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Please cite this paper as:

OECD (2001-10-29), "The Development of Broadband Access in the OECD Countries", *OECD Digital Economy Papers*, No. 56, OECD Publishing, Paris.
http://dx.doi.org/10.1787/233822327671

OECD Digital Economy Papers No. 56

The Development of Broadband Access in the OECD Countries

OECD

Organisation de Coopération et de Développement Economiques
Organisation for Economic Co-operation and Development

29-Oct-2001

English - Or. English

DIRECTORATE FOR SCIENCE, TECHNOLOGY AND INDUSTRY
COMMITTEE FOR INFORMATION, COMPUTER AND COMMUNICATIONS POLICY

DSTI/ICCP/TISP(2001)2/FINAL
Unclassified

Working Party on Telecommunication and Information Services Policies

THE DEVELOPMENT OF BROADBAND ACCESS IN OECD COUNTRIES

JT00115500

English - Or. English

FOREWORD

In June 2001, 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) in October 2001.

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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Main points

The development of broadband access to the Internet is gaining increasing prominence. This is occurring in fields that go well beyond communications policy. One reason for this is the role advanced communication capabilities may have played in generating higher growth in productivity rates, as well as new network-based economic activities, in some countries over recent years. If, as many believe, new communication tools such as the Internet and wireless networks boosted growth in the latter half of the 1990s, and softened the current cyclical downturn, then the next steps toward broadband access are of critical importance that go beyond the communications sector.

The current bottleneck to growth in the communications sector, and beyond for areas such as electronic commerce, is the limitations of local access networks. These limitations are not just technological. The inheritance of many decades of monopoly provision of access networks is that there is usually only one, or at best two, networks passing most homes and businesses in OECD countries. In some cases the same company still owns both these networks.

In liberalising their telecommunication markets OECD countries have taken a very necessary step in providing the competitive forces that will build choice for users. They have also unleashed a torrent of innovation in the communication industry that is, at last, beginning to rival that of information technology. New access technologies are being developed, existing networks being upgraded and new networks being built. The pace of development, however, is extremely uneven across the OECD area. Much can be done, in many countries, to increase the pace at which broadband access becomes available, the quality of service this involves (not all broadband is equally broad), and to reduce prices.

The aim of this report is to update developments in terms of the roll out of broadband access in OECD countries. It does not aim to provide a definitive description of the technological alternatives or the applications for which it is being used but rather to highlight developments in relation to the leading platforms. The focus of the analysis is on how fast broadband access is being developed, what regulatory barriers exist to this development and what initiatives might be taken to increase the pace of development.

The analysis of the report leads to the following policy conclusions:

- The most fundamental policy available to OECD governments to boost broadband access is infrastructure competition.

- A second necessary step is to open up the network elements, of players in dominant positions, to competitive forces. Policies such as unbundling local loops and line sharing are key regulatory tools available to create the right incentives for new investment in broadband access. The evidence indicates that opening access networks, and network elements, to competitive forces increases investment and the pace of development. Nearly all OECD governments have already introduced such policies, or taken decisions to introduce such policies, in respect to telecommunication networks.

- Open access to cable networks, where it is warranted by market conditions.

Arguably cable operators are in a less dominant position than incumbent telecommunication carriers. A case can be made for not subjecting new cable infrastructure to open access policies particularly where new entrants have little market power. The initial experience is that open access, for all mature platforms, increases the incentives for new entrants. On the other hand experience also indicates that the likely winners are those companies that own, manage and are responsible for their own infrastructures. Clearly,

infrastructure competition is the best policy tool available but, the reality is that, it takes time to rollout competitive platforms. By not making those network elements that take the longest time to build available to new entrants, some countries risk missing the immediate additional competition this can bring to a market.

At the beginning of 2001 just one person per 100 inhabitants, on average in OECD countries, was a subscriber to high speed Internet access. By way of contrast the leading country surpassed 10 subscribers per 100 in early 2001. The challenge for all other countries is to emulate and exceed that target as quickly as possible to break through the current access bottlenecks. This will not only stimulate growth in the entire communications sector but also drive growth in areas such as electronic commerce and contribute to overall growth in OECD economies.

Developing broadband access

There are a number of definitions of "broadband" (see Box 1). The analysis in this paper concentrates on the leading technologies currently being used to provide high speed Internet access. At the end of 2000 there were 14 million subscribers to high speed Internet access in the OECD area. This was up from just 3.1 million at the end of 1999. By the end of June 2001, the number of broadband subscribers had increased by 57% to just under 22 million. (**Figure 1**).

The two leading technologies used by subscribers were cable modems and Digital Subscriber Line (DSL). In 1999 the respective share of cable modems and DSL were 84% and 16%. However by the end of 2000 the respective shares were beginning to even, with cable modems holding 55% and DSL some 45%. By June 2001 the balance between the two was 51% for cable modems and 49% for DSL. Although other technologies are becoming available, with a few notable exceptions such as Sweden, their penetration is still too small to be reported in most countries.

Box 1: How broad is broadband?

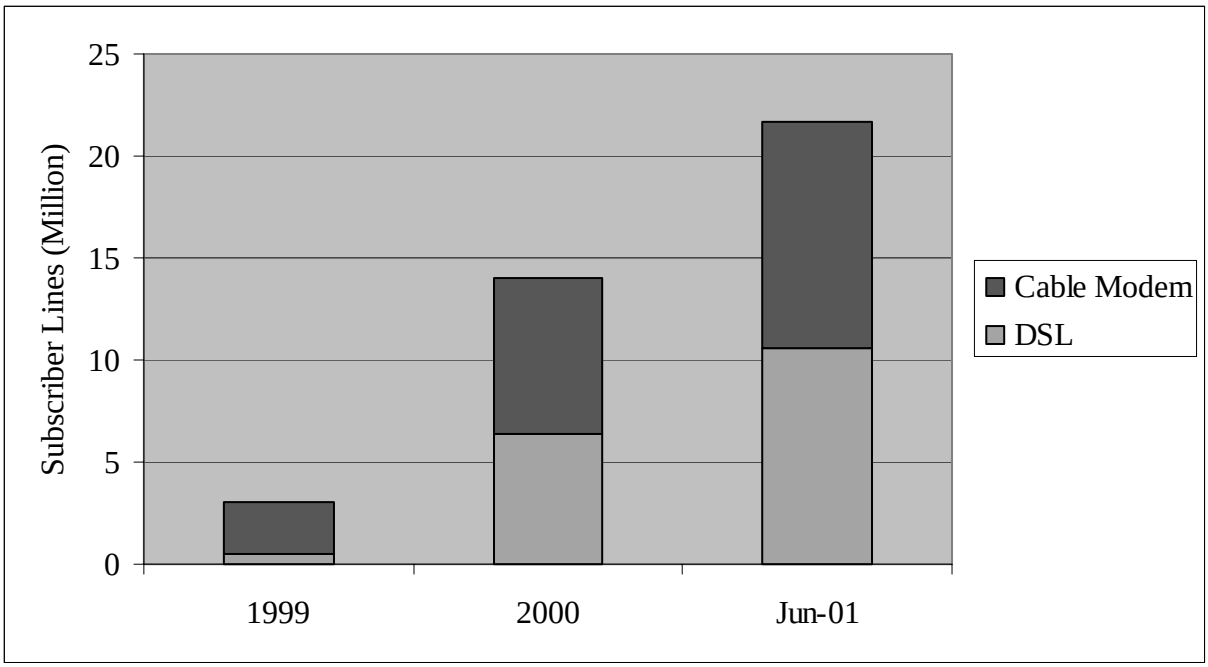
Definitions of broadband access vary widely. According to ITU-T Recommendation I.113, broadband means transmission capacity that is *faster* than primary rate ISDN (*i.e.* 1.5 or 2 Mbps).[1] Notwithstanding this definition, the term tends to be widely used simply as shorthand for high speed Internet access. Network operators widely advertise DSL and cable modem services to users starting at 256 Kbps as being 'broadband'. At the same time OECD governments attach a wide array of meanings to the term 'broadband' in policy discussions. In reference to policy making, the minimum threshold for 'broadband' only really takes on importance if a government has a specific service in mind that requires a certain level of network performance. One such service might be full two-way interactive video. On the other hand, even here there are a number of opinions on what such a minimum threshold might be in practice. One reason for this is the rapidly evolving field of compression technologies. Another is the different levels of quality that may be part of the objective.

In this report the approach adopted by the FCC is used with some slight modifications. In their first Inquiry Concerning the Deployment of Advanced Telecommunications, the FCC defined 'broadband' as having the capability of supporting, in both the provider-to-consumer (downstream) and the consumer-to-provider (upstream) directions, a speed (in technical terms, 'bandwidth') in excess of 200 kilobits per second (Kbps) in the last mile. This rate is approximately four times faster than the Internet access received through a standard phone line at 56 Kbps or 64 Kbps. The FCC chose 200 Kbps because, in their view, it is enough to provide the most popular forms of broadband – to change Web pages as fast as one can flip through the pages of a book and to transmit full-motion video.

This report raises the threshold, for a service to be considered broadband, in respect to downstream access to 256 Kbps. This is solely because this is the most basic speed being offered by DSL providers in OECD countries. On the other hand the threshold for upstream speeds has had to be lowered. This is because only a small number of the asymmetric digital subscriber line (ADSL) offers, aimed at residential users, exceed 200 Kbps for their upstream connection. The most common upstream speed offered with DSL options aimed at residential users is 128 Kbps. Moreover a large number of basic ADSL options only include upstream access at 64 Kbps.

The reasons for not excluding such 'low speeds' are several. First, the goal of this report is to compare the first developments toward broadband access. If the threshold was set, for example, in accord with the ITU or even the FCC's definition it would exclude consideration of most current developments aimed at residential users. Rather the aim is to compare and contrast the initial speeds on offer for broadband access. The second reason is that the availability of 'rate adaptive modems' means that the upstream and downstream service level can be increased without users needing to purchase new equipment. Accordingly, for policy makers, benchmarking the initial speeds on offer is more important than excluding their consideration. In this report the term 'broadband' is therefore simply used as shorthand for high speed Internet access. In this report DSL refers collectively to all types of digital subscriber lines, the two main categories being ADSL (Asymmetric digital subscriber line) and SDSL (Symmetric DSL). Other types of DSL technologies include High-data-rate DSL (HDSL) Very-High-data-rate DSL (VDSL). In other reports the term xDSL is sometimes used to refer to all types of DSL.

Figure 1. Number of subscribers to cable modem and DSL services in the OECD area

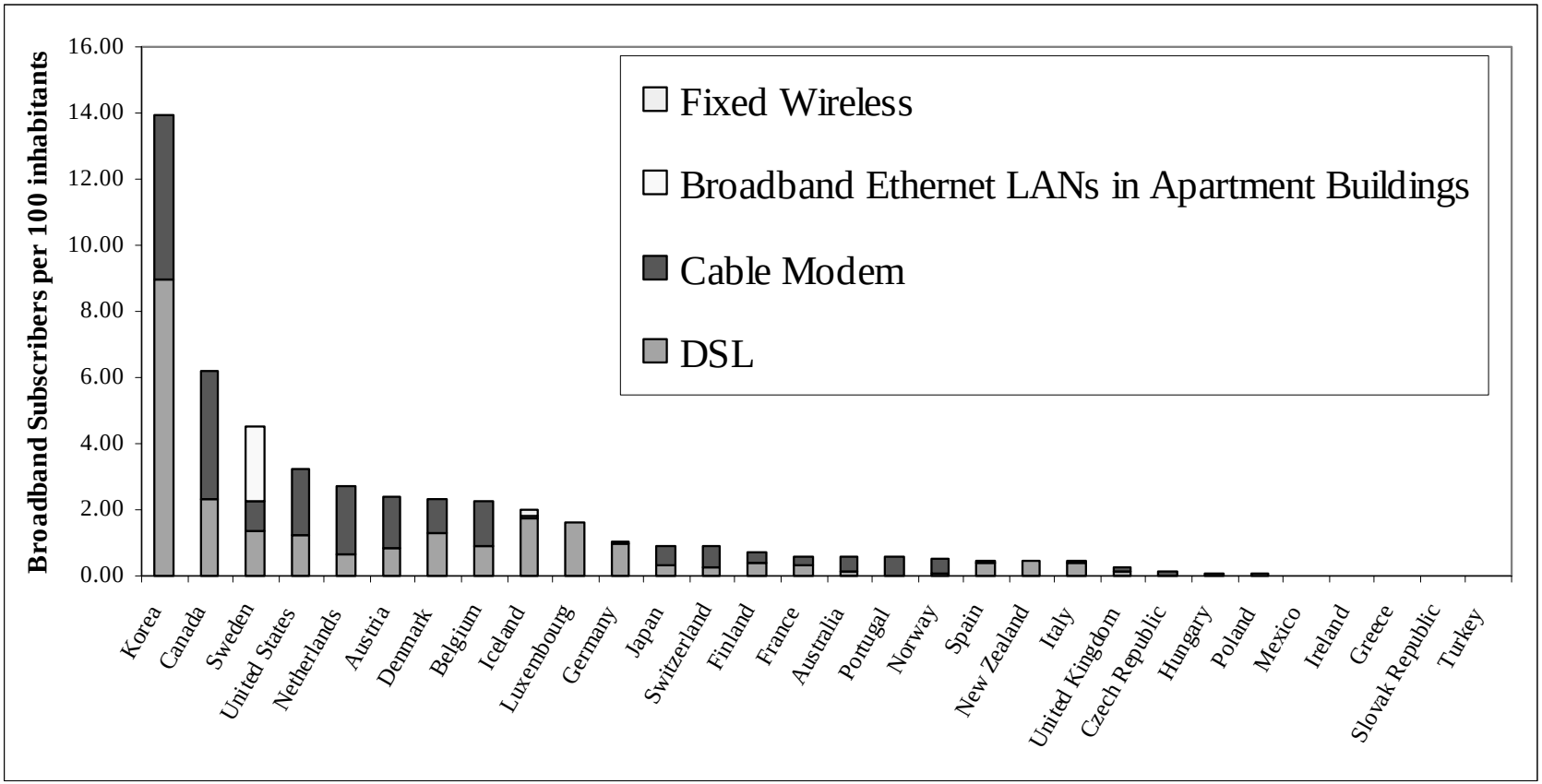


Source: OECD.

The other technologies that are being deployed in 2001 to provide broadband services are fixed wireless broadband, direct satellite broadband services (*i.e.* with return paths not needing the PSTN) and various forms of 'fibre to the residence'. The two leading examples of 'end to end' fibre connections are in Iceland (Lina.Net) and Sweden (Bredbandsbolaget - "B2"). In Sweden, at the end of 2000, there were around 80 000 subscribers to so called 'property networks' using fibre optic Ethernet LAN connections in apartment buildings (including customers of Telia). By June 2001 this number had increased to around 200 000 subscribers. For business users, leased lines also provide an important platform for broadband access. The focus of this report, however, is on DSL and cable modem broadband access. These technologies provide the leading options for broadband access to consumers, small business and individuals wishing to access corporate networks with permanent connections (*e.g.* tele-working).

At the end of 2000 commercial DSL services were available in 22 of the 30 OECD countries (**Table 1**). Cable modem services were available in 21 countries (**Table 2**). At the end of 2000, just three countries Canada, Korea and the United States accounted for 91% of all DSL subscribers and 81% of all cable modem subscribers. These countries were the only ones to have exceeded two broadband Internet subscribers per 100 inhabitants by the end of 2000 (**Table 3**, **Figure 2**). In Korea's case it had done this in spectacular fashion by surpassing 11 subscribers per 100 inhabitants by March 2001. By June 2001, four countries had exceeded three subscribers per 100 inhabitants (**Table 4**). These were Korea, Canada, Sweden and the United States. The Netherlands, Austria, Belgium and Denmark had all exceeded two subscribers per 100 inhabitants.

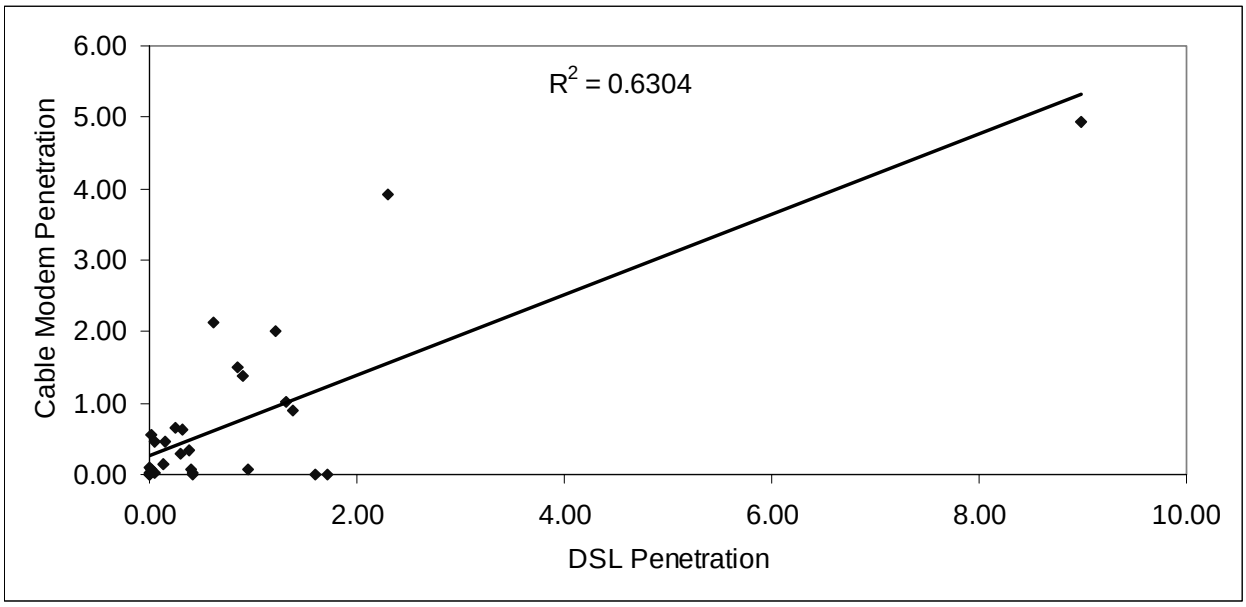
Figure 2. Broadband penetration in OECD countries, June 2001



Source: OECD

One of the key ingredients in why some countries are forging ahead, is whether there is competition between different networks and networks with different technologies. There is a significant correlation between the growth of cable modems and DSL services. (**Figure 3**). In some countries the main competition to DSL, the medium of choice for incumbent telecommunication carriers, comes from other technologies. This is either because cable networks have not been developed in these countries (*e.g.* Iceland and Italy) or because the incumbent telecommunication carrier owns a large part of the cable television infrastructure. In these countries competition is sometimes emerging on alternative platforms (smaller DSL or cable networks) and technologies (*e.g.* fibre to the residence, broadband fixed wireless).

Figure 3. Cable modem and DSL penetration, June 2001



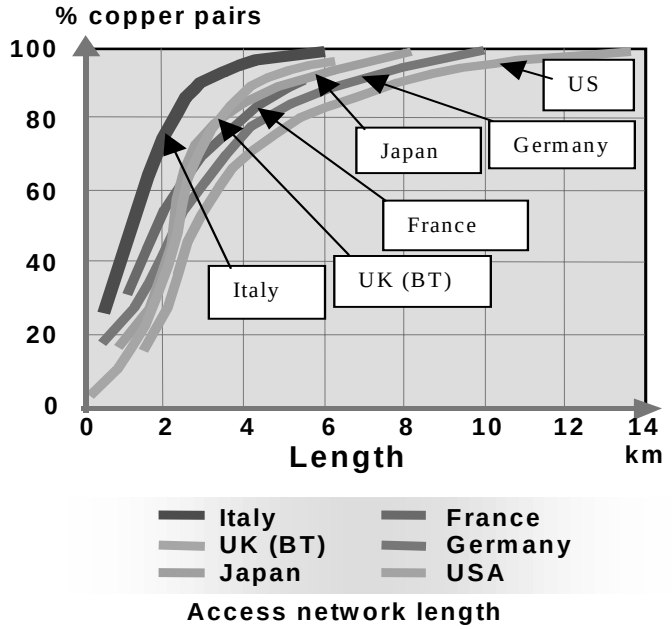
Source: OECD.

In terms of coverage broadband technologies are going to be available fairly quickly. By the end of 2000, for those countries for which data and services are available, more than half the population could access DSL services. In Korea a figure of 92% of the population could access DSL by the end of 2000. A number of other operators are expected to match or exceed this by end 2001. Belgacom, for example, says that DSL will be available across the entire country by end 2001. That being said the data may not be wholly comparable. This is because different operators report this measure in different ways. Some operators report coverage of households or population, while others report customers who can elect to receive the service or enabled lines. Sometimes it is difficult to be precise, as telecommunication operators need to estimate the proportion of potential users residing within a certain radius of a telecommunication exchange.

DSL services can currently be provided within a radius of 4 – 5 kilometres from a telecommunication exchange. That being said this distance is being expanded due to technological developments.[2] BT, for example, has introduced 'rate adaptive' modems that will extend the radius that can be served form their exchanges from 3.5 to 5.5 kilometres. In California, the Calaveras Telephone Company says it has successfully completed field trials for '2Wires' DSL loop extender technology.[3] The trials of the 2Wire DSL loop extender technology demonstrated downstream rates of 5.120 Mbps out to 10.4 kilometres, with loop extender circuits located at 4.6 kilometres to 6.4 kilometres from the telecommunication exchange. Calaveras Telephone Company is located in Copperopolis, California. It serves approximately 3 700 access lines in Calaveras County and the company says the technology will be beneficial for serving its low density rural service area.

