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**Working Party on Telecommunication and Information Services Policies**

**THE DEVELOPMENT OF BROADBAND ACCESS IN RURAL AND REMOTE AREAS**

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## **FOREWORD**

In December 2003 the report was presented to the Working Party on Telecommunications and Information Services Policy (TISP). It was recommended to be made public by the Committee for Information, Computer and Communications Policy (ICCP) in April 2004.

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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## THE DEVELOPMENT OF BROADBAND ACCESS IN RURAL AND REMOTE AREAS

### Main points

As the development of broadband access builds momentum, policy makers are increasingly turning their attention to the availability of these services in rural and remote areas. The economic and social case for developing broadband access is very strong and takes on added significance for rural and remote communities, where improved communications can address a variety of challenges posed by distance.<sup>1</sup>

This report builds on earlier work by the OECD on the development of broadband access.<sup>2</sup> The paper further strengthens the case made in “Universal service obligations and broadband” which argued that governments should act cautiously in providing financial assistance for the development of broadband, or including it as part of universal service obligations, until a clearer picture emerged of how new technologies and services, and the competitive market, could be used to foster broadband access in rural and remote regions.<sup>3</sup>

The report reviews progress on the availability of broadband access across the OECD area. It particularly focuses on benchmarking digital subscriber line (DSL) and cable modem expansion and availability, as well as the emergence of broadband wireless as a platform to provide low-cost high-performance access networks in rural and remote areas. The paper finds that DSL availability is proceeding apace, with around three-quarters of existing subscriber lines being able to provide service by 2003. Cable networks pass 58% of households with just under three-quarters of those networks having been upgraded for broadband access. The paper also explores the increasing capabilities of wireless networks and lower equipment costs that are enabling a considerable amount of new entry into the telecommunication services market. This is most evident in urban areas where public and private wireless LANs are proliferating. However, it is also evident in the provision of broadband access in rural areas, the subject of this document. The amount of new entry by Wireless Internet Service Providers (WISPs) in rural areas is virtually unprecedented.

The same dynamism which characterised the early provision of telephony, where monopolies were absent, is now emerging in the provision of broadband access. In rural areas the results are sometimes surprising and counter-intuitive. Indeed, the early experience indicates that some of the traditional paradigms for thinking about communications policy are being stood on their head. One such paradigm that is being challenged is that rural areas are unlikely to attract new entrants because they are high cost areas to serve and characterised by insufficient demand. Another is that if rural areas receive service, the prices charged will need to be higher than urban areas and the levels of service lower. More generally, it is common to read that such networks will need to be subsidised and that the lower availability of rural broadband is a sign of “market failure”. All these precepts are, in fact, proving to be contestable.

This report gathers together the growing evidence across the OECD which counters the foregoing assumptions. There is a rapidly increasing amount of new private sector entry occurring in the provision of broadband access in rural areas. The prices on offer are in some cases lower than those available in urban areas, using DSL and cable modems, and performance sometimes superior. Moreover, in a number of countries, demand is proving to be robust in rural areas and sufficient to attract innovative and low-cost service providers.

The implications for policy makers further strengthen the direction OECD governments have taken in relying on principles such as open and competitive markets, regulatory safeguards where dominance exists, technological neutrality, and so forth. While there may be a place for government funding under some circumstances, the market should be given time to work. Broadband is, in fact, rolling out apace and has one of the fastest take-up rates for all new communication services. On the other hand, performance varies greatly across the OECD area and this includes the provision of broadband in rural areas by new entrants. If rural broadband is not developing apace, in a particular country, this could signal the need for a review of the competitiveness of market settings before considering the need for subsidies that are likely to further distort competitive outcomes.

The main conclusions of the report are:

- The market is generating innovative broadband services in rural areas and responding to increasing demand in those areas.
- Broadband access prices in rural areas are sometimes lower than in urban areas and offer services with higher levels of capacity.
- Competition in the provision of broadband access is emerging in rural areas, and governments should take this into account before embarking on programmes to subsidise infrastructure.

## Introduction

The growth of broadband access continues to gain momentum across the OECD area. By December 2003, there were more than 82 million subscribers to broadband services – up from just 3 million at the end of 1999. That is one of the fastest take-ups of any new communication service experienced in the OECD. It took, for example, less than half the time for broadband to grow from 3 million to 80 million subscribers than it took for mobile cellular services to achieve the same result.

The main difference from earlier experience in the roll out of communication services is that broadband access is being developed in a competitive market. By way of contrast, the first-decade mobile cellular market was characterised by monopolies and duopolies. The sharp increase in growth in mobile cellular take-up only occurred from the mid-1990s onwards as new entrants made pricing more attractive to users and lifted the pace of innovation. The development of broadband access has developed at a much faster pace than the mobile market because it is taking place in a liberalised market.

Just as competition dramatically escalated the growth of mobile communications in the late 1990s, it is now increasing the pace of developments in broadband access. Obvious examples include the trend among leading countries to boost the speed of broadband access, such as via VDSL (very high rate DSL), and extending the capabilities of fixed broadband via wireless LANs. Indeed, it may be the competitive application of a range of wireless technologies, capable of delivering broadband access that provides the impetus for increased growth across the ICT sector.

Policy makers may well take a sceptical view of fixed wireless developments. Fixed wireless technologies have promised much in recent years, and have found roles in niche market segments, but have delivered little in the way of effective competition in telecommunication access. On the other hand, there have also been a number of high-profile business failures, starting with Ionica in the United Kingdom, through to Winstar Communications and Teligent in the United States. On the other hand, there is a considerable amount of new entry taking place across the OECD in the area of fixed wireless networks for the provision of broadband access. In some cases this is due to fixed network providers extending the capabilities of their networks by adding wireless capabilities (*e.g.* wireless LAN hotspots), while in other cases it stems from the development of new fixed wireless networks aimed at competing head on with DSL and cable modem services. Some of the latter providers have become known as Wireless Internet Service Providers (WISPs).

The development of WISPs is significant for a number of reasons. At a time when the telecommunication sector has experienced a downturn in growth, the trend towards fixed network providers extending their capabilities and the development of WISPs represent a new and growing market. This is true not only for the large, and well-known, equipment manufacturers such as Alcatel, Ericsson, Fujitsu, Lucent, Motorola, Nokia, Nortel and Siemens, but also for a growing number of smaller entrants. These include equipment suppliers such as Airgo, Airspan, Alvarion, ArrayComm, BeamReach, Broadstorm, DragonWave, Flarion, Keyon, IPWireless, Navini Networks, Nera, Proxim, Radionet, Redline Communications, Remec, Vivato and WaveRider.<sup>4</sup> In some cases these companies have partnered or received investment capital from larger ICT companies such as Cisco and Intel, both of which are strongly committed to the development of wireless broadband access. But, collectively, they represent a tremendous increase in the competitive provision of fixed wireless systems that was not readily evident when the telecommunication services sector was characterised by monopolies.

New entry into wireless system supply has in turn led to an increasing pace of innovation to tackle some of the problems that held back fixed wireless in the past. One example is the development of fixed wireless systems for providing broadband services that do not require line of sight. Another characteristic of the new environment is for suppliers to develop software and use off-the-shelf hardware.<sup>5</sup> Accordingly,

market entry by wireless equipment suppliers is burgeoning. In turn, the increased level of competition supports growing innovation and falling costs for fixed wireless systems. In fact, the supply of telecommunication equipment is increasingly coming to mirror the supply of information technology equipment. What set the two industries apart in the past were the different regulations applying to services.

As a result of the increasing capabilities of wireless networks and lower equipment costs, there is a considerable amount of new entry into the telecommunication services market. This is most evident in urban areas where public and private wireless-LANs are proliferating. However, and this is the subject of this document, it is also evident in the provision of broadband access in rural areas. The amount of new entry by WISPs in rural areas is virtually unprecedented. Perhaps the closest parallel was the original provision of telephony services by some rural communities in countries such as Finland and the United States.

The same dynamism which characterised the early provision of telephony is now emerging in the provision of broadband access. In rural areas the early results are sometime surprising and counter-intuitive. Indeed, the initial experience indicates that some of the traditional paradigms for thinking about communications policy are being stood on their head. One such paradigm is that rural areas are unlikely to attract new entrants because they are high-cost areas to serve and are characterised by insufficient demand. Another is that if rural areas receive service, the prices charged will need to be higher than in urban areas and the levels of service lower. More generally, it is common to hear that such networks will need to be subsidised, and that the low availability and penetration of rural broadband is a sign of “market failure”.

In liberalised markets all these foregoing assumptions are being challenged because they are premised on only one way of providing service. The very large sums noted by some governments to extend broadband are often estimates based on the cost of extending DSL or even fibre optic cable, rather than applying other solutions to extend the fixed network or to provide alternative networks. Estimates for upgrading networks to provide universal DSL coverage vary from country to country but, in some cases, are clearly commercially prohibitive at today’s costs. When such a judgement is made, it is generally because, in the assessment of the operator, there is not enough potential demand to meet the cost of a network upgrade. This may be because the number of potential subscribers is deemed to fall below the level of demand needed to justify the cost of upgrading the exchange. Alternatively, if this hurdle is overcome, the cost of provisioning “backhaul” (*i.e.* the connection between the local exchange and a backbone network) may be held to be too expensive. Even then, some users may reside beyond the distance from an exchange which can be served by a standard DSL deployment and would therefore entail a further cost if DSL were to be made available.

Undoubtedly, some of the new entrants will fail. Experience suggests that the large number of small start-up WISPs, testing the market with different business models and new technological platforms, is too great not to generate some casualties. Most WISPs are focusing on a region or a small number of rural communities, often without alternative service. This fact tends to set them apart from predecessors that tried to establish national service coverage.

The most vigorous challenges to traditional telecommunication paradigms are being made by relatively small WISPs. The initial experience, in a number of countries, is that some of the least expensive and highest performance broadband access offers are in areas where, to date, it has proven too expensive to extend DSL or cable networks. One such service, scheduled for launch in the first part of 2004 in the United Kingdom, proposes broadband access for rural users at up to 54 Mbps, using 802.11g, for under USD 16 per month with a 1 Gigabyte download cap.<sup>6</sup> There are a growing number of other examples, perhaps with less striking price and performance ratios, but already up and running in the United Kingdom and elsewhere. The West Norfolk Community Broadband Network (WNCB) and FDM Broadband both provide broadband wireless connections in rural areas with advertised price performance ratios that are

better than many DSL offers in the United Kingdom.<sup>7</sup> However, the major benefit is providing service in areas that may otherwise not receive service. In the rural town of Dundrum, in Northern Ireland, Aperture Wireless Broadband provides a 256 kbps service for less than USD 20 per month and a 512 kbps service for less than USD 30 per month.<sup>8</sup> Aperture uses a combination of fixed wireless for local access and satellite for backhaul. The same approach, using mesh wireless to provide local access, is used by small villages such as Hayfield in Derbyshire and the Scottish village of Drymen.<sup>9</sup> At the same time, WISPs are, of course, not going to have it all their own way for long. Incumbent providers, such as France Telecom and Telekom Austria, are conducting trials using WiFi to provide broadband access services to areas where it is not economical to upgrade to DSL. For its part BT says it will use wireless to offer broadband to small communities in rural and remote areas where it is not economical to provide DSL. Based on the use of DSL and wireless broadband BT aims to cover 100% of the United Kingdom by 2005.

There is also evidence to suggest that some incumbents are expanding the availability of DSL further than they initially planned. One reason for this is that the cost of provisioning DSL is falling such that telecommunication carriers are generally lowering the threshold level for upgrading smaller exchanges. Iceland has one of the lowest such thresholds, with the eventual aim of providing DSL to towns with as few as 500 inhabitants.<sup>10</sup> Moreover one major equipment supplier says they can provide an economic solution to upgrade local exchanges with as few as 10 subscribers.<sup>11</sup> The supplier stated, at the end of 2002, that such an upgrade could be accomplished for as little as USD 2 000 to USD 2 500.<sup>12</sup> In Australia, one ISP is installing Digital Subscriber Line Access Multiplexers (DSLAMs) serving as few as 16 lines.<sup>13</sup> To the extent that this can be emulated elsewhere, the only remaining barrier to providing service in small towns would be the cost of providing backhaul for users who reside beyond the range of a DSL-enabled exchange. Certainly the price of DSLAMs continues to fall with increasing competition between manufacturers and the economies of scale being generated by larger orders. One industry newsletter reported prices as low as USD 35 to USD 40 per port (USD 60 plus modem), for an 800 000 line tender, in October 2003.<sup>14</sup>

Technological development is only part of the story. A second factor is that WISPs are placing competitive pressure on fixed network providers to extend their coverage of DSL. If they don't upgrade, the incumbents not only face losing potential broadband customers but also existing telephony customers who may shift all their business to a new supplier. One of the factors driving DSL availability in Denmark to among the highest rates in the OECD was the threat posed by fixed wireless. In Denmark, Sonofon's fixed wireless network covers 96% of the country's territory and 99% of its population.

Incumbents are reacting to broadband wireless developments in two ways. One is to further extend DSL ahead of schedule and the other is to adopt the technology themselves. In New Zealand, DSL availability is also higher than initially projected. In addition, Telecom New Zealand is beginning to use fixed wireless to reach those areas that can not be served via DSL. One reason for this is the growing number of WISPs providing broadband access in rural areas of New Zealand, some of which offer higher levels of service at lower prices than are available in urban areas. To further increase the level of competition in the New Zealand market, the introduction of unbundling was considered during 2003 with the Government to make the final decision in 2004.<sup>15</sup> While the main impact of unbundling has, to date, been in urban areas, there are some instances of its application in rural markets. In Germany, EWE TEL has spurred competition in Lower-Saxony, Bremen and Brandenburg by providing DSL in 117 local networks, of which many are located in rural areas (for example Norderney, an island off the North Sea coast). In the United Kingdom, for example, a number of ISPs had lower thresholds than BT for provisioning DSL, and utilised unbundled local loops to provide broadband access in unserved areas. Norway reports similar experience in some of the remote areas of that country. As the cost of equipping smaller exchanges continues to fall, this option may become increasingly viable for rural areas.



The main point is that a variety of competitive pressure points are being applied to encourage incumbents to extend the availability of DSL. Some of these pressure points may range further than the direct competition from other broadband providers. For example, mobile networks are providing increasing competitive pressure on fixed networks for telephony. For the future, broadband access is the most obvious way for fixed network providers to maintain customers who might otherwise give up fixed network connections in favour of only having a cellular mobile service. Anecdotal evidence suggests this is playing a part in the strategic planning of fixed carriers in Finland in respect to upgrading exchanges. In time other platforms, such as power lines, may also emerge to provide additional competition in their own right or perhaps in combination with technologies such as WiFi. In the United States, Corridor Systems, for example, has demonstrated high-speed transmission over an electric grid and plans to use 802.11b and 802.11g to provide local access between the grid and the user from mid-2004.<sup>16</sup> The Federal Communications Commission (FCC) is studying the viability of power lines as an alternative last mile technology. However, the technology may not be appropriate for all countries. Following a review of international developments, in September 2003, the Australian Communications Authority (ACA) concluded that characteristics peculiar to the Australian power grid could create unacceptable levels of interference with High Frequency (HF) radio communications services.<sup>17</sup> Among the many uses Australia makes of the HF band (3-30 MHz), one includes the flying doctor service in rural and remote areas.

One further phenomenon coming out of the initial experience of WISPs deserves to be highlighted. Demand for broadband access, as reflected in take-up rates for services in rural areas, is often higher than the national average. In some rural Norwegian municipalities, for example, the take-up of broadband matches that in Oslo. In the United States, a number of rural WISPs have higher take-up rates, in the areas that they serve, than the national average. This contradicts a common perception that rural customers are slower in taking up new services and as such will be served later than urban customers.

