh (UK)	Amsterdam	n.a.	1 295 732	n.a.	8 360	46	
155	London	New York	5 585	7 450 000	n.a.	48 065	160	25 year URL on Gemini Cable. Price excludes operation and management. This price available for a minimum of 2x 155Mbit/s. Same supplier will do 3x155Mbit/s at 7.3m each and 4x155Mbit/s at 7.25% each.
155	London	New York	5 585	7 600 000	n.a.	49 032	163	25 year URL on Gemini Cable. Price excludes operation and management.
155	New York	London	5 585	9 200 000	250 000	60 698	339	Local tails included subject to location. 99.9% availability. 14 day delivery.
155	New York	London	5 585	8 000 000	270 000 p.a.	75 806	421	Local tails included subject to location. 99.9% availability. 30 day delivery.
45	London	New York	5 585	3 600 000		80 000	444	Purchase of 45Mbit/s at USD 3.6m provided with 5 additional 2Mbit/s free of charge for 12 months. If not used or resold within 3 months, purchase back at USD 5 000 per Mbit/s per month for remaining 9 months. Maximum purchase price of 45Mbit/s is therefore USD 3.375m with the ability to reduce this significantly with resale of free 2Mbit/s lines for 12-month period.
45	New York	London	5 585	3 250 000	90 000 p.a.	102 222	568	Local tails included subject to location. 99.9% availability. 14 day delivery.
45	London	Los Angeles	8 781	6 980 000	16 000 p.a.	160 444	891	99.9% availability.
45	Dublin	New York	5 126	4 615 385	923 077 p.a. + RPI.	410 256	1 368	25 year URL. 99.9% availability
2	Los Angeles	Tokyo	8 816	900 000	n.a.	450 000	1 875	20 year URL. 60 day delivery. 99.9% availability.
2	Dublin	New York	5 126	381 098	76 220 p.a. + RPI	1 143 293	3 811	25 year URL. 99.9% availability

Source : OECD from Band-X and RateXchange.

Table 12. Selected capacity prices at Band-X (February 1999)

Region	Capacity (Mbit/s)	Cities	Price per month (USD)	Price per Mbit/s (USD)	Tails Included	Distance (km)	Mbit/s price per km (USD)
Atlantic	2	London - New York	7 350	3675		5585	0.66
Atlantic	2	New York - London	10 000	5000		5585	0.90
Atlantic	2	New York- Frankfurt	11 400	5700		6215	0.92
Atlantic	2	London - New York	15 244	7622		5585	1.36
Atlantic	2	Toronto - Frankfurt	19 500	9750		6346	1.54
Atlantic	2	Toronto - London	18 500	9250		5728	1.61
Atlantic	2	Toronto-Paris	19 500	9750		6015	1.62
Atlantic	2	New York - Vienna	23 700	11850		6813	1.74
Atlantic	2	Zurich - New York	23 800	11900		6339	1.88
Atlantic	2	Brussels - New York	24 000	12000		5904	2.03
Atlantic	2	Dublin - New York	21 596	10798		5126	2.11
Atlantic	2	Milan - New York	34 000	17000		6480	2.62
Atlantic	2	Milan - New York	34 000	17000		6480	2.62
Atlantic	2	United States - Italy	24 500	12250		n/a	n/a
			Average	10253			1.66
Pacific	2 (US half circuit only)	West Coast US - Japan	32 000	16000		8276/2=4 138	3.87
Pacific	2 (US half circuit only)	West Coast US - Japan	30 121	15060		8276/2=4 138	3.64
Pacific	2 (US half circuit only)	West Coast US - Korea	32 000	16000		9034/2=4 517	3.54
Pacific	2 (US half circuit only)	West Coast US - Korea	30 117	15059		9034/2=4 517	3.33
			Average	15530			3.60
Europe	2	London -Paris	3 190	1595	included	343	4.65
Europe	2	Frankfurt- Stockholm	15 500	7750	included	1549	5.00
Europe	2	Milan - London	12 500	6250		959	6.52
Europe	2	London - Dublin	6 352	3176		469	6.77
Europe	2	London - Milan	14 000	7000	included	959	7.30
Europe	2	Paris - Vienna	15 300	7650		1037	7.38
Europe	2	Frankfurt - Paris	10 250	5125		471	10.88
Europe	2	Frankfurt - Vienna	13 200	6600		604	10.93
Europe	2	London - Milan	21 400	10700	included	959	11.16
Europe	2	Amsterdam - Paris	10 250	5125		429	11.95
Europe	2	London - Barcelona	27 500	13750		1146	12.00
Europe	2	London - Berlin	23 000	11500		929	12.38
Europe	2	London - Milan	24 000	12000	included	959	12.51
Europe	2	London - Amsterdam	9 909	4954		356	13.92
Europe	2	Amsterdam - Frankfurt	10 250	5125	included	365	14.04
Europe	2	Zurich - Vienna	18 000	9000		594	15.15

Table 12. Selected capacity prices at Band-X (February 1999) (*continued*)