Telecom Italia has provided an estimate for different countries of what proportion of their local loops are within a certain distance from a telecommunication exchange (**Figure 4**). For their network, Telecom Italia say that the average length of the local loop is 1.5 kilometres. The company says this is about half the average for many carriers in other countries. That being said if technological developments can push the potential service area for DSL to 10 kilometres, and perhaps beyond, the vast majority of users could be provided with service. According to Telecom Italia's data the vast majority of European local loops are less than 10 kilometres from an exchange. In Japan nearly of local loops are less than eight kilometres from an exchange. The data suggest that only about 5% of local loops in the United States are beyond this distance from a telecommunication exchange.

Figure 4. Proportion of lines that are certain distances from telecommunication exchanges in select countries



Source: Telecom Italia (CEPT).

A further complication is that some parts of an operator (such as the network provider) may be DSL enabled while others (such as the service provider) may not yet cover a certain area. For example NTT say they plan to cover nearly all the country with DSL enabled exchanges by March 2002. On the other hand ACCA, a DSL provider partly owned by NTT, had a more modest plan for coverage. ACCA's business plan called for 'build out' to over 450 central offices (COs) in 17 markets by the end of 2001. This was expected to cover 40% of businesses and 33% of homes in Japan.[4]

Data on cable modem coverage is harder to obtain, as the cable market is more fragmented in a number of countries. By the end of 2000 cable modem services were available to 60% of households in Canada and 59% of households in the United States.

While coverage is extremely important it is only part of the development needed to drive higher broadband access in OECD countries. In this respect it is worth remembering that ISDN availability reached very high levels many years before the service began to be used. Indeed, in some countries, the use of ISDN never really gained any momentum and the use is now decreasing as users switch to DSL. The more important factor is the commercial environment in which the new capability is marketed. Competition is a necessary prerequisite for the development of DSL services, something that was absent at the time ISDN was new to the market.

Table 1. DSL coverage in OECD area

	Commercial Service Launch	Coverage 2000 (%)	Coverage 2001 (%)	Indicator used to express coverage
Australia	August 2000	50		Customers - March 2001. Telstra say 90% of premises will be able to access DSL or Cable by 2003
Austria	November 1999	75		Households
Belgium	October 1999	75	100	Population
Canada	1996	69		Households
Czech Republic	4th Quarter 2001	..		Pilot project launched in Prague, July 2001
Denmark	July 1999	65		Households - 95% by 2002
Finland	May 2000	73		Sonera Lines Only (Elisa launched service in 1999)
France	November 1999	32	50	Lines - 66% by end 2002
Germany	August 1999	60	90	Households
Greece	Yet to Launch - Trial	..		
Hungary	September 2000			
Iceland	Beginning 2000	33		Households (Broadband)
Ireland	October 2001	..		Service initially available in Dublin
Italy	December 1999	52	80	Population – TI says it is a year ahead of its schedule
Japan (1)	December 2000			Nearly all the country by March 2002
Korea	April 1999	92		Population
Luxembourg	March 2001	..	66	Coverage of 90% of country expected by 1st quarter 2002
Mexico	August 2001	..		
Netherlands	December 1999	40	70	KPN had 55% population coverage by June 2001
New Zealand	June 1999	60		Customers -75% by 2002
Norway	December 2000	20		Network infrastructure
Poland	March 2001	..		TPSA in four largest cities. "Telefonia Lokalna" started to provide DSL services in March 2001
Portugal	December 2000	50		Population
Slovak Republic	Yet to Launch	..		
Spain	1999	74	81.2	Households
Sweden	September 2000			10% of exchanges were equipped for DSL by February 2001
Switzerland	October 2000			25 towns covered by February 2001
Turkey	February 2001	..		
United Kingdom	July 2000	50	60	Households
United States (2)	1997	50		Households - SBC says 80% of customers by 2003

1. The data are for NTT. Tokyo Metallic and KDD launched a DSL trial in November 1999 and commercial service in a limited number of areas in 2000. Tokyo Metallic held its first trial in 1997. NTT East and NTT West began an DSL-based Internet access service on a trial basis in December 1999.
2. United States coverage is for areas covered by SBC and Verizon. There were around nine companies offering DSL services by October 1997, although not all were commercial. SBC said it had covered 55% of locations by June 2001.
3. In some cases business DSL services were launched before residential services. In Sweden, for example, the date of launch is for individual households with earlier services being only available in apartment buildings.

Source: OECD.

Table 2. Cable modem coverage in the OECD area

	Commercial Cable Modem Service First Available	Households Passed and Connected by Cable -TV Networks, 1999 (%)		Households with Cable Modem Available, 2000 (%)	Comment
		Passed	Connected (1)		
Australia	May1997	34	16	34	Telstra Launch Date and household coverage
Austria	July 1999	53	30		
Belgium		100	96		
Canada	November 1996	93	69	60	
Czech Republic	April 1999	..	24		
Denmark	March 1999	70	56	30	Cable modem access will be available to around 70% of households with Cable TV by mid 2002
Finland	May 1998	63	42		
France	1997	32	12		First Trial was in 1996
Germany	2001	86	53		DT Trial/UPC Launch
Greece	..	0	0		
Hungary	November 2000	66	48		UPC Launch Date
Iceland	..	..	..		
Ireland	..	50	49		
Italy	..	5	<1		
Japan		..	17		
Korea	July 1998	48	12		
Luxembourg	November 2001	100	90		Aurora Launch Date
Mexico	2000	32	10		
Netherlands		94	89		
New Zealand	November 1998				Saturn Launch Date
Norway		47	40		
Poland	December 2000	..	31		UPC Launch Date
Portugal	November 1999	47	16		
Slovak Republic		..	..		
Spain		8	3		
Sweden		65	50		
Switzerland		72			
Turkey	..	..	7		
United Kingdom	April 1999	51	13		NTL Launch Date
United States		96	67	59	

1. This indicator shows the total number of households in the country which are connected to cable.

Source: OECD.

Table 3. Broadband penetration in OECD countries

	DSL			Cable Modems			Other Broadband	Total Broadband Penetration
	1999	2000	Per 100 Inhabitants	1999	2000	Per 100 Inhabitants		Per 100 Inhabitants
Australia	0	10 000	0.05	14 000	64 000	0.34		0.39
Austria	900	38 500	0.48	50 000	98 900	1.22		1.70
Belgium	1 000	43 000	0.42	50 000	102 013	1.00		1.42
Canada		465 600	1.53	479 000	918 000	3.01		4.54
Czech Republic	0	0	0.00	1 500	10 000	0.10		0.10
Denmark	800	26 399	0.50	11 000	41 000	0.70		1.27
Finland	0	15 000	0.29	7 500	15 000	0.29		0.58
France	0	64 000	0.11	50 000	121 911	0.21		0.31
Germany	5 000	200 000	0.24	0	65 000	0.08		0.32
Greece	0	300	0.00	0	0	0.00		0.00
Hungary	0	400	0.004	0	3 000	0.03		0.03
Iceland	0	1 957	0.70	0	0	0.00		0.70
Ireland	0	300	0.01	0	0	0.00		0.01
Italy	615	114 900	0.20	0	0	0.00		0.20
Japan	19	9 732	0.01	154 000	625 000	0.49		0.50
Korea	97 325	2 756 843	5.88	173 662	1 556 072	3.32		9.20
Luxembourg	0	0	0.00	0	0	0.00		0.00
Mexico	0	0	0.00	0	15 000	0.02		0.02
Netherlands	0	15 000	0.09	151 000	250 000	1.58		1.68
New Zealand	0	9 676	0.25		658	0.02		0.27
Norway	0	943	0.02	4 500	15 000	0.34		0.34
Poland	0	0	0.00	0	0	0.00		0.00
Portugal	0	1 000	0.01	297	25 154	0.25		0.26
Slovak Republic	0	0	0.00	0	0	0.00		0.00
Spain	1 848	47 950	0.12	0	13 459	0.03		0.15
Sweden	0	42 000	0.47	7 000	63 000	0.71	60 000	1.86
Switzerland	0	4 000	0.06	70	27 000	0.38		0.43
Turkey	0	0	0.00	0	0	0.00		0.00
United Kingdom	0	32 344	0.05	N/A.	19 693	0.03		0.09
United States	370 000	2 429 189	0.89	1 400 000	3 700 000	1.36		2.25
OECD	477 507	6 326 039	0.57	2 588 529	7 750 204	0.70		1.27
EU	10 163	637 699	0.17	361 797	815 130	0.22		0.39

1. DSL connections for Australia are an estimate based on Telstra's reported broadband subscribers and industry estimates for overall broadband connections.
2. Sweden's other broadband includes subscribers Ethernet LANs such as B2's high-speed fibre LAN service. Telia's LAN subscribers are reported under DSL.
3. DSL data for Greece and Ireland are trials.
4. DLS data for the US are from the quarterly Telechoice survey which is then checked against data reported by DSL providers. The number is higher than that reported by the FCC for DSL but is more comparable with data reported by DSL providers in other countries. The overall figure for the United States is lower than the FCC as technologies such as fixed wireless and satellite are not included in these data.[5]
Source: OECD.

Table 4. Broadband status (June 2001)

	DSL		Cable Modems		Other Broadband	Total Broadband Penetration	Rank (June 2001)	Rank (End 2000)
	June 2001	Increase from 2000	June 2001	Increase from 2000				
Korea	4 205 813	53%	2 310 330	48%		13.91	1	1
Canada	702 267	51%	1 194 700	30%		6.22	2	2
Sweden	122 000	190%	78 400	24%	199 000	4.52	3	4
USA	3 334 491	37%	5 500 000	49%		3.24	4	3
Netherlands	97 000	547%	336 000	34%		2.74	5	6
Austria	68 800	79%	122 300	24%		2.36	6	5
Denmark	69 740	164%	54 000	32%		2.33	7	8
Belgium	92 000	114%	140 264	37%		2.27	8	7
Iceland	4 764	143%	0	..	750	1.99	9	9
Luxembourg	6 920	..	0	0		1.60	10	NA
Germany	780 000	290%	..	..		1.03	11	15
Japan	400 760	4 018%	784 000	25%		0.94	12	11
Switzerland	18 000	350%	46 000	70%		0.90	13	12
Finland	19 623	31%	18 000	..		0.73	14	10
				..				
France	177 000	177%	174 000	43%		0.59	15	16
Australia	27 000	170%	85 000	33%		0.59	16	13
				%				
Portugal	2 000	100%	55 358	120%		0.57	17	18
Norway	2 500	165%	20 500	25%		0.52	18	14
Spain	157 702	251%	25 664	91%		0.47	19	20
New Zealand	16 000	65%	1 267	93%		0.45	20	17
Italy	239 000	108%	0	..	14 500	0.44	21	19
UK	80 772	150%	83 750	325%		0.28	22	22
Czech Rep.	0	0	11 000	10%		0.11	23	21
Hungary	1 000	150%	7 800	160%		0.09	24	23
Poland	18 000	NA	10 000	NA		0.07	25	28
Mexico	0	0	..	..		0.02	26	24
Ireland	300	0	0	..		0.01	27	25
		0						
Greece	300	0	0	0		0.00	28	26
Turkey	..	..	0	0		0.00	NA	NA
Slovak Rep.	0	0	0	0		0.00	NA	NA
OECD	10 643 752	68%	11 138 333	44%		1.96		
EU	1 913 157	200%	1 152 736	41%		0.82		

1. For countries where data were unavailable the most recent data are used to calculate their overall broadband penetration.
2. For Japan, cable data is March 2001 and DSL data is July 2001. In those cases where full second quarter cable modem data were unavailable for all companies end first quarter or end 2000 data are used (Denmark and Mexico). Norway's DSL data is end first quarter 2001. DSL data for Poland includes "Telefonia Lokalna" as at October 2001. No mid year data were available for TPSA in Poland but by October 2001 they had around 50000 subscribers.
3. Sweden's other broadband includes subscribers to high-speed fibre LAN services. Cable data are for the two largest networks with smaller networks being included in the 'other' category. Italy's other broadband include Fastweb's subscribers.

Source : OECD.

Unbundling and line sharing

Since 1997, some 26 of the 30 OECD Member countries had either introduced unbundling or taken the decision to introduce unbundling.[6] Although a number of European countries had already introduced unbundling, EU regulation requiring their 15 member states to unbundle access to the local loop came into force in January 2001. The Regulation requires incumbent operators throughout Europe to offer unbundled access to their local loops on reasonable request. Australia, Canada, Iceland, Japan, Norway, and the United States have all introduced unbundling of local loops. The Czech Republic, Hungary, Korea and Poland have all made decisions to proceed with unbundling although this is not yet in place. In all these cases stimulation of broadband access was one of principal policy objectives.

By 2001 only four OECD countries did not have timetables to proceed with unbundling local loops. These countries were New Zealand, Mexico, Switzerland and Turkey. In the case of Turkey the question has not yet arisen because of that country's monopoly over the provision of fixed network infrastructure. In Switzerland, the telecommunications regulator (ComCom) has proposed that local loops be unbundled.[7] However the Swiss Federal Court ruled, in March 2001, that the Swisscom local loop should not be opened to competition immediately. In New Zealand the Government decided against introducing unbundling in 2000. The Government believes the competitive delivery of local loop services is likely to be achieved in many areas of New Zealand using a variety of technologies, without the regulatory intervention associated with unbundling. In April 2001, the New Zealand Minister for Commerce and Information Technology was reported to say "…the issue of unbundling had not been put aside forever and that New Zealand would continue to monitor developments overseas."[8] In September 2001, the New Zealand Government announced mandatory reviews of the need to designate local loop unbundling and access to unbundled elements of (and interconnection with) Telecom New Zealand's fixed public data networks. These reviews are to be carried out by the Telecommunications Commissioner within 24 months of the commencement of the new Telecommunications Bill. In Mexico it is not currently Government policy to introduce unbundling. However, discussions are underway between industry participants to introduce line sharing for the provision of DSL services.

While the pace of progress in unbundling remains uneven it is significant that the majority of OECD governments have introduced this policy. New entrants and telecommunication user groups, in all OECD countries, support the policy. Understandably, some incumbents have been very reluctant to embrace unbundling, although it has been suggested, by some analysts, that it is in their interest.[9] Certainly incumbents that oppose opening up the local loop in their 'home markets' use the tools this enables as a means of entry into foreign markets (**Table 5**). On the other hand there are some service providers, owned by incumbent operators, that take very progressive views in respect to the introduction of competition. In Japan for example NTT owns a 41.8% stake in ACCA Networks, a company providing DSL services. NTT Communications Corporation, through its OCN and other brands plans to use ACCA's DSL lines to meet increasing customer demand for faster Internet access and other wide bandwidth applications. In launching the company, ACCA's CEO stated that the lack of competitive broadband access had been the bottleneck to growth in the use of information technology in Japan.[10]

Initiatives to open the local loop are viewed by most OECD governments as being fundamental to promoting a fast roll out of broadband services. For the purpose of discussion, **Table 6** sets out the advantages and disadvantages as summarised by ITU. To date the major criticism of unbundling or line sharing are that such policies allegedly discourage investment in new infrastructure. No evidence has been forwarded to substantiate this claim. By way of contrast there are huge investments being made by new entrants in local access markets, where unbundled elements are available, to provide broadband services. These investments take the form of facilities that link unbundled elements to provide broadband services and in alternative infrastructures that do not use unbundled elements. In the United States, for example,

AT&T has invested USD 12 billion annually between 1998 and 2000, a large part of which has been devoted to local access infrastructure. Unbundled network elements have been available, as mandated by the FCC, over this entire period. Since the FCC mandated unbundled elements in 1998, Competitive Local Exchange Carriers (CLECs) have invested USD 50 billion in network infrastructure in the United States.[11] In that country some 69% of CLEC lines were with companies investing in their own infrastructure and just 29% of lines were provided by pure resellers. The association that represents CLECs says they expect the percentage of pure resellers to decrease in the coming years as new entrants continue to build their own facilities. Nor does unbundling deter incumbents from investing in upgrading networks. Accordingly, to suggest that new entrants will not invest in their own infrastructure, due to unbundling, is erroneous.

Germany is one of the countries leading unbundling. In 2000, Deutsche Telecom invested USD 3 billion, just on its fixed network and is increasing that to just under USD 4 billion in 2001. Between 2001 and 2002 the company plans to spend USD 1 billion upgrading its network for DSL. In other countries where unbundling is available, such as Canada and France, the incumbent telecommunication carriers are stepping up their investment in DSL. In Italy, Telecom Italia says not only does it plan to invest more in DSL, and that it is investing such that it is one year ahead of its own schedule, but that unbundling will 'force its competitors to invest in infrastructure'.[12] In Ireland, Eircom has announced that it will spend USD 113 million over five years to upgrade its network for DSL. Eircom took that decision knowing that unbundled local loops would be available to its competitors.

In the long run infrastructure competition is the best way to develop broadband services. Korea's success is built on vigorous infrastructure competition with multiple independent DSL networks competing against cable networks. However very few OECD countries have even two competing providers using different infrastructures, on a widespread basis, for broadband access. Even in those countries, with two leading providers, experience shows that duopolies have not proved to be efficient in providing telecommunication services. While new technologies such as fixed wireless, UMTS, satellites and so forth, show a great deal of promise it will take time for providers to roll out infrastructure on a widespread basis. This is why, in the medium term, policies that open incumbent access networks to competition can drive a faster deployment of broadband services.

Table 5. Contrasting views in different markets

	Incumbent view in home market	Incumbent view as a 'new entrant' in another country
Telecom New Zealand (1) (Telecom owns AAPT a new entrant in Australia)	In 2000 Telecom New Zealand opposed unbundling during an inquiry into the future regulatory framework for telecommunications in that country. Telecom also opposed the establishment of a sectoral regulator.	AAPT has consistently supported the ACCC, the Australian regulatory authority, in its endeavours to open the local loop in Australia. In November 2000, AAPT stated "What competition exists today is based solely on Telstra's local network so it is quite wrong for it to state that it is experiencing competition at the infrastructure level in these areas. Clearly there is no viable alternative to Telstra's copper network in most parts of Australia".
Swisscom (2) (Swisscom owns Debitel a new entrant in Germany)	In November 2000, Swisscom opposed a proposal from ComCom, the Swiss regulator, to unbundle its local access network. Swisscom said it opposed market intervention by the regulator.	In November 2000, Debitel requested that RegTP, the German Regulator, open up Deutsche Telekom's local network.
Telmex (Telmex and its controlling shareholder the Carso Group have a 34.7% stake in Prodigy. SBC indirectly owns 43% of Prodigy and has a 7.6% share of Telmex)	Telmex opposes unbundling its local loop in Mexico.	In the United States Prodigy has entered into agreements with Verizon and Covad Communications for the provisioning of DSL services in states outside of the 13 state regions served by SBC. Covad uses unbundling and line sharing to provide DSL services for Prodigy. By the end of 2000 Covad's digital network reached more than 45% of all US homes and 50% of all US businesses. Covad achieved this coverage in only three years using open access to local loops.

1. Larry Williams, "The Vision of an Emerging Carrier", AAPT, http://www.aapt.com.au/investor/speeches/speech1a.asp "AAPT to expand further through access to Telstra's local call network", 22nd July 1999. "AAPT condemns Telstra's latest application to the ACCC", 13 November 2000 http://www.aapt.com.au/

2. Swisscom, "Unbundling of the access network: Swisscom to oppose market intervention by regulator", 10 November 2000. Reuters, "Debitel ups local loop pressure on Deutsche Telekom", 24 November 2000.

Source: OECD.

Table 6. Unbundling considerations

Advantages	***Disadvantages***	**OECD Comment**
Encourages competition by reducing the economic barriers to entry by allowing new entrants to construct some components of their networks and obtain other components from the incumbent operator.	*Reduces incentive for construction of competitive network facilities.*	Unbundled local loops should be made available at cost-based prices. Thus, there should be no 'disincentive' for new entrants to invest in there own facilities. Rather it lets new entrants deploy infrastructure in response to demand and to market services to a wider base of customers from the commencement of service.
Encourages innovation, since new entrants can combine new technologies with components of existing networks.	*Undermines investment in alternative access networks (wireline and wireless).*	The purported disadvantage is the same as line 1. There is no evidence that unbundling has slowed investment in new infrastructures or innovation. In OECD countries that have introduced unbundling investment is proceeding apace.
Avoids unnecessary and inefficient duplication of components.	*Can enrich the new entrant at the expense of the incumbent operator.*	Experience shows that competition has increased the size of the telecommunication market to the benefit of all players. Duplication allows choice, creates competition and can improve efficiency and is not necessarily something to be avoided. The key question is the speed with which broadband services can be offered.
Facilitates access to rights of way, towers, etc, by new entrants, and avoids the disruption to streets and to the environment during a duplicate roll-out.	*Requires detailed regulatory intervention and technical co-ordination.*	Introducing unbundling may be challenging for regulators if incumbents have business models that are negative toward unbundling or new entrants do not have well co-ordinated and planned entry strategies. This does not mean that unbundling should not be implemented as the benefits outweigh the costs. Critical issues needing to be considered by regulators, in relation to unbundling, include collocation, provisioning timeframes, service quality and access to operator support systems.
Provides a new revenue stream to incumbent.	*Requires technical co-ordination between operators.*	All telecommunication services provided between networks require some level of technical co-ordination between operators. This is not an argument against implementing unbundling.

Source: Columns 1 and 2, in Italics, are from the ITU Based on World Bank (2000), World Telecommunications Regulation Handbook, *Module 3. ITU, "Regulatory Implications of Broadband", Briefing Paper, Geneva, 2-4 May 2001.* They are not necessarily the views of the OECD or ITU.

Cable ownership

In 1995 the OECD undertook analysis which showed that incumbent telecommunication companies were rapidly increasing their share of cable television access provision.[13] This was as a result of telecommunication carriers purchasing cable network operators or building their own cable networks where none previously existed.

As markets were liberalised a number of countries took steps to act against this trend that threatened to slow the introduction of widespread competition. In some countries the telecommunication carriers were asked to divest their cable networks. In other countries moratoriums were imposed to give new entrants a period in which to roll out cable networks without incumbent telecommunication carriers entering the market. Since that time, pressure in several countries to sell cable networks has come from investors who would prefer that carriers focus on their core business. In these cases, carriers have sold cable networks and are upgrading their own networks to provide multi-media services.