The main message for OECD policy makers is to give the market time to develop broadband access. This is not a signal for inaction. Facilitating competition is the most obvious way to assist the market to develop apace. It is readily apparent that DSL availability is occurring much faster than expected in a number of countries. In Belgium, DSL is available to 98% of the population. This availability rate was a competitive response from Belgacom to meet the threat of cable television networks which are almost universally available in that country. It is true, of course, that Belgium is a geographically small country compared to many. On the other hand, a geographically mid-sized country such as France is projecting DSL coverage of more than 95% by 2005. In larger countries there may be up to 20% of the population that can not be economically served by DSL within that timescale. This will, however, be tested by the market. Several relatively small rural telephone companies in the United States already have 100% DSL availability.

A delay in the availability of service for rural users should not be taken to be an automatic sign of market failure. Equipment companies and service providers are working to lower the cost and extend the distance from an exchange that can be served by DSL. In addition, incumbents will respond to competitive pressure by upgrading exchanges if they are challenged by alternative network providers. The main objective for governments, therefore, should be to facilitate competitive entry in rural areas. This approach is likely to be far more conducive to the roll out of broadband availability than funding in the form of subsidies.

Government funding may, of course, have a role to play as long as it does not have negative implications for the development of competition. Various schemes to provide funding for rural broadband are described in the country reviews. In addition, the European Union has allocated USD 11.5 billion of so-called structural funds for information and communication technology projects.<sup>18</sup> The aim is to redirect aid, from existing structural funds allocated from 2000 to 2006, to support IT projects in rural and remote areas which are not covered by adequate infrastructure. In March 2003, the European Council endorsed

this approach and asked for guidelines to be set out on implementation, especially for broadband, in particular in areas of geographic isolation and low population density.<sup>19</sup> The guidelines developed were adopted on 25 July 2003. They include principles such as technological neutrality, open access, need for transparency, and so forth, to ensure they do not negatively impact on competition.<sup>20</sup>

In the same way, aggregation of demand by government users can be a useful policy tool in areas such as the provision of backhaul, as long as it does not distort competition. Indeed, as broadband wireless communication develops, it is increasingly apparent that the major barrier to rural broadband may not be the 'last mile' but backhaul required to service that local access network (*i.e.* the so-called middle mile). Where service providers do use wireless to extend the provision of broadband access, solutions can be readily found as evidenced by the growing number of rural WISPs. Indeed, wireless technologies themselves, such as WiMAX, may prove to be such a solution. Suppliers have begun marketing 802.16a systems offering a throughput of 70Mbps with a range of up to 50 kilometres.<sup>21</sup> For other providers the ongoing availability of interconnection on fair and non-discriminatory terms will remain paramount to connecting their local broadband network to backbone networks. In a competitive market, solutions such as WiMAX, leased lines, satellites and even DSL can be applied to deal with backhaul.

As noted in the country reviews, a growing number of OECD governments have introduced initiatives in respect to the allocation and management of the radio spectrum to permit new entry in licensed and unlicensed bands. Technological development will continue to mean that spectrum policy needs to be managed so that new technologies can be beneficially applied. Differences between countries can lead to significant differences in the solutions available for rural areas.

### ***Broadband availability***

In the majority of OECD countries, satellites are the platform with the widest geographical coverage for the provision of high-speed Internet access. This coverage represents the main strength of satellites both in terms of direct access but also to provide a backhaul option. On the other hand, satellites are not always regarded as an option of first choice if other platforms are available. This is because satellite services currently charge a higher ongoing price than terrestrial alternatives. In addition, two-way satellite services are not available in all countries, such that the PSTN is still needed to provide the upstream link. The latter characteristic means that a user's PSTN line is not available for simultaneous telephony as it would be in the case of DSL. Satellites also have an inherent latency which may be a drawback for some applications.

Placing satellites to one side, the most widespread platform available to provide broadband access is DSL. It is true that in a small number of countries cable modem services are more widely available geographically than DSL. This is true for Canada and the United States. In the United States, at the end of 2002, cable modem services were available to 80% of households compared to just below 70% for DSL. However, DSL is expected to match cable in terms of coverage in the near future.

Experience has shown that once telecommunication carriers have made a strategic commitment to providing DSL, the roll out has occurred at a relatively rapid pace. Some carriers, such as Belgacom and Telekom Austria, could provide DSL service to three-quarters of their lines less than 18 months after the launch of service (Table 1). In fact two-thirds of OECD countries had DSL available to more than three-quarters of their lines by 2003. In terms of the future, indications are that there may be three categories of countries over the next several years. In one category will be those countries that have DSL availability to more than 90% of lines. There were seven countries in this category in 2003 and they will be joined by several others in 2004. The second group is countries with larger geographical territories such as Australia, Canada and the United States. These countries are likely to have DSL coverage in the range of 80% to 90% over the next several years. The third category represents those countries that had a relatively

late start with broadband. Over time, they would be expected to migrate to one of the other categories depending on the geographical size of the country, population density, technological development, level of competition, and so forth.

The experience of the Nordic countries reflects the impact geography and population density can have on the rollout of broadband availability. Denmark has the highest population density of any Nordic country and this is one factor contributing to that country's high level of DSL availability.<sup>22</sup> Another factor impacting on DSL availability is the level of urbanisation. In Iceland 92% of the population live in urban areas even though that country has the lowest population density in the Nordic region. This compares with urban proportions of total population of 85% for Denmark, 83% for Sweden, 75% for Norway and 59% for Finland (Appendix 1).

For larger countries, development may plateau between 80% and 90% for the near future as it becomes harder to justify upgrading networks to provide DSL on purely commercial grounds. However, this does not mean that broadband availability will not continue to grow; nor does it exclude the possibility that DSL will be further expanded. Technologies that extend the range of DSL beyond six kilometres will continue to evolve, with some suggesting that SHDSL (symmetric DSL) may provide 100% service coverage as costs decline.<sup>23</sup> Currently SHDSL offers reach of four kilometres at speeds of 2.3 Mbps.<sup>24</sup> One Japanese provider already offers a 700 kbps ADSL service up to eight kilometres. Some WISPs are already providing service at distances up to 30 kilometres, albeit a range of 10 to 15 kilometres is more common. Fixed wireless is also continuing to evolve in terms of capacity and ability to scale with larger numbers of subscribers.<sup>25</sup> One manufacturer, for example, says its fixed wireless system can provide throughput of 300 Mbps to support 3 000 subscribers at a range of up to 15 kilometres.<sup>26</sup> The country reviews which follow document a very dynamic emerging market for the provision of wireless broadband access in rural areas as a means of extending the capabilities of the fixed network and providing an additional platform for competition. The important point is to place a far greater reliance on competition as a tool to expand service availability than has typified telecommunication policy in the past.

Cable television networks provide the second highest terrestrial availability and provide the most significant competition to DSL. On the other hand, apart from some significant exceptions, the majority of cable infrastructure is located in urban areas. Cable networks pass 58% of households with just under three-quarters of those networks having been upgraded for broadband access. In other words cable has recorded similar levels of upgrades to DSL but overall availability is much lower in terms of network reach. The main challenge is the economics of building new networks in areas where cable is not available.

Cable modem service is available to 172 million households or around 42% of all households in the OECD area. Canada (85%) and the United States (80%) have the highest availability of cable broadband access including some coverage in rural areas. In Europe cable modem availability varies with UPC, the largest company, having upgraded almost 100% of their networks in Austria and the Netherlands but only 25% of their networks in Eastern Europe. By November 2003, UPC had upgraded 5.5 of their 10 million homes passed in Europe, for digital or data services. Indications are that Belgium, the Netherlands and Switzerland have the highest overall availability of cable modems in Europe. Luxembourg and Germany have high availability of cable but have lower availability of cable modem service. Outside these countries most cable networks are urban. In the Asia-Pacific OECD countries cable networks have high service availability, where networks are available, but a relatively low availability overall due to networks not passing a large proportion of households. In addition there are few cable networks in rural areas in these OECD countries.

**Table 1. Availability of Digital Subscriber Lines (DSL) in the OECD area**

	Commercial service launch	Actual or projected coverage by year end (%)						Indicator used to express coverage
		2000	2001	2002	2003	2004	2005	
Australia	August 2000	50	72	75	75			Population
Austria	November 1999	72	77	80	80			Lines
Belgium	October 1999	75	93	98	98	98		Lines
Canada	1996	69	70	75	75.4			Population
Czech Republic	March 2003	0	0	0	44	60		
Denmark	June 1999	65	90	95	95	96	98	Lines
Finland	May 2000	50	60	75	85	95		Lines
France	November 1999	32	66	71	79	90	95	Population
Germany	August 1999	60	70	80	85	90		Lines
Greece	July 2003	0	0	0				
Hungary	September 2000		20	38	45	50		Lines
Iceland	April 2000	33	51	78	86			Population
Ireland	May 2002	0	0	45	62			Lines
Italy	December 1999	45	67.5	70	80			Lines
Japan	September 2000		73.5	80	90	90		Households
Korea	April 1999		70	89	93			Households
Luxembourg	2001	0	65	90	90			Population
Mexico	September 2001	0	0					
Netherlands	June 2000	40	67	85	85			Lines
New Zealand	June 1999	60	69	83	84.8			Population (Customers)
Norway	December 2000	20	50	58	65		80	Lines
Poland (TPSA)	2001	0	3.5	56	69			Lines
Portugal	December 2000		50	60.7				Population
Slovak Republic	Yet to launch	0	0	0				
Spain	1999	62.2	81.3	89.3	92			Lines
Sweden	October 2000		70	75	78			Lines
Switzerland	October 2000	0	85	95	95	98		Lines
Turkey	February 2001	0	0.01	2.5	5	10		Lines
United Kingdom	July 2000	50	60	64	85	95	99	Lines
United States	1997	36	50	68	75			Lines
OECD (Weighted average)		43.5	57.3	70.2	77.2	79.2	79.9	
OECD (Simple average)		32.8	51.4	64.0	76.3	78.6	79.6	

(1) Canadian data for 2001-2002 are for the largest operator only (Bell Canada). In Canada, cable modem is the platform with the widest coverage with 84% availability at the end of 2002.

(2) Data for the United States, in 2002, is an average for Verizon, SBC, Bell South and NTCA members. Verizon projects 80% coverage by 2003 and SBC by first quarter 2004. Qwest added to the average from 2003 which is for RBOCs.

(3) Data for Norway for 2003 are for September of that year. The projection shown for 2005 is for 2006.

(4) Projected coverage shown in italics. The projected weighted average is calculated using 2001 lines as base. The weighted average excludes lines where no information is available so it most likely overstates availability. Both the simple and weighted averages use the latest available figure for a country, if the present or projected coverage are unavailable.

Source: OECD.

Table 2. Cable modem availability in the OECD area, 2003

	Launch of cable modem service	Total households passed by networks upgraded for cable modem access (%)	Total households passed by cable television networks (%)
Australia	Sept-1996	37	37
Austria**	1997	38	54
Belgium**		80	100
Canada	Nov-96	85	93
Czech Republic	Apr-99	9	23
Denmark	Mar-99	47	75
Finland	May-98	25	67
France	1997	25	36
Germany	2001	10	83
Greece		0	0
Hungary	Nov-00		56
Iceland*		18	35
Ireland	2001	4	42
Italy (Fastweb)	1999	9	9
Japan*	1999	27	27
Korea	Jul-98	57	57
Luxembourg	Nov-01	38	94
Mexico	2000		32
Netherlands		79	97
New Zealand	Nov-98	11	11
Norway	1998	28	56
Poland	Mar-00	11	39
Portugal*	Nov-99	60	67
Slovak Republic	2003		23
Spain*	1999	40	42
Sweden	1999	23	62
Switzerland		76	95
Turkey	2000	14	17
United Kingdom	Apr-99	45	51
United States	1997	80	95
OECD (Weighted Average)		42	58

(1) \*Indicates Estimate Based on Company Information, \*\* Indicates based on earlier data on cable modem availability than 2003.

(2) Fastweb does not use cable modems but provides the largest alternative network providing broadband access to the incumbent in Italy.

Source: OECD.

## Country updates

### *Australia*

At the end of 2002, DSL was available to 74% of the Australian population. This was up from 70% in May 2001. By October 2003 Telstra, the incumbent operator, had enabled 1 000 exchanges. At that stage, the company said that any future upgrades of the remaining relatively small 4 000 exchanges would be based on their commercial viability.<sup>27</sup>

Cable television networks exist in Australia's largest cities and in some regional cities but DSL is the most widely available terrestrial platform. Telstra, the incumbent operator, provides a range of DSL services from 256 kbps to 1.5 Mbps. Broadband access via satellite services is available to 100% of the Australian population. Two-way satellite services are available at speeds up to 500 kbps. One-way satellite services (plus PSTN uplink) are available up to 400 kbps. Telstra also offers a service set at the sub-broadband speed (128 kbps) but capable of providing service up to 18 kilometres from an exchange using ISDN. This service covers 96% of the population, with the initial pricing comparable to DSL if the lower access speed is not taken into account.<sup>28</sup>

In the Riverina Region of Australia, Telstra is undertaking a pilot scheme to upgrade exchanges of several towns with more than 1 000 inhabitants.<sup>29</sup> The only requirement is that a minimum commitment of 25 subscribers be found in the service area. The pilot is part of a wider demand aggregation scheme of the local regional development board, municipal councils and Telstra.<sup>30</sup> At the heart of the scheme is an infrastructure fund which is linked to participation by telecommunication users in the region. Business and residential customers of Telstra register to participate and then USD 0.01 per call is placed into a fund by Telstra. The fund is then used to provide additional finance for the installation or upgrading of telecommunication infrastructure. The first three towns to be upgraded for DSL service were announced in July 2003.<sup>31</sup>

On a national basis, Telstra has adopted a scheme for pre-registration similar to the one pioneered by BT in the United Kingdom. Once a community reaches 60 pre-registered subscribers, Telstra makes an assessment of the threshold number of subscribers needed for the exchange to be upgraded. In most cases, Telstra expects 150 requests would be necessary before such exchanges would be deemed economically viable to upgrade but the threshold may be set at a higher level depending on a number of factors.<sup>32</sup> The scheme is also available for independent ISPs to register their prospective customers.

As in other countries, the availability of broadband access is a contentious issue in Australia. While alternatives exist for the 25% of the population that could not access DSL by October 2003, many people in the rural communities of Australia continue to call for services matching the pricing and performance of those in urban areas. The differences in available options are reflected in the take-up of broadband in urban compared to rural areas. In June 2003, the take-up of broadband was more than ten times higher in terrestrial broadband enabled areas (*i.e.* cable and DSL) than for the remaining satellite covered and ISDN areas (3.4 per 100 inhabitants versus 0.35 per 100 inhabitants).<sup>33</sup> Obviously price and performance are part of the reason. Users in those rural areas without terrestrial options appear to be much less attracted to broadband if the prices are higher and levels of service lower than for urban users. In other countries, such as Norway and the United States, take-up rates are comparable across urban and rural areas where a similar price-performance ratio is available.

There are multiple benefits to be derived from pre-registration schemes like the one introduced by Telstra. They can address some of the sources of frustration experienced by rural and remote communities as well as being a useful tool for service providers. One of the main benefits for all parties is transparency. From the perspective of the telecommunication carrier, such schemes provide a good indication of the level

of demand in any given community. For users and ISPs, pre-registration schemes provide a tool to demonstrate demand and obtain a commitment from the telecommunication carrier to produce a trigger point towards which they can work to have an exchange upgraded. A common source of frustration for rural and remote communities is not to be able to obtain information on the threshold number of subscribers which would initiate an exchange upgrade.

