

**WILL BROADBAND LEAD TO A MORE  
COMPETITIVE ACCESS MARKET ?**

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# Will broadband lead to a more competitive access market?

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## Introduction

High-speed access to the web appears to have enjoyed a considerable rate of growth in Europe in 2001. To a great many observers, the challenges surrounding this development – which remains fledgling and disparate in the various countries involved – constitute far more than a mere come-back for the communications technologies sector, and lie at the heart of many issues relating to the Information Society itself.

The creation of a high-speed access market has also become a key indicator of the existing regulatory framework's ability to organize competition on the telecom services market. As was to be expected, deregulation in 1998 manifested itself, above all, in investments made in alternative infrastructures by players come to compete with incumbent operators on the trunk and international markets. While open competition appears to now be a reality on these markets – given that former monopolies have all lost a substantial share of control – in both Europe and the US, incumbents operating on the local telephony and access markets generally continue to enjoy a clearly dominant position.

This domination derives in large part from the investments that are required to deploy an alternative access network, coupled with the difficulty in achieving a return on investment on this deployment – including innovative services such as high-speed internet access. Investments in alternative networks have been limited to major business centres and conditioned by the required upgrades to cable networks. It is for this reason that, parallel to the establishment of interconnection and call pre-selection regulations, regulators have deemed the local telephone loop an essential facility and imposed its unbundling.

The aim of this article is twofold. We will first offer up an intermediary and provisional view of the situation that has arisen from the application of unbundling and, second, provide an analysis of the high-speed investment strategies (xDSL, cable, WLL) of new entrants operating in Europe's major countries. Unbundling the local loop gives rise to a number of operational issues; here, we will focus primarily on the aspects linked to its implementation and will discuss, most notably, the strategies both relating and unrelated to tariffs that

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incumbent operators are applying. The state of national markets, and particularly the many bankruptcies among new entrants, will be addressed with respect to the efficiency of current regulatory frameworks.

This paper will be structured as follows: the second section will take stock of the organization of the telecommunications market in Europe by discussing the two exceptions which are the development of cable telephony in the UK and the phenomenal growth of the mobile telephony market. The third section will analyse the implementation of unbundling in Europe by focusing particularly on initial results and on the development of high-speed access. The fourth section will discuss the efficiency of regulatory regimes. The final section will offer up concluding remarks.

## **1. Assessment of the organization of the telecommunications market in Europe's major countries**

### **1.1. Telecom Europe**

Ever since Europe's telecom market was deregulated in 1998, new entrants have focused their investments primarily on operations linked to routing long-distance and international traffic. Within months, these new operators had created a great many offers come to compete with those marketed by the incumbents. Offers continued to proliferate as operators authorized to enter the market deployed their networks and signed interconnection agreements with the incumbent.

Table 1 illustrates total market share by segment of activity (local, long-distance and international) in 2001, for the UK, France, Germany and Spain.

**Table 1: Share of the total market, by segment (%), in volume, in 2001**

	<b>Local</b>	<b>LD</b>	<b>International</b>	<b>Total</b>
<b>The UK</b>				
- BT	71.8	49.9	32.7	64.6
- Other	28.2	50.1	67.3	35.4
<b>France</b>				
- FT	99*	72.2*	67.8*	-
- Other	1*	27.8*	32.2*	-
<b>Germany</b>				
- DT	96.9	60	46	67*
- Other	3.1	40	54	33*
<b>Spain</b>				
- Telefonica	-	-	-	87*
- Other	-	-	-	13*

\* 2000 figure.

Source: IDATE.

The data included in this table indicates that incumbent operators in Europe have lost a substantial share of the long-distance and international telephony markets. This phenomenon is the most pronounced in the UK: in 2001, BT had a 49.9% share of the long-distance market

was and a 32.7% share of the international market. While less pronounced than in the UK, the effect of competition on these two segments in Germany is nonetheless significant since Deutsche Telekom's market shares in 2001 dropped to 60% and 46% on the long-distance and international markets, respectively. In France, competition was less intense, with France Telecom maintaining a fairly large share of both markets: 72.2% and 67.8%, respectively.

While it appears that competition in Europe has clearly developed on the long-distance market, incumbent operators continue to dominate the local calling market by a sizeable margin. The optical local loops deployed in Europe's major business centres still only represents a small portion of the market. Colt, the leading pan-European operator specialized in this segment, posted a turnover of €1,450M in 2001.

In 2000, France Telecom boasted a 99% share of the local market, while Deutsche Telekom controlled 96.9% of its local calling market in 2001. In Spain, Telefonica's share of this market is, *a priori*, very high given that it holds an 87% overall share of the market. Lastly, in the UK, British Telecom continues to maintain a relatively sizeable share of the local calling segment (71.8%), when compared to its share of the long-distance market.

It should nevertheless be pointed out that this initial analysis applies only to fixed telephony and, consequently, does not take into account alternative modes of telephony which now include cellular. We shall come back to this further on.

Equally worth underlining is the fact that the recent introduction of local call pre-selection – very recent in the UK and France, and not likely to become effective in Germany until early 2003 – may well have a very significant impact on alternative operators' revenues.

The preceding figures therefore show that in the UK, while still in a dominant position with respect to local calls, British Telecom has a much smaller share of its home market than France Telecom and Deutsche Telekom do. This observation serves to underline the particular landscape in the UK where deregulation of telephony services took place earlier than in other European countries, and where there has been considerable incentive to invest in the local loop via cable telephony.

## **1.2 Cable operators in the UK**

The UK is in fact home to a form of exception concerning the local loop, on the one hand, and to considerable cable development, on the other – made concrete through the deployment of multi-service platforms that were quick to incorporate telephony and internet access services. This particular feature is tied to the technological options that were adopted for the deployment the infrastructures of those British cable operators who hold a services operator license for copper pair-based networks. These ancient infrastructures were gradually upgraded, particularly in view of broadcasting digitised audiovisual programmes and providing high-speed access to the net.