In 1999 the European Union took a further initiative in this area. That year a directive was adopted that meant Member states had to ensure that telecommunication carriers in dominant positions legally separate their cable and telecommunication activities. At the time the European Commission noted that an operator active on both networks was much less likely to upgrade a cable network to use it to compete with its own PSTN for telephony or broadband services.[14] The European Commission stated that this was the minimum action required to deal with this issue. Subsequent to this directive, a number of operators began to legally separate their cable operations and some took the decision to take this further by structurally separating and selling their cable networks. At the time, the Commission reserved the right to go further and would have enforced divestiture had the proposed Telia-Telenor merger proceeded.

As a result of the foregoing there are a now fewer countries where the incumbent telecommunication carriers, providing local access to the PSTN, also have a cable network or a major shareholding in a cable network. These countries are Australia, Denmark, France, Finland, Hungary, Italy, Luxembourg, Mexico, Norway, Portugal and Sweden. That being said a number of developments were occurring in these countries. In 2001, France Telecom retained a cable network but the company has reduced its share of the French cable market over recent years. In Mexico, Telmex was also in the process of shedding its share in a cable network.

The Nordic countries, with the exception of Iceland, have a relatively high CATV subscriber base. However, it is noteworthy that no Nordic country was ranked higher than seventh in terms of the combined DSL and cable modem penetration at the end of 2000 (*i.e*. excluding other technologies such as Ethernet LANs). Usually, in OECD telecommunication performance benchmarks, at least one Nordic country would be ranked among the top six countries for a new communication service. The obvious question this raises is have developments been slower in the Nordic region because of the ownership of cable television networks by telecommunication carriers. Open access policies need to be reviewed in respect to cable networks particularly where the telecommunication incumbent owns both networks.

Broadband technologies

The focus of this report is on the development of DSL and cable modem services. This is because these two technological platforms are the leading choices currently available to most residential users. There are, of course, other technologies being developed. These include data services provided over electrical power lines, broadband fixed wireless and satellites. In respect to services over power lines there are trials being held in a number of countries but, as yet, no significant commercial deployment. In respect to satellites, the

first services with direct interactive return paths (*i.e.* not requiring use of the PSTN for the upstream path) are being deployed on a commercial basis for the first time in the United States in 2001. The initial business plans of these services are to target areas not covered by terrestrial broadband networks. The use of fixed wireless broadband is also gaining momentum but the rollout of services was still at a very low level, at the beginning of 2001, compared to DSL and cable modems.

In addition to the foregoing, the use of fibre is once again being considered as a possible technology for the 'local loop' connection to homes. One reason for this is that technological developments are bringing down the cost of deploying this technology but also because new entrants are focusing on providing services to apartment buildings rather than individual dwellings.

The two countries leading this development are Iceland and Sweden and, in both cases, it is new entrants that are leading developments. Although the number of subscribers to 'Lina.net', in Iceland, and 'Bredbandsbolget', in Sweden, are still small, the impact they are having on the incumbent telecommunication carrier is significant. Some incumbents also have plans for using 'fibre to the home', most notably NTT, but it is likely to be several years before the service is widely available. NTT East and NTT West initiated trial fibre-optic IP connection services of 10Mb/s, in December 2000, with 41 lines and 100 users. In July of 2001, full-scale consumer services will commence with the addition of 100 Mb/s service to the menu of options. The service area will be expanded to regional capitals and other cities of equivalent size by 2003 and to smaller cities by 2005. In the United States SBC is also reported to be considering deployment of fibre optic cable for new housing developments.[15]

Does this mean that fibre will eventually win out as the medium of choice? The answer is that it may not as the speed of DSL connections can also be increased. STMicroelectronics and Telia Research AB have announced the successful demonstration of their jointly developed 'Zipper-VDSL' (Very high bit-rate Digital Subscriber Line) system.[16] The Zipper-VDSL system offers a data capacity of up to 60 Mbps over conventional telephone lines.[17] Telecom Italia is one company planning to roll out VDSL in 2003 with 26 Mbps downstream capabilities. Significantly Telecom Italia says it has excluded pure fibre because it believes the cost of high speed DSL is decreasing while pure fibre optic connections are still too expensive for most users (*i.e.* they will use fibre where it is economical for large users). Telecom Italia say they can provide Internet video services at between 6 Mbps to 8 Mbps and therefore avoid using fibre.

Some telecommunication carriers believe xDSL (*i.e.* all the different types of DSL) are the best option to provide broadband services. Others are clearly backing a range of technologies, including fibre optic local loop connections, and will apply them to suit the particular needs to customers. The important point for policy makers is not to try to pick technological winners but rather to create a framework in which different operators compete with the technologies they judge to be the best available to suit given markets.

Some may argue that mobile wireless should also be considered in a discussion of broadband access. On the other hand Durlacher have projected that European consumers will have to wait four to five years before services will be accessible at convenient and affordable 'broadband speeds' (**Table 7**). Although the timetable may vary by a year or so, depending on the OECD country, widespread affordable broadband access via mobile wireless is at least several years away. While high-speed mobile access has obvious advantages it is fairly clear that access speeds will significantly lag those of the fixed network for the immediate future.

Table 7. Mobile wireless access speeds

Mobile Generation	Mobile Technology	Theoretical Data Speed	Actual Data Speed	Forecast Data Speed 2006
2G	GSM	14.4 Kbps	7-9 Kbps	..
	HSCSD	36 Kbps	20 Kbps	30 Kbps
	PHS and PDC	64 Kbps	10-20 Kbps	..
	CDMA	64 Kbps	10-20 Kbps	..
2.5G	GPRS	115 Kbps	25 Kbps	60 Kbps
2.75G	EDGE	384 Kbps	36 Kbps	80 Kbps
3G	UMTS	2 Mbps	40 Kbps	200 Kbps
4G	OFDM	20-54 Mbps	Not expected before 2008	..

Source: Durlacher "UMTS Report: An investment perspective", (www.durlacher.com), eMarketeer (www.emarketeer.com).

Broadband developments in OECD countries

The following sections detail the development of broadband access by OECD country. Where some form of broadband access had commenced by the end of 2000, those countries are ranked in terms of their overall broadband penetration. The key questions addressed are whether there is infrastructure competition between DSL and cable networks; whether there is competition between operators using the same technologies but different infrastructures; and whether unbundling, line sharing or other open access policies are in effect to speed the development of broadband services. In those countries where incumbent telecommunication carriers own the largest alternative infrastructure, such as a cable television network, this is highlighted. Projections made by companies for the rollout of broadband services and the goals governments have in this respect are also reported where they were available.

It is worth stressing that investment in upgrading networks to support DSL by the incumbents, especially in European OECD countries, was given a significant boost by the adoption of unbundling policies. In Europe where the EU Directive on unbundling came into effect in January 2001 a number of incumbents had cited technical reasons and cost for delays in providing high speed Internet access in 1999 and 2000. The reality that their competitors could request unbundled loops and upgrade them to provide high speed access seemed to put these concerns aside.

Australia

Australia was one of the first countries to have two alternative broadband access networks in its three largest cities. Accordingly, it might have been expected that Australia would be among the leaders in broadband Internet access. Yet with around 80 000 broadband Internet subscribers, at the end of 2000, Australia's penetration ranked 13th in the OECD.

The two leading providers of broadband Internet access are Telstra and Optus. Both companies have hybrid fibre-coax networks that were constructed during the duopoly, in the provision of telecommunications infrastructure, between 1992 and mid-1997. Telstra's cable network passes 2.1 million homes along the eastern coast of Australia. Optus offers services to potentially 2.2 million homes in Brisbane, Sydney and Melbourne – 70% of which are also within Telstra's reach.

The dupoly period was typified by an extremely fast rollout of hybrid fibre-coax infrastructure and intense competition for content to attract cable television subscribers. For Optus, the construction of a new network held out the potential of being able to offer a range of services to customers and to outflank its rival. Telstra's *raison d'être*, during this time, was to defend its dominance in telecommunication network access. In the main both companies were focused on using the networks for cable television rather than high speed Internet access.

In May 1997, a month prior to the end of the duopoly, Telstra chose to launch its first broadband Internet access offer via its cable network rather than a DSL service. Optus did not launch its own cable modem service until February 2000. Without competition the take up of cable modems was relatively slow during this period. Telstra's initial pricing was aimed at what the company called "Internet enthusiasts" rather than the wider Internet access market. The monthly price was USD 49, with an additional USD 0.27 per Mbyte, after the initial allowance of 100 Mbyte. At that time the company sold cable modems for USD 450. At that stage Telstra said they expected the average customer to spend between USD 60 - 75 per month.

Take up of Telstra's cable modem service was very low between 1997 and the beginning of 2000 with only 14 000 subscribers electing to take the service. In February 2000, the first competition emerged when Optus launched a cable modem service. The 'Optus@Home' service, created Australia's first broadband unlimited-access plan with no variable or traffic charges for USD 49 a month. In the same month Telstra responded by lowering its prices and introducing flat rate options.[18] By the end of 2000, Telstra had increased its number of cable modem subscribers to around 40 000. In May 2001, Optus reported that it had around 30 000 cable modem subscribers.

Telstra commenced broadband satellite access in August 1999. Together with a relatively small number of DSL subscribers, they make up the balance of Telstra's 50 000 broadband subscribers, for all technologies, by the end of 2000. Telstra's DSL service commenced in August 2000. In September 2000 the company signed the first agreement to provide a competitor with an unbundled local loop. This followed a July 1999 decision by the Australian Competition and Consumer Commission to require Telstra to give access on its local service network to its competitors. By June 2001, Telstra's total broadband subscribers had grown to 78 000.

By the beginning of 2001 competition in the provision of broadband services was increasing considerably in Australia. A number of companies are using unbundled local loops to provide DSL services. In addition there are some companies that have emerged and built infrastructure since the end of the duopoly. One example of a company that is targeting those areas that were not cabled during the duopoly period, is TransACT. TransACT offers broadband Internet access in the nation's capital.[19] TransAct aims to connect 25 000 homes in Canberra by mid 2001 and 60 000 by the end of that year. The company has a goal to connect 100 000 homes by the end of 2002. TransAct uses fibre optic cable to within 300 meters of homes and businesses and uses very high speed DSL over copper wires for the final connection. The company aims to provide connections up to 52 Mbps. As is the practice of a number of new entrants the company is offering free connections.

In addition the Australian government has auctioned spectrum, which is expected to be used for the provision of broadband Internet access. Austar, for example, has acquired wireless spectrum in mainland capital cities to provide a broadband wireless Internet access network. At the same time smaller cable operators are cabling some regional cities and towns. Neighbourhood Cable is cabling certain regional cities in Australia. The company aims to pass 250 000 homes by the end of 2002.[20] These were also among the first regional cities to receive Telstra's DSL service during 2001 increasing the choice available to users.

The lesson from Australia's experience is that the roll out of broadband services has kept lockstep with the roll out of competition. In terms of the availability of infrastructure the country is now well placed to quickly increase the take up of broadband access. By March 2001, Telstra had upgraded 400 exchanges with DSL capability providing coverage to around 50% of its PSTN customers. This had increased to 500 enabled exchanges by May 2001. This meant that around 70% of Australian homes and businesses had coverage by Telstra's broadband services using DSL or cable modem.

By 2003, Telstra says that 90% of Australian premises will be able to get its DSL or cable modem service. For users in these areas, the choice of service supplier should become varied. As a large country with a low population density outside capital cities, Australia, more than most other countries, can expect to benefit from technological developments that make distance less a factor in broadband availability. Technologies that extend the radius from a telecommunication exchange that can be served by DSL, will be one such development. For remote users the emergence of broadband satellite services with interactive capabilities will add another option (*i.e.* not needing the PSTN for the upstream link as currently is the case with such services in Australia). In May 2001, Telstra announced it would offer two-way satellite for later in that year.

For its part, Telstra aims to have 1 million broadband customers by June 2005.[21] Telstra has projected that other players may also have a million subscribers by 2005. In total this would mean Australia would have in the order of ten broadband subscribers per 100 inhabitants by June 2005. This penetration rate would, however, be unlikely to put Australia among the leading countries at that time. This is why the successful implementation of unbundling is critical if Australia is to exceed current forecasts. In this respect, the Australian government has mooted streamlining the processes by which access is gained to bottleneck infrastructure.[22] For its part Telstra has said it plans to introduce line sharing in November 2001.

Austria

Ranked 5th in the OECD, in overall broadband connectivity at the end of 2000, the pace of development in Austria is propitious. The market leader is United Pan-Europe Communications (UPC) cable with a reported 100 000 cable modem subscribers at the end of 2000.

By the end of 1999, some 53% of Austrian homes were passed by a cable network. In that same year the number of cable modem subscribers reached 50 000. Telekom Austria does not own a cable television network. Galvanised by this competition, Telekom Austria's response has been to quickly upgrade its network to provide DSL services. In just the 12 months to November 2000, Telekom developed the capability to provide DSL services to 75% of Austria's households.[23] The fact that Austria was one of the EU countries that implemented unbundling from 1998 may have also helped accelerate the process of upgrading networks.

Commencing DSL services in November 1999, the number of DSL subscribers in Austria grew to 38 500 by the end of 2000. This figure comprises the DSL customers of Telekom Austria and other Internet service providers. Telekom's 'Jet2Web' Internet had 34 600 of these subscribers. The pace of this growth was expected to increase in 2001, with Telekom Austria ordering 100 000 additional DSL lines from Alcatel, during the first quarter. By the end of June 2001, Telekom Austria had increased the number of DSL connections to 68 800. This included 8 000 connections, over Telekom Austria's local loops, for other entities.

Belgium

Belgium has the leading penetration rate for cable television networks in the OECD. In August 1997, Telenet was one of the first cable companies, in Europe, to launch high speed Internet access. Subsequently a number of other Belgian cable companies launched service during 1998 and 1999. By the end of 2000, there were more than 100 000 cable modem subscribers in Belgium. The impact on the incumbent telecommunication carrier, of a competitive alternative being available for users, has been significant.

Belgacom was the second incumbent operator in Europe to introduce a commercial product based on DSL technology when it launched its service in October 1999. There has also been competitive pressure on the price of DSL services in Belgium. In 2000, rate structures were revised downward twice and performance upgraded. In October 2000, Belgacom substantially changed its Internet offering for DSL. The speeds achieved with the basic package, Turbo Line, were increased considerably. The monthly traffic volume allowed was also been significantly increased and self installation modems were introduced as soon as they became available from equipment suppliers.

At the end of 2000, Belgacom had more than 43 000 subscribers to its DSL service. At that stage Belgacom was signing an additional 2 000 new customers per week. In May 2001, Belgacom launched free DSL kits to further boost growth in DSL service. Coverage of Belgium has also been quickly rolled out to meet the challenge of cable networks. By the end of 2000, the DSL services were available for 75% of the Belgian population. Belgacom aims for complete national coverage by the end of 2001. If this goal is achieved Belgium will be the first country in the OECD to have DSL services available to all its population. At the end of 2000, Belgium was ranked 7th in the OECD in terms of broadband penetration. Belgium appears to be very well placed for rapid growth of broadband access. This was evident in the first half of 2001 when the number of DSL connections grew 114% to 92 000.

Canada

At the end of 2000, Canada was ranked 2nd in the OECD in terms of overall broadband penetration. At that stage, Canada had 1.4 million subscribers to cable modem and DSL services. As with the other leading countries a key ingredient in Canada's rapid development of broadband services is competition between different networks owned by independent actors. Canada was also one of the first countries to introduce unbundling for telecommunication networks and open access for cable networks.

Canada has an established cable network infrastructure with 93% of homes being passed by a cable network, and 69% being subscribers, at the end of 1999.[24] Canadian cable networks were some of the first to introduce commercial cable modem services with the launch of commercial services in some regions as early as November 1996. By the end of 1997 there were already 21 000 subscribers.[25] At the end of 2000 this had increased to 918 000 cable modem subscribers. A survey conducted by the Canadian television association (CCTA) found that cable television networks can potentially provide high speed access to 6 million homes.

The early launch of cable modem services in Canada spurred the telecommunication carriers to act. In fact, in November 1996, SaskTel became the first telecommunication carrier in the OECD to offer commercial high speed Internet service using DSL technology. By the end of 2000, Canada's telecommunication carriers had 465 000 DSL subscribers. Data available for the fourth quarter of 2000 show demand for DSL services was strongly increasing. TELUS and QuébecTel, for example, expanded DSL Internet subscribers by 20 500 in the fourth quarter of 2000, up 69% from the net additions one year before. For the year, some 57 000 new DSL subscribers were added by TELUS and QuébecTel. Canadian carriers are also investing to support this growth. In November 2000, Teleus announced a commitment of up to USD 321 million over the following five years to expand DSL Internet services in 38 communities in British Columbia and Alberta. In 2001, TELUS plans to invest USD 122 million on ADSL, with the goal to more than double the number of high-speed subscribers by the end of the year.[26]

Canada is well placed to accelerate the use of broadband Internet access. In the first half of 2001, the number of DSL subscribers increased 51% and the number of cable modem subscribers by 30%. The Canadian Government has a commitment to achieving the goal of high-speed broadband access to businesses, and residents in every community in Canada by the year 2004. At the end of 2000, DSL

services were available to 69% of Canadian households. By 2004 this is expected to increase to 78%.[27] Cable modem services were available to 60% of households at the end of 2000 and this coverage will also increase. In addition broadband access via fixed wireless is expected to be available to 60% of households by 2004. Satellites are, however, the only broadband option expected to have universal coverage by 2004. The introduction of interactive broadband services, not requiring the PSTN for the return path, should prove a major boon for remote areas in Canada. One satellite broadband provider, WildBlue, plans to launch such a service over Canada in 2003. [28]

Czech Republic

The Czech Republic was ranked 21st in terms of broadband Internet access in the OECD area at end June 2001. High-speed Internet access services provided by UPC's 'Chello' broadband service were launched in the Czech Republic during 2000. UPC had 2 500 high speed Internet access subscribers as of the end of 2000. This had increased to 3 300 by June 2001. The Czech Association of Cable Communications (CACC) says it expects around 12 000 cable modem subscribers by the end of 2001. Czech Telekom plans to launch DSL in the fourth quarter of 2001. In July 2001, a pilot project was launched over eight telecommunication exchanges in Prague and will connect the first 500 users. This project is expected to run for four months before the general commercial launch in the fourth quarter of 2001. The Czech government plans to introduce local loop unbundling after 2002 but bringing this forward could stimulate growth in broadband access.

Denmark

At the end of 2000 Denmark ranked 8th in the OECD in terms of broadband penetration. Like the other Nordic countries, the rollout of high speed Internet access has been slower than might have been expected. One common factor in Denmark, Finland, Norway and Sweden is that the incumbent telecommunication carriers also own significant shares of the cable network markets. The incumbent telecommunication carrier in Denmark is TDC (formerly known as TeleDanmark). TDC's 'Kabel TV' had a 61% share of cable subscribers at the end of 1999. This means there has been less competitive pressure from that source than in the countries leading broadband penetration rates.

The second largest cable company in Denmark belongs to Telia Stofa. Telia's Danish cable network passes around one fifth of all households in Denmark. Following the launch of high speed Internet access the company gained 11 000 subscribers in 1999. In 2000, the number of Telia Stofa cable modem subscribers increased to 30 000 and by June 2001 had reached 43 000. For its part, TDC launched a DSL service with metered pricing in July 1999. During the second quarter of 2000 the TDC offered a new flat rate structure indicating competition was building. At the end of the second quarter of 2001, TDC had 39 000 DSL subscribers.

The Danish regulator says that 40% of households had access to lines capable of providing DSL service by the end of 1999. This increased to 65% by the end of 2000. In February 2001, TDC said it was accelerating the rollout of DSL broadband services to give access to more than 95% of Danish households within the next 17 months.[29] The Swedish company Bredbandsbolaget signed its first agreement to connect its service to 488 households in Denmark in May 2000.

Finland

Finland was ranked 10th in the OECD, in terms of broadband penetration, at the end of 2000. The country has a reasonably high penetration of cable networks, with some 62% of households passed by cable. In September 1996, Sonera (Telecom Finland) was the first in the world to bring fast Internet services for households in the city of Lappeenranta.[30] However commercial services only became widely available in 2000. This may be because most cable networks in Finland are backed by telecommunication companies. Therefore there may be less enthusiasm for creating a rival broadband platform than might otherwise be the case if these networks were wholly independent. By the end of 2000, cable companies in Finland are believed to have had around 15 000 high speed Internet access subscribers.

In May 2000, Sonera commenced a commercial DSL service, although some DSL services for business users had been on offer since the first half of 1998. By the end of 2000, Sonera said that 73% of the access lines in its traditional area were capable of providing DSL service. Sonera's local access network covers approximately 28% of Finland's population and 80% of its geographical area. Sonera had 575 consumers subscribing to DSL at the end of 2000. In the fourth quarter of 2000 the number of DSL lines for corporate customers more than doubled.

In the areas where Sonera's competitors provide the local access network the company aims to capture 90% of businesses and 40% of consumers purchasing DSL access. Sonera's largest competitor is Elisa. Elisa launched DSL services in October 1999. By the end of 2000 Elisa had 4 700 DSL subscribers. Elisa's DSL subscribers had increased to 11 623 by June 2001. At that stage, HTV the largest operator of cable modem services had around 15 000 subscribers.

France

At the end of 2000 France ranked 16th in the OECD area in terms of broadband penetration. Cable modem services were launched relatively early in France with the first trial being held in Nice, by NC Numérique, in 1996. By July 1997, cable modem services were available, in the 7th district in Paris, Le Mans, Annecy, Strasbourg, Nice and in Saint-Quentin-en-Yvelines. However several factors have combined to slow the take up of services.