Other parties can also benefit from transparent pre-registration schemes. Policy makers, for example, may be able to use the information made available by such schemes to assist in the application of government initiatives aimed at promoting the development of broadband access in rural areas. In addition, once demand is demonstrated, independent service providers may decide to deploy their own facilities at lower thresholds than those set by the incumbent. This could occur for example if an independent operator decided to deploy an alternative access network (*e.g.* fixed wireless) or to use unbundled local loops, in combination with their own facilities, to provide DSL service. By way of example, one independent service provider says it can economically provide broadband access to small communities in Australia with as few as 20 to 30 subscribers.<sup>34</sup>

In the first such development, Agile Communications, in partnership with the local municipal authority originally stemming from financial contribution under a government programme, provided broadband access to a town of 900 residents. The price and performance of the service was set at the same level as urban areas served by Agile. DSL service is provided up to 1.5 Mbps downstream, although Agile reportedly aims to eventually provide its customers with download speeds of up to 3.5 Mbps.<sup>35</sup> According to Agile, it can provide a more economical deployment of DSL services because the company deploys compact IP-based equipment specifically designed to serve a small number of users as opposed to ATM-based platforms used by the incumbent. Agile reported good co-operation from the incumbent's wholesale unit with Australia's first implementation of line sharing in a rural area. Commentators have noted that the benefits for the incumbent include not only the wholesale revenue but their ability to resell Agile's service under their own brand.<sup>36</sup> Further benefits include being able to demonstrate that there is nothing to stop other providers from entering the market to serve small communities.<sup>37</sup>

As in other countries, a number of fixed wireless broadband providers are emerging in Australia. The two largest prospective entrants are "Unwired Australia" and "Personal Broadband Australia" (PBBA). PBBA plans to offer wireless broadband to up to 75% of Australia's population.<sup>38</sup> Vodafone Australia is one of the investors in PBBA. Commercial service was planned for launch in 2003. By mid-2003, the PBBA network covered about 100 000 people in a 100 square kilometre area of Sydney. Unwired Australia was also conducting trials of fixed wireless broadband in Sydney during 2003, with commercial service due in February 2004.

Both PBBA and "Unwired Australia" use licensed spectrum and are mainly targeting urban areas. PBBA's service is being deployed under a single nationwide radio spectrum licence acquired through the Australian UMTS auction in March 2001. Unwired Australia was the successful bidder in the Federal Government's 2000 auction of spectrum licences in the 3.4 GHz band and holds spectrum licences for around 95% of the Australian population. The company plans to roll out service in Australia's major cities and larger regional centres.<sup>39</sup>

Australia also has a vibrant grass roots movement of community WiFi networks using unlicensed spectrum. Some of these networks only operate at the local level and do not connect to the Internet. Examples include WAFreeNet in Perth and Air-Stream in Adelaide but there are many more. One reason for the popularity of these networks in Australia, despite not having Internet access, is that they allow users to play games and exchange data without the metered charges that typify broadband pricing among the largest Australian providers. Whether they will continue as the Australian market becomes increasingly

competitive is a moot point. Flat rate offers and higher download caps are increasing in Australia as independent ISPs take advantage of improved access to Telstra's local loops.

Commercial services using unlicensed spectrum are also emerging. For example, the Alphalink Wireless provides service using WiFi to a growing number of Melbourne suburbs. The baseline broadband service provides up to 2 Mbps access for USD 20 per month with a 10 Gigabyte download cap.<sup>40</sup> This is one of the least expensive broadband offers in the OECD area. The model is being replicated by other companies in larger regional centres in Australia, usually at prices comparable to DSL but with higher advertised access speeds.

Providers of fixed wireless broadband service are also emerging outside Australia's largest cities. HunterLink, in conjunction with Wireless Networks Australasia (WNA), are rolling out a wireless broadband solution to businesses and homes across the Hunter Region in the State of New South Wales.<sup>41</sup> The service is now available in the regional city of Newcastle and surrounding suburbs. The company also plans to cover Lake Macquarie and the Hunter Valley. Etherwave Networks provides a similar service in the regional city of Wollongong and surrounding areas.<sup>42</sup>

One of the most promising platforms for some rural and remote areas may be a combination of satellite and fixed wireless. One such company in Australia using this combination is eSat.<sup>43</sup> eSat is trialling a service in a number of rural and remote communities in Australia, using satellite to provide the backhaul and fixed wireless to provide local access. eSat has a threshold of 50 customers to provide service. Following installation, the company says that up to 1 000 customers can be served within a radius of 10 to 15 kilometres of the ground station.<sup>44</sup> eSat is also providing the service in rural areas of New Zealand.

In June 2003, the Australian government announced funding for a number of initiatives designed to improve the availability of broadband access in rural Australia.<sup>45</sup> The total funding announced was USD 94 million over four years.<sup>46</sup> The largest part of this expenditure, some USD 75 million, was allocated for a Higher Bandwidth Incentive Scheme to provide a financial incentive to higher bandwidth providers to offer higher bandwidth services in rural and remote areas at prices comparable to those available in urban areas. A one-off "per customer" payment will be made to providers of higher bandwidth data services in areas where a defined minimum level of service, in terms of price and functionality, is not likely to be provided commercially in the immediate future. To receive the payment, providers will need to offer services at prices broadly comparable to prices charged in urban areas.

A further USD 16 million was for a Coordinated Communications Infrastructure Fund (CCIF) to further drive the roll out of broadband infrastructure into regional areas using key sectors such as health, education and local government as "anchor tenants", with States and Territories asked to match this funding. Some USD 5.5 million was also allocated to promote broadband demand aggregation activities for regional communities, through the funding of demand aggregation brokers. A National Broadband Strategy Implementation Group (NBSIG) will develop and oversee the Strategy. The Australian government stated that all these initiatives are aimed at promoting competition in the delivery of broadband access in rural areas and will be implemented in a pro-competitive manner.

### ***Austria***

In March 2003, 80% of the households in Austria were in areas provided with DSL. This was up from 77% at the end of 2001. At the beginning of the century, Telekom Austria was one the leading telecommunication carriers in promoting high availability of broadband access. By the end of 2000, DSL availability in Austria was second only to Belgium. Since that time, however, a number of countries have



surpassed the availability of DSL in Austria. The CEO of Telekom Austria has stated that he would like to return the country to its position among the leaders.<sup>47</sup>

Telekom aims to redress this situation by creating “partner communities” and continuing to upgrade exchanges in Lower Austria, which has an availability rate lower than the national average. By the end of 2003, Telekom planned for Lower Austria to have a DSL availability of 70% of all households. However, the company believes that the cost of upgrading all remaining exchanges is prohibitive in the more sparsely populated areas of Lower Austria.<sup>48</sup> Accordingly, Telekom Austria has turned to wireless technologies to provide service in rural areas. In April 2003, Telekom Austria announced it would offer broadband via wireless-LAN in the town of Grafenwörth, and would undertake a trial with a view to using this technology to serve those areas which are not economical to reach via DSL.<sup>49</sup>

Fiscal incentives have been among the tools discussed for increasing broadband development in Austria. For its part, Telekom Austria raised the possibility of investment incentives and tax breaks for consumers to acquire broadband access lines. On 11 June 2003, the accompanying law to the 2003 budget was enacted by the National Council, providing for a temporary fiscal subsidy for residential broadband Internet connections.<sup>50</sup> Under the new initiative, up to USD 57 can be deducted from the installation cost of a broadband connection. In addition, up to USD 45 monthly can be deducted for ongoing rental of a broadband connection. These deductions are applicable until the end of 2004.

Although Telekom Austria had argued for subsidising existing broadband access lines, the measure enacted by the National Council applies only to DSL access lines installed for the first time after April 2003.<sup>51</sup> In terms of the new fiscal subsidy, Telekom Austria says that broadband technology implies a physical download bandwidth of at least 256 kbps and permanent Internet access with no time limit and a specified monthly rental. The limited time for the tax break, in the accompanying law to the 2003 budget, follows the recommendation of the EU Commission within the framework of the plan of action “eEurope 2005”.

### ***Belgium***

Belgium has the highest availability of DSL in any OECD country, with 98% of all lines covered. Belgium also has the highest availability of cable television, with networks passing virtually every household in the country. Although data are not available for the availability of cable modem service, this provides a further extensive platform. The high availability of DSL and cable modems is the result of strong competition between the two platforms.

Belgacom is extending the capabilities of both fixed and cellular services by introducing WiFi.<sup>52</sup> From September 2003, it was to be possible to obtain access from a hotspot with a Belgacom DSL subscription package. In the beginning, this was a free service. Thereafter, Belgacom introduced a supplementary charge, which is included on the customer’s bill. Belgacom’s mobile provider is Proximus. Access to Proximus hotspots was also initially free of charge. From the third quarter of 2003, various prepaid hotspot-access packages were marketed.

### ***Canada***

Canada has a goal of making broadband access available to all communities by 2005. According to data collected in the context of Industry Canada’s Broadband for Rural and Northern Development Pilot program, access to high-speed Internet via DSL and/or cable modem services was available in some 1 282 communities, representing about 85% of the Canadian population and 24% of all Canadian communities.<sup>53</sup> The 76% of communities without access to DSL or cable modem services were mainly in rural and remote areas.

The overall percentage of the population with broadband access may be slightly less than that for the population covered by communities served. Although a community may have a provider or providers within its geographical area, not all people in that community may be able to access broadband service. This could be the case, for example, if a user resides beyond the distance able to be served using DSL from an upgraded local exchange. Offsetting this, however, is the fact that cable modem service is widely available in Canada.

The Canadian Cable Television Association estimates that, by the end of 2002, cable modem service was available to 9.9 million of Canada's 11.8 million households.<sup>54</sup> On that basis, around 84% of all Canadian households had access to cable modem service.<sup>55</sup> This was up from 9.4 million households in 2001, 7.4 million in 2000, 4.8 million in 1999, 4.3 million in 1998 and 1.6 million in 1997. Given that cable television networks pass just under 11.2 million households in Canada, and are less restricted by distance than DSL, there may be scope for further availability as cable networks continue to be upgraded.<sup>56</sup>

At the end of 2002, DSL had a similar availability to cable for the regions covered by major operators. The two largest local exchange carriers in Canada are Telus and Bell Canada. At the end of 2001, Telus was reported to have a 63% DSL coverage in the provinces of Alberta and British Columbia.<sup>57</sup> The same source reported Bell Canada had a 70% coverage rate in its regions (Ontario and Quebec).<sup>58</sup> In October 2003, it was reported that Bell Canada could serve around 75% of the company's subscriber lines with DSL.<sup>59</sup> Telus says that it had an 83% DSL coverage of its "top 38 communities" in the provinces of Alberta and British Columbia, by the end of 2002, but did not indicate an overall rate in its annual report.<sup>60</sup> In February 2004 it was reported that MTS (Manitoba Telecom Services) was able to provide high-speed Internet access to 85% of Manitoba's population.<sup>61</sup> By end 2003, the national coverage of DSL in Canada was 75.4% of the population.

In September 2002, to address areas without service, the Canadian government launched the Broadband for Rural and Northern Development Pilot Programme.<sup>62</sup> The total funding for the programme is USD 76 million. The programme uses a competitive process to support the deployment of innovative and sustainable broadband services to Canadian communities that currently have no high-speed Internet access. Priority is given to First Nation, northern, remote and rural communities that do not have service.

The first round of funding for the Broadband for Rural and Northern Development Pilot Programme was awarded in January 2003 and the second round in July 2003. Selections were made through a two-step process. The first step involved applicants submitting proposals for funding to support the development of a business plan. Successful applicants were then eligible to receive up to USD 22 000 for this purpose. Additional funds were then available on a competitive basis to eligible applicants to implement their business plans. The level of contribution is subject to the quality of the submissions and the availability of funds.

During the first round, 89 applications, representing 1 149 communities, received funding to develop business plans showing how their communities would deploy high-capacity, or broadband, Internet service. In July 2003, the second round of funding allocated USD 1.2 million to 65 recipients. These applicants represented approximately 906 communities across Canada. The programme runs until March 2005. The Canadian government also has a National Satellite Initiative.<sup>63</sup> This joint project between Infrastructure Canada, Industry Canada, and the Canadian Space Agency (CSA) aims to provide broadband Internet access services via satellite to communities located in the Far and Mid North, and in isolated or remote areas of Canada. The Canadian government is contributing USD 116 million towards the costs of purchase and access to satellite capacity. Of the total, just over half is to be allocated from the "national priority project envelope" of the Canada Strategic Infrastructure Fund. The remainder is to be provided in-kind through a service credit from the Canadian Space Agency, for satellite capacity that will be made available to the Government of Canada, and through additional satellite capacity managed by Industry Canada.

A number of provincial, territorial and municipal government programmes with similar goals have been launched. The total funding allocated for these initiatives, over a number of years, is more than USD 437 million.<sup>64</sup> The largest individual programme was Alberta's "Supernet" initiative, aiming to connect 422 communities, with funding of USD 139 million. In order of magnitude, this was followed by Saskatchewan with USD 51 million, and an aim to connect 366 communities.

In some cases, communities can receive joint funding from the different levels of Canadian government. The Nemiah Aboriginal Wilderness Preserve is located in the isolated mountain-rimmed Nemiah Valley in central British Columbia, and is the homeland to a Native American Indian community. Within the Preserve, the community government prohibits construction of paved roads, electric power and telephone pole lines. To replace the sole narrowband radio-telephone link then available to community government and residents, the Canadian and British Columbia governments, in 2001, jointly funded deployment of wireless medium-speed Internet access (including backhaul) to the medical clinic, the school, the community and tourist office, and to several clusters of residences.<sup>65</sup>

The foregoing example is not unique in terms of new technologies being deployed to provide high-speed communications to the remotest areas. Another example is provided by Baker Lake, a remote Arctic community of 1 500 inhabitants located north of the 60th parallel.<sup>66</sup> In September 2002, the community deployed a fixed wireless system to broadband access. The only previous broadband option was via satellite. Satellite is still used to provide backhaul but local access is provided by fixed wireless to business and residential users. Canadian companies are also using fixed wireless to provide backhaul.<sup>67</sup>

Communities in a number of remote locations in Canada are using innovative wireless technology. In August 2002, Churchill, Manitoba, with a resident population of 900, deployed a high-speed fixed wireless network with non-line-of-sight (NLOS) capabilities and self-install customer units providing fully mobile access to the Internet.<sup>68</sup> The all-IP system, which follows the IEEE's 802.16a standard, can deliver data at rates of up to 8 Mbps per user, with a total throughput of 48 Mbps per base station.<sup>69</sup> The Churchill project was deployed through a local co-operative ISP, funded with interest-bearing loans from both federal and provincial government agencies.

As in a number of other countries there has been a proliferation of wireless ISPs providing broadband access in small regional cities and rural areas in Canada. Canopy Canada for example provides baseline broadband access at 2.5 Mbps in a growing number of locations for USD 38 per month including the rental of a subscriber receiver.<sup>70</sup> Other fixed wireless offers tend to be less expensive if the user provides their own customer premise equipment. For example, the Peace River Internet Society, serving the Peace River Region of British Columbia, provides wireless broadband access for USD 23 per month at speeds in excess of 2.5 Mbps if users provide their own equipment.<sup>71</sup>

The distances achieved, using fixed wireless broadband, are also significant. Pathcom, a wireless ISP in Alberta providing services to small rural communities, says that it can provide broadband access at distances up to 30 kilometres, (although the company tries to build repeater stations such that most users are within 10 kilometres).<sup>72</sup> Pathcom provides unlimited broadband access for USD 43 per month. Worthy of note is that, apart from serving business and residential users, Pathcom has connected a number of schools in rural areas that would have had to otherwise wait for the roll out of Alberta's "Supernet" programme. "Supernet" aims to provide broadband access to all homes, businesses, schools, libraries and municipalities by 2005. In addition, rural schools that had previously only been able to get between three to seven students on line at the same time using 56 kbps dial-up or ISDN, can now have entire classrooms on line at the same time.

In February 2004, Inukshuk Internet launched a fixed wireless network serving Yellowknife, the capital of Canada's North West Territories.<sup>73</sup> Inukshuk offers a non-line-of-sight service using the licensed

2 500 to 2 596-megahertz frequency band. The service can be used in surrounding areas at distances up to 32 kilometres from Yellowknife. The company reports that its network is capable of download speeds up to 4 Mbps and upload speeds to 1 Mbps, albeit the service is currently marketed at between one and 1.5 Mbps for downloading and 256 Kbps for uploading. The price for residential use is USD 45 per month. The capabilities of the network are also worthy of note. In launching the service "...the operator demonstrated the system by displaying a live video feed from a truck moving around Yellowknife, with a simultaneous feed from a Global Positioning System (GPS) receiver on the truck showing its route and a brief voice-over-Internet-Protocol (VOIP) conversation."<sup>74</sup>

Wireless ISPs are also serving islands off Canada's mainland. Gulf Island's Wireless Network provides a line-of-sight broadband access network in the Southern Gulf Islands of British Columbia and their surrounding areas.<sup>75</sup> Access up to 11 Mbps is available for USD 22 with a 1 Gigabyte download cap. The one-off cost of the customer premise equipment to receive this service is USD 216.