Table 2 indicates the growth of cable telephony in the UK, between December 1997 and December 2001.

**Table 2: Growth of cable telephony in the UK in % of lines**

	<b>Dec. 97</b>	<b>Dec. 98</b>	<b>Dec. 99</b>	<b>Dec. 00</b>	<b>Dec. 01</b>
<b>Residential lines</b>					
- BT	87.1	84.6	81.5	81.3	81.5
- Cable operators	8.3	10.3	13.4	18	17.9
<b>Professional lines</b>					
- BT	89.6	88.6	89.2	88.1	88
- Cable operators	2.8	3.7	3.3	5	5.2
<b>Total</b>					
- BT	87.8	85.7	83.6	83.3	83.4
- Cable operators	6.9	8.5	10.6	14.3	14.2

Source: OFTEL.

Cable operators' market share grew considerably between December 1997 and December 2001, having more than doubled: increasing from 6.9% to 14.2%. It is on the residential market in particular that competition amongst cable operators has developed; by last December their share of this segment had reached 17.9%. We should nevertheless point to the serious financial difficulties being experienced by Telewest and NTL, which have resulted in a high concentration of the cable sector, and a relative levelling-off of BT's loss of its share of phone lines over the last few months. Similar to what transpired on the other side of the Atlantic, concentration of Britain's cable industry led OFTEL to conduct a consultation in late 1999, focusing on the opportunity to impose the principle of Open Access on cable operators, a fact which would require them to open up access to their local networks according to a model similar to the one applied to copper pair unbundling. The consultation, which covered all of the services that could potentially be offered via cable (TV, interactive TV, telephony and internet) culminated in the publication of a document in April 2001. This document specifies the three conditions needed to impose such a principle:

- a cable operator's market power on a given market must be significant;
- the costs for implementing this regulatory policy must be compensated by the expected profits;
- the open access requirement must be an efficient and proportionate measure that enables increased development of competition.

OFTEL nonetheless concluded this report by stating that cable operators did not hold significant market power, added to which, in January 2001, the condition of exclusive distribution for franchises was removed with the goal of stimulating competition, allowing operators to market their services throughout the country.

While investments in cable in the UK worked as a considerable lever for competition on the residential telephony market, two issues at least remain:

- to what extent has the support given to investments in cable hampered OFTEL's efforts to implement efficient rules for unbundling phone lines? their efforts to back precocious application of equal access procedures on the telephone market, procedures such as call pre-selection that makes it possible to avoid using a code to access an alternative operator's local or long-distance services?
- Does the triple play model (audiovisual programmes, telephony, internet) allow cable to achieve an economic balance coming up, most notably, against satellite platforms' audiovisual offerings?

### 1.3 Competition in the mobile telephony sector

The mobile telephony market has grown substantially over the past few years, and continues to grow at a relatively steady pace – despite early signs of decelerating that appeared in 2000, compared to previous years. Since the early 1990s, the number of cellular subscribers in Western Europe has increased by over 50% annually on average, with certain countries posting a much higher rate than this. Forecasts established by IDATE nevertheless indicate that, in the coming years, and in light of the penetration rates that have already been achieved, annual growth of the subscriber base will diminish throughout Europe. While growth rates were high in 2000, in Germany, France Italy and the UK – 91%, 47.6%, 33.8% and 51%, respectively – Table 3 shows that the annual growth rates for these same countries are expected to be much lower in 2004: roughly 8%, 10%, 5% and 8%, respectively.

**Table 3: Growth in the number of cellular subscribers in Europe (in millions)**

	1998	1999	2000	2004*
<b>Germany</b>	14	23.1	44.2	60.1
<b>France</b>	11.1	20.6	30.4	44.5
<b>Italy</b>	20	30.4	40.7	49.5
<b>UK</b>	13	23.9	36.1	49.1

Source: IDATE.

\* forecast.

The spectacular increase in the number of cellular subscribers in Europe translates directly into a very high rate of penetration for mobile. At the end of 2000, cellular telephony's penetration rate in Europe had reached 63%, much higher than in Japan (46%) or the US (40%). This growth is such that, since 2000, the number of mobile subscribers has exceeded the number of fixed subscribers in several European countries. The figures presented in Table 4 indicate that this phenomenon was consolidated in 2001: in France, for instance, the mobile subscriber base outnumbered fixed line accesses for the first time by a ratio of 1:1.01. Of all European nations, Italy is the most exemplary of this phenomenon, with a ratio of 1:1.72 in 2001.

**Table 4: Fixed versus cellular lines in Europe, end of 2001**

In millions

	Number of fixed subscribers (1)	Number of cellular subscribers (2)	(2)/(1)
<b>Germany</b>	49.4	56.3	1.14
<b>France</b>	35.0	35.4	1.01
<b>Italy</b>	26.7	45.8	1.72
<b>UK</b>	36.1	44.5	1.23

Source: IDATE.

According to IDATE, in terms of call volume, calculated in minutes, mobile traffic in 2000 represented close to 13% of fixed traffic in the UK, 24% in France and 15% in Spain. In a great many countries, however, we can discern a trend toward decreasing volume of fixed telephony calling minutes, thus pointing to substitution by cellular networks.

In terms of value, and despite a clear trend over the last few years of lowering ARPU (average revenue per user), mobiles account for an increasingly large share of the telecom services market.