Although France's cable networks were rapidly digitalised these networks only passed 32% of French households by the end of 1999. A further factor limiting the growth of cable modem services, was that the telecommunication incumbent owned much of the underlying cable infrastructure. The advent of the possibility to offer high speed Internet services over cable networks heightened tensions, that already existed, between France Telecom and cable service providers over use and financial arrangements surrounding the infrastructure.

In April 1997, Paris TV Câble (Suez Lyonnaise des Eaux group) called upon the French Telecommunications Regulatory Authority (ART) to settle a dispute between itself and France Telecom over the charges levied and technical conditions imposed for Internet access provision via cable TV networks in Paris.[31] A similar dispute, involving 18 networks, was brought before ART on 18 April 1997, by Compagnie Générale de Vidéocommunication (Générale des Eaux group). In ruling on this dispute ART determined that the network operation agreements concluded between France Telecom and the two cable operators must be altered to allow for the provision of Internet access over cable TV networks. ART also ruled that France Telecom's cable TV networks must be upgraded quickly to allow for Internet access. ART thus set a deadline requiring the contracts to be signed for network upgrading work by September 1997. In June 1998, Paris TV Câble brought the matter before ART again, as it had noticed delays in the accomplishment of the work. ART issued a decision to settle the matter in July 1998. This decision set a

deadline for the commercial launch of the service, requiring Internet access service to be available from the entire Paris cable network by the end of January 1999.[32] The decision also laid down certain quality of service objectives.

On its own wholly owned and operated network – France Telecom Câble – the incumbent launched cable modem services in 1998. France Telecom Câble is the second largest cable operator in France. The company also took a decision to convert its ownership of infrastructure provided for other operators, into equity in the cable companies, with an intention to sell off these stakes at a later date. In August 2000, the first such sale occurred when France Telecom sold its 49.9% stake in NOOS, France's biggest cable network operator. At the end of 2000, NOOS had 63 000 cable modem subscribers. By June 2001, NOOS had increased this number to 81 000.

For its part, one of France Telecom's stated goals for 2001 is 'to make DSL a mass market phenomenon in France.' France Telecom plans to spend USD 354 million upgrading its network for DSL services between 2000 and 2002. At the end of 2000, some 11 million lines were capable of providing DSL services and this will be increased to 16 million lines by the end of 2001. France Telecom's goal for the end of 2002 is that 66% of all France Telecom's lines will be capable of providing DSL services.

At the end of 2000 France Telecom reported that it had 64 000 DSL business and residential subscribers. Of these, Wanadoo, France Telecom's ISP, reported 54 831 DSL subscribers. By June 2001, this had increased to 177 000. France Telecom aims to have 600 000 DSL subscriber lines in service by the end of 2001.[33]

Wanadoo reported that it had 88 170 broadband Internet access subscribers at the end of 2000, up from 78 041 in June of that year. These data would also include cable modem subscribers to France Telecom's Casema unit, in the Netherlands. It was significant that the growth in Wanadoo's DSL subscribers was much faster than for Wanadoo's cable modems.

By the end of 2000, France's cable operators had 121 911 subscribers, up from 80 897 in June of the same year.[34] France Telecom's gradual withdrawal from the cable market is undoubtedly creating a more favourable framework for the development of competition between cable modem and DSL services. Any further sale of France Telecom cable properties would further this development. It would ensure that there were at least two competitive platforms available to households passed by France Telecom Cable's network. For the moment, users' primary choice is between France Telecom's DSL and France Telecom Câble's high speed Internet access service. On the other hand, increasing choice will be available as the impact of unbundled local loops comes into effect and competitive DSL providers gain access to infrastructure in these areas.

Germany

At the end of 2000, Germany ranked 15th in the OECD in terms of broadband penetration. Although some 86% of German households are passed by cable television networks, commercial services using cable modem were very recent. By September 2000, cable modem service providing bi-directional access to the Internet was available to around 260 000 households of which around one quarter subscribed.[35] The main reason for the recent start to service has been the restructuring which has occurred in the cable industry. Once the decision was taken for Deutsche Telekom to divest its ownership in Germany's cable networks the company did not have a tremendous incentive to develop cable modem services. Deutsche Telekom signed an agreement for the first sale of cable assets in February 2000. In February 2001, Deutsche Telekom announced the sale of its last remaining cable properties.

Greece

There is only a very minor cable television network in Greece and consequently no platforms for the delivery of high speed Internet access via cable modems. As telecommunication liberalisation did not occur until January 2001 there has only been a relatively short time for new entrants to roll out new infrastructure. For its part OTE has held a trial for DSL service but, in the absence of any competitive pressure, had not launched a commercial service by early 2001. In this environment unbundling local loops becomes imperative to kick-start broadband developments.

Hungary

At the end of 2000, Hungary ranked 23rd in the OECD area in terms of broadband penetration. Matav the telecommunication incumbent launched DSL services in September 2000. By June 2001, Matav had around 1 000 DSL subscribers. The company has a target of 10 000 DSL subscribers by the end of 2001.[36]

The largest cable operator in Hungary is United Pan-European Communications (UPC). In November 2000 UPC, using the 'Chello' brand, launched cable modem services in Hungary. UPC are launching cable modems services in four districts of Budapest and in Miskolc and expect to reach 400 000 homes with two-way capacity in the country by the end of 2001. At the end of 2000 the company had 3 000 broadband Internet subscribers. This had increased to 7 800 by June 2001.

Matav owns the second largest cable operator after purchasing several small operators. The company is precluded, by regulation, from purchasing any more cable operators. By the end of 2000, Matav Cable was not offering cable modem services. Some 66% of Hungarian households were passed by cable at the end of 1999. With the full liberalisation of the Hungarian telecommunications market in 2002 it will be possible for the owners of these networks to offer a full range of services. This should increase the incentive to invest in upgrading and expanding the infrastructure available for broadband services. On the other hand Matav's ownership of cable networks in some areas reinforces the need for local loop unbundling. Hungary has indicated that it will introduce local loop unbundling in association with liberalisation.

Iceland

Iceland Telecom (Siminn) launched commercial DSL services in 2000. By the end of 2000 the company had just under 2 000 subscribers. At this time, Siminn had rolled out broadband capabilities to more than half of the homes in the capital city and about one third of homes on a national basis. Siminn distributes 27 foreign television stations, five domestic stations and numerous radio stations via its broadband network.

Although Iceland has no alternative cable television networks, competitive pressure on Siminn has developed from another source. Following the liberalisation of Iceland's telecommunication market the Reykjavik Energy Company set up a company called "Lina.Net" to provide communication services. In July 2000, Lina.Net signed a contact with Ericsson to provide a fibre-to-the-home network with speeds of up to 100 Mbps per second.[37] The technology used promises to be more economical for installation than previously proposed models for fibre to the home.[38] By June 2001, Lina.net had connected around 50 homes to its fibre network and was adding at the rate of 10 homes per month. The company has also undertaken Internet trials over power lines in 20 homes. This technology turns the electricity grid in a home into a 4.5 Mbps network. Overall the company aims to win a 20% market share of the 60 000 homes in Reykjavik.

One of the leading rivals to Siminn is 'Islandssimi'. A new entrant into the Iceland market, Islandssimi says it has over 30 of Iceland's top 100 companies as its customers and runs more than 60% of Iceland's Internet traffic through its network.[39] Late in 2001, Islandssimi entered the home marked by offering a xDSL (*i.e.* both ADSL and SDSL) to the home market. Local loop unbundling came into force in October 2000. The company has partnered with Lina.net to build a fibre optic network that spans Reykjavik and neighbouring towns.

Ireland

In the first half of 2001, there were no commercial high speed Internet access services in operation in Ireland, using DSL or cable modems. Eircom, the incumbent telecommunications carrier, began a DSL trial, with 300 users in Dublin, in 2000. The company says it will launch a commercial service in the Dublin area in October 2001.[40] Eircom says it will invest USD 113 million over the following five years to roll out service on a wider basis.

The largest cable television network in Ireland is owned by NTL Communications. NTL has yet to launch high speed Internet access. The company's 2001 plans involve the launch of digital television services over its existing network.[41] Cable networks pass around half of all households in Ireland and these networks hold the potential to be upgraded for high speed Internet access. However, due to Eircom's relatively late deployment of DSL, there had been little competitive pressure for the launch of cable modem services.

The first competition to the PSTN and cable networks may come from wireless Internet access. Late in 1999, 'Chorus' was awarded a licence to create a high-speed wireless broadband network. The company is progressively rolling out digital television and telephony services across Ireland, using wireless access, including an option for high speed Internet access. In April 2001, services were launched in the city of Kilkenny.[42] Ireland is initiating full local loop unbundling in 2001 and this should assist to 'kick start' broadband developments. In mid 2001, the telecommunications regulator said there was substantial unmet demand for broadband services in Ireland.[43] ODTR stated that its plans for alternative infrastructure and local loop unbundling are intended to help alleviate this unmet demand. The need for this action is reinforced by Eircom's launch prices for DSL being among the most expensive for this service in the OECD area.

Italy

At the end of June 2000, Telecom Italia's DSL service was offered in 41 cities. In the following six months service was extended to a total 120 cities in Italy.[44] Originally Telecom Italia planned to offer services in 250 cities by the end of 2001 but this has now increased to 600. In terms of population coverage Telecom Italia could offer DSL services to 52% of the population by the end of 2000. Telecom Italia is continuing to invest in network infrastructure, and claims it is now a full year ahead of schedule to extend ADSL coverage to 600 cities in Italy, which corresponds to about 80% of the population.[45] Telecom Italia says it plans to invest over USD 3.2 billion in broadband infrastructure between 2001-2003.

At the end of 2000, Telecom Italia supplied 114 900 DSL lines to retail and wholesale markets. Some 28 900 DSL lines were provided to Telecom Italia's business customers. Telecom Italia and CLECs provided a further 86 000 DSL lines for the consumer market. Telecom Italia's goal is to have something in the order of 600 000 DSL services, by the end of 2001 and 1.5 million by the end of 2002. In early 2001, Telecom Italia was offering DSL installations with no initial charge. This offer included home delivery and installation of modem and filters as well as on-site configuration of customer PCs. Several other companies, during 2001, had periodic offers to waive initial connection charges, such as Belgacom, Bell

Canada, and Verizon. These offers encourage users to self-install their modems. Telecom Italia's offer to include a so-called 'truck roll' installation, where a technician visits the customer's residence, shows extraordinary keenness to increase the DSL market.

Italy's cable television network penetration is very low and its development recent. The major cable company is also partly owned by the Telecom Italia. Competition may first arise from other sources. Fastweb is a joint venture between e.Biscom and the Milanese utility AEM. The company plans to deploy fibre-to-the-home cable networks throughout Italy.[46] The networks will provide 10 Mbps of bandwidth to the home and 100 Mbps to businesses. Fastweb began services to businesses in February 2001.[47] By June 2001 Fastweb had 14 500 subscribers of which 11 000 were residential. The Fastweb network has reached nearly 12 000 buildings, corresponding to 145 000 households, at the end of June 2001. The whole city of Milan will have access to Fastweb's broadband service by the end of 2002.

Numerous territorial bodies have also decided to intervene directly in the creation of broadband access networks. For example, financed by territorial bodies, a network is being created in Sienna that aims to put all the local authorities of the province on line. In the city of Milan, Sesto San Giovanni and Prato, the municipal firms that run public utility services (electricity and water) are committed to the creation of a broadband infrastructure in partnership with telecommunication firms.

At the end of 2000, Italy ranked 19th in the OECD in terms of overall broadband penetration. The lack of cable infrastructure has meant that competition will have to be developed from other sources. Telecom Italia's plan to make DSL services available to 80% of Italy's population by 2001, combined with unbundled local loops, is the most promising avenue to achieve widespread competition.

In February 2001, the Prime Minister's Office – Information Society Forum – published a report containing proposals for broadband growth, especially in less developed areas (see www.governo.it/fsi). Highlighted in the report is the need for the development of widespread use of the telecommunications network. This is an important factor that would enable all areas to overcome the peripheral and marginalised nature of territories which are characterised by minor economic development, and help in guiding them towards growth and increased competition for the whole country. This report suggests that access to broadband and its services should form a part of universal service. The report says further studies are necessary into whether and to what extent public intervention can be used to support investment into infrastructures.[48] In July 2001, the government announced the preparation of a broadband national action plan.

Japan

In January 2001, the Japanese government announced the "e-Japan strategy". This plan has the goal of encouraging the private sector to provide high-speed 'always-on' access networks to at least 30 million households, and ultra high speed access to 10 million households, within five years. This was followed, in March 2001, by the Japanese government creating the "e-Japan Priority Policy Program", with a specific action plan to stimulate broadband development. A further announced policy, in May 2001, was the "e-Japan 2002 Program" which stated the priorities for information technology policies. The government says it is planning to implement, intensively and strategically, information technology policies in relation to broadband development.

The increased policy focus on broadband development, together with increasing competition, is beginning to stimulate growth. In the first quarter of 2001 the number of cable modem subscribers increased from 625 000 to 784 000. Between the end of 2000 and July 2001 the number of DSL lines increased from less than 10 000 to 400 000. In the month of August 2001, 110 000 DSL subscriber lines were added in Japan. Moreover new entrants had commenced service with prices significantly lower that the initial prices of NTT.

In September 2001, a DSL service was launched by the Softbank Group and two of its subsidiaries, Yahoo! Japan Corporation and BB Technologies Corporation. Softbank said, at the time, that it had received more than a million subscriber reservations with an initial 40 000 subscribers connected.[49] The advertised price for this service is very inexpensive. For around USD 21 per month (USD 14 expressed in purchasing power parities) users can access the Internet over DSL.[50] Modems can be purchased for USD 206 or rented on a monthly basis for USD 4.60. The monthly price is the least expensive for DSL in the OECD and can be expected to tremendously accelerate the take up of broadband access in Japan.

Prior to 2001, NTT East and NTT West had been relatively slow to embrace DSL, preferring, like a number of incumbents, to market ISDN access to the Internet. This position started to change at the end of 2000. At that stage the majority of Japan's 10 000 DSL subscribers belonged to new entrants. In 2001, however, NTT East is moving aggressively to deploy DSL services and aims to sign up 1 million subscribers by the end of 2001.[51] If NTT East accomplishes this target, and NTT West together with other companies match this performance in total, it is possible that Japan may have more than 2 million subscribers by the end of 2001. To assist in achieving this target NTT, in July 2001, made a 6% reduction in DSL rates. This follows price cuts at the commercial launch of service in December 2000. Coinciding with the commercial launch of Softbank's DSL service a further reduction of 18% was announced for October 2001.[52] The company is also racing to upgrade its networks. By the end of March 2002 the service area for these services will be expanded to cover almost the entire country.

One of the leading reasons NTT initially stepped up the pace of DSL deployment was the competition the company was facing from cable networks. The penetration of cable television networks in Japan has been steadily increasing over recent years. Jupiter Telecommunications broadband network, for example, could service just over 4 million households with cable Internet access by the beginning of 2001. The increase in availability of service has led to a greater penetration rate and a higher growth rate for cable modem services to the end of 2000. In 2000, Jupiter Telecommunications' broadband Internet service subscribers reached 141 500 up from 12 900 in 1999.[53] At that stage, the overall penetration of cable modem services was well ahead of DSL. On the other hand more recent developments in the reduction of pricing of NTT's DSL service are clearly related to the competition the company is experiencing from other operators using its local loop. It is worth noting that new entrants, such as Softbank, do not price services in relation to other pre-existing telecommunication services (*e.g.* leased lines, ISDN) as do incumbents.

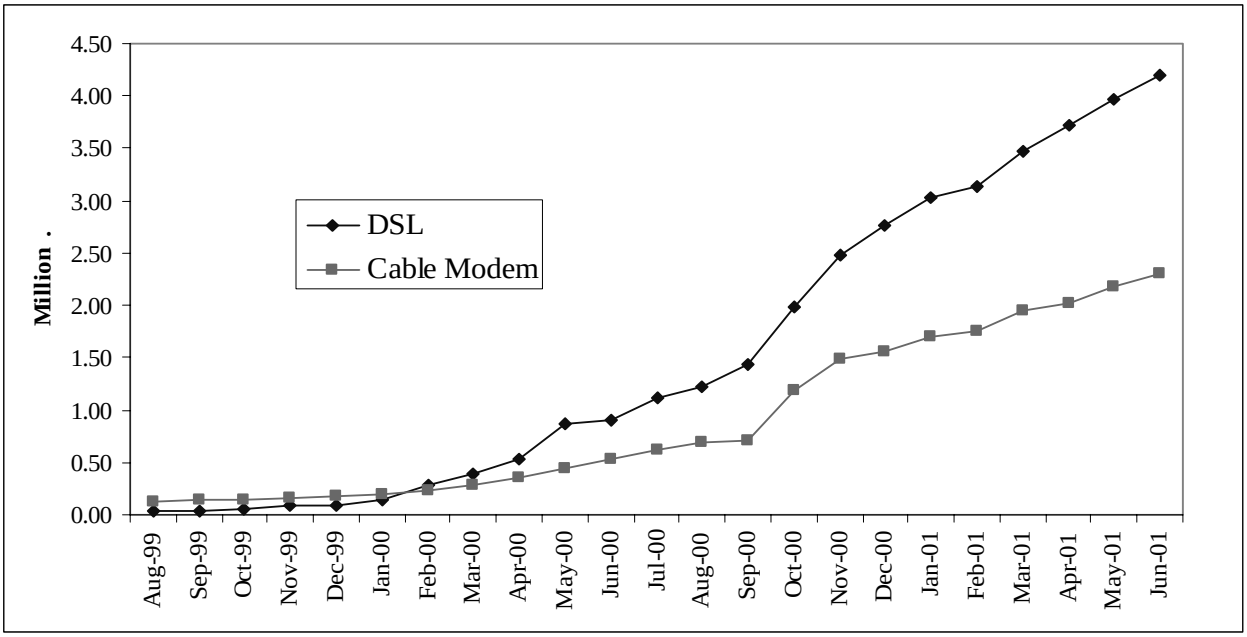
At the end of 2000 Japan ranked 11th in the OECD in terms of broadband penetration. At that stage, this was almost entirely due to the efforts of the cable networks. NTT's operating companies have stated goals to redress this situation, further progress can be achieved with unbundling local loops and line sharing. As with all OECD countries it is no longer possible for one telecommunication carrier to solely provide the pace of development required to meet broadband goals. One example in Japan is provided by the new entrant *eAccess*.[54] At the end of March 2001, *eAccess* had connected 16 000 subscribers and aims for 200 000 by the end of 2001.[55]

For its part NTT has announced some of the most ambitious targets for any incumbent operator. NTT aims to make DSL service available to almost the entire country by March 2002. The company also aims to roll out very high speed (10 Mbps-100 Mbps) fibre optic connections to end users in major cities by March 2003 and small cities by March 2005. By mid 2001, the number of subscribers to fibre optic cables was approximately 300. The number of fixed wireless broadband subscribers was 910 at the end of March 2001. Competition is also bringing about changes in the traditional 'supply push' concept of telecommunications development to one which is demand driven. Henceforth, NTT East and NTT West say they "…will effectively deploy optical fibres based on the actual demand for services in individual areas, without sticking to the old concept for planned infrastructure development."[56]

Korea

In terms of broadband access to the Internet, Korea is by far the leading performer in the OECD area. In February 2001, Korea's broadband penetration passed 10 subscribers per 100 inhabitants – at that stage more than double the next best performing country. In the first six months of 2001, Korea added 1.4 million DSL subscribers and 750 000 cable television subscribers (**Figure 5**). This lifted the national broadband penetration rate to 13.9 subscribers per 100 inhabitants. Accordingly, for countries that want to be among the leaders, projections and performance in the roll out of high speed Internet access are likely to be measured against Korean benchmarks for the next several years.

Figure 5. Trends in broadband access in Korea



Source: KR NIC.

To place the Korean growth rate, for broadband, in perspective it is useful to compare growth in the service with another dynamic service, such as cellular mobile communications. In reaching more than 6 million subscribers, in around two years, Korea has accomplished a penetration rate that took the mobile sector some 13 years to reach in that country.

The success being experienced by Korea in the roll out of high speed Internet access is due to competition between companies, different technologies, and infrastructures. There are multiple companies competing with their own broadband infrastructure. The faster roll out of infrastructure upgrading in Korea, than other OECD countries, means that companies have a larger potential market to serve. By the end of 2000 Korea Telecom could offer DSL services to 92% of the Korean population. One factor contributing to the speed of the roll out is the high proportion of Koreans living in apartment buildings. On the other hand one of the vaunted advantages of DSL is that is uses existing copper local loops. So the advantage may be in the density of the population relative to exchanges. Yet, whatever factors are mentioned they raise just as many questions as to why development has not occurred, at the same speed, in other countries with similar characteristics. The main factor that sets Korea apart is the high level of competition between different infrastructure providers (Box 2).

Cable modem services, introduced in July 1998, were available in Korea before DSL services. In August 1999 the ratio was one DSL subscriber to every four cable modem subscribers. At that stage, the DSL subscribers were mainly Hanaro customers – a new entrant in the telecommunications market following liberalisation. Unlike many new entrants to the telecommunication market Hanaro put emphasis on the provision of multimedia services to customers rather than telephony. Hanaro began offering high-speed Internet services, over its own network, in April 1999. Hanaro's success in signing up 1.1 million DSL subscribers by the end of 2000 had a major impact on the incumbent. Although starting service later than Hanaro and the cable networks, Korea Telecom had signed up 2 million subscribers to its DSL service by the February 2001 – up from just half a million in mid 2000.

For their part Hanaro and the cable networks were also continuing to increase their number of subscribers in early 2001. Hanaro aims to double its subscriber base in 2001 to 2.1 million. If other companies match that growth rate it is possible that Korea may have something approaching 20 broadband subscribers per 100 inhabitants by the end of 2001.