There are many more wireless ISPs serving regional, rural and remote areas in Canada. In fact, Canada probably has the most wireless ISPs of any country outside the United States. An extensive list of Canadian wireless ISPs is available.<sup>76</sup> Canadian wireless ISPs are providing comparable or higher-speed services than cable and DSL in areas that are often not served by these platforms. Their prices are typically less than or comparable to DSL and cable. This takes on added significance as Canada has among the lowest prices for broadband access via DSL and cable in the OECD.

To further the development of wireless access the Canadian government has announced that a spectrum auction will take place in January 2004.<sup>77</sup> Five licences in each of 172 service areas across the country (with the exception of the 3500 MHz licences for Vancouver Island), totalling 848 licences, will be auctioned for companies to provide innovative wireless services, such as high-speed Internet. The purpose of this licensing process is to facilitate the growth of wireless communications services in the 2300 MHz band and fixed wireless access in the 3500 MHz band in both rural and urban areas, as well as to facilitate the implementation of new and innovative services. The government aims for the auction to result in more communities with broadband access, more competition in telecommunications and greater choice for consumers in terms of service alternatives and service providers.

One further broadband project in Canada is worth highlighting. The township of South Dundas built a municipal fibre and wireless network that was launched in June 2001. South Dundas is located in Ontario and, together with small surrounding villages, has a population of around 11 000 inhabitants. The initial cost to build the network was USD 566 000 and just under USD 1 million had been invested by August 2003.<sup>78</sup> A 512 kbps connection for residential users costs USD 78 per month and various options are available for business users, such as 1.5 Mbps for just under USD 600 per month.<sup>79</sup>

As one of the first rural towns to install a broadband network, neither the cost nor the capabilities of the South Dundas network, measured in today's terms, are exceptional. South Dundas did, however, commission a study of the economic impact which, published in October 2002, is one of the first of this type.<sup>80</sup> Using an input-output model, the resulting study concluded that the total value of the commercial and industrial expansion generated in the first 16 months was USD 2.1 million. The study also documented cost savings and revenue increases for existing businesses, together with an increase in employment attributed to the network.

### ***Czech Republic***

DSL services were first launched by the incumbent telecommunication operator, Cesky Telecom, in March 2003. By August 2003, Cesky Telecom had upgraded exchanges serving 44% of all lines in the country.<sup>81</sup> Cesky Telecom has also launched WiFi services and is one of the first telecommunication

carriers to report data subscribers.<sup>82</sup> The company's hotspots are, however, in urban areas. A number of small ISPs have also developed shared-access models, with one subscriber receiving a DSL connection and others paying to share that connection via WiFi.<sup>83</sup>

Satellite broadband services for residential users were launched by Tiscali in April 2003.<sup>84</sup> Residential end-users in the Czech Republic located beyond the reach of DSL can now get a two-way broadband satellite connection to the Internet, with a download speed up to 400 kbps and upstream of 150 kbps.<sup>85</sup>

There are a number of fixed wireless providers in the Czech Republic. Star21 offers fixed broadband service to business users and ISPs.<sup>86</sup> The company plans to expand its operations, enabling it to cover more than 70% of the Czech Republic's small and medium-sized enterprises. Star21 holds a licence to build up and operate a FWA (Fixed Wireless Access) network. ISPs using Star21's network can provide unlimited and dedicated access, using line of sight, at 256 kbps or higher. Other wireless providers in urban areas include Broadnet, Skynet and subsidiaries of Norway's Telenor and Telekom Austria.

### ***Denmark***

Denmark has the second highest availability of DSL in the OECD area. TDC, the Danish incumbent has upgraded exchanges serving 95% of all lines in that country. TDC has announced that DSL coverage will be expanded to 96% during 2004 and reach 98% in 2005. Denmark is also exceptional in one other respect. It is the only country where fixed wireless broadband has a wider availability than DSL. This phenomenon, in part, explains the high availability of DSL.

In December 2000, Sonofon was awarded two licences to operate fixed wireless broadband services. At that stage the incumbent had upgraded 65% of their telecommunication lines to provide DSL. In August 2001, Sonofon connected its first customer to fixed wireless broadband and began to roll out service across the whole country. In the same year TDC increased its DSL availability from 65% to 90%. TDC lifted this coverage to 95% by end-2002. For its part, by the same date, Sonofon had reached coverage of 99% of the Danish population and 96% of all Danish territory. One advantage Sonofon had in rolling out a fixed wireless broadband network, was that as an existing provider of cellular mobile services, the company could use existing towers. The only restriction with the Sonofon service is that it needs line-of-sight to provide service. A number of equipment providers now have non-line-of-sight broadband systems available.

Due to TDC's rapid expansion of DSL availability, which meant that TDC took some of the market Sonofon originally hoped to serve first, the company has instead focused on the business market. Sonofon's highest capacity offer is at 4 Mbps downstream and 2 Mbps upstream. That being said, offers are available for residential users. Prices for Sonofon's baseline service are comparable to TDC's DSL prices for the service operating at 512 kbps, albeit TDC has an additional baseline offer at 256 kbps. Other fixed wireless operators in the Danish market focus mainly on business customers in urban areas, or are wholesale providers for other ISPs such as Butler Networks.<sup>87</sup> Redspot is one relatively small WISP providing broadband service to residential users in the city of Arhus.<sup>88</sup>

### ***Finland***

The Government of Finland has stated as a goal that broadband access be available to all citizens by 2005. At the moment broadband access is already available to all 440 municipalities in Finland, or at least in population the centres of these communities. The Government's policy is worded, "... Using technologically neutral means, every citizen will be ensured access to fast, regionally extensive and reasonably priced communication links by the end of 2005."<sup>89</sup> During the latter half of 2003 a working group appointed by the Ministry of Transport and Communications in June 2003, developed policies to

meet the goals set by the Government and determine a National Broadband Strategy. The strategy's targets, by the end of 2005, include one million broadband connections and that the entire population has access to affordable, high-speed telecommunications with comprehensive geographical coverage.<sup>90</sup>

At the end of 2001, Finland's numerous local exchange carriers could provide DSL coverage to 60% of the country's total lines. This was expected to have increased to 75% by the end of 2002. The largest provider of telecommunication services in rural and remote areas is TeliaSonera. By the end of 2002, that company could provide DSL service to 66% of its total lines.<sup>91</sup> The Finnish government projects that by the end of 2003 some 85% of all lines will be DSL-enabled and that this will increase to 95% by the end of 2004. One factor believed to be driving telecommunication carriers to upgrade smaller exchanges is the increasing substitution of cellular wireless services for PSTN telephony in Finland.

A number of energy utilities are using fixed wireless platforms to provide broadband services. The Finnish power company Haminan Energia provides a wireless broadband network in the regional city of Hamina.<sup>92</sup> The network covers an area of 20 square kilometres. Commercial services began in September 2002. At that stage Hamina was the seventh Finnish town to deploy Radionet's wireless equipment. Radionet's technology is based on the 11 Mbps wireless LAN standard conforming to IEEE 802.11b. Radionet has delivered wireless broadband networks to eight cities in Finland: Vaasa, Mäntsälä, Vantaa, Espoo, Porvoo, Kotka, Hamina and Rauma as well as a WLAN network for port operations in Turku.<sup>93</sup> As in Hamina, a number of the service providers are energy utilities expanding into the telecommunication market.<sup>94</sup>

### *France*

At the end of 2002, France Telecom, the incumbent operator, reported that it had made DSL available to 71% of the French population.<sup>95</sup> by early 2003, this had been increased to 74%. In June 2003, France Telecom announced a major drive to extend the coverage of broadband access in France. As part of this announcement, France Telecom said it would upgrade local exchanges to provide DSL access as rapidly as possible when service is requested by at least 100 customers in a given local area.<sup>96</sup> France Telecom also plans to equip all exchanges of over 1 000 lines (which serve areas with about 2 000 inhabitants) with DSL access equipment by 2005. By that date, France Telecom projects that DSL will be available to over 95% of the French population.

The CEO of France Telecom has stated that a clear objective for the company is to make broadband access available to everyone in the country.<sup>97</sup> DSL deployment is proceeding apace, but to go beyond 90% coverage France Telecom realises that other technologies can be usefully applied to extend coverage. In September 2003, France Telecom launched satellite broadband access. The company is also conducting trials with WiFi in rural areas to provide local access using satellite for backhaul. France Telecom also plans to lay an additional 7 500 kilometres of fibre optic cable to increase backbone reach. The cost of upgrading France Telecom's network, between 2003 and 2005, is put at USD 680 million.

France Telecom says the company plans to work closely with local and regional authorities. Potential user demand will be evaluated in liaison with municipal authorities, and followed by pre-reservation of connections by ISPs.<sup>98</sup> When the number of confirmed requests reaches the threshold, France Telecom says it will make a firm commitment to municipalities, users and ISPs to deploy DSL service.

France Telecom's trials aim to provide platforms that will bring broadband service to municipalities and customers in areas that have only partial or no DSL coverage. The first trials scheduled are in: Autrans (a town in the Isère region with 1 644 inhabitants), La Cavalerie (a town in the Aveyron region with 1 031 inhabitants), Moustier Sainte Marie (a town in the Alpes de Haute Provence with 685 inhabitants),

Neulise (a town in the Loire region with 1 173 inhabitants) and Vernou en Sologne (a town in the Loire et Cher region with 535 inhabitants).

To date, France Telecom's roll out of DSL has been entirely on commercial grounds. In January 2001, France Telecom said it would not invest to upgrade exchanges in towns below 15 000 inhabitants before 2003, because it would not be economically viable.<sup>99</sup> By December 2002, however, France Telecom's threshold for rolling out DSL on a commercial basis had been reduced to 5 000 inhabitants. At that stage the company said that perhaps only 5% of Internet users in France could not be reached economically with DSL.<sup>100</sup> As dial-up Internet is available over all PSTN lines in France, this would be close to the equivalent percentage of population which France Telecom believes could not be served commercially by DSL. Lowering the threshold for DSL in June 2003 to towns with 2 000 inhabitants or 100 customers will take France Telecom's DSL coverage to more than 90% of the population. It is worth noting that 100 customers is one of the lowest thresholds for schemes designed to upgrade exchanges based on exhibited demand (*i.e.* local potential users pre-registering for broadband).

There has been considerable debate and discussion in France about how to provide broadband access to that part of the population which was not expected to be reached by market forces. The French government has clearly stated that, as envisaged in the "e-Europe Plan 2005", the private sector should take the lead in developing infrastructure and services.<sup>101</sup> However, with France Telecom saying that it would not be able to make a commercial case for towns below 15 000 people before 2003, it appeared that a large proportion of the French population would not have access to broadband services within a reasonable time. One estimate, by *Le Conseil économique et social* in June 2001, was that some 20% to 30% of the population of France would not have access by 2005.<sup>102</sup>

In order to accelerate development in areas without service, the French government has undertaken a number of initiatives since 2001. These included a greater role for local authorities in the development of broadband infrastructure, mandating that the *Caisse des Dépôts et Consignations* (CDC) be able to support telecommunications infrastructure projects, and encouraging the deployment of fibre optic networks in rural areas using state-owned electrical infrastructure.<sup>103</sup> The *Caisse des Dépôts et Consignations* is a state-owned bank dealing with territorial development.<sup>104</sup> The new mandate enabled the CDC to make loans at reduced interest rates to local municipalities for broadband development. *Réseau de transport d'électricité* (RTE) is also the sole operator of the French high-voltage and extra-high-voltage public power transmission system. By February 2002, a total of nearly 2 000 kilometres of power lines were equipped with RTE's optical fibre cable. By 2007, RTE plans to extend this to 15 000 kilometres.

In July 2001, the Interdepartmental Committee for National and Regional Development (CIADT) announced a number of measures enabling local communities to provide access to high-speed communication networks. In February 2002, the government further decided that deployment of optical fibres on RTE power lines (*i.e.* using the same poles) could contribute to extending the access to high-speed communication to all the French regions.<sup>105</sup> Among the first actions undertaken, RTE launched jointly with the CDC a project with the Midi-Pyrénées Regional Council for the initial study of the potential supply of urban areas of more than 3 000 inhabitants. The most recent development at the time of writing was RTE forming a partnership with the General Council of La Manche Department for the development of access to digital technologies in the Department.<sup>106</sup>

While RTE and CDC involvement in extending broadband development in rural areas was relatively straightforward, the involvement of municipal authorities in providing local networks has proven more complex. Under French law, local authorities could establish infrastructure supporting independent operators or users' needs but could not act as telecommunication operators.<sup>107</sup> Local municipalities are also subject to regulation to ensure fair, transparent and non-discriminatory action in terms of rights of way and so forth.<sup>108</sup> In 2003, a bill was placed before the French Parliament to enable local authorities to also be

operators.<sup>109</sup> In June 2003, the French Senate passed an amendment such that local municipalities would only be able to operate networks where they could prove there is a lack of private alternatives.<sup>110</sup> Proponents of the amendment say it is necessary to make sure local municipalities do not compete unfairly with the private sector. Critics of the amendment say that it may slow the pace of broadband development in rural areas, and note that more than 100 municipal projects are under way or planned.

The issues being raised in France are common to many OECD countries. When the government began the process of encouraging alternative regional and municipal networks, France Telecom said that it would not be commercially viable to serve a large proportion of the French population. It is undoubtedly the case that the cost of upgrading exchanges to provide DSL has decreased, stronger demand is evident and France Telecom has embraced DSL as a core strategic part of the company's future. On the other hand, the question might be raised as to whether France Telecom would have moved as fast to extend broadband coverage in rural areas, had the threat of municipal broadband networks not emerged. Moreover, if the threat of alternative networks receded, would development continue apace? The most important point is that there is some form of competition in rural areas but on terms and conditions that are equal for all players.

The danger with municipal networks is that they may compete unfairly against existing players or make more difficult new entry by the private sector in France. On the other hand, the threat posed by these networks may have prompted France Telecom to extend broadband at a faster pace. A further issue is what level of service is expected from broadband infrastructure in regional and rural areas. Some municipalities would like to have a higher level of service than is provided by France Telecom. If France Telecom provided DSL to 95% of the population, and this included their locality, some municipalities still envisage providing higher levels of service. For example, the municipality of Pau has plans to deploy a fibre-to-the-home network with connection rates up to 100 Mbps.<sup>111</sup> By way of contrast, France Telecom's standard residential DSL offers range from 128 kbps to 1 Mbps, with 2 Mbps available for business users. This raises the question as to whether the level of service should also be considered as a criterion for deciding if municipalities can become operators. A list of municipal broadband projects is available.<sup>112</sup>

The other factor likely to speed the development of broadband access in France is the introduction of fixed wireless technologies and services. In 2002, the telecommunication regulator (ART) announced it was opening up the use of WiFi for the creation of public "hotspots" and for use in rural or underserved areas not covered by DSL or cable networks.<sup>113</sup> The regulation of wireless LAN was further simplified in July 2003.<sup>114</sup> Some developing standards, like WiMAX, will allow operators to extend network coverage and to increase the capacity of backhaul connections. Fixed wireless has, to date, mainly been employed by large users in France as an alternative broadband platform. The new generation of bi-directional multimedia satellites, which include an upstream return path, enable downstream high speed access services. Satellites also have the advantage of being able to provide complete geographical coverage of France. Satellite and WiFi technologies can, of course, be used in tandem. The French government aims to have 10 million high-speed Internet subscribers by 2007 and for broadband to be available in every district of France by the same date.<sup>115</sup> There were 3.5 million broadband subscribers, in France, at the end of 2003. In September 2003, the French government announced a number of measures to further boost rural broadband development, including the promotion of alternative platforms such as WiFi, satellite and electrical power lines.<sup>116</sup> Also included in the measures were tax breaks for companies purchasing satellite receivers and plans to grant free WiFi licences from 2004-06. With the recent technological developments, these alternatives to DSL could be economically relevant to serve rural and remote areas.