**Table 5: Mobile’s share of the telecom market (in %)**

	<b>2000</b>	<b>2001</b>
Germany	38.3	43.6
Spain	43.3	49.1
France	38.8	42.9
Italy	48.1	51.5
UK	30.8	35.1
<i>Total</i>	<i>39.2</i>	<i>43.2</i>

Source: IDATE

Lastly, it would be worth characterizing incumbent operators’ presence on the mobile telephony market. *The world atlas of mobiles*, published by IDATE, indicates that at the end of 2001, incumbent operators’ share of mobile subscribers on their national market does not point to a clear domination on their part. In most European countries, with the exception of Spain, they have an average share of roughly 50%. In France, the incumbent has an estimated 48.2% share of the mobile market, in Italy: 47.6%, in Germany: 41.2% and, lastly, in the UK: 23.5%. This trend is expected to further confirm itself, even though the inflation of licenses upon the advent of 3G cellular systems is likely to trigger a major consolidation movement on Europe’s mobile market.

Even when dominated by a relatively oligopolistic organization, which justifies regulators’ vigilance, mobiles no doubt now constitute the most significant expression of deregulation of the telecom sector.

Furthermore, this growth and competition dynamic is expected to be increasingly heightened with the unveiling of new services that are planned to accompany the introduction of 3G networks. Even though the launch of pioneer networks has been delayed and W-CDMA’s performances will be only gradually enhanced, the functionalities and bitrates offered will further accentuate the overlap of fixed and cellular telecommunications. In other words, the position of those players operating on high-speed markets should be examined in light of the offers and positions they have forged on cellular networks.

**2. Application of unbundling in Europe’s major countries**

Incumbent operators’ domination of the local loop was the primary source of the European regulation of December 2000 which imposed unbundling of telephone lines, thereby recognizing them as an essential facility. This regulation was particularly motivated by the fear of seeing incumbent operators’ dominance of classic phone services extend to new high-speed services markets. Here we will first then examine the implementation of unbundling in major European nations, in terms of both the process itself and initial results.

## 2.1. The unbundling process and initial results

Incumbent operators' obligation to open up access to their local loop, as mandated by regulators – that must enable new entrants to market data services without having to build their own local loop – holds major implications with respect to xDSL (see 2.2).

A great many processes for implementing unbundling are possible. The most radical solution allows alternative operators to control the copper pair, either fully or in terms of the bandwidth that corresponds to DSL services ("shared line"). In the case where an alternative offer includes analogue telephony, the incumbent is no longer able to bill end users.

On the other end of the unbundling spectrum is the resale of telephone operator services. For a high-speed solution in this case, alternative operators distribute the incumbent's DSL service. Here, ISPs' focus is on equal treatment being given to those ISPs which are incorporated with the incumbent and to competing ISPs. Lastly, let us note an intermediary solution known as bitstream access whereby the incumbent provides the new entrant with the bitstream that corresponds to his data traffic.

With respect to the financial aspects of unbundling, available data indicates that there exists a certain disparity in the tariffs applied by the various incumbent operators around Europe. Although the different tariff components vary from one country to the next, it is possible to break these tariffs down into three parts:

- monthly line leasing costs,
- connection (and possibly disconnection) fees,
- equipment co-location costs.

The various tariffs presented in Table 6 allow us to make several comparisons – albeit only approximate in light of the preceding remarks – of fully unbundled access rates in Europe. In Germany, Spain and Italy, for instance, the monthly cost of leasing an unbundled line is comparable: 12.48, 13 and 11.62 euros, respectively. In the UK and France, these rates are much higher: 16.67 and 14.48 euros, respectively.

While the price of unbundled lines must be viewed with respect to the costs shouldered by the lines' owners, in order to assess its impact on competition, we must also take into account the retail price of the corresponding service, as marketed to end users by the incumbent operator.

Table 6 gives us an idea of the price squeezing conducted for fully unbundled access. Unbundling tariffs are higher than the retail prices applied by incumbents, the difference being roughly 12% to 13%, depending on the country. This observation has led a number of new entrants to file a complaint with either the European Commission or national competition authorities. It is worth noting that these differences give rise to questions concerning the level of tariff rebalancing which has now been achieved in Europe. To be pertinent – and given that unbundled lines are integrated by alternative operators into a competing high-speed or LL substitution offering – this assessment must also be associated with an evaluation of differences in the retail rates being charged by incumbents for (x)DSL and leased line (LL) services.

**Table 6: Fully unbundled access tariffs, versus retail price, in 2001 in Europe**

Country	Connection fee	Disconnection fee	Monthly rental (euros)		Margin (%) (RP)/(UA)
			Unbundled Access	Retail Price	
France	107.90 (*)	-	14.48 (*)	12.55	-13%
Germany	92.59	38.07	12.48	10.94	-12%
Spain	-	-	13.00	11.40	-12%
Italy	90.07	41.83	11.62	-	-
UK	196	46.55	16.67	14.60	-12%
European average	-	-	12.35	12.53	1%

Source: E.U.

(\*) In May 2002, the ART imposed a decrease to €78.70 on connection fees, to €10.50 for full unbundling, along with a drop from €6.10 to €2.87 for partial unbundling (line sharing).

In both Europe and the US, the complexity of these evaluations, coupled with those involved in establishing practical and operation rules for unbundling – in a context where incumbent operators have little reason to favour opening up their infrastructure – have led to a generally slow rate of development for unbundled lines. In all European Union countries combined, only 0.2% of phone lines have been unbundled. Table 7 presents the number of fully unbundled lines in five European countries, at the end of 2001.

**Table 7: Number of fully unbundled lines, end of 2001**

	Number of lines	Number of fully unbundled lines
France	34,000,000	400
Germany	49,400,000	400,000
Italy	25,990,000	1,000
Spain	20,320,000	7
UK	28,500,000	137

Sources: ART, ECTA.