Europe	2	Copenhagen - Amsterdam	23 000	11500		622	18.49
Europe	2	Brussels - Paris	10 250	5 125		266	19.27
Europe	2	Milan - Frankfurt	21 000	10 500		508	20.67
Europe	2	Frankfurt - Zurich	24 000	12 000		297	40.40
			Average	7 821			13.07
North America	1.54	New York – Los Angeles	3 975	2 574	included	3 961	0.65
North America	1.54	New York – Miami	1 900	1 231	included	1 751	0.70
North America	1.54	New York – Miami	2 050	1 328	included	1 751	0.76
North America	1.54	New York – Chicago	1 363	883		1 158	0.76
North America	1.54	New York – Dallas	2 624	1 699		2 210	0.77
North America	1.54	New York – Los Angeles	4 800	3 109	included	3 961	0.78
North America	1.54	New York – San Francisco	5 150	3 335		4 156	0.80
North America	1.54	Washington – San Francisco	4 925	3 190		3 941	0.81
North America	1.54	New York - Seattle	5 000	3 238		3 884	0.83
North America	1.54	New York - Atlanta	1 650	1 069		1 204	0.89
North America	1.54	New York - Denver	4 300	2 785	included	2 621	1.06
North America	1.54	New York -Dallas	4 000	2 591	included	2 210	1.17
North America	1.54	New York - Atlanta	2 200	1 425	included	1 204	1.18
North America	1.54	New York – Chicago	3 500	2 267		1 158	1.96
North America	1.54	Toronto – New York	2 750	1 781		558	3.19
North America	1.54	New York - Washington	1 800	1 166		328	3.55
North America	1.54	New York - Boston	1 800	1 166		306	3.81
North America	2	Mirando City (Texas) – Mexico City	7 500	3 750		883	4.25
North America	1.54	Vancouver - Seattle	2 450	1 587		189	8.40
			Average	2 190			1.91

The distances between San Francisco and Seoul and Tokyo are used for Pacific.

Source : Band-X (February 1999).

Table 13. Types of connection to the Internet for business users in the United States

	Small/ Residential ISPs	Small/Mixed Business ISPs	Large/Mixed Business ISPs	Large Business ISPs	Total
Dial-up	80	71	51	37	65
Leased line	4	9	16	35	12
ISDN	8	10	18	8	11
Frame relay	7	8	14	15	10
All other	0	2	1	7	2

1. This survey was conducted in 1997. Very small business ISPs were defined as those ISPs earning less than USD 1 million per year. The definition of Medium-sized Business ISPs, were those earning from USD 1 million to under USD 50 million. Large Business ISPs, with revenues greater than USD 50 million per annum, are mostly business oriented.

Source : CIX.

Table 14. Distance rebalancing of leased line tariffs (2 Mbit/s)

OECD average	1992	1993	1994	1995	1996	1997	1998
2 km	100	101	110	113	113	108	101
50 km	100	101	94	91	87	83	71
100 km	100	101	94	91	87	83	71
200 km	100	102	101	96	88	83	72

Source : OECD.

Table 15. INTUG survey of national/international leased line charges in Europe (monthly charges, 1 January 1999)

Country	Currency	Distance	64kbit/s			2Mbit/s			34Mbit/s		
			National	International	Ratio (%	National	International	Ratio (%)	National	International	Ratio (%)
Austria	ASH	300	11 667	25 956	222	65 000	317 913	489	397 500	n/a	
Belgium	BEF	80	22 048	35 530	161	160 139	486 500	304	1 077 906	5 108 250	474
Denmark	DKK	143	2 387	4 600	193	18 321	49 220	269	98 743	332 000	336
France	FFR	400	4 335	4 300	99	35 100	72 400	206	n/a	n/a	
France (1.1.99)	FFR	400	4 130	4 300	104	30 600	72 400	237	n/a	n/a	
Germany	DMK	300	1 059	1 275	120	6 947	22 235	320	53 764	112 000	208
Italy	LIT	180	1 780 000	5 129 250	288	19 820 000	62 956 000	318	n/a	n/a	
Netherlands	NGL	166	1 381	1 760	127	8 560	16 340	191	n/a	168 856	
Norway	NOK	300	2 238	3 650	163	12 428	40 540	326	69 276	220 130	318
Portugal	PTE	300	139 387	351 000	252	1 308 512	4 656 600	356	n/a	n/a	
Spain	PES	335	135 586	285 000	210	1 503 105	3 562 500	237	7 043 232	42 750 000	607
Sweden	SKR	400	3 300	4 800	145	15 000	45 000	300	85 000	360 000	424
Switzerland	SFR	150	955	2 094	219	6919	25 683	371	n/a	n/a	
United Kingdom	LST	230	471	967	205	3756	8 883	237	30 048	75 750	252

Source : INTUG.