### *Germany*

Deutsche Telekom, the incumbent operator in Germany, can provide DSL service to 90% of that country's access lines.<sup>117</sup> Some of the lines that can not be served via DSL are in areas where fibre-to-the-



curb or fibre-to-home platforms are used to provide telecommunication services. In February 2003, Deutsche Telekom was still assessing the most economical way of providing broadband to customers with access served by these fibre networks. The choices included laying new copper lines that would enable the provision of DSL or upgrading the fibre networks to provide broadband access. In the interim, Deutsche Telekom had introduced broadband via satellite and says that this product enables the company to offer broadband service also to around 5 million customers in urban and rural areas than can not currently be served via DSL.<sup>118</sup> The downstream speed of the satellite service is up to 768 kbps with the upstream connection being provided via the PSTN. The monthly cost of the satellite link (*i.e.* excluding the PSTN and ISP charges) is around USD 20 including 500 Megabytes. Additional data above the monthly cap are charged at USD 0.05 per Megabyte. New entrant operators such as Strato, with its ‘skyDSL’ offer, also provide satellite broadband solutions over all Germany.<sup>119</sup>

There are a number of wireless ISPs in Germany. Kevag Telekom, for example, offers services using unlicensed spectrum in Germany's Rhineland-Palatine region to business and public sector clients.<sup>120</sup> TGNET is one of the larger wireless ISPs in Germany.<sup>121</sup> Prices for TGNET services start at USD 21 per month for an 800 kbps downstream service with a 6 Gigabytes download cap.<sup>122</sup> In the town of Bergen, Midas Telecom has built a pilot mesh wireless network capable of connecting 400 households and they plan to extend that to 2000 households during 2004.<sup>123</sup> In Germany, as in many countries, fixed wireless initiatives were still on a relatively small scale in 2003. Their development, however, is likely to be boosted by the decision that licences would not be required to operate such services in some parts of the radio spectrum. This came into force in 2003. At present, the most-used radio technology is satellite access, provided by ISPs such as Strato, Tiscali and Deutsche Telekom.

### *Greece*

In May 2003, the incumbent telecommunication provider OTE announced its first pricing plans for DSL services. Following two years of trials, OTE then launched what it termed a “commercial trial”, in June 2003.<sup>124</sup> OTE's initial deployment had the capability to serve 18 000 users, with the company projecting 8 000 subscribers by the end of 2003. Service was initially limited to four urban areas, three in Athens and one in Thessalonica. During the remainder of 2003, OTE planned to make service available to most of the larger cities in Greece. OTE says its target market is business users.<sup>125</sup> In July 2003, one of the largest independent ISPs in Greece announced the availability of DSL service.<sup>126</sup> At that stage service was only available in limited areas of the country. The late arrival, relatively high prices and limited coverage available for DSL should mean that wireless is a viable alternative to provide broadband access but, by mid-2003, wireless was yet to impact on developments in Greece.

### *Hungary*

Matav is the largest telecommunication provider in Hungary. The company's traditional service area covered 72% of the Hungarian population. Matav provided DSL service to 49 cities at the end of 2002. This was up from 12 cities at the end of 2001. At the end of 2002, Matav said it could, in principle, serve 1.4 million lines with DSL service.<sup>127</sup> This represented around 50% of all lines. In Budapest, Matav served 76% of all lines with DSL by end-2002 while some regions had no enabled exchanges.<sup>128</sup>

Matav's strategy is to serve areas of high population first and then roll out service to less populated areas. The company's aim is to protect their core telephony business by bundling broadband in those areas where competitors can provide alternative telephony services over their own networks. In 2002, the ratio of Matav's traditional areas of operation facing competition from cable was 30 to 35%. By September 2003, in total 265 towns had been covered by a broadband connection by Matav and other service providers.

Although fixed wireless-LAN services have emerged in Hungary, Matav regards cable television networks as a larger threat. One reason for this is that fixed wireless providers have largely targeted business users in areas without DSL rather than compete head-on with Matav.<sup>129</sup> In 2002, Matav said that fixed wireless services generally offered less bandwidth at higher prices than their own DSL offers. In Hungary there are more than 20 service providers offering wireless LAN services. Enernet is one ISP providing wireless LAN in smaller towns as a substitute for leased lines.

### *Iceland*

At the end of 2002, Siminn the incumbent telecommunication carrier could provide DSL service to 78% of Iceland's population. If DSL provided by other operators is included the national total increased to 86% by January 2003.<sup>130</sup> Iceland has some of the lowest thresholds for provisioning DSL in the OECD area. The ITU reports that all towns with more than 1 000 inhabitants had DSL by the end of 2002 and all those towns with 500 inhabitants will have access by end 2003.

In Iceland, eMax is offering a WiFi service to provide broadband access to rural users.<sup>131</sup> In mid-2003, eMax began services in a number of smaller communities that do not have DSL. The company also competes against DSL in some rural areas where it is available. The areas served by eMax include Eyjafjardarsveit in the north of the country, farms around Stokkseyri and Eyrarbakki in the south, and the farms around Borgarnes and Skorradalur in the west.

Skorradalur is an area with around 600 houses used mainly for summer vacations. eMax uses a wireless system in that valley, which is 20 kilometres long and 4 kilometres wide. The company has a 10 Mbps full duplex backbone on 5.8 GHz and the last mile solution is 2.4 GHz on the ISM band. eMax connected 30 houses in the first few weeks of operation, including vacation residences and some farms and the local school.

eMax's advertised service operates at 11 Mbps, as per 802.11b standard, but the actual throughput is reported to be somewhere between 7 Mbps and 9 Mbps. In August 2003, eMax had nine communities waiting for the service and planned for most of them to be connected during the third quarter of 2003. Apart from providing direct services to end users, in some areas eMax works with a local ISP, and only delivers the wireless link to subscribers, with the local ISP providing Internet access. eMax says IP phones are the next step the company will take and it was testing the service in 2003. The company believes IP phones represent a less expensive way to provide telephony in rural areas than fixed or mobile services.

### *Ireland*

By June 2003, DSL was available to around 52% of lines in Ireland. By the end of 2003, Eircom the incumbent telecommunication operator planned to enable 1 million lines – the equivalent of around 62% of all lines in Ireland. In January 2004, Eircom announced plans to introduce a trigger mechanism for towns with a population of less than 1 500. The threshold for automatically upgrading an exchange was set at between 200 and 700 residential customers. Eircom have stated that they plan to roll out DSL to every town in Ireland with a population greater than 1 500 by March 2005.<sup>132</sup> In late 2003, Eircom's price for 512 kbps service was over USD 60 per month but price reductions for retail and wholesale products were announced in February 2004.

Due to the relatively late start of DSL in Ireland, fixed wireless provided a significant proportion of all broadband connections as at March 2003. A number of firms offer broadband services via fixed wireless including Irish Broadband, Leap Broadband and Skynet.<sup>133</sup> All three providers offer services to business users in the Dublin area, and Irish Broadband also offers services to residential users. In August 2003, Irish Broadband charged USD 54 per month for a 512 kbps service but this was lowered to

USD 34 in September 2003.<sup>134</sup> Fixed wireless operators are also operating in regional centres. Amocom offers broadband access to business and residential users in Cork.<sup>135</sup> Amocom offers a symmetrical 512 kbps service for USD 68 per month.

In February 2003, the Irish government announced the roll out of a USD 73.5 million national broadband scheme with the aim of delivering high-speed Internet access to 19 towns and cities around the country.<sup>136</sup> The project was later extended to cover 88 towns with a population of over 500 inhabitants.<sup>137</sup> The networks will be constructed over 18 months and will be fully operational by the end of 2004. The project, 90% grant-aided by the government under the National Development Plan 2000-06, is co-funded by the European Union under the European Regional Development Fund.<sup>138</sup> Whilst ownership of the completed networks will remain with the State, the marketing, management and maintenance of the infrastructure will be undertaken by a Management Services Entity (MSE) on a concession basis.<sup>139</sup> The Management Services Entity will administer access to the networks on an open access basis. The government is tendering for a Management Services Entity to manage, maintain and operate access to these networks. The Irish Government is also undertaking an initiative to bring low cost backhaul to the regions of Ireland.<sup>140</sup> This is in addition to the fibre rings/MSE initiative.

One of the government's policy goals is to provide broadband connections to all schools, libraries and community learning centres in the country.<sup>141</sup> This is in line with recommendations made by a government advisory body.<sup>142</sup> To that end, the government announced plans for a national tax on major telecom firms that is expected to raise up to USD 34 million after it becomes law.<sup>143</sup> The Irish Business and Employers Confederation (IBEC) is opposed to the creation of this levy, as are the major telecommunication carriers. IBEC's Telecommunications Users Group (TUG) is, of course, concerned about the "digital divide" between users in urban and rural areas and has been lobbying the government to address the issue.<sup>144</sup> According to IBEC, the difference in levels of service and higher prices for rural users are emerging as major issues for established businesses in these areas. However, IBEC does not support using an industry levy to address these issues.

In January 2003, the Irish government named five trial programmes that will receive funding to deliver wireless broadband Internet access across the country.<sup>145</sup> The trials are aimed at demonstrating the feasibility of wireless LAN broadband technology. Total funding for this initiative amounted to USD 294 000. The Irish government has also established a Web site which enables users to see which broadband providers are in their area together with available offers and prices.<sup>146</sup> This includes a tool enabling potential users to register their interest in subscribing to a broadband service with only aggregate data being passed to service providers. Eircom has also established a Web site allowing potential subscribers to register their interest in broadband access.

Ireland's South West Regional Authority is undertaking a broadband trial aimed directly at rural communities.<sup>147</sup> The scheme is jointly funded by the European Space Agency and aims to provide broadband access to 2 000 residential and small-business subscribers. Backhaul is being provided by satellite with local access via wireless platforms using 802.11b at 11 Mbps. The 802.11g wireless standard is also being trialled. One novel part of the scheme is that it allows users to roam in those rural areas covered by the project. In other words, a user can access the service at any location using the same account. The initial three months are free for subscribers, with a reported aim of eventually providing a commercial service at USD 28 per month. This is about half the price of baseline DSL in urban areas of Ireland.

### *Italy*

By the end of 2002, Telecom Italia, the incumbent telecommunication carrier, could provide DSL service to 70% of all the company's lines in Italy.<sup>148</sup> At the same date, DSL had been extended to

2 120 local exchanges and this is projected to increase to 3 000 by the end of 2003. Telecom Italia expects that this will provide coverage to 80% of lines by the end of 2003. The same coverage is available to independent ISP's reselling Telecom Italia's wholesale DSL service. One advantage Italy has had over a number of countries is that a high proportion of its local copper loops serve relatively short distances. In Italy, more than 80% of twisted pair connections are less than 2 kilometres in length.<sup>149</sup> Some 95% are within 3.5 kilometres from an exchange, and nearly all are less than 5 kilometres from an exchange. Thus while the same economic challenges exist, as for upgrading small exchanges, distance is less of a barrier to customers receiving service for those exchanges that justify a commercial upgrade.

One-way broadband satellite services are available in Italy using the PSTN to provide an upstream connection. For example, Tiscali provides a baseline satellite service for USD 27.47.<sup>150</sup> The maximum speed is 2 Mbps but in practice the speed is determined by the type of subscription taken by the user. The baseline subscription provides an average speed of 400 Kbps for the first 150 Mbytes downloaded by a user and of 200 Kbps for the successive blocks of 150 Megabytes. The next level of service costs USD 43.92 and provides an average speed of 400 Kbps for the first 400 Megabytes and of 200 Kbps for successive blocks of 400 Megabytes. Users would also need to pay the applicable PSTN charges for upstream access to the Internet.

Wireless ISPs are developing in Italy both in urban and rural areas. "Nocable" was among the first companies to be authorised to experiment with WiFi in Italy. Nocable expects to introduce wireless Internet service by the end of 2003 in 100 coastal resorts in Southern Italy.<sup>151</sup> Among other locations, service is available on the Island of Capri. Nocable says that it intends to demonstrate the feasibility of providing broadband service that may not be economical for other platforms.

The basis of the Italian government's plan for developing broadband in under-served areas was set out by a Ministry of Communications Task Force which reported in November 2001.<sup>152</sup> The Task Force identified a number of points in terms of bringing broadband to under-served areas. They noted that, while DSL had the potential to reach the majority of the population, some areas would need to be served by alternative technologies. The Task Force also recognised the barrier that backhaul represented to serving some rural and remote areas. Policy recommendations included the consideration of the role demand aggregation and public procurement could play in encouraging the deployment of backhaul capacity. These initiatives, it was suggested, should be linked with Italy's overall plan for placing government services online and connecting public sector sites (*e.g.* schools, hospitals, post offices, and so forth). The resulting plan aims to aggregate public sector demand and link public sites in a single national network.<sup>153</sup>

A number of innovative approaches are being used in rural areas. IBAX is a non-profit consortium that designs, deploys and manages networks across Italy.<sup>154</sup> IBAX is rolling out a fixed wireless broadband network for Italian public administration sites in a number of rural and remote areas.<sup>155</sup> IBAX is initially deploying high-speed data services for the private networks of municipal and provincial governments to bring government services primarily to townships of 2 000 to 10 000 people in mountain areas not served by DSL. The first deployment, in the Lombardy and Piedmont Regions, will serve areas which currently have no broadband access; enabling users in schools, government offices, and so forth, to access the Internet at broadband speeds.

During 2003 IBAX plans to deploy fixed wireless in hundreds of mountain communities throughout northern, central and southern Italy. The aim is to enable innovative government services and generate enough savings for public sector users to trigger the Italian government's subsidies for innovation.<sup>156</sup> IBAX's first network provided fixed wireless access to all municipalities in the Parma Province in Northern Italy.

It says something about the pace of change in the telecommunications sector that the Italian Task Force, while recognising that wireless local loops were one of the alternative platforms, consulted experts who felt that the costs associated with deployment might limit their application to operators seeking rapid financial returns and to mainly serving industrial districts.<sup>157</sup> As it has turned out, Nobile is first serving resort areas, while IBAX provides service in rural areas. Key elements in the reversal of expectations have been the falling cost of fixed wireless networks, the development of non-line-of-sight systems and the new entry made possible by unlicensed spectrum. Accordingly, the Task Force's own conclusions that "Current technologies are developing so rapidly that planning large-scale infrastructures projects would be ineffective", and that "...broadband can not be delivered over a single technology alone..." have proven robust.<sup>158</sup>

### *Japan*

At the end of 2002, Japanese DSL providers could cover 80% of all households in Japan. This will be raised to 90% by the end of 2003. Most of those households that are not currently served are in rural areas or about 300 remote islands out of the 6 852 islands that make up Japan.<sup>159</sup>

Through the "e-Japan strategy" the government aims to extend the availability of broadband so that the digital divide resulting from geographic constraints is closed.<sup>160</sup> Since 1998, the Ministry of Public Management, Home Affairs, Posts and Telecommunications (MPHPT) has been helping local government to establish public intranets (Regional Public Network). These intranets connect locations such as city halls, schools, libraries and community centres but the programme is not only applied in rural areas.<sup>161</sup> These intranets mostly employ fibre optic cables but there are some cases where wireless access is used. MPHPT supports either one-third or half of the total project cost of building these intranets. The public intranets are connected to the Internet. By the end of August 2003, 754 intranet projects had been granted financial assistance by MPHPT. In the 2003 budget, MPHPT continued to support the creation of regional broadband networks including funding for regional public bodies to implement regional public networks.<sup>162</sup>

Along with the intranet programme, some initiatives are specifically targeted at rural areas and remote islands.<sup>163</sup> Should fibre optic cable be used to connect residential users to the public intranets, in rural areas or remote islands, then MPHPT may provide one-third of total project cost for fibre-to-the-home. Since 2002, four such projects have been granted financial assistance. In July 2003, the government published the "e-Japan strategy II", which stated that wireless access should also be considered as a solution for local broadband access in rural areas. Some experiments using wireless platforms for broadband access in rural areas have been carried out. For example, the Bureau of Telecommunications in Hokkaido, in the far north, characterised by rural areas, conducted a field experiment in Takikawa city to demonstrate the practicability of broadband wireless access. This experiment demonstrated that wireless access could be a practical and simple solution for broadband Internet access.