## 2.2. Development of high-speed access modes

More than a year behind developments being made in the US, 2001 was the stage for high-speed's first significant steps in Europe. To illustrate, we have chosen to focus on the three main access platforms: DSL, cable modem and WLL technologies, after having recalled the main features of the internet access market. This will lead to an initial assessment of high-speed developments in Europe.

### 2.2.1. Main features of internet dial-up access markets

The challenge facing unbundling derives in large part from the growth of internet access which is still largely conducted over the phone networks' copper pairs. Unbundling, which constitutes a key phase in telecom deregulation, is expected to provide considerable impetus to the high-speed internet access market.

The internet has undergone phenomenal development, particularly in Europe, since the late 1990s. Table 8 reveals that Europe's internet markets have all enjoyed relatively high growth rates. In France, the market increased by 65% in 2001, in Germany by 42% and in Spain by 40%. This considerable growth, in large part relative to the late start taken compared to the US, was reinforced by the gradual introduction of new pricing options, based on notions of free access (supported by interconnection agreements allowing alternative operators to earn from "free" ISPs, and by expected advertising or spin-off revenues). This was followed by a partial transition (that was more or less smooth depending on the country) to flat rate offers that include local calling charges and the subscription to an ISP.

**Table 8: Evolution of internet markets' growth rates, in Europe (1999-2001)**

	<b>1999</b>	<b>2000</b>	<b>2001</b>
<b>France</b>	70%	83%	65%
<b>Germany</b>	78%	69%	42%
<b>Italy</b>	76%	58%	39%
<b>Spain</b>	50%	47%	40%
<b>UK</b>	65%	42%	30%

Source: IDATE.

In this context of high growth for internet markets, it is nevertheless worth noting the often considerable share of the ISP market acquired by incumbent operators. Table 9 presents the market share controlled by each country's top three ISPs.

**Table 9: Incumbent operators' share of their national internet dial-up access market, in 2001**

<b>Country</b>	<b>Market share</b>	<b>Country</b>	<b>Market share</b>
<b>France</b> - Wanadoo (FT) - LibertySurf - AOL	35% 18% 15%	<b>Spain</b> - Terra Lycos (Telefonica) - Retevision/EresMas - Ya.com	37% 20% 12%
<b>Germany</b> - T Online (DT) - AOL - Freenet	43% 15% 11.5%	<b>The UK*</b> - Freeserve - AOL - BT	18% 17% 15%
<b>Italy</b> - New Wind - Tin.it/Virgilio Tin (TI) - Tiscali	40% 32% 20%		

Sources: IDATE

\* Share of the residential market (in % of subscribers).

In Germany, Spain and France, the incumbent enjoys a relatively large share of the market. In Germany, for instance, T Online's 43% share allows incumbent Deutsche Telekom to dominate the national internet access market. Incumbent France Telecom's ISP Wanadoo also boasts a relatively large share of the French market with 35%, compared to the second-ranked

ISP which holds an 18% share. Similarly, Spanish incumbent Telefonica's ISP Terra Lycos controls 37% of subscribers. In Italy, however, the incumbent has an only 32% share, second to rival New Wind which boasts a 40% share of the country's internet subscribers.

The only exception to this market domination by a single operator is the UK where the internet market is far less concentrated than elsewhere, and where the incumbent can lay claim to only 15% control.

### *2.2.2. (x)DSL service offerings in Europe*

Since mid-2000, then, high-speed access has become a priority for all of Europe's internet players. Faced with a host of technological solutions that currently make it possible to provide high-speed access (DSL, cable modem, WLL), DSL technologies are those which enjoyed the highest rate of increase in Europe in 2001, keeping in mind marked disparities in national situations. Of all European countries, Germany boasts the greatest number of deployed ADSL lines: a little over 2 million. After Germany come France and Italy, albeit with far fewer lines – numbering a half a million.

Overall, and comparable to the situation in the US, the emerging DSL market is currently dominated by incumbent operators in most European countries, with market shares of between 90% and 95%

The complexity and sluggishness of unbundling, referred to here above, are often held up to explain this situation. It should nevertheless be noted that in a country such as Germany, which has been operating under unbundling regulations for some years now, only a very small portion of unbundled lines are used by Deutsche Telekom's rival DSL operators.

The brutal reversal of fortune that telecom operators experienced when the internet bubble burst in 2000 also triggered a considerable shift in the landscape. In those countries, such as the UK, where there were over 30 candidates seeking to market DSL services using unbundled lines, there are now only three or four alternative operators present on BT's premises.

The failure of leading American DSL players, including Covad, NorthPoint and Rhythm – all of which crumbled under the weight of deficits that grew parallel to the increase of marketed lines, coupled with investors' and financial markets' new-found reticence – gave European candidates pause to reflect on the viability of the pure player model. Under this model, a DSL operator owns neither the lines nor the clientele since his customer is an ISP or a long-distance operator. At the same time, he is committed to often massive investments that frequently require large technical crews as well. He must therefore – and this point has become crucial – shoulder the risks of lost earnings from those customers (ISPs, long-distance operators) who have become insolvent.

In this context, then, we can discern an approach being taken by European players (other than incumbents) which reflects a heightened awareness of the commercial and financial risks involved. They are committing to investments that are confined to large cities; they are targeting a corporate clientele which allows them to play on quality of service (or on features such as SDSL symmetrical access) and thereby enjoy higher margins, or they are incorporating the DSL offering into a value chain that includes long-distance services, webhosting, etc.

It would be equally wise to take a closer look at the development of competition on the DSL market in the coming months – particularly on the residential market – and to compare the number of lines marketed by the incumbent operator with the number of high-speed internet accesses marketed by their subsidiary ISP. This would make it possible to measure the market that is likely to emerge in terms of resale of the incumbents' DSL offers. In France, for instance, France Telecom stated some 420,000 DSL lines at the end of 2001, while its subsidiary Wanadoo announced that it was serving 370,000 DSL subscribers (along with 45,000 broadband internet via cable subscribers). In November of that year, France's second-ranked ISP, Club Internet (a T-Online subsidiary) stated that it had 30,000 DSL subscribers.