To stimulate further growth Korea has decided to introduce unbundling and line sharing. A final determination on this is expected in May 2001 although the basic principles have been agreed. These services will be available to facilities-based carriers such as Hanaro, Thrunet, Onse Telecom and GNG. The Korean Government has set a target of broadband connections ranging from 155 Mbps to 5 Gbps to be nationally available by 2005.

Box 2. Korea: Is IP telephony the reason for the broadband boom?

Various factors have been forwarded to help explain the remarkable growth of broadband access in Korea. The ITU has noted that the popularity of IP telephony may have played a role.[57] Serome Technology introduced its 'DialPad' service in Korea in January 2000. In its first month 950 000 users signed up and the number increased by 300 000 per month for the rest of the year.[58] The ITU report that by December 2000 some 4.3 million users had signed up for the service. Other IP Telephony companies also began offering services in Korea throughout 2000. One of the major attractions of the Dial-Pad service was that it offered free PC to PSTN Phone calls. The IP telephony companies also offer heavily discounted PC to PSTN Phone international calls. DialPad's PC to PC international calls are free.

Several features of broadband access lend themselves to the use of IP telephony. DialPad's 'presence technology' allows users to signal that they are online to other users. When this feature is combined with the 'always on' capability of DSL and cable modem services it removes one of the barriers to PC to PC use of IP Telephony. A second advantage of broadband access is the higher quality and improved performance it enables. In December 2000, DialPad introduced video IP telephony as part of its service.

In Korea the low cost of IP telephony is an obvious attraction over the cost of PSTN calls. In addition the rapid increase in the use of IP Telephony closely correlates with the boom in broadband access, and the latter technology has tremendous advantages for IP telephony users. On the other hand, how much weight should be given to these factors? It would be somewhat surprising if the 'killer application' for broadband access was telephony – a service which can be adequately provided over the 'plain old telephone network'. Furthermore it raises the question of why other countries have not received stimulus from IP telephony.

In Korea some 68% of IP telephony users make less than 30 minutes of IP telephony calls per month. Expressed in purchasing power parity, a monthly DSL service will cost USD 57. On the one hand, PSTN line rentals in Korea are the least expensive in the OECD (less than USD 4 per month). On the other hand international call charges are relatively high in Korea. However it is likely that IP telephony is viewed as a bonus to the other advantages broadband access to the Internet provides. In addition, the competition provided by Internet telephony to some segments of Korea Telecom's traditional revenue base have undoubtedly been significant in that company's efforts to roll out DSL. One obvious attraction for Korea Telecom is to hugely increase the revenue from copper wire local loops (*i.e.* the revenue from DSL is large compared to the fixed line PSTN rental) and this can be used to offset decreasing revenue in other areas.

Luxembourg

P&T Luxembourg launched commercial DSL services in March 2001. By mid 2001 there were just under 7 000 DSL subscriber lines in Luxembourg. P&T provides cable television networks in Luxembourg and this has contributed to the late development of cable modem and DSL services in that country. Visual Online and Cegecom both plan to commence DSL services in late 2001 with services in the largest cities.

Aurora, a multimedia company based in Luxembourg, plans to introduce high speed Internet access over cable networks by the end of 2001. Eltrona has a cable modem trial called 'TVSurf' in the municipality of Bonnevoie.

Mexico

Although Mexico has a relatively low penetration of cable television networks it has been via that platform that the first high speed residential Internet access services have been made available. In November 2000, Megapo launched high-speed broadband Internet access services for its subscribers in five nodes in the Cuernavaca system, and is planning to launch United's European-based 'Chello' broadband ISP service in 2001.[59] Cable California, the Mexican operation of Las Americas Broadband, Inc. offers broadband services targeted at residents of Tijuana, Mexico. Cable California's "OPTI NET" is the company's Internet access service. The service is bundled with a premium cable television service and includes unlimited Internet access.

Telmex launched its DSL service, under the brand name Infinitum, in August 2001. In part, the relatively recent start may be because there was no readily available platform to offer competition to Telmex for high speed Internet access. In fact Telmex, via America Movil, owns 49% of Cablevision a leading cable television network. In 2001, Telmex is spinning off America Movil and there will be no cross ownership, although initially they will have the same group of shareholders. Telmex says America Movil is expected to divest all or a portion of its ownership in Cablevision.

Although Telmex opposes unbundling the company has announced it is considering line sharing.[60] Telmex has held discussions on line sharing with other telecommunication carriers wishing to offer DSL, but launched its own service in advance of agreements over wholesale services being available.

At the end of 2000, Mexico was ranked 24th in terms of broadband penetration and is only ahead of those countries where commercial service had not yet been deployed by the end of 2000. In the absence of any competitive infrastructure, alternatives such as unbundling and line sharing become an even more attractive option for Mexico. If unbundling or line sharing do not proceed apace, the roll out of DSL services will largely be determined by Telmex.

Netherlands

The Netherlands has one of the highest penetration rates for cable television networks in the OECD area. Only Belgium and Luxembourg have a greater percentage of households passed by cable and only Belgium has a higher penetration rate for subscribers. In recent years a considerable amount of investment has been put in place to upgrade these networks for high speed Internet access. This was assisted by the divestiture of KPN's cable network at the end of 1997. KPN is the telecommunications incumbent.

Accordingly, at the end of 2000 the penetration of cable modems services in the Netherlands was second only to Canada and Korea. Like the other two countries it might be expected that this development would have spurred the incumbent telecommunication carrier to roll out DSL services. However by the end of

2000, KPN only had around 15 000 DSL subscribers. As with a number of other countries one reason for this relatively late start may have been KPN's commitment to ISDN. In 2001, however, the gap between theory and practice is closing and DSL service is beginning to take off.

KPN commenced DSL service in mid-2000 in three cities: Amsterdam, Rotterdam and Utrecht.[61] The company plans to cover all metropolitan areas in the Netherlands by the end of 2001 when the potential customer reach will be between 3 and 4 million people. The 15 000 DSL subscribers at the end of 2000 was lower than KPN had originally forecast. The company attributed this to technical difficulties and the lack of 'plug and play' modems. Notwithstanding this, by the end of the first quarter of 2001, KPN had reached its year-end target of 60 000 subscribers. At that stage some 75% of new DSL services were 'self install' and this increased to 85% in the second quarter of that year. At the end of June 2001, KPN reported 84 000 DSL subscriber lines were connected to its customers. KPN projects it will have between 300 000 and 500 000 customers by the end of 2001.

KPN offers wholesale DSL lines to ISPs for USD 21 per month and ISPs add their Internet subscriptions to the charges for end users. KPN introduced a 'do it yourself' installation package in September 2000. By January 2001 five ISPs were marketing KPN's service. Lines are also made available to competitors for business customers. Telecom Italia's broadband subsidiary, in the Netherlands, aims to connect 100 000 DSL lines to its network. Target clients include large wholesale end-users, Internet and application service providers, and small and medium-sized enterprises.

Ranked 6th in the OECD by broadband penetration at the end of 2000, the Netherlands is well placed for a rapid expansion of broadband access. Policies have been developed for open access to both the PSTN and cable networks. The early divestiture of cable networks by the incumbent telecommunication carrier has also played an important role. As a result there is widespread penetration of cable networks offering high-speed services in direct competition with each other.

New Zealand

The arrival of cable television networks is relatively recent in New Zealand. In mid-1998, Saturn launched Internet/data services via cable modems to the business market and began offering residential dial-up Internet/data services in November 1998. In February 2000, Austar United agreed to form TSL, a 50/50 joint venture between Saturn and Telstra's New Zealand operation. TSL plans to create a state-of-the-art national broadband network that will include a submarine fibre backbone linking Auckland, Wellington and Christchurch before 2005. At the beginning of 2001 TSL had around 650 subscribers to its cable modem service. By June 2001 this had grown to 1 267 but this includes a number of subscribers accessing the Internet at 128 kbps over cable modems.

Telecom New Zealand (TCNZ) commenced offering commercial DSL services (JetStream) in June 1999. By November 2000 TCNZ reported that DSL services were available to about 60% of their customers. Telecom New Zealand expects to make JetStream available to 75% of all customers by the end of 2002. Significantly TCNZ report that they can connect an average of 95% of customers on exchanges upgraded for Jetstream services, who ask for the service. They have concluded from this that the distance a customer lives from their exchange is not such a factor as they first thought it would be. In March 2001, TCNZ reached 12 000 DSL subscribers and by June 2001 this had increased to 16 000. These data include some subscribers accessing the Internet, via DSL, at only 128 kbps for general services. These customers can, however, access Telecom New Zealand's games site at up to 4 Mbps.

Although the penetration rate of DSL is growing in New Zealand, it is doing so at a relatively slow rate compared to the leading countries. At the end of 2000, New Zealand ranked 17th among OECD countries in broadband penetration but by June 2001 had slipped to 19th. One reason for this may be the attractive

dial-up pricing available in New Zealand. On the other hand unmetered dial-up access is widely available in countries, such as Canada and the United States, with much higher growth rates. More likely it is the pricing of high speed Internet access that is still not attractive to the mass market. Unlike Canada and the United States, the pricing of high speed Internet access over both cable and DSL in New Zealand generally involves some metered charges.

Norway

At the beginning of 2000, cable television networks passed just under half of all households in Norway. At first glance this would appear to provide a significant competitive platform to Telenor for high speed Internet access. To some extent this is true but Telenor is also the second largest cable provider in Norway with a 35.6% share of cable television subscribers. The largest cable network is owned by UPC Norway with 41.5% of cable television subscribers. Accordingly, in considering the market that can be addressed by competition it is necessary to exclude those homes not passed by UPC.

For those homes passed by independent cable networks cable modems have been in use since 1999. UPC Norway launched a dial-up Internet access service in March 1998, and introduced its 'Chello' broadband service in June 1999.[62] By the end of 2000 the company had 15 000 subscribers. Coincidentally, Telenor also launched a DSL service for business users in June 1999 and by September 2000 had 350 customers. Telenor's commercial DSL service for residential users was not launched until December 2000. By the end of 2000, Norway had 943 DSL lines.

At the time of the launch, more than 20% of Telenor's network infrastructure could support DSL. The rollout first took place in the city centres of Oslo, Stavanger, Bergen and Trondheim, as well as some suburbs of Oslo. Telenor plans to extend the service to other cities and towns throughout Norway. Telenor says: "A gradual and controlled rollout of ADSL to the private market is planned for 2001."[63] Worthy of note is that at least one new entrant has indicated that it plans to use unbundled local loops in areas of low population density in the north of Norway.

Placed 14th in the OECD area, in terms of the penetration of broadband subscribers at the end of 2000, Norway has a much lower rank than is typical for that country in other telecommunication services. It seems reasonable to conclude the Telenor's position as a major owner of cable networks has meant that the incumbent was not under the same competitive pressure as if the network were independently offering services. The initial prices for DSL services are much higher than in Sweden and that is no doubt commensurate with the lower level of competitive alternatives. Bredbandsfabrikken (B2), a subsidiary of the Swedish company 'Bredbandsbolget', which has placed tremendous competitive pressure on Telia in Sweden, is planning roll out of services in the densely populated areas around Oslo. This increase in competition would be welcome. However B2 is saying that in the current economic climate it is concentrating its focus on those areas where it has already built a network and this may have an impact on its plans for expansion in Norway.[64]

Poland

Poland is one of six OECD countries in which there were no cable modem or DSL services at the end of 2000. At that stage TPSA had a trial for DSL services and commercial services were not introduced until mid 2001. By October 2001, TPSA indicated in one media report, that it expected rapid growth and had 50 000 subscribers.[65] One reason for this rapid growth has been competition provided from other infrastructure providers. Besides TPSA, DSL services are provided by a venture of local telephony operators "Telefonia Lokalna" (their commercial brand is Dialog). Dialog started to provide DSL services on March 2001 and by October 2001 had gained more than 18 000 clients. Dialog offers broadband

Internet access up to 2 Mbps. UPC passed just under 1.8 million homes with its cable network at the end of 2000. At that stage, however, the company had not launched high speed Internet access services, using cable modems, in Poland. Cable modem service was launched in 2001 and, by mid year, UPC reported 4 400 subscribers. By October 2001 there were about 10 cable TV operators in Poland providing broadband services. Aster City has about 4 500 subscribers and Toya operating in Lodz city has about 2 300 clients. All cable TV operators have about 10 000 broadband subscribers in Poland.

Although liberalisation has occurred at the local level and this is stimulating broadband development, the international PSTN monopoly will continue until 2002. In this situation adopting a policy for unbundling the local loop should be brought forward to stimulate the provision of DSL services and to spur the cable companies to increase the roll out of cable modem services.

Portugal

At the end of 2000, Portugal ranked 18th in the OECD in terms of broadband penetration. The Portuguese telecommunications market was fully liberalised at the beginning of 2000. This meant that the first competition for high speed Internet access emerged on cable networks, which themselves have been tremendously stimulated by liberalisation.

Cabovisao, a subsidiary of the Canadian company Cable Satisfaction International Inc. (Csii), entered the Portuguese cable television market in 1996. Between then and the end of 2000 the company built over 3 000 km of hybrid coax-fibre distribution networks comprising 700 km of fibre optic cable. By the end of 1999, Cabovisao passed 204 000 homes. One year later, the Cabovisao network passed 399 000 homes and, by the first quarter of 2001, this had been increased to 428 000 homes passed. In 2001, a license obtained from *Instituto das Communicações de Portugal* (IPC) gave the company the right to cover Lisbon and the surrounding region, bringing their number of potential homes to 3.8 million.

In January 2000, Cabovisao launched high speed internet access over its cable network. By the end of 2000, Cabovisao had 6 120 high speed Internet access subscribers.[66] This number increased to 10 550 during the first quarter of 2000. During the first quarter of 2001, the number of subscribers to Cabovisao's telephony service increased from 1 520 to 5 397. Cabovisao also had 110 000 basic cable television subscribers, a 71% increase over the previous year, making it the second largest cable network in Portugal.

The largest cable television network in Portugal belongs to Portugal Telecom (PT), the incumbent telecommunication carrier. By the end of 2000, PT had 808 000 cable television subscribers, a rise of 17% over 1999. PT has been expanding its provision of interactive multimedia and Internet services, having established a sub-holding company designated by PT - Multimédia, SGPS, S.A. ("PT Multimedia" or PTM), to which it transferred its holdings in TV Cabo Portugal. PTM continued to roll out its cable network and at the end of 2000 had passed 2.117 million homes, 673 000 of which had two-way capacity. TV Cabo Portugal is responsible for the development of Internet access by high-speed cable modem.

Knowing that competition would first emerge on cable networks PT launched its cable modem services a year in advance of its DSL services. NetCabo, PT's broadband Internet access through cable, was launched in November 1999. By December 2000, the NetCabo service had over 18 000 subscribers, reaching a penetration of 5% in those areas where the service is available. This number was more than double the 8 826 subscribers the company reported at the end of the third quarter of 2000. At the end of March 2001, NetCabo had just under 30 000 subscribers.

Portugal Telecom launched DSL services in December 2000. The company had 7 500 registrations of interest in the service by mid-December and around 1 000 subscribers by the end of the month.[67] These services are marketed by PT Prime and Telpac to end customers.[68] PT Communicações has a wholesale

offer available to other operators and providers of telecommunication services on the same terms as offered to PT Prime and Telpac. In 2001, local loop unbundling is also being introduced. During 2001, ADSL will cover 70% of the city of Lisbon and 60% of the city of Porto, representing a nation-wide coverage of 50%.

Portugal's high speed Internet access has been kick-started by infrastructure competition in the cable sector. The liberalisation of the telecommunications market has added impetus to rolling out networks, by allowing new entrants to offer telephony in addition to cable television and Internet services. However the incumbent telecommunication carriers ownership of the largest cable television network and the PSTN, mean that DSL is being developed at a slower pace than might otherwise be the case. If PT Multimedia was a separate company, then direct competition between the largest cable network and DSL services would be able to develop and Portugal's broadband penetration would increase at a much faster rate. The other significant development is the introduction of unbundled local loops. Following a decision by the regulator, in June 2001, Portugal Telecom has published its offer for unbundled local loops.[69]

Slovak Republic

Slovak Telecom has a monopoly over the provision of PSTN infrastructure until January 2002. Accordingly, there is currently no competitive pressure on Slovak Telecom to roll out a commercial DSL service. UPC passed just under 300 000 homes, with its cable network, at the end of 2000. At that stage, however the company had not launched high speed Internet access services, using cable modems, in the Slovak Republic.

The full liberalisation of the Slovak telecommunications market in 2002 is a necessary step in developing broadband services. For a country with no broadband services local loop unbundling becomes even more of a priority to kick-start development.

Spain

The largest provider of broadband access to the Internet in Spain is Telefonica, the incumbent telecommunication carrier. Telefonica launched DSL services in 1999 and by the end of that year had nearly 5 000 subscribers. By the end of 2000 this had increased to 47 950. By June 2001, Telefonica had 157 702 DSL lines connected in Spain and in the following two months added an additional 40 000.

Telefonica's goal is to have 1 million DSL subscribers by 2002 to 2003. By the end of 2000 the company reported that 12.5 million access lines were capable of providing DSL services. Noteworthy is that Telefonica also report the capabilities of their DSL enabled lines. Telefonca say that they have passed 74% of households with 2 Mbps capability. A further 58% of households have 4 Mbps capability and 53% have 6 Mbps capability. This is important in terms of the services the company wishes to offer. For example, Telefonica say that 4 Mbps to 5 Mbps can provide video and television quality at current levels.

The development of cable networks in Spain has been relatively recent. At the beginning of 2000 around 10% of households in Spain were passed by cable networks. During the initial licensing process, Telefonica and an independent operator were given a licence in each of the 43 franchise areas. A condition of Telefonica's licence was that it could not build cable infrastructure for two years. Subsequently Telefonica decided not to construct cable networks and to focus on DSL. Accordingly, without the additional competition this may have provided, investment in cable networks has been slower in some franchise areas than might have been expected. The launch of DSL services and unbundling will both provide a competitive spur to the roll out of cable networks.

ONOLab Internet is the largest provider of broadband Internet access over cable networks. ONOLab launched its cable modem service in Valencia in November 1999.[70] ONOLab Internet, a subsidiary of the ONO Group, provides high speed Internet access to its franchise areas which comprises 4 million homes and 270 000 businesses representing 23% of homes and 18% of businesses in Spain. At the end of 2000 ONOLab had 13 459 Internet broadband access subscribers, up from 303 at the end of 1999. This number had increased to 25 664 by the end of June 2001. The other large cable group is Auna in which Telecom Italia has a 27% share of ownership.

At the end of 2000 Spain was ranked 20th in the OECD in terms of overall broadband connectivity. If Telefonica meets its targets for growth there would be 2.5 DSL subscribers per 100 inhabitants by 2003. For Spain to have a significantly higher penetration of broadband, new entrants will need to advance the use of unbundled local loops and the cable networks accelerate the rate of availability and take up of cable modem services. The other potential source of competition, particularly for access to small and medium-sized enterprises, is high-speed wireless access. Spain awarded six fixed wireless licences in March 2000 and some of these licensees have commenced services in limited areas.

Sweden

At the end of 2000, Sweden ranked 4th in the OECD area in terms of broadband penetration. The country is home to some of the most innovative broadband developments in the OECD area. The leading technology used to connect users at the end of 2000 was neither cable modem nor DSL.[71] The broadband technology connecting the largest number of subscribers was Ethernet LANs or so called 'property networks'. At the end of 2000, these networks connected 80 000 subscribers. By June 2001 they connected in the vicinity of 200 000 subscribers. The additional competition brought to the market via these networks has meant that Sweden has some of the lowest prices for broadband access in OECD area.

As with the other Nordic countries, where DSL and cable modem growth is slower than might be expected, Sweden's incumbent telecommunications carrier owns a cable television network. Telia's cable network (ComHem) is the largest cable television operation with around 60% of all cable television subscribers. This has meant that the strongest competitive threat to Telia has had to come from beyond the cable television sector. Moreover the uncertain status of Telia's ownership of 'ComHem' may have also impacted on Telia's commitment to the development of cable modem services. It is worth looking at the take up of Telia's cable modem services in Sweden and Denmark. In Sweden, where Telia markets DSL over its fully owned PSTN, the take up rate of cable modems is just 2.8% of its total cable television subscribers, as at June 2001. In Denmark, where Telia does not own the PSTN, the take up rate for cable modems services was 23.9% of its total cable television subscribers in June 2001. This appears to indicate that Telia is more strongly marketing cable modems where they compete independently with DSL.

Telia, as with other European carriers, no doubt took stock of its ownership of a cable network when the European Commission began to look at structural separation of telecommunication and cable networks owned by incumbents. The question was posed again, towards the end of 1999, when the European Commission made cable divestiture a condition of the proposed merger between Telia and Telenor. Although this merger did not go ahead at that time, Telia subsequently announced that it would like to sell 'ComHem'. By mid 2000, Telia said it would not sell ComHem but instead float the cable business. Telia subsequently reversed that decision and the ComHem operations were transferred to Telia Internet.

UPC's Stjärn cable network launched Internet services in one area in the City of Stockholm in April 1999, and introduced the 'Chello' broadband service in November 1999. High speed Internet services had been offered to approximately 75 000 connected homes, with 33 100 subscribers by the end of 2000. As of this date, Telia's cable television network had 22 000 cable modem Internet subscribers. Telia also had 40 000

subscribers connected to its DSL and high speed LAN networks. During the six-month period to June 2001, the number of DSL and LAN connections grew by 80 000 to 122 000, of which 14 000 were delivered to operators and service providers outside of Telia.

One of Telia's most innovative rivals is Bredbandsbolaget (B2). B2 provides broadband communications at 10 Mbps per second fibre-optic network access, and related broadband services primarily to residential as well as small and medium-sized business customers. B2 is currently rolling out a fibre-optic network linking key metropolitan areas in Sweden and Norway. Within metropolitan areas, B2 is extending fibre-optic networks to customers' buildings and switched Ethernet networks within customers' buildings.