In July 2003, MPHPT submitted an inquiry to the Radio Regulatory Council concerning an amendment to regulations to enable the Ministry to allocate 18 gigahertz for the development of broadband wireless access. Local governments will be able to use this spectrum to create municipal broadband networks.<sup>164</sup> Ministry officials were reported as saying the aim was to promote the use of wireless high-speed communications networks in rural areas in a bid to bridge the "digital divide". The spectrum concerned had been previously used for trunk communications but this utilisation had largely been superseded by the use of fibre optics. According to the Ministry's plan, local governments will be able to install antennas on top of government offices, public schools and other public facilities to develop a network capable of providing service at up to 156 Mbps. Individual households could then connect to the network, with smaller antennas from several kilometres distance, at a fraction of the cost of building a fibre link.<sup>165</sup>

The private sector has a number of trials underway using wireless to provide broadband access. IPMobile, for example, has equipped three cell sites in the Tokyo metropolitan area for one of these experiments.<sup>166</sup> New services are also extending the distance capabilities of DSL. YahooBB, for example, has a service called “reach ADSL” and this service uses lower frequency than regular ADSL services. YahooBB say that lower frequency only enables a 960 kbps service to be provided but that it is less affected by distance and interference. Accordingly, in addition to their very high capacity DSL services up to 4 kilometres the company also offers 700 kbps up to 8 kilometres.

### ***Korea***

Korea has by far the highest penetration of broadband access among OECD countries. By mid-2003 more than 70% of households had a broadband connection.<sup>167</sup> Business use of broadband was also high, with some 62.7% of all Korean businesses using DSL to access the Internet and 21.9% using leased lines. One factor in the Korean success is the ready availability of broadband access.

KT is the incumbent telecommunication carrier in Korea. KT has the advantage that approximately 98% of the Korean population live within a four kilometre radius of existing telephone offices.<sup>168</sup> KT says this makes DSL available to most of the Korean population and by 2003 some 93% of households could access DSL service. The Korean National Computerization Agency says DSL can be used to transmit data over a distance of 5 to 6 kilometres.

If coverage by satellite is included broadband access is available to 98% of towns and country areas.<sup>169</sup> The Mukoonghwa Satellite uses the PSTN for the upstream connection. In 2001, the Korean government financially supported the establishment of satellite facilities for the 367 households and farming co-operatives where DSL was not available. In 2002, a further 400 households received satellite service under this programme. That being said the use of satellites for broadband access is declining in Korea. At the end of 2003, there were 5 889 subscribers to broadband satellite services. This number was half the total for the previous year when there were 12 020 subscribers. The decline was due to users giving up satellite connections as terrestrial options, such as DSL, became available in areas where there had previously not been coverage. According to the National Computerization Agency, the use of satellites is now limited to users in remote locations or mountainous regions.

The decline in satellite use would appear to indicate a relatively high and increasing level of DSL availability. At the end of 2002 some 89% of households in rural areas could access some form of broadband platform. This is projected to increase to 93% by the end of 2003. “Cyber Korea 21” was the framework guiding government action in Korea between 1999 and 2002. In that plan, the Korean Government stated that:

“Broadband networks will be implemented to access the Internet from rural and fishing areas, while remotely-located schools will utilise the Mukoonghwa Satellite. As a result, the general public will be able to enjoy 1.5/2Mbps-level high-speed services at affordable costs by 2002.”<sup>170</sup>

By most measures, the “Cyber Korea 21” goals have been reached and significantly exceeded. Much has been written on how this was accomplished and will not be repeated here. The conclusion of previous OECD work very much supports a statement by the Korean Minister for Information and Communications, who in November 2002 said:

“In particular, the government encouraged competition in the broadband Internet market as a strategy to boost its penetration. Such market competition induced the companies to make necessary investment and to keep the service tariff at a reasonably low level.”<sup>171</sup>

It is also true that the Korean government, beginning in 1995, funded the development of national backbone networks to all Korean regions in return for use by the public sector. By 2002, the entire investment had been repaid through usage of these networks by the public sector. While significant in the story of Korea's broadband development, it is worth noting that a number of OECD and non-OECD governments have funded backbones but have not had anywhere near the success that Korea has achieved, in terms of the take-up of broadband access. In these other countries, the missing ingredient was local access competition. In Korea's case, the most important elements were extremely vigorous local access competition in a country with the highest population density in the OECD.

Low-interest loans were also available for Korean companies to build broadband infrastructure but were little used because of less expensive capital being available in Asian financial markets. For example, low-interest loans only made up a very small fraction of the Hanaro's expenditure in rolling out broadband networks that are now available to more than three-quarters of Korea's households. The amount of USD 60 million was available in 2003 to fund low-interest loans for extending broadband access. While this money was not specifically allocated for rural areas, in practice all urban areas have broadband access available.

Korea's success in terms of broadband penetration has led that country to set more ambitious goals. In March 2002, the Korean government declared that broadband Internet service would become a universal service.<sup>172</sup> This was formalised in the 2001 "Act on Closing the Digital Divide". The new plan to put this into practice is the "Broadband Information Communication Infrastructure Advancement Plan (2001-2005)". The main goal under this plan is for 90% of Koreans to be able to access a 20 Mbps connection by 2007.<sup>173</sup> In high-density areas, the government envisages that high-capacity local area networks, very high bit rate DSL (*i.e.* VDSL) and cable networks will be utilised. At the same time, the goals for rural broadband access are a baseline of 1 Mbps and up to 8 Mbps where DSL is made available.<sup>174</sup>

Following the privatisation of KT in July 2002, the company is legally required to provide universal service. In Korea, broadband access is not a legal requirement stemming from universal service obligations but the privatisation did impose some requirements on KT in respect to rural areas. As in the past, however, the goals set by the government for the development of broadband access will continue to be met mainly by competition. Korean broadband providers launched 13 Mbps VDSL services in 2002 and have increased offerings to 20 Mbps in 2003. VDSL has a shorter range than ADSL, at between 0.3-1.5 kilometres. Korea's leading broadband operators are also using various wireless platforms to provide broadband access but, to date, mostly in urban areas. Hanaro offers a fixed wireless service in 10 cities with downstream speeds up to 10 Mbps to small business and apartment buildings. In April 2003, some 865 buildings were connected. KT and Hanaro also offer an extensive and growing number of WiFi "hotspots" in urban areas. They are also trialling a number of different fixed wireless platforms for wider area coverage.

In February 2004, the Korean government announced that it planned to spend USD 60 million to expand broadband access in rural areas with more than 50 households.<sup>175</sup> This is expected to lift broadband access levels in rural villages to 95% by the close of 2004. The programme is also open to villages with less than 50 households if there is sufficient demand. KT has also announced expenditure in these rural areas of USD 30 million for 2004.

### ***Luxembourg***

P&T, the incumbent carrier in Luxembourg, says that DSL is available in practically all the Grand Duchy with all the 50 centres of telecommunications having been upgraded. P&T has also equipped 11 sites that are intermediate distributors of telecommunication lines to further extend the availability of

services. DSL services were available to 90% of Luxembourg's population by June 2002.<sup>176</sup> In June 2003, P&T still reported 90% availability of DSL.

### *Mexico*

Telmex, the incumbent telecommunication carrier in Mexico, provides DSL service in 1 036 service areas and says they are working to extend that coverage.<sup>177</sup> The percentage of lines able to be enabled for DSL or population coverage is not reported. However, even if all lines were enabled for DSL, it is necessary to note that Mexico has a low penetration of basic telephone service relative to other OECD countries. In April 2003 there were 14.3 fixed network access lines per 100 inhabitants. This compares to an OECD average of more than 54 lines per 100 inhabitants in 2001. While the provision of basic telephony will continue to be a priority in Mexico, that does not negate the role broadband can play for economic and social development where it is available. Nor does it mean that telephony will not be provided by broadband operators using new technologies.

Cellular wireless networks have arguably been more successful than fixed networks in rolling out telephone service in Mexico. In April 2003, there were 25.5 cellular subscribers per 100 inhabitants, or more than double the penetration of fixed networks. Most likely the majority of users of fixed and mobile services are people taking both services. On the other hand, the availability of pre-paid cards has enabled some users to afford a telephone for the first time. Fixed wireless services may now provide the same opportunity in terms of extending the availability of broadband access.

To compete against the incumbent local loop provider throughout Mexico, *MVS Comunicaciones* elected to build a wireless network that would extend services to business and residential customers in both rural and urban areas. MVS commenced service by deploying its high-speed wireless network in Mexico City and will complete deployments in Guadalajara and Monterrey, the second and third largest cities in Mexico, by mid-2003.<sup>178</sup> By December 2003, the company planned to extend its service offering to 50% of Mexico's population by launching the service in six additional cities.<sup>179</sup> In total MVS aims to expand its potential customer base to include 70% of Mexico's population.

The MVS system is one of the world's largest non-line-of-sight networks.<sup>180</sup> The company reports that although Mexico City has some challenging characteristics for a WISP, they are delighted with the performance of their fixed wireless network.<sup>181</sup> In fact, in some respects, the network has exceeded their expectations. MVS says that in trials the system has even been able to provide continuous service in downtown Mexico City to vehicles moving at speeds up to 100 kilometres per hour. The trials used standard CPE equipment with antennas mounted on automobiles. The fixed wireless network did not need modifications to hand off subscribers moving from one sector to another. MVS say that, as the technology they use is a candidate for the ITU's 4G standard, they have one of the world's first 4G applications.<sup>182</sup> In some parts of Mexico City, service is provided up to a range of 16 kilometres indoors and 20 kilometres outdoors, using a tower based on a high rise apartment block.<sup>183</sup>

MVS' broadband prices are comparable to Telmex. Both companies offer a 256 kbps service for USD 47 per month. The MVS system is stand-alone, whereas with the DSL service a subscriber would also have to pay for a PSTN line. In most OECD countries the latter point would not be significant because most users have a telephone line. However, in a country where mobile phones outnumber fixed telephones by two to one, it is possible that some users may prefer a combination of wireless technologies to provide communication services rather than the fixed network. MVS plays on this by offering a 128 kbps wireless service aimed at competing with dial-up. This MVS service is priced at USD 33 per month. The company compares this to dial-up by noting that the combined cost of a telephone line, ISP subscription and flat rate local calls would cost USD 37.71 per month.<sup>184</sup> At the same time, of course, 128 kbps is twice the highest available speed for dial-up.



The response of the incumbent to these developments is significant. In May 2003, Telmex placed a new order for wireless systems operating in the 3.5GHz band to extend basic service coverage to rural and suburban areas. Telmex says that with demand for Internet access growing, they are taking advantage of wireless technology to bring affordable broadband services to areas where the existing infrastructure cannot support DSL.<sup>185</sup> Telmex argues that this step will not only contribute to Mexico's economic and cultural development but also secure their revenue base.<sup>186</sup> In May 2003, Telmex also launched "Prodigy Movil" an 802.11b service.<sup>187</sup> In August 2003, the service was free for their DSL customers, an additional USD 9.50 per month for dial-up accounts and USD 19 per month when taken as a stand-alone service. These prices are some of the least expensive in the OECD for unmetered WiFi access, suggesting that Telmex believes it will be subject to considerable competition in this market segment.

### *Netherlands*

The Netherlands has a relatively high availability of DSL and cable modems. KPN, the incumbent telecommunication carrier, could provide DSL to 85% of its lines by the end of 2002. The Netherlands also has one of the highest availabilities of cable television, with virtually all households in the country being passed by a cable operator. In March 2003, cable networks had around twice the number of broadband subscribers as DSL.

Wireless networks are being used in the Netherlands to reach areas that are not served by other broadband platforms. One such company is "IntroWeb". IntroWeb offers high-speed data services primarily to residential customers who live in townships of 2 000 to 10 000 inhabitants and also to small-to-medium-sized businesses. Introweb charges USD 31 per month for a 128 kbps connection and USD 54 per month for a 512 kbps service.<sup>188</sup> The first deployment was in Losser, a town of approximately 4 000 residents, which previously had no broadband access.<sup>189</sup> Introweb plans to initially target customers in the eastern part of the country and to expand the offering to the northern region of the Netherlands within 12 months. The network is non line-of-sight.

Another company offering fixed wireless broadband access is Xtratyme. Services are being rolled out in the eastern part of the Netherlands where high-speed Internet access services are not widely available.<sup>190</sup> Xtratyme acts as a carrier-of-carriers and sells its wireless bandwidth to regional ISPs who then provide access services to businesses and consumers. Two regional ISPs who use Xtratyme's wireless network are BetuweNet in the city of Arnhem and Flakkee Net in the city of Oude Tonge.<sup>191</sup>

### *New Zealand*

In November 2000, Telecom New Zealand projected that they would have 75% DSL coverage by the end of 2002.<sup>192</sup> As it transpired that projection was exceeded. At the close of 2002, the incumbent operator had reached 83% coverage.<sup>193</sup> In June 2003, this had been further extended to 84.8% DSL coverage.<sup>194</sup> In rural areas, 46% of Telecom's customers could access DSL by June 2003.<sup>195</sup> Telecom projects that 80% of rural households will be able to access some form of broadband service via DSL or fixed wireless by June 2004. Telecom also says it is trialling satellite technology with a view to further extending coverage if it is economically viable.

Satellite broadband access has been available to many parts of New Zealand since December 2000.<sup>196</sup> From then onwards, "iHug" has offered a one-way satellite service at sub-broadband and broadband speeds. The service uses a satellite for the downstream link and the PSTN for the upstream link. While local calls are free for residential users in New Zealand, users of iHug's "Ultra" satellite service need to subscribe to a dial-up ISP. In August 2003, iHug's sub-broadband offer of 128 kbps downstream and iHug dial-up, for the upstream connection, was priced at a total of USD 38 per month. This offer included 250 hours of online time and 500 Megabytes of international traffic (national and international bytes are

priced differently by some providers in New Zealand).<sup>197</sup> iHug also had a number of higher-speed downstream offers. For example a 1 Mbps downstream connection was priced at USD 44 for 60 hours and 1 000 Megabytes of international traffic.

Using iHug's one-way satellite has obvious disadvantages compared to Telecom New Zealand's DSL service. One difference is the need to use the PSTN line for the upstream link, whereas a DSL user would still have the first line available for concurrent telephony use. In addition all satellite broadband services have an inherent latency that may be important for some applications such as online games. Notwithstanding these differences, depending on usage levels, iHug's pricing is comparable to or less expensive than DSL in New Zealand.

The parity of satellite and DSL pricing in New Zealand has meant that the satellite service has a relatively high take-up rate compared to other broadband platforms. By October 2002, iHug had gained 5 000 satellite subscribers.<sup>198</sup> To place satellite use in perspective, it can be compared with that in Australia. New Zealand has a higher availability of DSL than Australia and around a quarter of the population. Yet satellite services in Australia had only gained 11 200 subscribers by October 2002. Accordingly, New Zealand's penetration of satellite broadband was double that for Australia. The obvious difference between the two countries is that satellite costs significantly more than DSL in Australia (and most other countries) whereas the price of the two services is similar in New Zealand.

The foregoing raises a number of issues and questions. The most obvious is whether DSL and satellite are priced similarly because DSL is expensive in New Zealand. One characteristic of the New Zealand market, compared to most other OECD countries, is that the incumbent is not required to unbundle the local loop. As a result the incumbent has arguably had greater control over DSL pricing than in other OECD countries and has exercised this power through the structure and level of pricing. In turn this has resulted in the satellite service being priced at a similar or less-expensive level. This leads to the situation where, if the sole criteria for rural broadband success are widespread availability and price parity with urban broadband, then New Zealand has attained this goal. On the other hand, policy makers would no doubt want to factor in the technical performance of satellite relative to DSL and whether DSL pricing is subject to enough competitive discipline. For its part, iHug says it plans to introduce a two-way satellite service to improve services in rural areas.