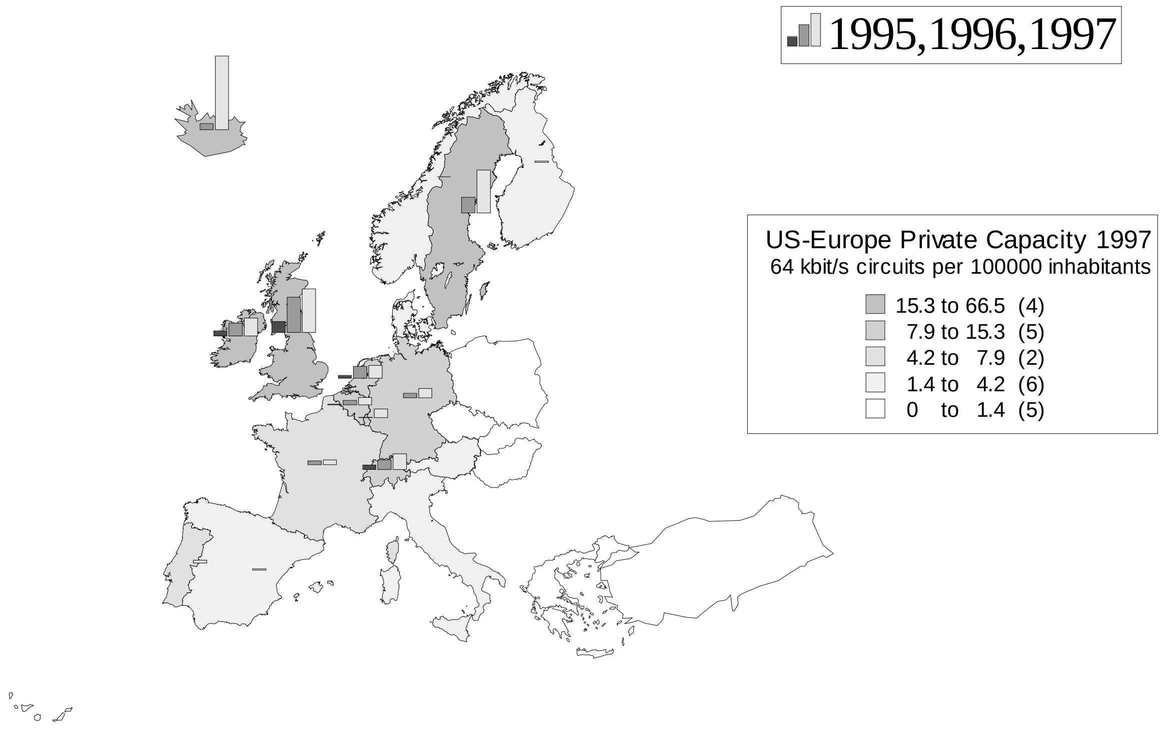
Table 16. INTUG 2Mbit/s leased line survey results

Pricing change from 1997 to 1998

	Distance (km)	Change to National Leased Line Price (%)	Change to International Half Circuit Price (%)
Austria	300	-7.14	253.24
Belgium	80	-15.00	-30.00
Denmark	143	-11.24	-56.46
France	400	-36.41	-28.09
Germany	300	-46.90	-19.48
Italy	180	0.00	0.00
Netherlands	166	0.00	0.00
Norway	330	-57.82	-2.48
Portugal	300	-10.59	-1.31
Spain	335	-33.19	-27.30
Sweden	400	-70.00	-62.50
Switzerland	150	-16.43	12.16
United Kingdom	230	-4.00	-17.46

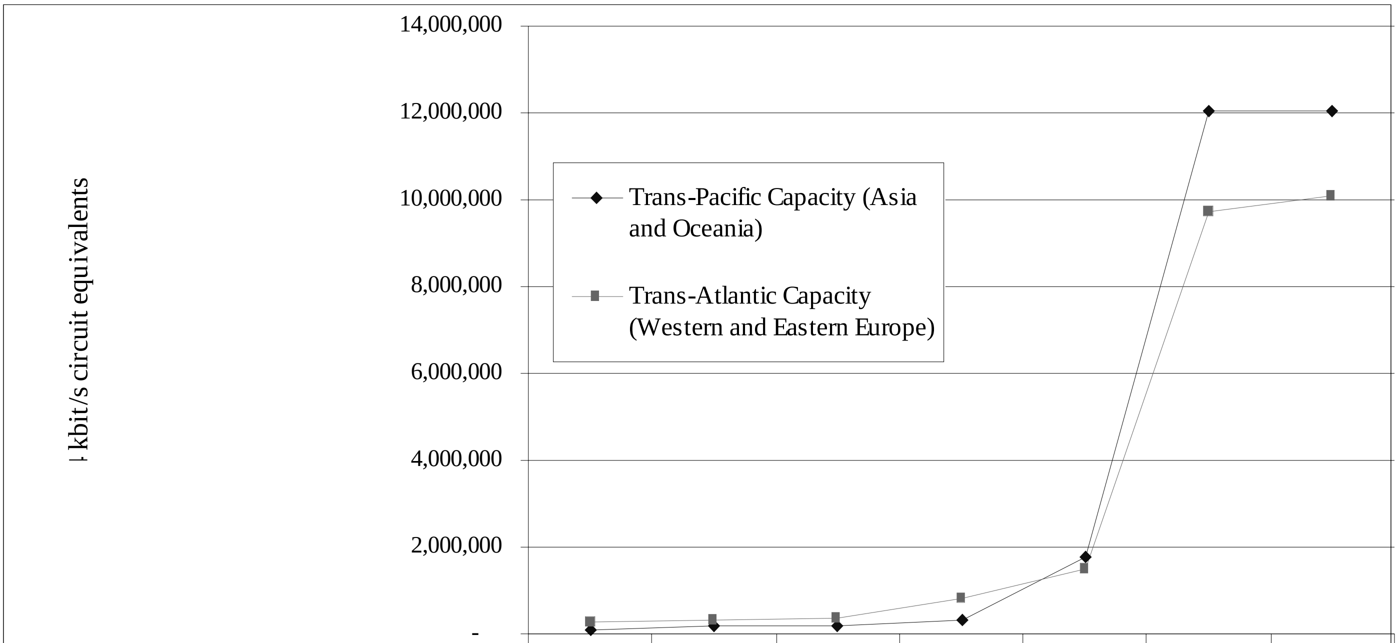
Source : INTUG.