B2 was founded in 1998 and had its network installed in 67 400 homes as at 31 October 2000. By January 2001, B2 was connected to 103 000 homes. An important part of B2's service is that it provides high speed symmetrical capabilities for users. B2 encourages users to host multi-media content and become their own 'webcasters'. This is in stark contrast to the policies of many DSL and cable operators who set limits on the amount of content that users can upload to discourage them running servers. In the first half of 2001, B2 increased its subscribers from 12 000 to 32 000.

Sweden has the highest penetration of broadband networks among the Nordic countries and some of the most innovative broadband services available. However these developments are relatively recent and the control of the country's largest cable television network by the telecommunication incumbent has narrowed the competitive platforms available. Although Sweden has among the lowest prices for DSL access in the OECD area, it should be noted that Telia has announced price increases. In September 2001, Telia says it will increase the price for DSL services to individual households by 30%. This is the segment in the market in which Telia faces no competition from B2 (which only serves apartment buildings).[72] The difference between the new price for DSL services to individual households, and the price Telia entered the market for apartments against B2, represents a 63% increase. It is the individual household segment of the market that would benefit from more competition being available if Telia's cable network was independently owned.

The Swedish government has a goal of ensuring that broadband connectivity reaches 98% of towns and villages by 2004. Between 1999 and 2001, Sweden's national fibre network increased by 13 000 kilometres and the number of communities and neighbourhoods connected quadrupled. For its part Telia say that 90% of the Swedish population live within 4 kilometres of an exchange and can therefore be served by DSL. By February 2001, Telia had upgraded 700 of its 7 200 telecommunication exchanges so that they could support DSL technology.

Switzerland

Switzerland has a well developed cable network. By the end of 1999, some 72% of households were passed by a cable network. The largest cable company is Cablecom with just over half of all cable subscribers. In December 1999, NTL purchased Cablecom from Veba, Siemens and Swisscom, the incumbent telecommunication carrier. In announcing the sale Swisscom said the network was not part of its strategy for delivering new services. Accordingly, Cablecom did not launch cable modem services until it was under its new owners in 2000. By the end of 2000, the number of Cablecom high speed Internet subscribers had grown to 27 000. In the first quarter of 2001, Cablecom increased that number to 35 100.

Swisscom launched its own DSL service in October 2000 and gained around 4 000 subscribers in the two months to the end of the year. To stimulate growth, in February 2001 Swisscom reduced charges for DSL service. Reductions of 44% applied to the 256 Kbps access speed and 53% to the 512 Kbps access speed.[73] The one-off connection charge was also reduced. 'Swisscom Wholesale' stated the price reductions were

aimed at helping the new technology to take hold and encourage Switzerland's 300 Internet service providers to develop the service. By June 2001, Swisscom had between 15 000 and 20 000 wholesale DSL ports in operation. Bluewin, Swisscom's own ISP, had around half of these DSL lines for its own customers.

At the end of 2000, Switzerland ranked 12th in the OECD in terms of broadband Internet access. Development of these services has been relatively recent but the potential growth has been boosted by separation of the incumbent telecommunication carrier from the leading cable network. Competition between the two platforms is already evident in major price reductions for DSL service. Unbundling appears to have stalled. In March 2001, the highest court in Switzerland ruled that the Swisscom local loop should not be opened to competition immediately.[74] An application by diAx for provisional opening was turned down by the highest jurisdiction.

Swisscom has vigorously opposed local loop unbundling.[75] Swisscom argues that unbundling would place "jobs and basic public service in outlying areas in jeopardy."[76] They argue this would occur because "…competitors would cherry-pick the most profitable customers in the agglomerations" and that if Swisscom "…loses these lucrative areas, it will be difficult for us to sustain a first-class service in less densely populated regions."[77]

These arguments are reminiscent of those that incumbent carriers used to oppose the introduction of competition for telephony. The assertion then being that competition would threaten universal service. They were subsequently shown to be erroneous, in all OECD countries, where liberalisation has occurred. The argument appears to be even more dubious in the context of expanding access to broadband services using DSL. In Switzerland DSL penetration is 0.06 per 100 inhabitants rather than being at universal service levels. The real question is what is going to drive the expansion of service. All the available evidence indicates that competition is the tool that will best accomplish this goal and unbundling is a mechanism that can be applied to hasten that process.

There are additional factors that make the roll out of DSL very different from discussion of PSTN service. One is that there are currently technical limitations on the distance users must be from exchanges to be served by DSL. Although the distance from telecommunication exchanges is expanding DSL is currently not a technology that can serve very remote users. In any event DSL development should not, as is implied by the Swisscom objections to unbundling, be funded by internal cross subsidies.

Swisscom has launched DSL services in seven Swiss towns in October 2000 and by February 2001 this had increased to 25. This expansion in service availability is being driven by competition. Just as important are the competitive pressures that will drive the take up of the service. For its part Swisscom say they expect the number of DSL lines to be around 45 000 by the end of 2001. Beyond that, they project the market for broadband access will reach 500 000 subscribers by the end of 2003. The company aims to win half that market with its own customers and through making a wholesale DSL offer available to other service providers. The question this raises is whether this growth rate is fast enough to meet the goals that policy makers have for broadband access.

Turkey

Turk Telecom launched DSL services in early 2001. Turk Telekom's prices for DSL are expensive compared to other OECD countries. The pricing, for example, for a DSL connection with a 256 Kbps downstream connection (64 Kbps upstream) was USD 68.71 per month (USD 137.42 expressed in purchasing power parities). The price for the same service with a 512 Kbps downstream speed (128 Kbps upstream) was USD 209.82 per month (or USD 419.63 expressed in PPPs). A less expensive DSL service is available but this option only provides access speeds comparable to ISDN performance. Turk Telekom's most basic offer for DSL is for 128 Kbps downstream access and 32 Kbps upstream.

As Turk Telecom has a monopoly over the provision of telecommunication infrastructure there is currently no opportunity for competition to bring down the extremely high prices for DSL service. This means that the only users of such a service are likely to be business users that are looking for a less expensive substitute for leased line Internet access. For its part, the incumbent carrier has little incentive to undercut the pricing for its existing leased line services.

Turkey has only a low cable television network penetration. Six cable television companies build and operate networks but the infrastructure is owned by Turk Telecom. Turk Telecom receives a share of revenue of the cable companies. If Turk Telecom divested its cable ownership this could provide a platform for the competitive provision of cable modem Internet access.

United Kingdom

At the end of 2000 the United Kingdom ranked 22nd in the OECD in terms of broadband penetration. This ranking is lower than might be expected given the early roll-out of infrastructure competition in the United Kingdom. In terms of both cable networks and DSL this suggests the focus of the companies involved has been elsewhere. In the case of the cable companies the priority has been on expanding their networks with NTL, for example, investing over USD 11 billion since 1993 in building its network infrastructure. At the same time there has been tremendous industry consolidation in the cable sector. At the beginning of 2001, mergers and acquisitions meant there were only two major cable operators in the United Kingdom – NTL and Telewest.

NTL launched cable modem services in April 1999 and Telewest in March 2000. In the absence of a competitive product from BT the initial prices were relatively high and service levels only needed to exceed those of ISDN. When, for example, NTL announced it would launch cable modem services it said the access speed would be set at 265 Kbps which was only around twice as fast as ISDN Internet access.[78] The speed of NTL's cable modem services was later increased to 512 Kbps. At the same time the prices for NTL and Telewest cable modem services are far lower than their launch prices. Cable modem services in the United Kingdom are now priced 50% less than at the time of launch.

The reductions in price have all occurred after the launch of BT's DSL service. Although some of the pricing was already less expensive than BT's prices at the launch of its service the cable companies are now clearly focusing on an expansion of broadband Internet access. Following price reductions, in February 2001, NTL's offer of high speed Internet access for USD 27.85 per month is among the least expensive in the OECD. In May 2001, Telewest reduced the price of its cable modem service by 25% to USD 34.83.

Some 12 million homes are covered by NTL's fibre-optic broadband network, which covers over 50% of the United Kingdom. In London, NTL is trialing a 'fibre-to-home' service which brings 'Ethernet' speeds of up to 10Mbps to the home. As a major shareholder in Sweden's Bredbandsbolaget, the company can also draw on that experience. At the end of 2000, NTL had 12 800 high speed Internet subscribers. At the same date, Telewest had 6 893 high speed Internet subscribers. In the first half of 2001, NTL increased cable modem subscribers to 45 750. Telewest announced it had 38 000 cable modem subscribers at the end of June 2001.

In many respects, the penetration of cable modems by 2001 was disappointing given the pioneering development of local infrastructure competition for telecommunication services in the United Kingdom. However it needs to be borne in mind that while the market was open, in practice there were only two major platforms passing most households. The original regional franchises meant the cable companies concentrated on building networks in their service areas during the 1990s, rather than competing with each

other. Moreover the consolidation of industry players meant that a number of the cable companies did not focus on broadband Internet access prior to being taken over. In addition some companies did not have an incentive to develop high-speed access services lest, like the incumbent, they undercut the market for ISDN and leased lines. In other words, due to early liberalisation, cable companies in the United Kingdom also provided PSTN based services over their own networks.

BT, like many other incumbents with large investments in ISDN, preferred to emphasise this technology in preference to introducing DSL as long as possible. With unbundling on the horizon BT's DSL service was launched in July 2000. By the end of 2000, BT and other companies using its network had 27 000 DSL subscribers. Kingston Communications, operating in the Hull region, had around 5 000 DSL subscribers by that date, having launched service at an earlier date. Although BT's commercial service was later into the market than Deutsche Telekom and France Telecom its growth rate has been higher in the first six months.

By June 2001, the number of BT's DSL subscribers had grown to 70 000. Kingston Communications had increased its DSL subscribers to around 10 700. At that stage BT was provisioning one new exchange each day for DSL. However BT had not introduced 'plug and play' modems during the first three quarters of 2001. Accordingly, in mid 2001, BT's DSL service was charging USD 221 for installation provided by a BT installer. In addition retail prices remained at the level they were at the launch of the service (*i.e.* USD 55.66 per month). Thus, it would appear that by early 2001, the launch of BT's DSL service had a bigger impact on the cable providers than vice versa.

The foregoing is likely to change rapidly. For its part BT can not allow the cable networks, given their extensive reach, to continue to undercut their prices. The impact of price reductions was evident in the number of cable subscribers growing twice as fast as the number of DSL subscribers in the first half of 2001. NTL's goal, for example, is to have 100 000 broadband Internet subscribers in the United Kingdom by the end of 2001.

At the end of 2000 BT reported they had enabled 681 exchanges for DSL and they had upgraded 1 000 exchanges by October 2001. This means the company can market DSL to a greater number of its customers. In addition the introduction of plug and play modems will reduce the initial cost to users of obtaining DSL service – as has been the case in other countries. BT conducted technical trials using self-installation modems from April 2001. BT Wholesale expects market trials with self-install modems to commence in December 2001. BT say this should lead to lower connection and rental charges from January 2002. In September 2001, BT halved the wholesale rate of its DSL installation and reduced the monthly wholesale rental charge by USD 7.23. This should lead to DSL pricing being more competitive with that for Internet access via cable networks and rapidly increase the number of DSL subscribers from its 100 000 base in October 2001.

Unbundling can be expected to increase the availability and competitiveness of broadband offerings. Oftel says that by the end of March 2001, unbundling of the local loop was proceeding smoothly after a 'very complex' and 'highly interventionist' process.[79] That being said Oftel has also called for stronger powers to ensure the incumbent acts in accordance with its determinations. In addition, Oftel's monthly updates on the progress of local loop unbundling make clear that many issues are still being worked on by industry participants and the regulator.[80] In August 2001, Oftel announced it was proposing BT should pay USD 14.56 for each working day an unbundled loop is unavailable and USD 116.52 per operator for each working day's delay in providing facilities for locating equipment in its exchanges.[81]

BT had 50% of households connected to a DSL enabled exchange (11.5 million households) by the end of 2000. BT increased coverage to 60% (13 million households) by the end of September 2001. Approximately 70-75% of households currently connected to DSL-enabled exchanges are sufficiently close to the exchange to receive ADSL service. Over 90% of households connected to DSL-enabled exchanges are expected to be sufficiently close to the exchange when BT introduces the rate adaptive modem later in 2001.

United States

The United States is the largest market for broadband services in the OECD and ranked 3rd in terms of overall broadband penetration at the end of 2000. At that stage, the United States had 3.7 million cable modem subscribers and 2.4 million DSL subscribers.

The key event in recent developments in the United States, is undoubtedly the passage of the Telecommunications Act of 1996. Since that time the cable industry has invested USD 42 billion to deploy broadband infrastructure in order to offer a wide array of advanced services, including digital video, digital music, high speed access to the Internet, and telephony.[82] These upgrades involve rebuilding more than a million miles of cable networks. At year-end 2000, this upgrade was approximately 75% complete.

While some have been impatient with the pace of local competition, it gained momentum in 2000. At the beginning of 2001 the cable industry served 1 million residential cable telephone customers, up from 200 000 at the beginning of 2000. Cable companies also provide more than 2 million telephony lines to business customers. Overall CLECs now claim 8.5% of the local telecommunication market with 16.4 million lines in service.[83]

That being said, for cable networks, it is in the provision of high speed Internet access that the fastest momentum has built. In March 2001, five years after the passage of the Act, cable networks added their 4 millionth high-speed Internet subscriber – more than double the year-end 1999 total of 1.6 million. At the end of 2000, some 64 million homes were eligible to receive cable modem service, equal to 59% of all North American homes passed.[84] Just as important has been the impact of this development on incumbent telecommunication carriers.

The cable industry likes to point out that DSL technologies have been available for more than a decade but have only been developed due to the competition they have provided to telecommunication carriers.[85] In 1999, the United States Council of Economic Advisers concurred noting that "…the incumbents decision to finally offer DSL service followed closely the emergence of competitive pressures from …the entry of new competitors…".[86] Although it is not clear, prior to the take off in Internet use, that there was sufficient demand from residential users for high speed connections it is certain that competition has driven growth since that time. In the residential market cable operators have spurred incumbents to offer DSL. In the business market it was pressure from CLECs that provided this spur. Without competition incumbent DSL services would not have been developed as fast as they have been because they have undercut the market for more expensive ISDN and local leased lines provided to business users.

At the end of 2000 four of the five largest providers of DSL service in the United States were Regional Bell Operating Companies (RBOCs).[87] At that stage, SBC had 767 000 DSL subscribers and Verizon had 540 000 DSL lines in service. In third place was Covad, a CLEC, with 274 000 DSL lines. In fourth place was Qwest (including the former US West) with 255 000 and fith was Bell South with 215 000 DSL subscribers. New entrants also provided more than 400 000 DSL lines although some had run into financial difficulties in the first half 2001. Leading CLECs in reorganisation proceedings, pursuant to Chapter 11 of the United States Bankruptcy Code, include Covad and Rythyms. Although explanations for why this

occurred at a time of increasing demand for broadband services were varied, it was clear that the telecommunication sector was becoming more like any other market.

Market exit is just as possible as market entry in the new environment. One thing that does, of course, distinguish the sector across all countries is the need for ongoing vigilance and safeguards against the abuse of dominant positions in key infrastructures. Important regulatory tools have been developed such as line sharing and unbundling local loops to facilitate new entry by service providers. The competition provided by new entrants utilising these tools is essential to drive growth in broadband access. Accordingly in May 2001, the FCC Chairman recommended increased enforcement power to open local markets to competition.[88] The FCC Chairman recommended, in testimony before the United States Congress, that the maximum penalty the Commission may impose on common carriers violating local competition provisions of the Telecommunications Act of 1996, be increased from the statutory limit of USD 1.2 million per violation to at least USD 10 million per violation. The 1996 Act required the regulator, the FCC, to monitor the deployment of broadband and determine whether broadband is being provided to all Americans in a reasonable and timely way.

Some analysts noted that incumbents raised retail prices for some DSL services during 2001, as some new entrants focused on marketing to existing deployments rather than continuing to expand into new areas.[89] Wholesale rates for unbundled local loops did not rise. For the incumbent local access providers growth continued during the first half of 2001, although some of the retail price rises did not commence until the beginning of May 2001. SBC, one of the first incumbents to raise retail prices for DSL, increased its number of subscribers by 35% to just over 1 million. Verizon grew its customer base by 56% to 840 000 lines and Bell South increased 77% to 381 000 lines. Qwest increased its DSL subscriber base 41% to 360 000 lines. However, growth rates for some of the leading CLECs slowed and some of the largest new entrants providing DSL services filed for bankruptcy protection.

In the United States, the largest new entrant providing DSL lines is Covad. It is worth noting how this company's subscriber growth is occurring, how it is using regulatory developments such as line sharing to assist this growth and that regulatory safeguards are still critical. At the end of June 2001, Covad reported that it had 360 000 DSL lines in service, a 22% increase from the 274 000 at the end of 2000. Through access to local loops Covad's network currently covers more than 40 million homes and businesses and reaches approximately 40 to 45% of all United States homes and businesses. Also significant is the growth in use of shared lines. In the third quarter of 2000 Covad added just 400 shared lines. In the fourth quarter of 2000 the company added 17 000 shared lines and in the first quarter of 2001 Covad added 36 000 shared lines. Covad say that they expects the number of shared lines will increase as operational processes continue to improve with the incumbent local telephone companies. They also note that success in installing 'line-shared services' varies significantly with the different incumbent local telephone companies.[90] The next largest CLEC provider of DSL is Rythms. During the first quarter of 2001, Rythyms increased its DSL subscriber base by 24% to 83 000 but the company ceased filing data in the second quarter of 2001 when it filed for bankruptcy.

DSL Prime, a source of industry news and analysis in the United States, reports that the largest incumbent telecommunication carriers, SBC and Verizon, covering two-thirds of the United States, have committed to make service available to over 80% of subscribers in their regions by 2002. [91] In March 2001, Verizon reported the number of lines qualified for the service was nearly 30 million, or 47% of the company's access lines. At that date, approximately 42% of the households served by Verizon had access to DSL. SBC reported that it was able to reach 21.7 million customer locations, up from 12.9 million a year earlier. This figure represents more than 50% of the SBC's customer base. In most of these areas services are available from several companies using their own infrastructure or unbundled local loops.

The United States is well placed to enjoy rapid expansion of broadband access. Competition exists between different infrastructures such as those that provide cable modem and DSL services. Use of unbundled local loops and line sharing is increasing and cable networks are beginning to open to multiple ISPs. The two largest cable companies are AT&T Broadband and AOL Time Warner. At the end of 2000 AT&T had 1.1 million cable modem subscribers. AOL Time Warner's cable division had 946 000 cable modem subscribers.

AT&T Broadband began testing its multi-ISP access platform, called Broadband Choice, in November 2000, in Boulder.[92] By mid-March 2001, 300 AT&T cable modem subscribers were connecting to the Internet through four different ISPs: Juno, Earthlink, AT&T Worldnet, and Excite@Home. Towards the end of 2001, AT&T plans to launch a large commercial trial of Broadband Choice in Boston, that will include several thousand cable modem subscribers and set the stage for a broader rollout starting in mid 2002. AOL-Time-Warner is also holding trials to facilitate open access. Due to a Federal Trade Commission (FTC) order, associated with the joining of the two companies, the AOL service may not be offered over a Time-Warner Cable system until at least one other unaffiliated ISP is available to subscribers first.[93] Once AOL is launched, the system must sign carriage deals with at least two other non-affiliated ISPs within 90 days.

In addition various companies are introducing fixed wireless broadband access and direct interactive satellite broadband access. Fixed wireless broadband access provides another technological choice for users and an additional competitive platform to DSL and cable modems. On the other hand, satellite technology holds tremendous promise for serving those regions where cable and DSL services will not be made available in the immediate future. While satellites have always held potential the key technological development, being introduced in 2001, are services that do not need the PSTN to provide an upstream path.

Services using direct return path technology became available in the United States in the first half of 2001. One company providing services is DirecPC (Hughes Network Systems).[94] This service provides a downstream path of 400 Kbps and an upstream path of 128 Kbps. Apart from DirecPC a number of ISPs are reselling the service. Pegasus Broadband, for example, launched the service with a price of USD 69.95.[95] In May 2001, Earthlink launched a similar service, using the same satellite system, at the same price. While the price of satellite broadband services is currently more expensive than DSL and cable modem services, prices will decrease as more players enter the market. ‘WildBlue’ is a company that plans to deliver affordable high-speed Internet access services via satellite to homes and small offices, virtually regardless of their locations, in the United States and Canada by early 2002.[96]

A growing number of companies are launching fixed wireless broadband services. Sprint, for example, provides broadband services over fixed wireless or DSL technologies. The fixed wireless service aimed at residential users typically offers download speeds from 512 Kbps to 1.5 Mbps. Significantly, some of the initial areas, in which Sprint is offering service, did not have other broadband options.[97] In Fresno California, for example, service was launched in January 2001. Users within a line-of-sight of the Sprint tower can technically receive service up to 35 miles away. However, the license service area for Fresno is within an 18.8 mile radius. The initial cost of equipment is USD 99 (based on a two year agreement) and the monthly charge is USD 44.95. The cost to business users is USD 199.95 per month.

In November 2000, WorldCom announced the availability of its new fixed-wireless MMDS (multichannel multipoint distribution service) high-speed Internet access service in Memphis, the company’s first commercial launch of the service in the United States.[98] By the end of 2001, WorldCom plans to rollout its fixed-wireless broadband service in 30 markets across the United States. WorldCom is focusing its fixed-wireless broadband service on small-to medium-sized businesses, apartment complexes and business parks.

Cisco forecast that 37% of households in the United States will have a broadband connection by the end of 2003.[99] For this to occur, broadband providers of all types need to add around 30 million subscribers between 2001 and 2003. This would be the equivalent of around 13 subscribers per 100 inhabitants.

DSL pricing update

The OECD undertook a preliminary comparison of DSL pricing at the beginning of 2000. In March 2001 an update of pricing was undertaken, including a greater range of countries, where services were then available. The structure of DSL pricing involves several elements.