Telecom New Zealand is beginning to experience competition in the provision of broadband access from fixed wireless development. Wireless ISPs are aiming to either compete head on with DSL, in those areas where it is available, or to provide service where the only option may be satellite. The two largest emerging fixed wireless players are Walker Wireless and BCL. Walker Wireless is a private company which has partnered with Vodafone.<sup>199</sup> Under an agreement signed in July 2003, Vodafone became a key marketing and distribution channel for the Walker Wireless broadband service.<sup>200</sup> Independent ISPs also resell the Walker Wireless service in areas where it is available and the pricing of these services initially tended to be comparable with DSL. In September 2003, however, Walker Wireless announced a new pricing structure for a commercial service beginning in urban centres of Auckland, to be followed by Wellington and Christchurch. Significantly, the baseline price for an unlimited 256 kbps service was the same as the DSL service at 128 kbps.<sup>201</sup> Walker Wireless also has plans to serve rural areas.

BCL is a 100%-owned subsidiary of the state-owned national television broadcaster (TVNZ). BCL has one of the largest communications networks in New Zealand. Television services supported by BCL's transmission services reach 99.8% of New Zealand's population, using more than 400 transmission sites throughout the country.<sup>202</sup> BCL has partnered with a number of ISPs, such as ICONZ and iHug, to resell its wireless service. The key partner, however, is Telecom New Zealand. The BCL-Telecom New Zealand service will be deployed over stage one of BCL's 28-site broadband wireless deployment. This network,

which is being rolled out in eight rural and provincial regions nationwide, has the ability to reach approximately 100 000 subscribers.<sup>203</sup>

A growing number of small wireless ISPs serving their local community are emerging in New Zealand. A wireless ISP called the “ThePacific.net” offers a fixed wireless line-of-sight service to two areas on New Zealand’s South Island.<sup>204</sup> ThePacific.net covers 90% of the population in its service area with line of sight wireless and the most distant fixed wireless customer is 19 kilometres from the transmission site. The company’s tariff plan, with the largest number of subscribers, is priced at USD 78 per month for 500 Megabytes of international traffic, 2 Gigabytes of domestic traffic and free exchange of local traffic.<sup>205</sup>

Rural Networks is a wireless ISP operating in the South Waikato area.<sup>206</sup> The company uses 802.11b and eventually plans to provide service in provincial centres and rural areas outside the five largest cities.<sup>207</sup> By June 2003, Rural Networks first development was nearing 70% coverage of the South Waikato area. The local municipality of this area contributed funding to the project in partnership with Rural Networks.<sup>208</sup> Rural Networks provided a bundled data and telephony service priced at USD 38 per month. The company offers incremental increases in blocks of 64 kbps up to the theoretical limit for 802.11b (*i.e.* 11 Mbps). The baseline advertised rate is a symmetrical 64 kbps connection but Rural Networks say that this is the minimum rate. In other words, the company says 64 kbps is the “true connection rate” that will be realised by subscribers. To illustrate this, they say that a dial-up connection of 56 kbps may only achieve an actual transfer rate of 5 kbps whereas they guarantee transfer rates equivalent to the actual rates experienced on broadband connections with higher advertised capacity.<sup>209</sup> Advertising actual transfer rates instead of maximum rates is uncommon among ISPs, not least because transfer rates can be impacted by the performance of other networks, and so forth.

Airnet is a broadband provider in Hawkes Bay, on the North Island of New Zealand.<sup>210</sup> Airnet’s baseline service is priced at USD 27 per month with a 500 Megabyte download cap. One of the greatest advantages of Airnet’s Internet is that their connections are symmetrical. The company offers a range of options up to 4 Mbps.

Wired Country is an ISP on New Zealand’s North Island, offering both fibre and fixed wireless connections in its service area. The Wired Country broadband network currently covers the greater Pukekohe area and is rolling out to Papakura and the surrounding Franklin region. The company is a subsidiary of Countries Power, a community-owned electric utility. Wired Country has agreements with a number of ISPs to resell its service. One such ISP is the “Packing Shed” which initially offered a range of fixed wireless services from 128 kbps to 512 kbps.<sup>211</sup> In August 2003, the baseline 128 kbps service was priced at USD 26 per month with a 1 Gigabyte download cap. A 256 kbps offer with the same download cap is priced at USD 38. Wave Internet is another wireless ISP partnering with Wired Countries as well as developing its own wireless infrastructure.<sup>212</sup> In September 2003, a significant development occurred with the Wired Country broadband service. To promote the service, the company decided to dramatically increase the speed of the service while holding prices at the same level. This meant that a user on 128 kbps had their service automatically raised to 1 Mbps. Those on a 256 kbps were moved up to 2Mbps, 512 kbps customers got 5 Mbps speeds, and 2 Mbps users were increased to 10 Mbps. Speeds of up to 100 Mbps were available for customers of the 10 Mbps service.<sup>213</sup> The promotion period was to be for at least seven months until March 2004, with Wired Country saying they hoped to further improve service in that time period by offering telephony. If the new levels of service, with the existing prices, are sustained in New Zealand, they are not only significantly better than those available via DSL in urban areas of the country but are also competitive by international standards.

The New Zealand government’s main programme aimed at encouraging the roll out of broadband access in rural areas is named “Project PROBE”.<sup>214</sup> Project PROBE has been developed jointly by the

Ministry of Education and the Ministry of Economic Development to roll out broadband to all schools and provincial communities in New Zealand by 2004. The programme was announced, in May 2002, with associated funding of USD 17.6 million.<sup>215</sup> A further objective of PROBE is to increase levels of competition in the telecommunications sector outside urban areas. A tendering process has been used, with companies such as Walker Wireless and BCL-Telecom New Zealand being awarded contracts to provide service.

The Project PROBE has not been without criticism from fixed wireless and satellite providers. The Chief Executive of "ThePacific.net" has argued that government funding to roll out infrastructure in rural areas competes unfairly against fixed wireless operators that have financed their own infrastructure.<sup>216</sup> ThePacific.net would have preferred for the funding to be given directly to the schools such that they could select their own broadband supplier. The satellite provider iHug has similar concerns that government-financed infrastructure will compete unfairly against that of the private sector.<sup>217</sup>

For its part, the government aims to increase competition in the provision of broadband in rural areas. This is not without challenges. For example, the South Waikato District Council was an unsuccessful bidder for Project Probe funding. The successful bid for funding for that area came from a joint tender by the government-owned BCL and the incumbent telecommunication carrier Telecom New Zealand. The probable result is that a municipal network funded in part by rate-payers will compete against a network funded by taxpayers. For its part, the municipal authority questioned whether the government should provide funding to the incumbent.<sup>218</sup> The danger is that the incumbent will be strengthened to an extent that others will not enter the market and rural start-ups may exit the market. In May 2003, Wave Internet, an independent ISP, announced plans to offer wireless service in a number of areas including South Waikato.<sup>219</sup>

Other local governments have also taken action in respect to the roll out of broadband in some parts of New Zealand. Some municipalities struck agreements with Telecom New Zealand to act as guarantor for certain levels of the DSL take-up in return for Telecom upgrading exchanges. The New Plymouth, Stratford and South Taranaki District Councils would have faced a USD 332 000 bill if Telecom had not met its threshold number of subscribers. However, Telecom exceeded its threshold such that the councils were not required to contribute funding. One factor was that demand exceeded expectations. Another factor, according to Telecom, was that over the course of the agreement the cost of DSL technology had sharply decreased such that smaller exchanges could be upgraded relatively inexpensively.<sup>220</sup>

### *Norway*

Policy makers in Norway have among the best data available in the OECD to assess the development of broadband access on a regional basis. Statistics Norway surveys all ISPs in that country and makes available the number of broadband subscribers in each county and municipality. The data also indicate whether subscriptions are business or residential and the number of connections by capacity (e.g. 384 kbps to 512 kbps; 1 Mbps to 2 Mbps and so forth).

At the end of 2002, Telenor, the incumbent Norwegian telecommunications carrier, provided DSL service to 58% of all lines and this had increased to 65% by September 2003. The geographical distribution of broadband in Norway is, of course, related to the availability of platforms such as DSL, cable modem, and so forth.<sup>221</sup> Where these platforms are not available, there is a dearth of broadband access. In September 2002, 270 of the 434 municipalities in Norway had few (less than 10) or no broadband subscriptions. On the other hand, where new providers are entering small rural markets, the penetration is second only to Oslo. For example, the municipality of Ulvik on the west coast of Norway<sup>222</sup> has a population of 1 210. Notwithstanding this the municipality had a broadband penetration of 7.8 subscribers per 100 inhabitants in September 2002. That figure compares with 8.1 subscribers per 100 inhabitants in

Oslo.<sup>223</sup> This figure is all the more remarkable in that Telenor had not enabled the Ulvik exchange to provide DSL. Instead, Ulvik was being served by a wireless ISP named INO using fixed wireless broadband.

INO, a subsidiary of Bergen Power Utility Company, provides wireless broadband access to more than 1 000 residential, small home office and small and medium-sized enterprise customers in approximately 30 areas in Norway.<sup>224</sup> In 2003, INO planned to expand service to an additional 20 areas. INO's aim is to deliver broadband services to smaller communities throughout Norway mainly using fixed wireless.<sup>225</sup> Together with BKK Broadband, they also aim to deliver broadband access via fibre and copper cable both to cities and smaller communities. In November 2000, the board of BKK decided to make broadband development a priority for the company.<sup>226</sup> BKK transmits power from power stations through 17 000 kilometres of lines and cables to 170 000 homes and workplaces in Western Norway. With electrical network in close proximity to the customers, the company believed it had a market advantage in building up broadband connections to individual consumers. BKK acquired its first broadband customers in Bergen in April 2001.

In some cases, the Norwegian municipalities themselves are Internet service providers. One example is the municipality of Modalen, where all the households in the municipality are offered free broadband access. This type of subscription is not included in the Statistics Norway data. Modalen, a small village on the west coast of Norway with a population of 360, is a somewhat special case.<sup>227</sup> Users in Modalen access the Internet at 2 Mbps via a fixed wireless network and use a set-top box on a TV, controlled by a wireless keyboard.<sup>228</sup> Each customer pays USD 18 a month for the service. The municipality covered the installation costs of nearly USD 345 000 for a network covering 385 square kilometres. The municipality could afford to do this because it earns a considerable amount each year from the nearby hydroelectric dam.<sup>229</sup> On the other hand, the cost should not be taken as indicative of the current cost of building a fixed wireless broadband network. In 2000, Modalen was one of the first trials in providing fixed wireless broadband access to a small village in a rural area.

WAN International, based in Halden, Norway, is building what it calls WiFi "zones", the largest of which has a radius of 12 kilometres.<sup>230</sup> WAN has built its own radio antennas to transmit WiFi signals over long distances and allows users to move between local WiFi networks and wide area networks. WAN's WiFi networks in Halden cover 65% of the city.<sup>231</sup> Infrastructure has also been installed in cities such as Oslo, as well as small cities and towns such as Skjærhallen, a community on a small island with some 1 000 inhabitants, and Rakkestad with some 4 000 inhabitants. WAN also cover some sparsely populated rural areas with only a few hundred people (*e.g.* Prestebakke). WAN reports that the level of security on their networks is such that the Norwegian government and communities are able transmit data from healthcare and social services over their WiFi networks.

Looking ahead, Telenor's forecast for DSL availability is that 80% of lines will be enabled by 2006. When it comes to overall coverage for Norway, taking all technologies into account, the Norwegian government forecasts a broadband availability rate in the range of 85% to 90% of all households during 2005.<sup>232</sup> In other words, up to 10% of households are expected to be served in areas that can not be reached by DSL by 2005.

### ***Poland***

In June 2003, Telecom Poland (TPSA) provided 90.5% of all the access lines in Poland. The remaining 9.5% of lines are provided by new entrants in the Polish market. The largest of these firms are Dialog with 3.1% of all lines, Netia with 2.9% and Elektrim with 0.6%. Other local access providers provide the remaining 3% of all lines.

TPSA introduced DSL services in 2001 but in a relatively small number of urban areas. By June 2003 the coverage had been expanded to 56% of all customer lines.<sup>233</sup> TPSA planned to increase that to 70% by the end of October 2003. TPSA say the increase is the result of investment connected with broadband access throughout Poland, including the largest cities, as well as districts and territorial divisions. By the end of 2003, TPSA plans for DSL to be available at 852 locations outside the 21 largest cities. TPSA say that its "Neostrada 512 kbps" DSL service is available up to between 3 and 4 kilometres from the local exchange. TPSA was aiming to increase DSL subscribers from 36 000, in June 2003, to 270 000 by the end of 2003.

There are several fixed wireless broadband operators in Poland. By 2003, they were mostly serving urban areas. Wireless broadband networks are being developed by Formus Polska, Crowley International (Data Star network), Futuro and Tele2.<sup>234</sup> TPSA is also investing in wireless broadband technology, and has conducted a trial in Warsaw. Futuro is licensed by the Polish government to construct and operate a telecommunication network as well as provide data transmission and Internet access services.<sup>235</sup> The company also has been assigned 26 GHz spectrum for LMDS operations covering 25% of the Polish population.<sup>236</sup> The rollout started in September 2000 in Lublin. In June 1999, Crowley Data Poland was granted a 15-year licence to perform telecommunication services in Poland, and in mid-2000 the company put into operation broadband networks designed for the delivery of wireless services based on an LMDS technology.<sup>237</sup> By 2003, the company had deployed broadband networks in six major Polish cities containing around 40% PSTN lines.

### ***Portugal***

At the end of 2002, Portugal Telecom, the incumbent telecommunication carrier, offered DSL service to 60.7% of all lines in Portugal.<sup>238</sup> The cities of Lisbon and Porto had 78% and 68% coverage, respectively. To further expand broadband availability and take-up, the Portuguese government launched the National Broadband Initiative. It aims at creating conditions to attain, by 2005, broadband access to the Internet in 50% of all households and enterprises as well as broadband access in all central Public Administration institutions.

The National Broadband Initiative also includes specific measures envisaging widespread access to broadband in rural and remote areas, namely by the deployment of Broadband Community Networks in municipalities not yet covered by adequate infrastructure. The target of the Broadband Community Networks project is to provide broadband access in 15 underserved municipalities by 2005, by supporting the construction of new broadband networks; sharing investments on broadband infrastructure development with private operators and leveraging already existing public infrastructures (*e.g.* utilities) for the development of broadband networks in underserved areas. The Portuguese government aims for these infrastructures to be open to all operators and services providers under attractive and non-discriminatory conditions. Prices to end users are expected to fall as competition conditions improve in areas that Portugal expects would otherwise be underserved without State intervention.

Another initiative is the Electronic Union Programme, developed under a public-private partnership model, which envisages the setting up of a virtual campus in every higher education institution of the country (including institutions in rural and remote areas), providing free high-speed wireless Internet access to all university students. This programme also includes the development and supply of scientific and educational contents online as well as the provision of 'World Wide Web' university services and roaming facilities between all campuses. Students, teachers and staff will also be given the opportunity to purchase laptops at reduced prices.

A number of fixed wireless services are licenced in Portugal. Jazztel, for example, is deploying fibre backbone networks and holds a licence to offer fixed wireless access. In June 2003, Anacom announced a public consultation on the state of fixed wireless access in Portugal.<sup>239</sup>

### ***Slovak Republic***

DSL services were being trialled in the Slovak Republic but had not entered commercial service by June 2003.

### ***Spain***

Spain is one of the few OECD countries that do not have universal access to dial-up Internet services at 56 kbps in rural areas. An innovative wireless solution to provide basic telephony services was introduced in the early 1990s and, by the beginning of 2003, supplied service to around 240 000 households. The service is known as TRAC (*Telefonia Rural Acceso Celular*).<sup>240</sup> The data rate supported by the TRAC service is 2.4 kbps. To address this situation, the Spanish government intends that 70% of rural Spanish homes be able to access dial-up services by the end of 2003 and to reach universal availability by December 2004.<sup>241</sup>

By the end of 2002, Telefonica, the incumbent operator in Spain, could provide DSL service to 89.3% of the company's lines. This represented a relatively high availability of DSL in comparison with other OECD countries, yet by one estimate some 8 000 rural communities in Spain have little or no broadband access.<sup>242</sup> To address this situation, there are a growing number of wireless broadband access trials in Spain.