Figure 1. United States to Europe private capacity trends



Source: OECD.

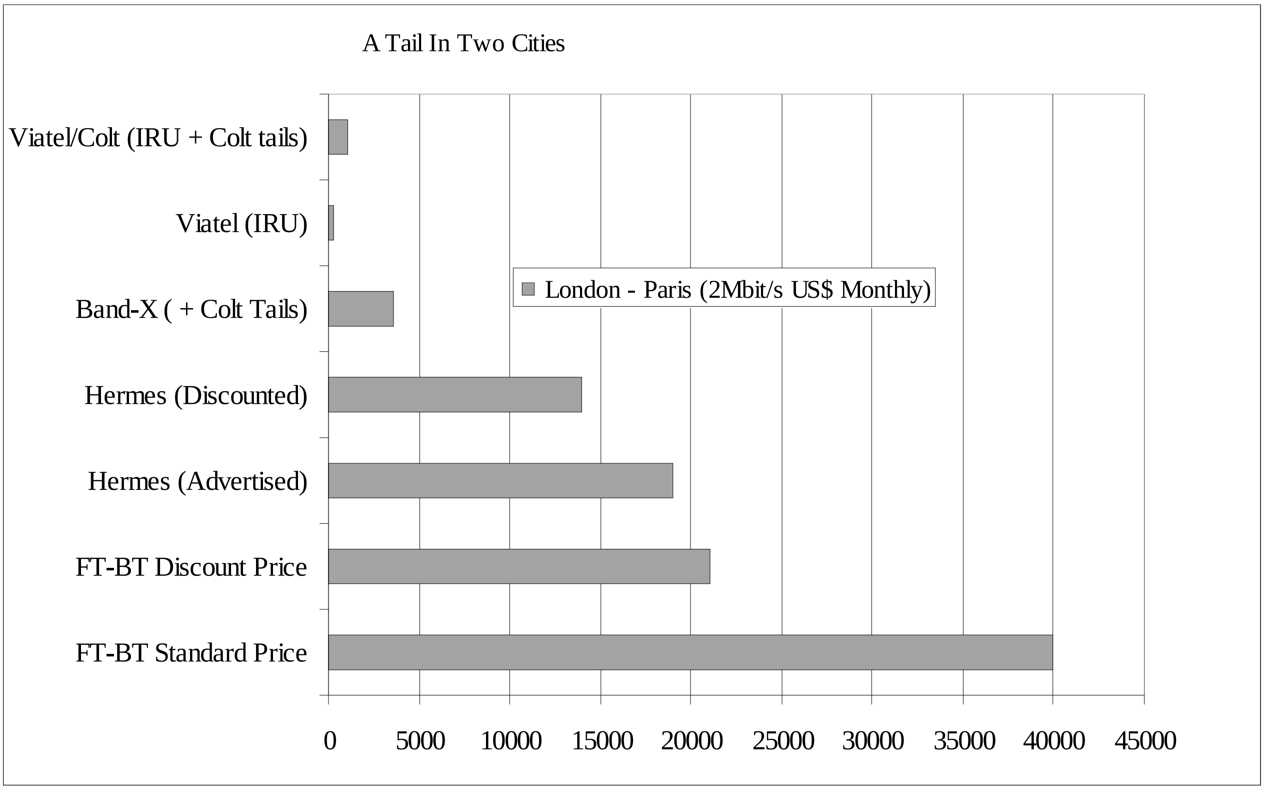
Figure 2. Transatlantic and Trans-Pacific capacity trends



	1995	1996	1997	1998	1999	2000	2001
Trans-Pacific Capacity (Asia and Oceania)	69,930	190,890	190,890	311,850	1,763,370	12,044,970	12,044,970
Trans-Atlantic Capacity (Western and Eastern Europe)	251,370	311,850	372,330	795,690	1,521,450	9,746,730	10,109,610