### *2.2.3. Alternative technologies*

DSL is not the only means for marketing high-speed access. In business centres in major European and American cities, operators have deployed fibre optic networks that respond to large corporations' connection needs. Our thoughts on competition on the local loop will not be expressed in this paper, even if an evaluation of this phenomenon is well warranted. Let us only offer up, by way of illustration, the 2001 turnover of Europe's leading operators in this field: Colt (1450M ).

Here, satellite as well, when combined with the phone network or using a two-way configuration, has the potential to be serving the 20% of the European continent which, for the decade to come, will not be covered by DSL infrastructures, although its impact remains marginal for the meantime.

Our comments on possibilities for additional competition over subscriber access will therefore remain confined to cable, which has already been addressed with respect to the UK, and to the wireless local loop (WLL).

### **Cable modem**

In the first part of this paper, we discussed at some length the British exception with respect to the role that cable operators play in competition on the local loop. We shall now take a broader look at the alternative solution offered by cable networks in Europe.

For some time now, faced with the difficulties of implementing efficient unbundling, cable networks have become the focus of government and regulators, refuelling the debate over the importance of investments in infrastructure-based competition.

We already know that the cable situation diverges widely across Europe. While certain countries such as Belgium boast 90% cable coverage, the technology is virtually non-existent in Greece. Taking a look at major national markets, Table 10 here below indicates that the number of marketable sockets and the subscription rates in these countries are equally disparate. Nevertheless, the proportion of homes passed for cable is by no means negligible, and therefore justifies the European Commission's early desire to see incumbent telephony operators withdrawal from the sector. This preamble, which applies particularly to France and Germany, is on the verge of becoming a reality, despite the fact that Deutsche Telekom's sale of 60% of its shares to Liberty Media was recently delayed and that France Telecom still controls a significant share of the sockets that it continues to operate, in addition to a large share of the networks operated by the country's number three cable operator NC-Numericable.

**Table 10: Size of cable networks in 2001 (in thousands)**

	Number of marketable sockets (1)	Number of subscribing homes	Number of fixed subscribers (2)	(1)/(2)
<b>Germany</b>	34,650	22,240	49,400	70%
<b>France</b>	8,700	3,130	34,000	25.6%
<b>Italy</b>	1,040	70	25,990	4%
<b>Spain</b>	2,080	480	20,320	10.2%
<b>UK</b>	16,590	3,770	28,500	58.2%

Sources: IDATE, MMTV.

Network ownership is not, however, the only obstacle preventing cable from becoming a vehicle for competition on the telephony and high-speed internet markets. In a great many countries, such as Belgium and Germany, cable is still regulated by a public utility model. Even when marketing audiovisual offers, cable operators are forced to play the relatively transparent role of distributor.

If we then consider those countries whose cable networks are governed by more ambitious approaches, derived from what we know of cable in the US, and particularly well illustrated in the UK and France, we may well balk at the ongoing investments required to finance upgrades, migrating channels to digital, high-speed internet and the distribution of the associated set-top boxes and cable modems... while competition amongst satellite television bouquets is increasingly dynamic. This is true to such an extent that 1) companies such as UPC, NTL and Telewest have reached unsustainable levels of debt that are likely to impede marketing of internet services and 2) it appears unlikely that, in the medium term, we will witness a significant renewed round of investments that would help develop cable networks in those countries where they are absent.

Given these conditions, then, the number of web subscribers via cable modem remained relatively low in 2001, and this across Europe: roughly 200,000 for Germany, France and the UK and only 100,000 in Spain. Forecasts calculated by IDATE (cf. Table 12) on the growth of internet cable modem subscribers reveal a market potential for this technology which is well under that which has been observed and forecast for the North American market.

### **The WLL**

WLL presents itself as a wireless technology that operates independently of telephone and cable. It nevertheless requires the deployment of high point equipment that offer a direct line of sight with client premises. It does however make it possible to create offers of simultaneous links providing speeds of up to 8Mbps, in other words faster than the transmission speeds offered by DSL or cable modem.

Despite these assets, the year 2001 was relatively disappointing for Wireless Local Loop technology which had been the focus of a number of projects in Europe. By the end of 2001, operators in Germany, France and Spain were marketing commercial offers, although the number of subscribers remains very low: only several thousand (cf. Table 11). In the UK and Italy, license allocation is only partially complete and not yet definitive; in any case, no service is currently available.

**Table 11: WLL operator presence in Europe (2001)**

	<b>Number of subscribers</b>
Germany	6,000
France	1,500
Italy	-
Spain	3,100
the UK	

Source: IDATE.

WLL technology became operational later than cable modem and DSL. Operators were therefore hit hard when the bottom fell out of the telecom market. The euphoria over a host of projects (encouraged by a model of licensing in Germany dominated by micro-, or regional licences) gave way to bankruptcies – particularly in Germany (FirstMark, Associated Com /Teligent and Calino /Formus) while in Spain and France, the sector underwent drastic consolidation, and this even before the infrastructures had been deployed.

Europe's surviving WLL players must now demonstrate that the frequencies in all areas for which they hold licences are in use, or face losing them without compensation. For the regulatory and licensing authorities, question is to decide if they have to take back spectrum, or to change the licences conditions.