Initial service charges

A connection charge is a familiar part of traditional communication services. It must be remembered, however, that connection charges were common in markets with monopolies or for new services where there are not many suppliers in the market. In competitive markets connection charges tend to be reduced or eliminated and the costs associated with a new service provision recouped in ongoing charges. Some examples of services where the initial service charges have been eliminated include ISP dial-up services. Indeed, it is common for some subscription based ISPs to now offer a certain period of 'free' service to attract customers.

In a number of OECD countries, where there are alternative suppliers of broadband access, any connection fees are already being waived. In March 2000, for example, there was no initial connection charge to join the DSL services of Belgacom, Bell Canada, Telecom Italia and Verizon in the United States. On the other hand in markets where there was a limited choice of suppliers connection fees were still applied.

Part of the initial cost faced by users is for the equipment associated with the communications service. The largest element of this cost is the DSL modem (others might be smaller items such as splitters). In some countries the cost of a DSL modem is included in the initial service charge such as in the case of France Telecom's service. In other countries, such as Portugal Telecom's service, the cost of the modem is treated separately and users can choose which modem they wish to purchase. Another common pricing structure is for the cost of the modem to be included in the monthly charge. For example, some 25% of the monthly charge to use Bell Canada's service is for the modem rental. By way of contrast Portugal Telecom's customers choosing not to purchase a modem can rent one at an additional charge to the standard monthly fee. In the case of Verizon, the DSL modem is free and the cost is recovered in the monthly charge.

The advent of 'plug and play' modems means that self-installation is increasingly common. This means that so called 'truck rolls', where a technician installs the service on the customer's premises, are becoming a thing of the past. This is an important development because it considerably reduces the initial cost to users of obtaining a DSL service. It is also much more convenient for the users in terms of eliminating delays or missed appointments, choosing their own installation times and so forth.

Monthly service charges

The most significant charge for users is the monthly cost of DSL service. In most countries the leading telecommunication carriers offer an unmetered service. In other words users pay one flat rate per month and this charge does not vary according to their usage patterns. Flat rate pricing plans have significantly increased usage and encouraged more efficient use of networks for Internet access.[100] In the case of DSL the phrase 'always on' is often applied. This means that there are no charges related to the duration of time

that a user is connected each month. A true unmetered service, however, also means that the amount of data a user downloads each month are also not metered.

In a number of countries although services are 'always on' users may be charged if they download more than a certain number of Mbytes each month. Countries where some element of usage charges are applied by telecommunication carriers, beyond a certain amount of downloaded data for the two lowest service speeds are: Australia, Austria, Belgium, Iceland, New Zealand, Portugal and Switzerland.

Telekom Austria's basic DSL service includes 1 Gbyte each month. In Portugal, the most basic level of DSL service includes 2 Gbytes and the medium level service includes 5 Gbytes. In Switzerland the most basic level of DSL service has 1.5 Gbytes included and the medium level of service has 3 Gbytes included. In Australia, Telstra has set a 3 Gbyte limit before additional charges are applied. In Belgium, Belgacom's basic DSL service includes 10 Gbytes per month. This is large enough to be considered 'almost unlimited'.

In some of these countries the increase in price includes a higher speed connection (downsteam/upstream) and a higher threshold after which metered pricing commences. So the increase in charges reflects two elements of service. In other cases the threshold is kept at the same level and the user is simply paying a higher charge for the increase in access speed. Telecom New Zealand applies an almost totally different model for its broadband Internet access.

Telecom New Zealand's most basic DSL product is called 'Jetstart'. Although Jetstart uses DSL the downstream speed is limited to 128 Kbps – the same level as a basic ISDN service. There are, of course, other advantages over ISDN, such as being 'always on' and having an unmetered pricing structure. In addition users of this service can access Telecom New Zealand's games site at 4 Mbps. However the higher speed is limited to gaming and not available to Jetstart users for other applications. If users in New Zealand wish to access the Internet via DSL at speeds that would be commonly considered as broadband for other services, they face a radically different pricing structure.

The next step up in Telecom New Zealand's DSL access connects users at speeds of 4 Mbps. This is among the highest in the OECD for basic service levels. Other countries with high basic speeds included Korea with speeds upward from 1.5 Mbps for basic DSL downstream access and Japan with 1.5 Mbps DSL basic downstream access. In other countries these speeds are generally reserved for options aimed at business users. The reason for this is that Telecom New Zealand's 'Velocity Jetstream' option applies the lowest threshold for downloading data. The most basic DSL service includes only 400 Mbytes per month. Each additional Mbyte a user downloads beyond that threshold costs USD 0.13. An additional feature of Jetstream is that access to New Zealand Telecom's games site is included in the monthly fee. In other words any Mbytes downloaded while playing games are not counted toward the 400 Mbyte limit.

It is Iceland Telecom, however, which has the pricing structure that is most different from other OECD countries. In Iceland all bytes that are downloaded from domestic servers are included in the monthly fee. For example if a user reads an Icelandic newspaper or listens to an Icelandic radio station over the Internet they would not incur an additional charge if that content were hosted within Iceland. On the other hand, all bytes which are downloaded from servers located outside Iceland incur a charge. So if the same user read the New York Times or listened to the BBC they would be charged according to the number of bytes generated by this activity. For each 100 Mbytes of foreign content a user downloads they would pay USD 14.00 (*i.e.* 0.14 per Mbyte). However if they downloaded 500 Mbytes of foreign content that would cost USD 24.00 (*i.e.* 0.04 per Mbyte). In other words the price continues to decrease the more foreign content a user downloads. Although distinctions between domestic and foreign content are extremely rare there are other examples. In New Zealand, for example, the cable modem provider also differentiates prices according to domestic and foreign content.[101]

The foregoing complicates comparisons of prices. Although it is relatively easy to compare flat rate monthly fees for unmetered DSL Internet access the element of usage-based charging complicates this for eight countries. This is because, to undertake a comparison where some element of metered charges apply, it is necessary to construct a benchmark for the average usage. In other words it is necessary to know how much an average user downloads in these countries before the price for service can be compared. If average usage is within the initial allowance then the thresholds become less important. On the other hand if users exceed these thresholds, and incur additional charges, this is important in any comparison with unmetered DSL options. In the case of Iceland this is further complicated by how much foreign content the average user downloads each month. In New Zealand it might depend on whether users are playing games (where there are no additional charges per Mbyte downloaded) or whether they are using other applications (*e.g.* listening to or watching webcasts) where additional charges would be incurred if they exceed certain limits.

There are very little data available on average usage patterns of broadband access. What data are available tends to be measured by online time rather than how much data the average user downloads. Australia is perhaps the only country that has national data available on how much data users download each quarter. This information is gathered by the Australian Bureau of Statistics (ABS), from a survey of ISPs. It is necessary to remember that because the penetration of broadband is low, the figures would mainly relate to dial-up users. In December 2000, household subscribers downloaded 583 million Mbytes (average of 171 Mbytes per household subscriber). Although this is well within the thresholds of data included in basic broadband offers, it is necessary to consider that broadband usage patterns are likely to be radically different. One reason for this is improved access to multimedia, game playing and so forth that comes with broadband access. A further reason is that unmetered prices typify broadband to a greater extend than dial-up services so that average usage tends to be much higher with broadband.

Connection speed

The other element that needs to be considered in any pricing comparison is the connection speed. The lowest speed for a DSL connection is Telecom New Zealand's Jetstart service at 128 Kbps. The highest speed aimed at residential users, for a metered DSL service, is also in New Zealand at 4 Mbps. That being said, Korea Telecom advertises that users can expect download speeds of between 1.5 Mbps to 8 Mbps. In Japan DSL providers also offer 1.5 Mbps as the basic level of service. The main difference between Korea and Japan compared to New Zealand, is that Telecom New Zealand's higher speed offers are subject to download thresholds, after which users pay metered charges.

There are 12 countries in which 256 Kbps is offered as the most basic download speed. The most common download speed on offer is 500 to 512 Kbps, albeit in a number of countries this attracts a premium price rather than being included in basic offering. In some countries the speed on offer varies according to the type of dwelling. The rates included for Verizon for example, are its standard tariffs for DSL to individual dwellings. The company has other offers with higher and lower speeds (and higher and lower prices) aimed at users in apartment buildings.

Impact of competition on pricing

Competition has the ability to impact on various aspects of service in respect to DSL. The first is the connection speed, the second is the level of usage included and its 'user friendliness', and the third is the level of price.

It is significant that in the three countries with the highest penetration of broadband users the most basic speed is higher than average. In Korea the most basic DSL offer starts at 1.5 Mbps while in Canada it is

960 Kbps. In the United States Verizon's download offer is for 740 Kbps. In Germany, where unbundling is advanced, the basic DSL offer from Deutsche Telekom is also 740 Kbps. In Japan, where cable companies have a strong lead in penetration, basic DSL offers are also higher than average being 1.5 Mbps.

In general DSL offers try to match the competition. In New Zealand, Telecom's 'Jetstart', its slowest speed DSL service, is configured to compete with the cable television company Saturn's lowest speed 'broadband' offer which is also 128 Kbps. In Australia, Telstra actually lowered the speed of its most basic cable modem service to 256 Kbps from 512 Kbps when it launched DSL services. The reason for this appeared to be so that the then most basic cable offer at 512 Kbps, was not providing better value than the most basic DSL offer to be launched at 256 Kbps. This example highlights the disadvantages of one company owning both infrastructures.

A second part of service that is influenced by competition is the level of usage included and its 'user friendliness'. In competitive markets unmetered rates are typical because the market increasingly demands them. In less competitive markets usage based charges are more evident. One reason usage based charges are less 'user friendly' is that they tend to be more complicated and less predictable (even if in some cases they are less expensive for a particular usage pattern). Differentiation in the pricing treatment of domestic and foreign content is also not evident in competitive markets.

The third element that is being influenced by competition is price. As would be expected prices are lower and service levels are higher in countries where competition is highest. Measured in United States dollars, using purchasing power parities, Canada, Finland, Japan, and Sweden all have unmetered offers for downstream access at speeds greater than 500 Kbps for less than USD 40. Measured in United States dollars, using exchange rates, Korea joins this group.

In the United States, Verizon was offering DSL for USD 39.95 per month in the first four months of 2001. In May 2001, the company raised the price to USD 49.95 per month for users wanting the free installation. If new users paid USD 200, as an initial fee, they could remain on the USD 39.95 option.[102] The price existing customers pay for this plan did not change. SBC and Bell South also charge USD 49.95 for their standard DSL service.

Comparing DSL prices

Another way to compare pricing, given the range of access speeds on offer, is to weight the overall price of the DSL by the bandwidth made available. In this approach the advertised upstream and downstream speeds are added together to form the total 'bandwidth' made available to the user. This bandwidth is then divided by the monthly cost of service (*i.e.* connection cost spread over four years plus monthly fee). This comparison is available in USD (**Table 8**) and USD (PPP) (**Table 9**). For this comparison an incumbent telecommunication carrier was used in each OECD country where service is available. If one of these carrier's most basic DSL offer for downstream access was below 500 Mbps, then their second level of pricing was also included.

Using this methodology the most bandwidth per dollar spent is available in Canada, Finland, Germany Korea, Japan, Sweden and the United States. In these comparison it is necessary to remember that New Zealand and Iceland's pricing structure sets them apart from the other countries. In New Zealand, for example, prices are relatively inexpensive if users stay within their allowance. However the limits are relatively low compared with other countries with similar pricing structures making it difficult to compare the pricing.

Clearly, some of the tariffs for DSL are entry prices and will come down as competition increases and telecommunication carriers become more confident of meeting demand. On the other hand once prices reach a certain level it is possible that carriers will try to compete in performance rather than price. The range of basic level DSL speeds on offer in some countries may increase faster than the price decreases.

Comparing cable modem prices

Cable modem Internet access pricing has a similar structure to DSL pricing. One significant difference is that different prices are often on offer if users also take cable television. A selection of representative prices are available in USD (**Table 10**) and USD (PPP) (**Table 11**). One significant difference with DSL is that many cable companies do not specify the maximum upstream and downstream speeds available unless they have several options with different prices. In these cases the cable companies generally say that users should expect speeds up to 50 or 100 times faster than dial-up access. For those companies that do specify download speeds the lowest connection is 128 Kbps, while 256 Kbps and 512 Kbps are the most common. Japan's J-Com advertises the highest speed, as its standard offering, with downstream access up to 2 Mbps.

The least expensive cable modem service, at speeds up to 256 Kbps, is TDC's service in Denmark. The least expensive service, at speeds up to 512 Kbps, is NTL's service in the United Kingdom. Both options demonstrate the need to take the access speeds available into account when comparing services. If a user in Denmark chose TDC's service at speeds of 512 Kbps, they would pay much more than a user of NTL in the United Kingdom. In addition, it is necessary to take into account that some of the options shown also include metered charges if users exceed a certain threshold. This is the case for some options in Australia, France, Mexico, New Zealand, Portugal and Spain. Saturn, a cable operator in New Zealand, is the only company that differentiates between the price of domestic and international traffic.

Table 8. DSL pricing in OECD countries (USD)

	Company	Initial charge (USD)	Monthly charge (USD)	Mbytes included	Additional cost per Mbyte (USD)	Speed of connection downstream (Kbps)	Speed of connection upstream (Kbps)	Total Downstream/ Upstream Kbps per USD per month
Korea	Korea Telecom	28.53	38.04	Unlimited	0.00	1.5-*8000*	64-*640*	42.75 (*224.32*)
New Zealand	Telecom NZ	234.76	30.62	400	0.08	4 000	740	*(137.28)*
New Zealand	Telecom NZ	234.76	39.49	600	0.08	4 000	740	*(109.21)*
Japan	NTT (ACCA)	182.11	53.79	Unlimited	0.00	1 500	512	35.41
Canada	Bell Canada Sympatico	0.00	32.71	Unlimited	0.00	960	120	33.02
Sweden	Telia	153.19	26.41	Unlimited	0.00	512	400	31.49
Germany	Deutsche Telecom	48.42	42.67	Unlimited	0.00	768	128	20.61
Finland	Elisa	118.43	38.69	Unlimited	0.00	512	256	18.89
United States	Verizon	0.00	49.95	Unlimited	0.00	768	128	17.94
Belgium	Belgacom	0.00	61.30	10 000	0.17	750	128	14.32
France	France Telecom	141.70	42.65	Unlimited	0.00	500	128	13.95
Iceland	Iceland Telecom	70.63	58.86	All domestic	0.14	512	256	*12.79*
Iceland	Iceland Telecom	70.63	29.43	All domestic	0.14	256	128	*12.55*
Australia	Telstra	143.71	49.38	3 000	0.00	512	128	12.36
United Kingdom	British Telecom	221.60	59.02	Unlimited	0.00	500	250	11.96
Austria	Telekom Austria	6.75	54.52	1 000	0.07	512	64	10.54
Hungary	Matav	106.27	85.02	Unlimited	0.00	768	128	10.32
Hungary	Matav	106.27	42.51	Unlimited	0.00	384	64	10.12
Denmark	TDC (TeleDanmark)	125.13	62.75	Unlimited	0.00	512	128	9.87
Portugal	Portugal Telecom	134.79	92.16	5 000	0.03	768	128	9.49
Switzerland	Swisscom	91.46	66.91	3 000	0.06	512	128	9.35
Luxembourg	P&T	141.51	64.00	Unlimited	0.00	512	64	8.68
Netherlands	KPN	232.71	63.05	Unlimited	0.00	512	64	8.61
Spain	Telefonica	124.82	42.55	Unlimited	0.00	256	128	8.60
Denmark	TDC (TeleDanmark)	125.13	43.89	Unlimited	0.00	256	128	8.35
Italy	Telecom Italia	0.00	47.71	Unlimited	0.00	256	128	8.00
Norway	Telenor	167.37	104.29	Unlimited	0.00	704	128	7.77
Australia	Telstra	143.71	43.28	3 000	NA	256	64	7.01
Spain	Telefonica	193.55	91.41	Unlimited	0.00	512	128	6.76
New Zealand	Telecom NZ	75.84	27.65	Unlimited	0.00	128	128	8.85
Luxembourg	P&T	141.51	46.55	Unlimited	0.00	256	64	6.54
Switzerland	Swisscom	91.46	48.49	1 500	0.06	256	64	6.40
Portugal	Portugal Telecom	134.79	51.84	2 000	0.03	256	64	5.92
Norway	Telenor	167.37	87.47	Unlimited	0.00	384	128	5.67
Turkey	Turk Telekom	6.75	68.71	Unlimited	0.00	256	64	4.65
Turkey	Turk Telekom	6.75	209.82	Unlimited	0.00	512	128	3.05

1. The minimum speed is used to calculate Korea's Kbps per USD data. The results using the maximum possible speed are in italics.
2. New Zealand Kbps per USD data, and other countries with caps on included Mbytes, are only comparable if users remain below the included allowance.
3. Services were not available in Czech Republic, Greece, Ireland, Mexico and the Slovak Republic at that time.
4.The data include tax.
5. The Kbps per USD use the initial cost (spread over five years) and the monthly cost.
6. Belgacom, Telecom Italia and Verizon were waiving connection fees at the time these data were collected.
7. AUP stands for acceptable usage policy.
Source: OECD.

Table 9. DSL pricing in OECD countries (USD, PPP)

	Company	Initial charge (USD PPP)	Monthly charge (USD PPP)	Mbytes included	Additional cost per Mbyte (USD PPP)	Speed of connection downstream (Kbps)	Speed of connection upstream (Kbps)	Total Downstream/ Upstream Kbps per USD per month
Korea	Korea Telecom	43.32	57.76	Unlimited	0.00	1544-*8 000*	64-*640*	27.50 (*147.74*)
Japan	NTT (ACCA)	109.50	32.34	Unlimited	0.00	1 500	512	58.89
New Zealand (1)	Telecom NZ	367.53	47.93	400	0.13	4 000	740	*(87.68)*
New Zealand	Telecom NZ	367.53	61.83	600	0.13	4 000	740	*(69.76)*
Sweden	Telia	142.38	24.55	Unlimited	0.00	512	400	33.88
Canada	Bell Canada Sympatico	0.00	35.19	Unlimited	0.00	960	120	30.69
Finland	Elisa	114.57	37.43	Unlimited	0.00	512	256	19.52
Germany	Deutsche Telecom	53.23	46.91	Unlimited	0.00	768	128	18.75
United States	Verizon	0.00	49.95	Unlimited	0.00	768	128	17.94
Belgium	Belgacom	0.00	59.05	10 000	0.16	750	128	14.87
Iceland	Iceland Telecom	61.09	25.45	All domestic	0.12	256	128	*14.51*
Iceland	Iceland Telecom	61.09	50.91	All domestic	0.12	512	256	*14.79*
United Kingdom	British Telecom	208.97	55.66	Unlimited	0.00	500	250	12.68
France	France Telecom	159.40	47.98	Unlimited	0.00	500	128	12.40
Norway	Telenor	116.46	72.57	Unlimited	0.00	704	128	11.17
Switzerland	Swisscom	76.73	56.13	3 000	0.05	512	128	11.15
Denmark	TDC (TeleDanmark)	115.32	57.83	Unlimited	0.00	512	128	10.71
Australia	Telstra - Big Pond	182.70	62.78	3 000	0.00	512	128	9.72
Austria	Telekom Austria	7.43	59.93	1 000	0.08	512	64	9.59
Denmark	TDC (TeleDanmark)	115.32	40.45	Unlimited	0.00	256	128	9.06
Portugal	Portugal Telecom	151.45	103.56	Unlimited	0.03	768	128	8.45
Norway	Telenor	116.46	60.87	Unlimited	0.00	384	128	8.15
Luxembourg	P&T	159.18	72.00	Unlimited	0.00	512	64	7.72
Switzerland	Swisscom	76.73	40.68	1 500	0.05	256	64	7.63
Netherlands	KPN	277.94	75.31	Unlimited	0.00	512	64	7.21
Spain	Telefonica	167.72	57.17	Unlimited	0.00	256	128	6.40
Italy	Telecom Italia	0.00	62.38	Unlimited	0.00	256	128	6.16
Luxembourg	P&T	159.18	52.36	Unlimited	0.00	256	64	5.82
New Zealand	Telecom NZ	90.58	33.02	Unlimited	0.00	128	128	7.41
Australia	Telstra	182.70	55.02	3 000	NA	256	64	5.51
Portugal	Portugal Telecom	151.45	58.25	Unlimited	0.03	256	64	5.27
Spain	Telefonica	260.07	122.83	Unlimited	0.00	512	128	5.03
Hungary	Matav	269.50	215.60	Unlimited	0.00	768	128	4.07
Hungary	Matav	269.50	107.80	Unlimited	0.00	384	64	3.99
Turkey	Turk Telekom	13.50	137.42	Unlimited	0.00	256	64	2.32
Turkey	Turk Telekom	13.50	419.63	Unlimited	0.00	512	128	1.52

1. The minimum speed is used to calculate Korea's Kbps per USD data. The results using the maximum possible speed are in italics.
2. New Zealand Kbps per USD data, and other countries with caps on included Mbytes, are only comparable if users remain below the included allowance.
3. Services were not available in Czech Republic, Greece, Ireland, Mexico and the Slovak Republic at that time.
4. The data include tax.
5. The Kbps per USD use the initial cost (spread over five years) and the monthly cost.
6. Belgacom, Telecom Italia and Verizon were waiving connection fees at the time these data were collected.
7. AUP stands for acceptable usage policy.

Source: OECD.