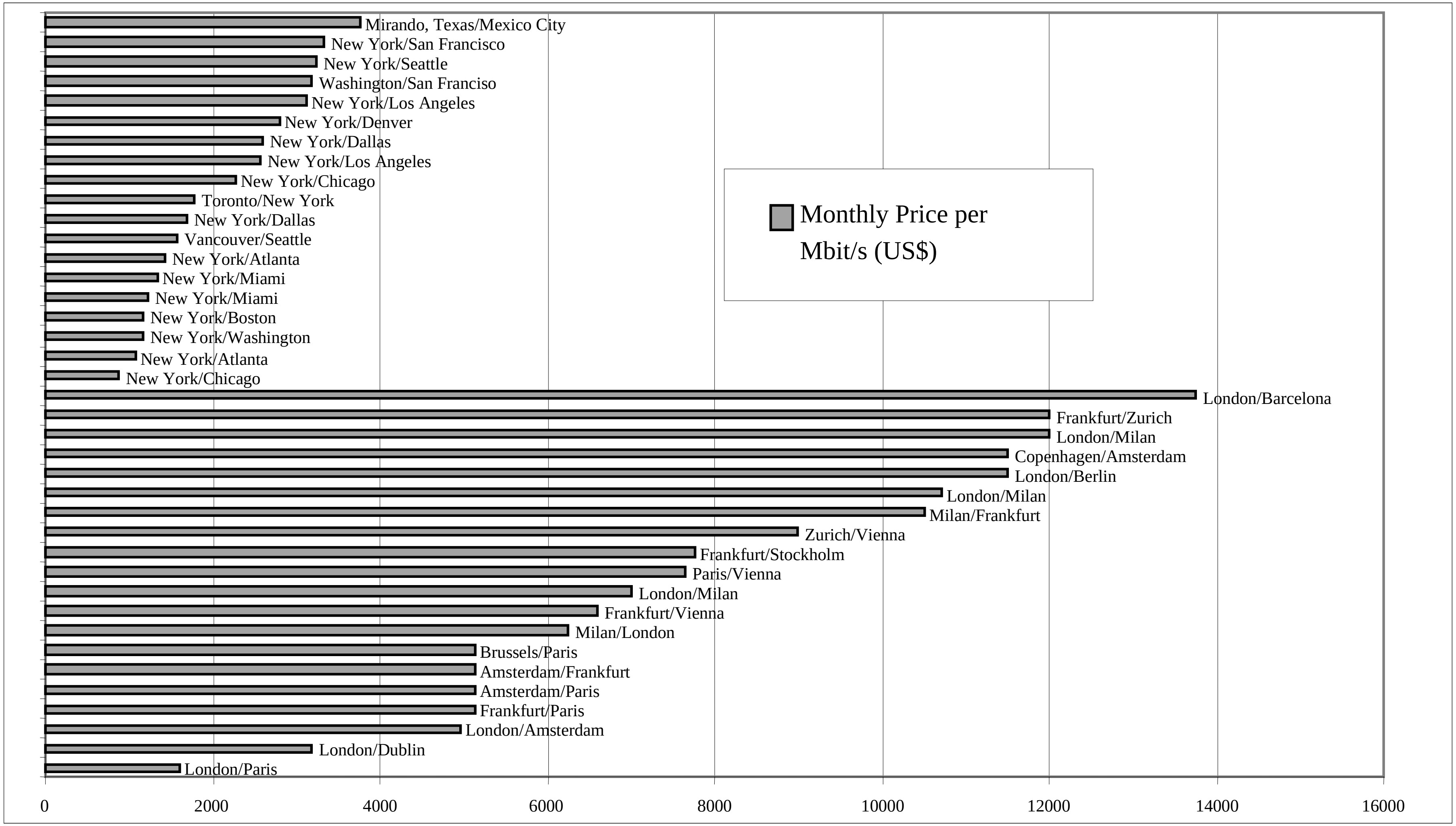
Source: FCC.