**Table 12: Growth of the total high-speed subscriber base (consumer + corporate)  
(consolidation of the 17 EU countries)**

In millions of subscribers

	<b>2001*</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>WLL</b>						
- best case scenario		0.1	0.2	1.2	2.9	5.7
- worst case scenario		0.1	0.2	0.7	1.6	2.9
<b>DSL</b>						
- best case scenario	5	15	22	30	40	50
- worst case scenario	5	13	18	22	28	34
<b>Cable</b>						
- best case scenario	2	4	5	8	10	13
- worst case scenario	2	4	5	6	7	9
<b>Total</b>						
- best case scenario	7	19.1	27.2	39.2	52.9	68.7
- worst case scenario	7	17.1	23.2	28.7	36.6	45.9

\* 2001 figures are recorded.

Source: IDATE.

Forecasts for the growth of the WLL subscriber base nonetheless project a relatively sizeable development for this market in the years to come. Taking a look at Table 12, the number of WLL subscribers is expected to increase from 0.1 million in 2002 to 2.9 million in 2006 (worst case scenario). Under the best case scenario, however, the WLL subscriber base would be close to nine times smaller than DSL's in 2006.

## Leased Lines

Although rarely cited when we identify the various types of high-speed access, leased lines (LL) are nonetheless the most common means used by medium-size enterprises for accessing the net or for connecting the company's web server. For this reason, they constitute the starting point for all DSL and WLL sales pitches. Companies would be offered DSL access running at 1 Mbps for the price of a 512 Kbps leased line. For alternative operators involved on the corporate market, and who are often required to pay the cost of LL imposed by the incumbent for connecting to their customers, DSL access (and singularly SDSL) represents a way for them to lower the bill without cutting their margin.

It is true that in Europe's leading business centres there exist optical network alternatives to the incumbents' LL. Incumbent operators must nevertheless arbitrate between the benefits of maintaining the comfortable margins imposed on leased lines for as long as possible while, on the other hand, valorising their DSL platforms and staving off the rise of competing solutions.

**Table 13: Elements of rate comparison for short-distance LL (under 3 km)  
(total for line set up + subscription)**

In euros

	<b>512 Kbit/s</b>	<b>1 Mbit/s</b>	<b>2 Mbit/s</b>
<b>Deutsche Telekom</b>	6,054	-	14,279
<b>France Telecom</b>	11,859	13,846	14,360
<b>Telecom Italia</b>	10,494	-	12,496
<b>Telefonica</b>	8,104	14,211	15,216
<b>British Telecom</b>	9,490	12,157	14,279

Source: IDATE.

Table 13 presents the main elements for comparing short-distance LL tariffs.

### 3. The efficiency of regulatory regimes

The brief overview that we have just given quite clearly reveals incumbent operators' dominance of the local access market. Even though patience is required, as a look back over GSM's very gradual development in France will ascertain, all evidence points to the fact that the application of unbundling and new entrants' strategies for investing in high-speed have yet prove themselves.

Far more than a mere problem of competition on the telecommunications market, local access is now at the heart of a much broader debate over the connection between the rate of innovation and distribution in the ICT sector, and the degree of openness to competition on the more downstream networks segment. More specifically, we have shifted from a microeconomic view of the issue, where the goal was to stimulate competition in telecommunications by promoting the development of high-speed access, to a far more political objective (G. Le Blanc (2001)). This political objective consists, most particularly, of grasping the regulatory regimes that support facilities-based entry and/or services-based entry

as a means for driving innovation and accelerating the new technologies' penetration rate, seeking to reach a macroeconomic growth objective.

Speaking more generally, in order to judge the efficiency of regulatory regimes, we must properly distinguish their static efficiency – based on minimisation of costs and the enhancement of the quality of service offered to end users – from their dynamic efficiency which is based on the rate of innovation and on the level of investments being made in new technologies. At first glance, the quest for dynamic efficiency appears to be favoured largely by policies that target the development of competition amongst infrastructures. To judge the efficiency of regulatory regimes it is therefore important to discern both entrants' incentive to invest and to evaluate incumbent operators' investment strategies.

With respect to the first point – as Jorde, Sidak and Teece (2000) and Crandall and Hausman (2000) have pointed out – the juxtaposition of the two policies, one which drives facilities-based competition and the other services-based competition, would lead to a bias for entrants' decisions that favours the most radical unbundling solutions (cf. infra section 2.1). Unbundling, particularly when associated with regulation that seeks to align prices with cost, will naturally diminish entrants' incentive to invest in infrastructure. The subsequent impact is well documented in the latest economic literature on innovation and the theory of real options (see, for example Dixit and Pindyck (1994), Dixit (1995)): the risks tied to investing in new technologies favours imitation over innovation, particularly when regulators require that the price of unbundled access be aligned with costs. Here, unbundling creates a second-mover advantage and substantially reduces entrants' incentive to shoulder a sunk investment. Potential competition may therefore prefer unbundling to investing in alternative infrastructures.

This same literature offers up arguments that lead one to conclude that imposing access unbundling reduces incumbent operators' incentive to invest in existing facilities and in new technologies. More specifically, regulatory imposition of unbundling whose price is based entirely on cost may well lead to diminished incentives for at least two reasons. The first argument derives directly from the rules governing investment decisions which, for companies, consist of arbitrating between the hoped-for return and the risk of failure associated with the investment project. To be precise, basing the price of unbundled access offers on cost, invariably reduces the company's probability of generating a high return. The second argument, which makes it possible to establish a correlation between incumbent operators' loss of incentive to invest and unbundling, consists of underlining the fact that setting tariffs based on cost virtually eradicates the cost advantage that would ensue from this investment. This regulatory principle in fact ensures a constant ratio between marginal costs, those of the incumbent and those of the entrant; despite investments and the drop in marginal cost which may result, the value of this ratio is the same, *ex-ante* and *ex-post*. This clearly constitutes a hindrance to the competition dynamic since the incumbent operator has no incentive to invest in a technology that reduces its own marginal cost, while its competitors can obtain the same economy thanks to regulatory provisions. This potential loss of dynamic efficiency then leads to a distorted view of consumers' well-being due to the cost of opportunity tied to the absence of improved quality that the investment could have produced.