Table 10. Cable modem Internet access prices (USD)

	Company	Plan	Connection charge (US$)	Monthly rental (US$)	Mbytes included	Additional cost per Mbyte (US$)	Speed of connection downstream (Kbit/s)	Speed of connection upstream (Kbit/s)
Portugal	Netvisao	128 Kbps*	23.42	24.59	3 000	0.01	128	128
Denmark	TeleDanmark	Webspeed2	125.13	25.03	Unlimited	0.00	256	64
Canada	Shaw Communications	Shaw @ Home	106.80	26.58	Unlimited	0.00		
United Kingdom	NTL		36.93	29.53	Unlimited	0.00	512	
New Zealand	Saturn Communications	Paradise Broadband 128	133.11	29.71	10 Gb of international traffic	0.20/Mbyte international traffic, 0.02/Mbyte for national traffic	128	128
Australia	Telstra Big Pond	Blast Off	104.87	30.49	250	0.10	256	64
Sweden	ComHem	Internet Cable	142.62	31.17	Unlimited	0.00	512	128
Portugal	Netvisao	256 Kbps*	23.42	31.61	5 000	0.01	256	128
Korea	Thrunet	Thrunet	28.29	32.85	Unlimited	0.00		
United States	Cablevision Systems Corp.	Optimum online*	108.90	32.95	Unlimited	0.00		
Canada	Shaw Communications	Shaw @ Home*	106.80	33.24	Unlimited	0.00		
New Zealand	Saturn Communications	Paradise Broadband 256	133.11	34.14	5 Gb of international traffic	0.20/Mbyte international traffic, 0.02/Mbyte for national traffic	256	128
New Zealand	Saturn Communications	Paradise Broadband Max	133.11	35.47	1 Gb of international traffic	0.20/Mbyte international traffic, 0.02/Mbyte for national traffic	512	128
Spain	ONO	128 Kbps	65.46	35.97	750	0.00	512	128
Australia	Telstra Big Pond	Freedom Standard	104.87	37.17	3 000	0.00	256	64
Hungary	UPC Chello	Chello	0.00	38.61	Unlimited	0.00	512	128

Table 10 (cont'd)

	Company	Plan	Connection charge (US$)	Monthly rental (US$)	Mbytes included	Additional cost per Mbyte (US$)	Speed of connection downstream (Kbit/s)	Speed of connection upstream (Kbit/s)
Finland	Helsinki Television	Welho	52.01	38.69	Unlimited	0.00	500 -1500	768
Switzerland	Cablecom	Hispeed: COMFORT	0.00	39.29	Unlimited	0.00	256	64
Norway	Chello	Chello	0.00	39.77	Unlimited	0.00	384	128
Australia	Telstra Big Pond	Freedom Delux	104.87	40.25	3 000	0.00	512	128
Austria	UPC	Chello*	47.08	40.26	Unlimited	0.00		
France	France Telecom Cable (Wanadoo)	Prime@accès*	48.66	40.36	500	0.29	512	128
Mexico	InterCable	CableLink 500	51.23	40.99	500	0.14		
Portugal	Netvisao	512 Kbps*	23.42	42.15	8 000	0.01	512	128
Netherlands	Casema (Wanadoo)	Wanadoo	63.91	42.39	4 000	0.00	256	96
Belgium	Chello	Chello	0.00	43.06	Unlimited	0.00		
United States	Time Warner Cable	Roadrunner	110.00	43.95	Unlimited	0.00		
United States	Cablevision Systems Corp.	Optimum online	108.90	43.95	Unlimited	0.00		
France	France Telecom Cable (Wanadoo)	Prime@accès	77.29	45.66	500	0.29	512	128
Austria		Chello	47.08	46.06	Unlimited	0.00		
Spain	ONO	256 Kbps	65.46	49.06	1 000		128	
Switzerland	Cablecom	Hispeed: Comfort	0.00	49.11	Unlimited	0.00	512	128
Japan	J-Com	J-Com@home	0.00	49.64	Unlimited	0.00	2000	128
Denmark	TeleDanmark	Webspeed2	125.13	50.18	Unlimited		512	128
Norway	Chello	Chello Plus	0.00	53.45	Unlimited		768	128
Mexico	InterCable	CableLink 1000	51.23	61.48	1 000	0.12		
Spain	ONO	512 Kbps	65.46	75.24	1 500		512	

1. The prices for options marked with an asterisk are for users also taking cable television.

Source : OECD.

Table 11. Cable modem Internet access prices (USD, PPP)

	Company	Plan	Connection charge (US$ PPP)	Monthly rental (US$ PPP)	Mbytes included	Additional cost per Mbyte (US$ PPP)	Speed of connection down-stream (Kbit/s)	Speed of connection upstream (Kbit/s)
Denmark	TeleDanmark	Webspeed2	115.32	23.06	Unlimited	0.00	256	64
United Kingdom	NTL		34.83	27.85	Unlimited	0.00	512	
Sweden	ComHem	Internet Cable	132.56	28.97	Unlimited	0.00	512	128
Japan	J-Com	J-Com@home	0.00	31.34	Unlimited	0.00	2000	128
United States	Cablevision Systems Corp.	Optimum online*	108.90	32.95	Unlimited	0.00		
Switzerland	Cablecom	Hispeed: COMFORT	0.00	32.96	Unlimited	0.00	256	64
Portugal	Netvisao	128 Kbps	32.36	33.98	3 000	0.02	128	128
Norway	Chello	Chello	0.00	34.04	Unlimited		384	128
Canada	Shaw Communications	Shaw @ Home*	132.11	35.19	Unlimited	0.00		
Australia	Telstra Big Pond	Blast Off	133.32	38.76	250	0.13	256	64
Switzerland	Cablecom	Hispeed: Comfort	0.00	41.20	Unlimited	0.00	512	128
Portugal	Netvisao	256 Kbps	32.36	43.69	5 000	0.02	256	128
United States	Time Warner Cable	Roadrunner	110.00	43.95	Unlimited	0.00		
United States	Cablevision Systems Corp.	Optimum online	108.90	43.95	Unlimited	0.00		
Canada	Shaw Communications	Shaw @ Home	132.11	43.99	Unlimited	0.00		
Austria	UPC	Chello*	51.76	44.26	Unlimited	0.00		
France	France Telecom Cable (Wanadoo)	Prime@accès*	54.74	45.41	500	0.32	512	128
Finland	Helsinki Television	Welho	50.32	45.66	Unlimited	0.00	500 -1500	768
Norway	Chello	Chello Plus	0.00	45.75	Unlimited	0.00	768	128
Denmark	TeleDanmark	Webspeed2	115.32	46.24	Unlimited	0.00	512	128
New Zealand	Saturn Communications	Paradise Broadband 128	208.40	46.51	10 Gb of international traffic	0.20/Mbyte international traffic, 0.02/Mbyte for national traffic	128	128
Australia	Telstra Big Pond	Freedom Standard	133.32	47.26	3 000	0.00	256	64
Spain	ONO	128 Kbps	87.95	48.33	750		128	
Belgium	Chello	Chello	0.00	50.19	Unlimited	0.00		

Table 11 (cont'd)

	Company	Plan	Connection charge (US$ PPP)	Monthly rental (US$ PPP)	Mbytes included	Additional cost per Mbyte (US$ PPP)	Speed of connection down-stream (Kbit/s)	Speed of connection upstream (Kbit/s)
Netherlands	Casema (Wanadoo)	Wanadoo	76.33	50.63	4 000		256	96
Austria		Chello	51.76	50.63	Unlimited	0.00		
Australia	Telstra Big Pond	Freedom Delux	133.32	51.18	3 000	0.00	512	128
France	France Telecom Cable (Wanadoo)	Prime@accès	86.95	51.36	500	0.32	512	128
Mexico	InterCable	CableLink 500	66.79	53.43	500	0.19		
New Zealand	Saturn Communications	Paradise Broadband 256	208.40	53.46	5 Gb of international traffic	0.20/Mbyte international traffic, 0.02/Mbyte for national traffic	256	128
Korea	Thrunet	Thrunet	47.26	54.87	Unlimited	0.00		
New Zealand	Saturn Communications	Paradise Broadband Max	208.40	55.54	1 Gb of international traffic	0.20/Mbyte international traffic, 0.02/Mbyte for national traffic	512	128
Portugal	Netvisao	512 Kbps	32.36	58.25	8 000	0.02	512	128
Spain	ONO	256 Kbps	87.95	65.92	1 000		256	
Mexico	InterCable	CableLink 1000	66.79	80.14	1 000	0.16		
Hungary	UPC Chello	Chello	0.00	97.92	Unlimited	0.00	512	128
Spain	ONO	512 Kbps	87.95	101.10	1 500		512	

1. The prices for options marked with an asterisk are for users also taking cable television.

Source : OECD.

NOTES

[1] ITU, "Regulatory Implications of Broadband", Geneva, 2-4 May 2001. ITU Recommendation I113: Vocabulary of terms for broadband aspects of ISDN: http://www.itu.int/itudoc/itu-t/rec/i/index.html.

[2] Michelle Donegan, "Service File: G.SHDSL - Another boost for the broadband revolution", *Communications Week International*, 19 February 2001.

[3] *Business Wire*, "Calaveras Telephone Company Trials 2Wire's ADSL Loop Extender Technology", 24 April 2001. 2wire's Website is at: www.2Wire.com

[4] Covad, "Covad Communications, NTT Communications, ACCA Networks and Ignite Japan Sign Agreement to Provide DSL in Japan", 10 August 2001. http://www.covad.com/companyinfo/pressreleases/pr_2000/081000_press.shtml.

[5] FCC, "High Speed Services for Internet Access: Subscribership as of December 31, 2000", Industry Analysis Division, Common Carrier Bureau, August 2001.

[6] Other OECD references on unbundling include OECD, "Interconnection and Local Competition", DSTI/ICCP/TISP(2000)3/FINAL, 7 February 2001 and the *OECD Communications Outlook 2001*.

[7] Swisscom, "Unbundling of the access network: Swisscom to oppose market intervention by regulator", 10 November 2000. http://www.swisscom.ch/gd/information/press_releases/2000/unbundling-en.html.

[8] Michael Foreman, "Local investors key to sector's growth: Swain", *New Zealand Herald*, 10 April 2001.

[9] Emily Bourne, "Report advises incumbents to welcome unbundling", 26 October 2000.

[10] Covad, "Covad Communications, NTT Communications, ACCA Networks and Ignite Japan Sign Agreement to Provide DSL in Japan". Op.cit.

[11] ALTS, "The State of Local Competition 2001", February 2001. http://www.alts.org/Filings/022001AnnualReport.pdf.

[12] Roco Sabelli, "Telecom Italia Wireline services", 5-6 February 2001. http://www.telecomitalia.it/roadshow/

[13] OECD, "Current Status of Communication Infrastructure Regulation: Cable Television", OCDE/GD(96)101, http://www.oecd.org/dsti/sti/it/cm/prod/e_96-101.htm.

[14] European Commission, "XXIXth Report on Competition Policy 1999", 1999. p 37 http://europa.eu.int/comm/competition/annual_reports/1999/en.pdf.

[15] John Borland and Cory Grice, “SBC looks to fiber for superfast Net speeds”, 4 May 2001. http://news.cnet.com/news/0-1004-200-5825806.html?tag=mn_hd

[16] ST’s Website is at: http://eu.st.com/stonline/index.shtml.

[17] Telia, “Technical push for new business”, http://www.issls-council.org/proc00/papers/8_3.pdf

[18] Telstra, “Telstra dramatically reduces Big Pond Prices”, Press Release, 17 February 2000.

[19] TransACT’s Website is at: http://www.transact.com.au/index.asp

[20] David Adams, “Neighbourhood Cable moves in down the road”, F2 Communication News, 17 April 2001.

[21] Ziggy Switowski, Telstra CEO reporting First Half 2001 Results, March 2001. http://www.telstra.com.au/investor/docs/ceoasx.pdf

[22] Keynote speech by Senator the Hon. Richard Alston, Minister for Communications, IT & the Arts, 9 May 2001. http://www.dcita.gov.au/nsapi-text/?MIval=dca_dispdoc&ID=5705

[23] Telekom Austria, Telekom Austria Group: 2000 Results http://www.telekom.at/e_news/enews.html.

[24] Statscan, “Internet by Cable”, http://www.statcan.ca:80/english/research/56F0004MIE/56F0004MIE01002.pdf.

[25] Ibid.

[26] Telus, “Revenue increases 18% led by wireless and Internet growth”, Press Release, 14 February 2001. http://about.telus.com/.

[27] National Broadband Task Force, “Infrastructure Working Group”, 7-8 February 2001. http://broadband.gc.ca/english/5000_e.html

[28] Wild Blue’s Website is at: http://www.wildblue.com/flash.htm

[29] Clare MacCarthey, “Denmark Promises Net access”, *Financial Times*, 21 February 2001.

[30] http://www.hkkk.fi/mmedia/itp97/reports/report3.html

[31] ART, Press Release, Paris, 11 July 1997 http://www.art-telecom.fr/communiques/pressrelease/97-16a.htm

[32] ART, Press Release, Paris, 5 August 1998. http://www.art-telecom.fr/communiques/pressrelease/98-22a.htm

[33] Mark Fossier, “Fixed Line and Regulatory Issues”, France Telecom, 22 March 2001. http://www.francetelecom.fr/vanglais/finances/relations/int_210301.htm

[34] Avicam, Data for 31st December 2000. http://www.avicam.org/site/info/frame.htm.

[35] Regulatory Authority for Telecommunications and Posts, “Annual Report 2000”, p 22 http://www.regtp.de/en/aktuelles/start/fs_03.html

[36] Emma McClune, “Central Europe set to be ADSL battle ground”, *Communications Week International*, 8 December 2000.

[37] Totaltele, “Iceland to get fibre to the home”, 10 July 2000. http://www.totaltele.com/.

[38] For a description see Bill St Arnaud’s “Jet fibre could reduce costs of fibre to the home”, 9 January 2001. http://www.canarie.ca/MLISTS/testnet2000/0223.html

[39] Islandssimi’s Website is at: http://www.islandssimi.com/um/cprofile.jsp.

[40] Eircom, “Eircom announces commercial launch of ADSL service; eircom i-stream”, 11 September 2001. http://mmm.eircom.ie/about/PressReleases/PressRelease.asp?id=360

[41] NTL, “Statement from Brian Moore, Managing Director, ntl Ireland”, Press Release, 30 March 2001, http://www.ntl.com/ireland/frames/press/press105.html

[42] Chorus, “Chorus Launches Services in Kilkenny”, 5 April, 2001, http://www.chorus.ie/press_releases.php3?prid=6

[43] ODTR, “The Internet in Ireland - Communications Transmission and Delivery Issues”, Consultation Paper Document No. ODTR 01/47 4th July 2001, http://www.odtr.ie/docs/odtr0147.doc

[44] R. Sabelli, “Telecom Italia’s Wire Services”, February 2001, http://www.telecomitalia.it/roadshow/.

[45] Telecom Italia, “Introducing BB·B (Broad Band Box): "ready to run" ADSL for the residential market”, 24 April 2001. http://www.telecomitalia.it/stampa_inglese/comunicati_telecom/0424.html

[46] RDSL, “Fastweb to deploy fibre-to-the-home network,” Totaltele, 13 June 2000.

[47] Fastweb’s Website is at: http://www.fastweb.it/

[48] An abstract of the report is available at: http://www.governo.it/fsi/eng/worldwide/broadband_abstract.htm

[49] Softbank, “YAHOO! BB Broadband Internet Service Progress Report”, 4 September 2001. http://www.softbank.co.jp/e_corpnews/2001release/e010904_2.htm

[50] The charges are JPY 2 467 per month (JPY 990 for DSL access, JPY 1 290 for the ISP service, and JPY 187 for NTT). ADSL modem costs JPY 550 per month for rental, or it could be purchased at JPY 24 600 (tax is additional at 5%). User support costs JPY 150 per three minutes.

[51] Laurie Falconer and Dori Braun, “Japan DSL Market: What It Takes To Be A Leader” http://dslprime.com/News_Articles/2001_February/Japan.html.

[52] Reuters, “NTT will further cut ADSL rates from October”, Totaltele, 29 August 2001.

[53] Jupiter’s Website is at http://www.jcom.co.jp/eng/

[54] The eAccess Website is as http://www.eaccess.net/en/index.html

[55] Dave Burstein, “DSL Prime Newsletter”, 6 April 2001. http://dslprime.com/News_Articles/news_articles.html.

[56] NTT, “NTT Group Three-Year Business Plan,” 16 April 2001. http://www.ntt.co.jp/news/news01e/0104/010416.html

[57] ITU, Regulatory Implications of Broadband”, op.cit.

[58] ITU, "IP Telephony and the Internet: Republic of Korea Case Study", ITU, January 2001. http://www.itu.int/wtpf/casestudies/korea.pdf

[59] Refer http://www.unitedglobal.com/laMexico.html.

[60] Totaltele, "Telmex prepared to open local loop", 5 September 2001.

[61] KPN, Presentation of Half-year results 2000, 15 January 2001, http://www.kpn.com.

[62] Refer to UPC's at http://www.unitedglobal.com/euNorway.html

[63] Telenor, "Nextra on track to becoming a leading CSP", 16 February 2001. http://www.nextra.com/

[64] Bredbandsbolaget, "Bredbandsbolaget consolidates investments", 15 February 2001, press release at: http://www.bredbandsbolaget.com/eng/node103.asp?ID=227.

[65] Interview with Pawel Rzepka, *Gazeta Wyborcza*, 5 October, 2001 P.32.

[66] "Csii. Service Units Increase by 20.1% in The First Quarter of 2001 in Portugal", Canadian Corporate News, 5 April, 2001.

[67] "*7.500 registos na NETfast da Telepac*" 12 December 2001. http://tek.sapo.pt/4500/231121.html The figure for DSL subscribers at year end was reported by ECTA in its DSL scorecard.

[68] Portugal Telecom, "Report of 2000 Results", 13 March 2001, http://www.telecom.pt/uk/financeiras/noticias/ra2000.asp#.3.

[69] Information is available from ICP at: http://www.icp.pt/oll/deliberacoes/indexuk.html

[70] ONO's Website is at: http://www.ono.es/ho/ono/index.html

[71] National Post and Telecom Agency, "The Swedish Telecommunications Market 2000", http://www.pts.se/

[72] Telia, "Telia raises monthly rate for broadband access", Press Release, 20 March 2001.

[73] Swisscom, Press Release, February 2001. http://www.swisscom.ch/gd/information/press_releases/press_releases-en.html.

[74] Sunrise, "Competition on the local loop still prohibited", Press Release, 15 March 2001. http://www.sunrise.ch/en/med.htm#2

[75] Swisscom, "LLU: Why Swisscom is opposed to unbundling the local loop", http://www.swisscom.com/gd/information/corporate_profile/ull-en.html

[76] Ibid.

[77] Ibid.

[78] NTL, The "World-Wide Wait" is over - NTL links with 3COM for super-fast internet service", Press Release, 20 January 1999.

[79] Emily Bourne, "Oftel says U.K. unbundling now business as usual", Total Telecom, 28 March 2001.

[80] Oftel, “Local Loop Unbundling Fact Sheet”, April 2001. http://www.oftel.gov.uk/publications/local_loop/llufacts.htm#progress

[81] Reuters, “Oftel intervenes in BT local loop service dispute”, Totaltele, 23 August 2001.

[82] Robert Sachs, “Cable and Video: Competitive Choices”, Testimony before Senate Subcommittee on AntiTrust Business Rights and Competition, Washington D.C., April 4, 2001. http://ncta.cyberserv.com/qs/Qspage.cfm?pageid=241.

[83] FCC, “Local Telephone Competition: Status as of December 31, 2000,” Table 1, Industry Analysis Division, Common Carrier Bureau, May 2001.

[84] Cable Datacom News, “Cable Modem Market Stats & Projections”, 1 March 2001. http://www.cabledatacomnews.com/cmic/cmic16.html

[85] Sachs, Op.Cit.

[86] ALTS, Op.cit.

[87] : “The 1984 break up of AT&T's nationwide monopoly of local and long-distance services created seven Regional Bell Operating Companies (RBOCs). Due to several subsequent mergers, there are now four RBOCs: Verizon, BellSouth, SWBT (SBC), and Qwest.”

[88] FCC, “FCC Chairman Powell Recommends Increased Enforcement Powers for Local Telephone Competition”, News Release, 7 May 2001. http://www.fcc.gov/Bureaus/Common_Carrier/News_Releases/2001/nrcc0116.html

[89] Bruce Myerson, “Phone Companies hike DSL charges”, Associated Press, 2 May 2001.

[90] Covad, “Covad Announces Operating Statistics For the Fourth Quarter and 2000” 8 January 2001, and “Covad Announces Operating Statistics for the First Quarter of 2001” 5 April 2001, http://www.covad.com/companyinfo/pressreleases/pr_2001/.

[91] DSL Prime - http://dslprime.com/Providers/providers.html#notserve.

[92] Cable Datacom News, “AT&T Expanding Open Access Pilot”, April 2001. http://www.cabledatacomnews.com/apr01/apr01-3.html

[93] Cable Datacom News, “Time Warner Cable Taps AP Engines For Open Access”, March 2001 http://www.cabledatacomnews.com/mar01/mar01-5.html

[94] DirecPC’s Website is at: http://www.direcpc.com/

[95] Pegasus Broadband’s Website is at: http://www.pgtv.net

[96] Wild Blue’s Website is at: http://www.wildblue.com/flash.htm

[97] Sprint, “Sprint Introduces New Broadband Wireless Service to Fresno's Residential and Small Business Customers”, 23 January 2001.

[98] Worldcom, “WorldCom Launches Fixed-Wireless High-Speed Internet Service in Memphis”, 15 November 2000. http://www.worldcom.com

[99] ALTS, Op.cit.

[100] OECD, "Local Access Pricing and E-Commerce.", DSTI/ICCP/TISP(2000)1/FINAL, May, 2001.

[101] Saturn's pricing is at: http://www.saturn.co.nz/internet/default.cfm?nav=internet&page=1

[102] Verizon, "Verizon Online Introduces New High-Speed Options for Residential Customers Nationwide", 3 May 2001. http://newscenter.verizon.com/proactive/newsroom/release.vtml?id=53592