Figure 3. Leased line pricing options between Paris and London



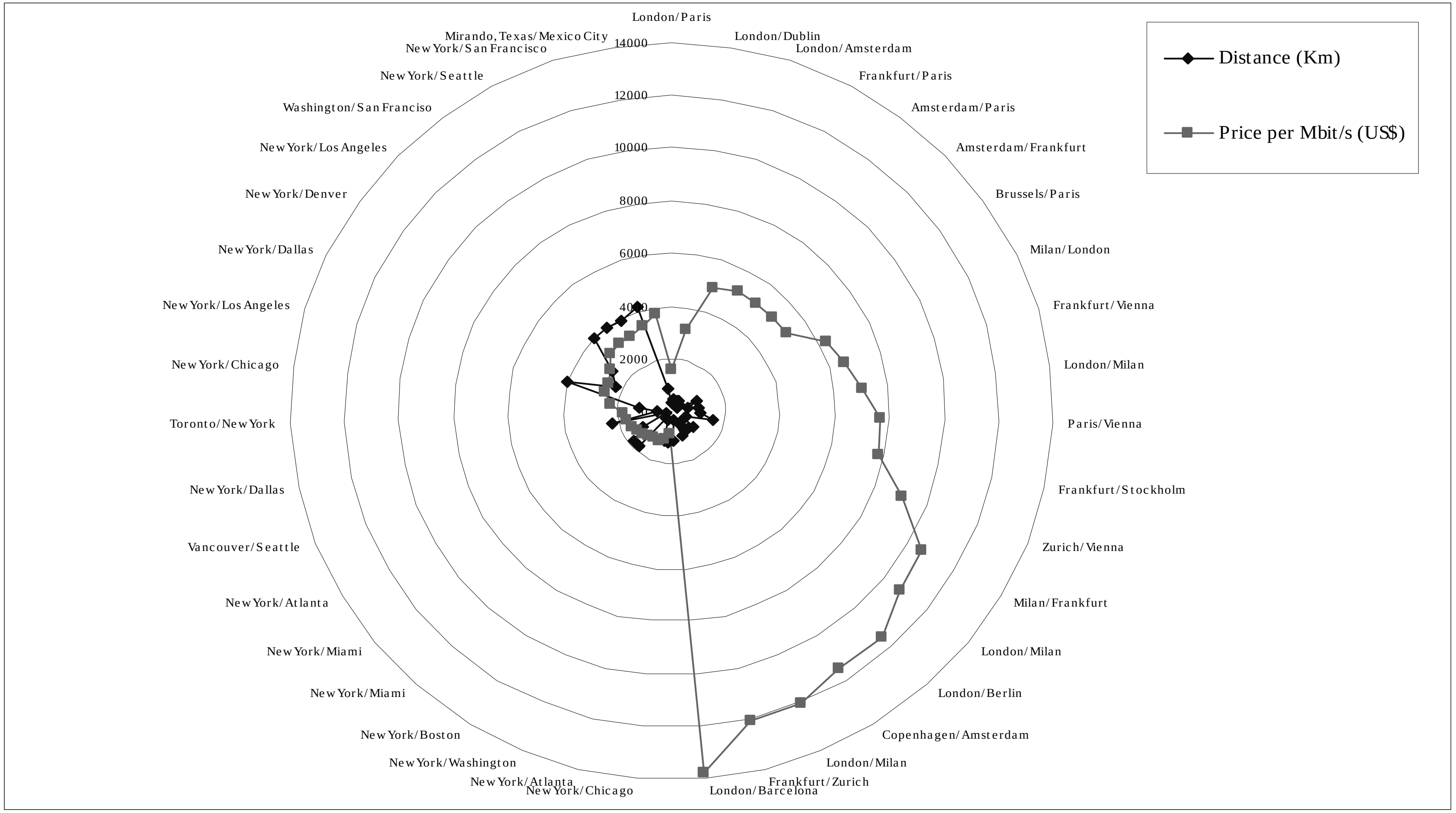
Source: Reuters, Band-X, Viatel.

Figure 4. Band-X North American and European intercity leased line price offers



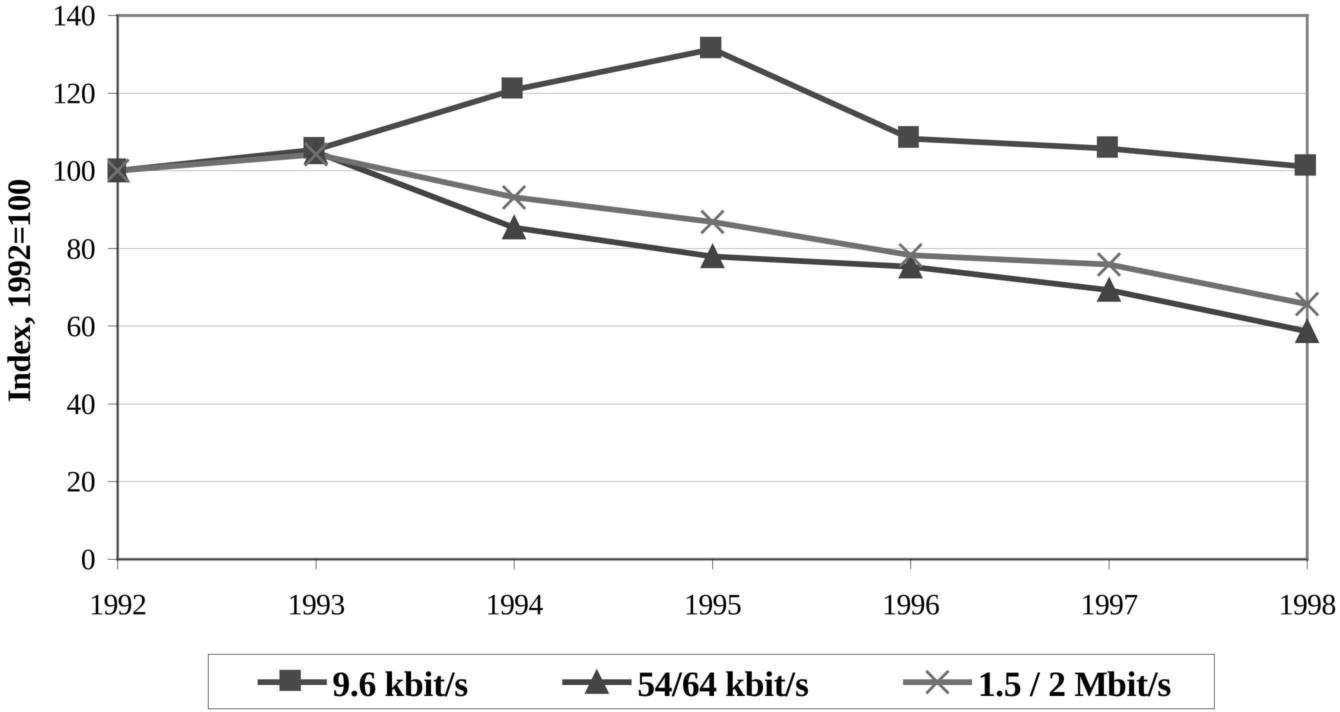
Source: OECD.