This discussion hints at the conclusion that, at first glance, unbundling hampers incentives to invest in existing networks as well as in new technologies. We must nonetheless remain very prudent in the way we interpret these various arguments, to the extent that here we have provided only partial analysis of the impact. Our statements have focused primarily on a

highly microeconomic aspect of investment decisions, without taking into account the fact that these regulatory regimes are generally associated with industrial policies that seek to create incentives – through often very complex economic policy leveraging – for firms to invest and innovate (A. Jacquemin and L. Pénch (2001)).

Up until now, we have supposed a perfect correlation between facilities-based competition and firms' investment. In other words, at no point did we wonder whether a policy of facilities-based competition indeed leads inexorably to efficient sums and rates of investment in local networks and to the adoption of the most advanced technologies. It would be well worth addressing this aspect here now.

There is a relative wealth of theoretical economic literature on facilities-based entry's effect on industrial investments. The literature generally distinguishes non-strategic from strategic motives.

The classic approach is to regroup non-strategic investments into three categories: renewal investments, growth investments and upgrade investments. The issue that interests us above all in this article is most certainly linked to the last category of investments whose most marked characteristic is their very high level of cost and associated risks. From the incumbent operator's standpoint, the prime motive appears to be the regulatory variable, through the definition of norms or certification of procedures, for instance. It clearly ensues that regulation will have a direct impact on the development facilities-based investments. Similarly, for entrants a certain number of investment motives are disconnected from purely strategic aspects. In an open network environment, entrants are free to choose their technology(ies), their level of entry as well as those markets which they will truly enter. In the same vein, they can elect the unbundling solution, as well as its degree, to install their own facilities or even to deploy a combination of the two.

Parallel to these non-strategic motives, a certain number of investments form an integral part of incumbent operators' and entrants' strategies. A great many writings have focused on the strategic nature of incumbents' investment decisions when faced with competitive pressure from potential entrants. In this case, the investment can serve as an entry barrier strategy that allows the incumbent to dissuade entry due to the additional costs it entails. More specifically, incumbent firms have the choice between discouraging entry by over-investing and accommodating entry by opting for a better investment strategy, knowing that entry will take place. Choosing between these two alternatives depends precisely on the nature of the technologies, on consumers' preferences and on the regulatory stipulations in effect on the market in question (Spence (1977), Dixit (1979) and Tirole (1988), among others). For their part, entrants can also elect to invest strategically. These strategies are illustrated by entry for buyout strategies, for instance, which have been used widely by competitive access providers (CAPs). This strategy corresponds to a certain extent to entrants taking a speculative approach to certain investments. More specifically, it involves entrants investment in "growth" technologies in the hope of later selling them to other firms or of an eventual takeover. Several CAPs have thus been taken over by TV cable operators and, more recently, by long-distance operators (Woroch (1998)).

While the theoretical literature conveys the strong presumption that facilities-based competition stimulates investment, the results of empirical studies in the field are more contrasted. Overall, the hypotheses that underlie the results of theoretical models do not appear to have been verified empirically for a great many industries (Geroski (1995)).

Traditionally, in a certain number of cases studied, the econometric tests do not manage to establish a clear link between entry and a drop in prices pre or post entry, and its purportedly negative effect on the incumbent firm's profits. Along with this is the fact that the results concerning the level and rate of investments seem, to a certain degree, to be even less firmly established (Taylor, Zarkadas and Zona (1992), Greenstein, Mc Master and Spiller (1995), Ros (1999)). There nevertheless exist several studies specific to the telecommunications sector and which provide a more precise view of the relationship. Such is notably the case of Greenstein, McMaster and Spiller (1995) who demonstrate there is indeed a link between facilities-based competition and incumbent operators' investment decisions. This relationship is, however, minimal. Other works, more focused on cellular telephony services and fibre optics indicate that this type of link can be established (see for instance Dekimpe, Parker and Sarvary (1998) or Woroch (2000)).

All of these studies are embryonic to the extent that we still do not have the required hindsight (nor volume of data), given the relatively recent application of facilities-based entry. Regulatory authorities must adopt a very cautious attitude in light of the many uncertainties surrounding the rate of innovation and the direction being taken by innovative processes, in addition to those surrounding new and long-standing consumers' behaviour.

#### **4. Concluding remarks**

Several years after opening Europe's telecommunications markets up to competition, the local telephony market remains largely dominated by incumbent operators. Local call pre-selection was introduced far too recently to be able to assess the impact that it will eventually have, while cable telephony remains largely confined to the UK where it targets primarily residential customers. Even in this country where deregulation came into effect early on and where business centres were rapidly equipped with optical loops, the incumbent operator, BT, still controls 70% of the local calling market. Lastly, the introduction of cellular telephony onto the telecom services market brought about a significant decline in incumbent's power.

Hasty though it was, our look at the internet and high-speed access markets does not make it possible to state that these services will lead to the swift creation of a competitive landscape, regardless of the technology deployed.

Today, there is no explicit relationship between the maturity of the unbundling process in a given market and CLECs' share of high-speed access market. There is also currently no explicit relationship between unbundling and the speed of creation of a broadband access market. Korea, which is the world's leader with more than 50% of the households using high-speed access, primarily via DSL lines, began implementing unbundling rules in late 2001. The Korean government's very dynamic public policy to promote demand and to encourage operator's investments was crucial.