Figure 5. Band-X North American and European intercity leased line price offers and distance



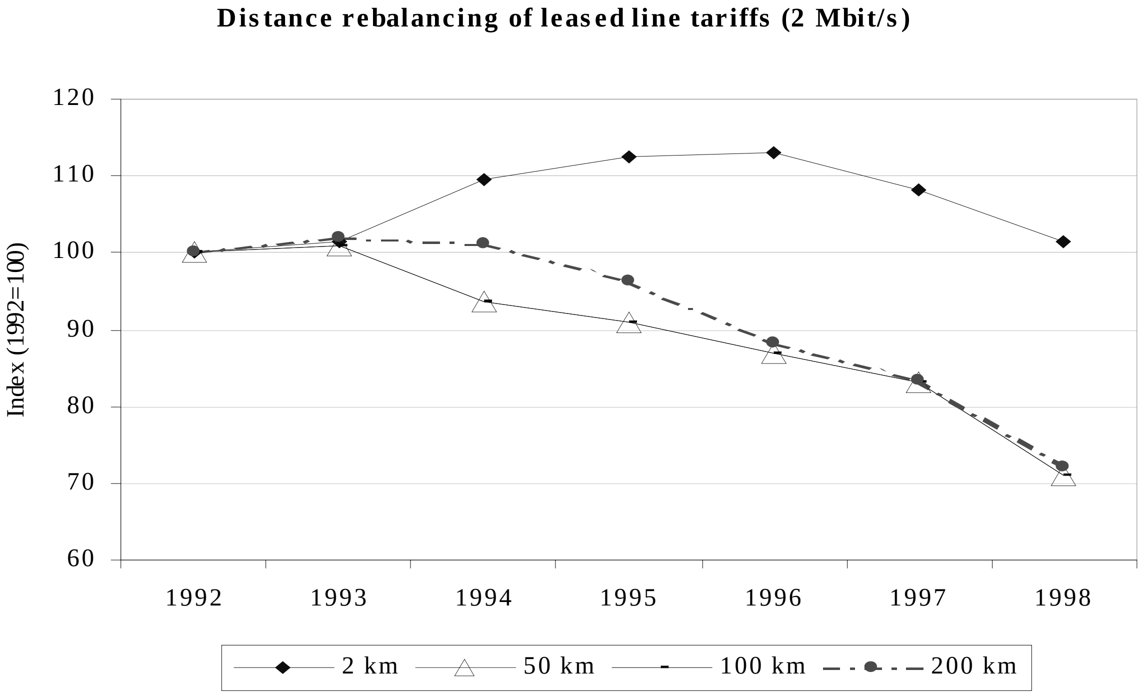
Source: OECD.

Figure 6. Leased line pricing trends



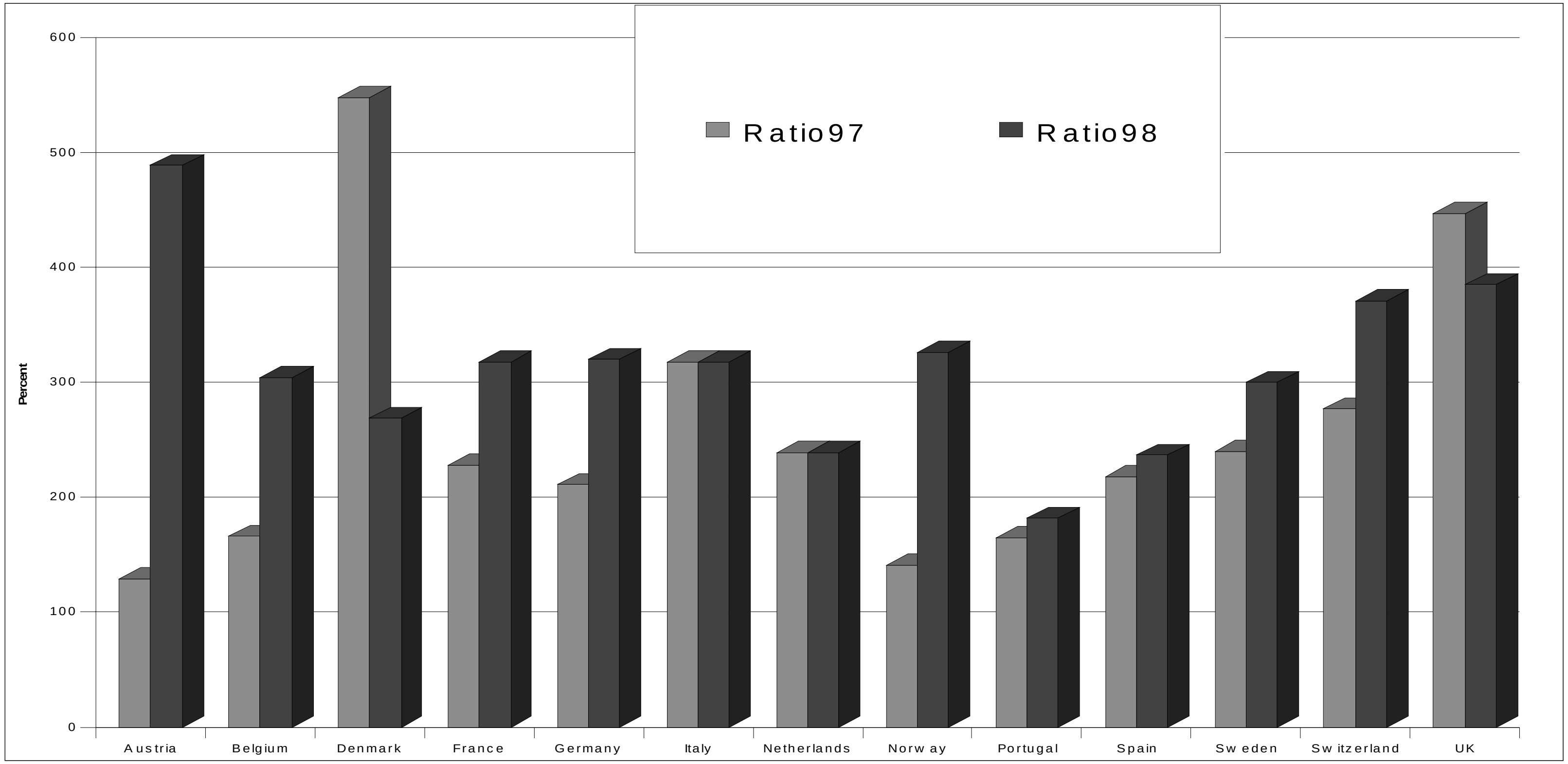
Source: OECD.

Figure 7. Distance rebalancing of leased lines



Source: OECD.

Figure 8. INTUG survey comparing national and international leased line prices



Source: OECD.

NOTES

1. See the background paper, "The Role of Telecommunications and Information Infrastructure in Advancing Electronic Commerce", OECD, 1999, DSTI/ICCP/TISP(98)8/FINAL (forthcoming).

2. OECD Ministerial Conference, "A Borderless World: Realising The Potential of Global Electronic Commerce", Ottawa, 7-9 October 1998, Conference Conclusions SG/EC(98)14/FINAL.

3. Liberal markets are defined in this paper as those markets that permit infrastructure competition in the provision of telecommunication services.

4 . The ITU Telecommunication Indicators Handbook defines leased lines in the following way: "Lease circuits refer to a two-way link for the exclusive use of a subscriber regardless of the way it is used by the subscriber (e.g. switched subscriber or non-switched, or voice or data). Leased circuits also referred to as leased lines, can be either national or international in scope."

5 The term "public" is used here to denote operators and networks offering services to the public rather than indicate ownership status.

6 . DCITA, Media Release, December 1998. http://www.dca.gov.au/nsapi-text/?MIval=dca_dispdoc&ID=3408

7 . ATUG, "Bandwidth Use the Big Issue", March 1999. http://www.atug.org.au/cgi-bin/ShowNews.cgi?Id=921632470

8 . Blaise Zerega, "The right stuff: Virtual private networks are taking e-commerce into the next frontier. Network Alchemy is leading the charge", *Red Herring Magazine*, February, 1999. http://www.herring.com/mag/issue63/vc-right.html

9 . Ken Cukier, "Prices may halve as Europe's bandwidth booms", *Communications Week International*, 19 October 1998. http://www.totaltele.com/secure/view.asp?articleID=20129&Pub=CWI

10. One definition of "hubbing" is that it is the practice of moving traffic from one carrier to another via an intermediary. Refer Camille Mendler, "Battling to Attract the World's Traffic", *CommunicationsWeek International*, 2 February, 1998.

11. OECD, "Internet Traffic Exchange: Developments and Policy", Paris, 1998, http://www.oecd.org/dsti/sti/it/cm/prod/ONLINE.HTM

12. OECD, "Refile and Alternate Calling Procedures: Their Impact on Accounting Rates and Collection Charges", Paris, 1995. http://www.oecd.org/dsti/sti/it/cm/prod/ONLINE.HTM

13. SSL data by country was published in the OECD *Communications Outlook 1999*.

14. Refer Global Crossing Press Release, 24th March 1999. http://www.globalcrossing.bm/pr_032499.html

15. Pagea, Press Release, March 1999.

16. Carrier One, Press Release on their Website, February 1999. http://www.carrier1.com/news7.htm

17. Phil Sayer, "Doing Business in Europe – The impact of Leased Line prices on Electronic Commerce", A presentation by Reuter's Global Communications Director to the TMA Competition and Markets Workshop, 13 October 1998.

18 . Jennifer L Schenker, "Down to the Wire", *Time*, 8 February, 1999.

19. Viatel, Form 10k, Filing with the United States Securities and Exchange Commission, 31/03/1998.

20. For a discussion of the problems in determining predatory investment see Russel W. Pittman, "Predatory Investment: US vs IBM", *International Journal of Industrial Organisation*, 2, 1984. Pp 341-365

21. See, for example, Peter Huber et. al., "The Geodesic Network II: 1993 Report on Competition in the Telephone Industry", The Geodesic Company, Washington, 1992.

22. Refer OECD *Communications Outlook 1999* for analysis of dial-up pricing and trends.

23. "INTUG Leased Line Survey National vs International Cost", Montrichard, January 1999.