Given the complexity involved in implementing unbundling rules, it is quite natural that incumbent operators have generally taken a significant lead in marketing DSL access. In recent troubled times, even the CLECs seem prefer use of a DSL wholesale platform to launch their DSL services rather investing in DSLAM. It is nevertheless likely that – on the corporate market initially (with the arrival of G.SHDSL technology) and later the consumer market for the most solid ISPs – we will witness a gradual decrease in the number of DSL lines being billed by incumbents. On the residential market, the arrival of competitors could

derive from the current massive consolidation of ISPs in Europe, given the impact of economies of scale on the profitability of DSL offerings. Competition is also likely to issue from the gradual creation of a market at the end user level that goes beyond merely billing access, in other words a market of value-added services (video, music, e-commerce, e-learning,...). The introduction of voice over IP in the medium term (and VoDSL) also constitutes a possible means for destabilizing incumbent operators as it would undermine fixed earnings generated by phone line subscriptions.

In many large European cities, the greatest competition for incumbent operators' high-speed offerings on the residential market will come from cable operators' broadband internet services. As we have already indicated, however, major European cable operators' current level of debt may well hamper the widespread distribution of their internet and telephony offerings.

We must also expect to feel the gradual impact of wireless technologies which include the still difficult to establish development of WLL, the promise of 3G mobile as well as WiFi services (802.11).

In the particularly difficult context that is currently being experienced by the entire telecom sector, it also seems necessary to point out that a too great "impatience" on the part of public authorities – seeking to pressure incumbent operators into lowering the price of DSL access, for example – may well prove counterproductive.

Lastly, while it is true that regulators must remain circumspect in seeking to maintain an efficiently competitive landscape, we find it impossible to adhere to certain convictions which perceive in the current situation overt undermining of competition on the part of the natural monopoly. The technological effervescence, which gives no indication of subsiding, constitutes in itself a powerful vector for challenging acquired positions, benefiting specialized players and often targeting a particular market. The serious crisis that the sector is enduring should lead to the ultimate emergence of a smaller number of more solid rivals for incumbent operators. Lastly, our conviction, in the wake of the early developments of broadband services, is that the telecommunications services market will be more or less closely intertwined with complex services being marketed to both consumer and corporate customers, calling upon skills, brands and distribution networks that will all represent chances to challenge the dominant position of the market's most powerful players. It will not be a perfect competitive market, and will require the ongoing vigilance of regulators and anti-trust authorities, but neither will it continue to resemble the telephone network's monopoly.

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## References:

-Bourreau M., Debroeck E. (1999), "Le développement de la concurrence dans la boucle locale," *Communications & Strategies*, n°36, P.145-162.

-Buigues P.A. (2001), "European policy on local loop unbundling – competition law landscape and implementations issues," *Communications & Strategies*, n°42, p.51-66.

-Curien N., Gensollen M. (1992), "Economie des télécommunications: ouverture and réglementations," *Economica*.

- Crandall R. and J. Hausman (2000), "Competition in U.S. Telecommunications Services: Effects of the 1996 Legislation," S. Peltzman and C. Winston, editors. *Deregulation of network industries*. Washington, DC: Brookings Institution Press, pp. 73-111.
- Dekimpe M., P. Parker and M. Sarvary (1998), "Staged Estimation of International Diffusion Models: an Application to Global Cellular Telephone Adoption," *Technological Forecasting and Social Change*, 57, pp. 105-132.
- Dixit A. (1979), "A Model of Duopoly Suggesting a Theory of Entry Barriers," *Bell Journal of Economics*, Spring, 10, pp. 20-32.
- Dixit A. (1995), "The options Approach to Capital Investment," *Harvard Business Review*, May-June.
- Dixit A. and R. Pindyck (1994), "Investment under uncertainty," Princeton University Press, Princeton.
- Geroski P. (1995), "What Do We Know about Entry?," *International Journal of Industrial Organization*, 13, pp. 421-440.
- Greenstein S., S. MacMaster and P. Spiller (1995), "The Effect of Incentives Regulation on Infrastructure Modernization: Local Exchange Companies' Deployment of Digital Technology," *Journal of Economics and Management Strategy*, 4:2, pp. 187-236, Summer.
- IDATE (2001), "Telecoms in Europe," *Market Report*.
- IDATE (2001), "European Broadband Markets," *Market Report*.
- Jacquemin A. and L. Pench (2001), "What Policies in Support for R&D?," *Revue d'Economie Industrielle*.
- Jorde T., G. Sidak and D. Teece (2000), "Innovation, Investment, and Unbundling," *Yale Journal on Regulation*, vol. 17:1.
- Le Blanc G. (2001), "Market Efficiency in the Digital Economy: Lessons from the US and European Telecom Industry Dynamics," *Communications & Strategies*, n°44, 4<sup>th</sup> quarter, p.29.
- Ros A. (1999), "Does Ownership or Competition Matter? The Effects of Telecommunications Reform on Network Expansion and Efficiency," *Journal of Regulatory Economics*, January.
- Spence A. (1977), "Entry, Capacity, Investment, and Oligopolistic Pricing," *Bell Journal of Economics*, Autumn, 90, pp. 534-44.
- Taylor W., C. Zarkadas and D. Zona (1992), "Incentive Regulation and the Diffusion of New Technology in Telecommunications," National Economic Research Associates, presented at the ninth biennial conference of the ITS, Sophia-Antipolis, France.

- Tirole J. (1988), *Industrial Organization*, MIT Press.
- Woroch G. (1998), "Investment in Local Network Infrastructure by Incumbents and Entrants," presented at the Fourth Annual Conference of the Consortium for Research on Telecommunications Policy, University of Michigan-Ann Arbor, June.
- Woroch G. (2000), "Competition Effect on Investment in Digital Infrastructure," presented at the 4<sup>th</sup> annual Center for Research on Telecommunications Policy conference, University of Michigan.

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