The town of Somiedo, in Spain's Asturias region, has a population of 1 600 people. Somiedo is one of two communities chosen by Neo-Sky, a Spanish broadband service provider, which was given a contract by the European Union to trial high-speed Internet connectivity for rural communities in Spain.<sup>243</sup> In Somiedo, Neo-Sky used a satellite to provide backhaul and fixed broadband wireless to provide local access. The other town to receive service under this trial was Molina de Aragon, located approximately 160 kilometres east of Madrid. In Somiedo, the satellite link provides a connection of up to 8 Mbps, with local access at 256 Kbps downstream and 128 Kbps upstream.

WiFi is also being used to provide broadband coverage of smaller regional cities in Spain. Zamora, for example, has a population of around 70 000, the majority of which are covered by a WiFi network.<sup>244</sup> Following a trial deployment, in June 2002, Afitel, a wireless ISP in Zamora, began commercial service in conjunction with a major IT supplier.<sup>245</sup> The price for unlimited monthly access is slightly less than USD 12 per month. Afitel says its infrastructure cost per customer is about USD 65 (*i.e.* Afitel spent about USD 650 to install an antenna serving about 10 accounts).<sup>246</sup> Zamora is the first implementation in a plan to make 200 cities and towns wireless in three years.<sup>247</sup> The plan envisions 180 000 wireless access points with perhaps as many a one million users wireless-enabled by 2005.<sup>248</sup>

### ***Sweden***

At the end of 2003, TeliaSonera could provide DSL service to 78% of all households in Sweden.<sup>249</sup> TeliaSonera is the company which resulted from the merger of Telia, the incumbent Swedish telecommunication carrier, and Sonera, the incumbent operator in some areas of Finland. Skanova is a unit which has been set up within TeliaSonera in charge of backbone networks and wholesale of infrastructure. Skanova's network includes 50 000 kilometres of fibre cable (*i.e.* corresponding to two million fibre kilometres).<sup>250</sup> The network reaches all of Sweden's municipalities and rural districts, and 3 000 population centres. In other words, 91% of all households and 95% of all companies in Sweden are located in areas

connected by a fibre optic cable backbone.<sup>251</sup> At the end of 2002 around 15% of Swedish households were connected via some form of high capacity link.

In March 2000, the Swedish government presented its proposal for its future information technology policy in the Bill “An information society for all”.<sup>252</sup> The government set out in the Bill a new objective for IT policy: Sweden was to be the first country to offer ‘an information society for all’. Among other action points, the government committed to ensuring that within a few years households and businesses in all parts of Sweden would have access to networks with a high transfer capacity.<sup>253</sup> This Bill was passed by the Swedish Parliament in June 2000.<sup>254</sup>

In endeavouring to provide all households and businesses with broadband access, the Swedish government stated that market mechanisms would be the primary instrument. At the same time, the government said that its overall responsibility was to ensure that broadband networks were available nationwide. The government’s belief is that competition is best assured by giving large numbers of players the opportunity to use any networks which involve government funding. The government also stated that any measures it undertakes should serve to ensure competitive neutrality and network diversity.

To implement its policy, the Swedish government allocated USD 1 billion, of which USD 700 million would be in the form of public financial support.<sup>255</sup> The remainder was the estimated cost of building a national backbone network financed on commercial grounds.<sup>256</sup> In August 2000, the state-owned electrical utility was commissioned to build a fibre network reaching the main urban centre of each municipality by December 2002.<sup>257</sup> The Government proposed that this development would be funded by the state-owned authority from its own resources.

By the end of 2003, the Swedish National Grid and its partners had reached 215 of the 290 municipalities. The backbone network was originally due for completion in 2002. To encourage expansion, municipal councils can also apply for up to USD 55 million in supplementary funding to help cover the cost of connection of the backbone.

The Swedish government’s policy to increase the availability of broadband across all municipalities also included funding for regional networks in rural areas. The criteria used were that municipalities needed to be sparsely populated and be unlikely to have a commercial development of a fibre optic network within five years.<sup>258</sup> Funding of USD 322 million was allocated for the period 2000-05 and the scheme covered 30% of the Swedish population.<sup>259</sup> The policy requires municipalities to contribute at least 5% of the project cost and to choose an independent operator (as the municipalities are not permitted to own the network). Government funding covers from 33% to 89% of the cost of deploying these regional networks.<sup>260</sup> As a matter of policy, the municipality needs to develop a plan to show that the network will be implemented in a way that is competitively neutral.

Government funding is also available for the development of local networks. Originally this assistance was limited to communities having population thresholds below 3 000 inhabitants. Other criteria were similar to those for regional networks.<sup>261</sup> By mid-2001, only two municipalities had submitted applications for grants.<sup>262</sup> One factor contributing to the low number of applications was that only sparsely populated regions could receive grants from European Union Structural Funds which could be used by those municipalities as their own contribution to the overall project cost. These funds were not available to larger communities. Accordingly, the government reduced the amount to be contributed by municipalities and mandated that communities with a population above 3 000 could also be eligible. A change was also made in June 2002 in the ordinance regulating grants to municipalities for the extension of local networks.<sup>263</sup> The modification implied a possibility, if there are special circumstances, to approve grants for the increase of transfer capacity in existing infrastructures. It is hence only in exceptional cases that support can be awarded to the upgrade of existing networks (such as telecommunications networks where



TeliaSonera could use its standard DSL offerings). The measure is targeted towards areas that are sparsely populated and with long extension distances where it is not commercially feasible to roll out new networks with high transfer capacity. The total funding available for the local network programme is USD 391 million between 2000 and 2005.

Following the modifications to the funding criteria, a growing number of Swedish municipalities had taken advantage of the government's programme. By June 2003, 270 communities had received funding, with 53 networks being deployed and the balance to be completed by mid-2005.<sup>264</sup> One of the major beneficiaries of the new policy, on the supply side, has been Skanova. Skanova says that municipalities have been able to apply for government assistance to build out broadband networks based on DSL technology since mid-2002.<sup>265</sup> Accordingly, Skanova has reached a series of agreements with an increasing number of municipalities to provide DSL coverage.<sup>266</sup> In general these agreements provide DSL coverage for 85% to 95% of the population of these municipalities with connections to broadband backbone networks. The range of DSL is advertised in these areas at 5.5 kilometres. According to Skanova, DSL was available to between 85% and 90% of the Swedish population by April 2003.<sup>267</sup>

The Swedish government has also opened up opportunities for municipal authorities to use wireless networks. In April 2003, licences were granted to groups across Sweden to operate fixed wireless networks on the 3.5GHz bands, such that municipalities and other entities could establish broadband access.<sup>268</sup> In one of the first such deployments GEAB (Gotlands Energi AB), a Swedish utility company, is deploying a fixed wireless broadband network on Sweden's Gotland Island.<sup>269</sup> The network will be a non-line-of-sight fixed wireless system. The Gotland Municipality chose GEAB to be its operator under the funding criteria established by the government. Licences were also awarded to operate fixed wireless networks on the 10 MHz bands.

### *Switzerland*

Switzerland has one of the highest availabilities of broadband access in the OECD. Swisscom is the incumbent telecommunication carrier in Switzerland. Swisscom launched DSL service in October 2000 and by February 2001 it was available in seven locations – Basle, Bern, Geneva, Lausanne, Lucerne, St. Gallen and Zurich.<sup>270</sup> By September 2001, Swisscom could cover 60% of all lines and this was increased to 85% by the end of 2001. At the end of 2002, Swisscom could offer DSL services to more than 95% of the population of Switzerland.<sup>271</sup> In December 2003, Swisscom announced that further upgrading of their network meant that 98% of all lines could be served with DSL in Switzerland.<sup>272</sup>

By 2002, fixed wireless played virtually no role in providing broadband access in underserved areas.<sup>273</sup> Swisscom was, however, increasing the use of fixed wireless to provide additional broadband services in urban areas via WiFi hotspots. In August 2003, Swisscom Eurospot operated 1 000 hotspots (including roaming) in 12 European countries. A number of operators are locating WiFi hotspots in Swiss ski resorts.<sup>274</sup>

In its 2002 Annual Report, OFCOM, the Swiss communications regulator, noted the potential for wireless to extend fixed network and mobile services. In order to meet a growing demand for more bandwidth and higher transmission speeds, OFCOM has made some frequencies available in the 5 GHz band.<sup>275</sup> OFCOM says that due to the success of wireless LANs, it has proven necessary to release new frequencies in order to increase the available bandwidth and to allow higher transmission speeds. Since June 2003, all frequencies in the 5.15 GHz - 5.35 GHz band have been available for this application. As with the 2.4 GHz band, a licence is not required for use inside buildings. On the other hand, unlicensed outdoor use of the 5 GHz band continues to be prohibited as OFCOM says this frequency band is used by other systems and interference could result. Only the 2.4 GHz band may be used outside on an unlicensed basis.

### ***Turkey***

Turkey has a relatively limited availability of DSL even in urban areas. Accordingly, the most pressing need for Turkey is to build momentum for DSL in the commercial market. The most positive step towards that goal has already been taken and the Turkish market will be fully liberalised on 1 January 2004. In 2003, only Turk Telekom, the incumbent monopolist, can deploy DSL equipment. For its part, Turk Telekom has launched DSL but only a small number of exchanges have been upgraded. In August 2003, Turk Telekom placed an order for technology which will support a further 60 000 DSL lines.<sup>276</sup> The company expects to place an order for an additional 200 000 lines before the end of 2003. It will, of course, take time for alternative backbone and backhaul infrastructure to be constructed following liberalisation of the Turkish market. Once that infrastructure is available and able to offer competitive pricing for backhaul and backbone services, alternative platforms, such as fixed wireless, will be able to provide competition to Turk Telekom. Turk Telekom is also the provider of cable television infrastructure in Turkey. In November 2003, Turk Telekom's cable network passed just under 2.5 million households and 2.1 million of these households could be provided with cable modem service, in a relatively short time, on request.

### ***United Kingdom***

In the United Kingdom, by the end of February 2004, DSL was available to 85% of homes and businesses. However, BT advise that due to technical limitations, 3% of those living within an enabled exchange area will not be able to receive broadband services.<sup>277</sup> Cable modem services are available to 45% of people in the United Kingdom but mostly serve urban areas.

In February 2001, the UK government set a target for the country to have the most extensive and competitive broadband market in the "G7" by 2005, with significantly increased broadband connections to schools, libraries, further education colleges and universities.<sup>278</sup> Extensiveness was defined as making broadband available to households throughout the country, including rural and remote areas. Competitiveness was defined as providing users with value for money and a wide variety of product choice.

To achieve the foregoing goals in respect to rural and remote areas, the government has taken a number of initiatives. The government established a Broadband Task Force, in November 2002, with a remit to work on extending affordable broadband access especially in rural areas. The Broadband Task Force has developed the Broadband Aggregation Project, which aggregates public sector demand including in rural and remote areas. In May 2003, a new Rural Broadband Unit was created in the Department of Trade and Industry. Working with the Department of Environment, Food and Rural Affairs and Regional Development Agencies, their role will be to identify ways of accelerating the availability of broadband access in rural areas.

Further government initiatives on broadband include:

- The investment of just over USD 1.5 billion on public sector broadband connectivity between 2003 and 2006. This will include pooling demand for broadband services for schools and connecting up the surgeries of general practitioners, hospitals and health authorities. This includes broadband connections to every school by 2006 at a speed thought to be appropriate to their requirements, typically 2 Mbps for primary schools and 8 Mbps for secondary schools. The government has also defined a minimum aim of a 256 kbps connection for the surgeries of general practitioners and sufficient bandwidth to National Health Service sites to be able to use electronic patient records and transmit data-intensive images via e-mail, including broadband connections to hospitals. The Criminal Justice System will provide ICT infrastructure across the

six major criminal justice organisations – police, crown prosecution service, magistrates courts, probation and prisons.

- The establishment of nine Regional Aggregation Bodies (RAB) to provide better value for money to the public sector and improve investment in infrastructure. Each RAB will assess the demand for broadband from the public sector in its area. This demand will be bundled together, and telecoms operators will be invited to bid for contracts to satisfy this demand. The RABs will work with the Regional Development Agencies (RDAs) to bring together public sector customers who can benefit from the packages, and work on increasing availability to schools and health centres, particularly in rural and remote areas.
- Establishing a USD 47.4 million Broadband Fund to encourage pilot projects to explore practical solutions for business and improving public understanding of broadband. As part of that programme, the Remote Access Broadband Inclusion Trial (RABBIT) has established over 1 800 pilots to demonstrate wireless and satellite alternatives for businesses in more remote areas.<sup>279</sup>

Two approaches which the United Kingdom did not favour for developing broadband in rural areas, were: *i*) the general use of subsidies to providers and *ii*) mandating broadband access be part of universal service.<sup>280</sup> The main reason given for not being in favour of subsidies to providers was that they would be at odds with the government's policy of promoting competition in the United Kingdom. The government believed that such subsidies would not encourage innovation and sustainable low prices for subscribers. The government position on the possibility of broadband being made into a universal service obligation (USO) for BT, via an upgraded PSTN, was that it would not be consistent with technological neutrality. Moreover, BT's subsequent announcement about bringing broadband to exchanges serving 99.6% of UK homes and businesses, by Summer 2005, is also a significant reason for not imposing a USO.

In respect to the availability of DSL, market forces are clearly at work without provider subsidies or universal service obligations. In November 2002, BT said it would aim to provide DSL availability to more than 80% of the country by the end of 2005.<sup>281</sup> The achievements, to date, and the revised goal of 99.6% coverage, show the success of the UK government's approach, in relying on competition to expand broadband availability rather than mandating it as part of universal service.

In respect to technological innovation, BT has extended the range of DSL up to 6 kilometres, allowing some users who were previously too far from an exchange to receive DSL service.<sup>282</sup> In addition, BT is undertaking a trial, which aims to extend DSL service up to 10 kilometres and beyond.<sup>283</sup> Several schemes were also at work but may have been superseded by commercial and technological developments. For example, BT used a partnership scheme, which involved working with local public and private sector entities to extend availability in rural areas.<sup>284</sup> At the same time BT pioneered a demand registration scheme which was introduced in July 2002. The process worked by BT setting trigger levels for the upgrade of exchanges and allowing users to register their interest in a DSL connection.<sup>285</sup> Communities could monitor the number of registrations on line as they progressed towards the trigger level.

The threshold number of users needed under the BT registration scheme varied between 200 and 700 potential subscribers. The more expensive the exchange upgrade, the higher the trigger. Broadly, the cost components are equipment, accommodation and backhaul. The cost of the equipment required in each exchange is fairly consistent, and the cost of any accommodation upgrade is usually negligible, so the main variable is usually the cost of providing a backhaul link to the exchange. The cost of backhaul is a factor the government hoped would be positively affected by its demand aggregation scheme. On the other hand, with 99.6% coverage by 2005, policies such as demand aggregation may be addressing a smaller segment of the market than originally envisaged. For its part, BT announced, in April 2004, that it would close the

pre-registration scheme in favour of a planned rollout of areas that were still underserved.<sup>286</sup> While BT judged the scheme to have been very successful in assisting to identify demand, its value diminishes with near universal availability.

As an interim measure, BT offered ISDN for USD 39 per month including 75 hours of service at 128 kbps.<sup>287</sup> BT launched the service in June 2003. The main advantage of the scheme was that it introduced a new pricing structure for ISDN – a platform that is available to 97% of the population of the United Kingdom.<sup>288</sup> However, the so-called “midband” service was not sufficient to meet the aims the government has set for itself in terms of broadband access across the United Kingdom. To extend broadband beyond 99% availability will require a variety of technological platforms. In this respect, some of the most interesting developments in fixed wireless broadband access are occurring in the United Kingdom. BT has been running trials of radio broadband in Porthleven in Cornwall, Pwllheli in Wales, Ballingry in Scotland and Campsie in Northern Ireland.<sup>289</sup> BT says it is satisfied that the technology is now proven and reports that the feedback from trial customers has been very positive. Based on these results, BT aims to bring broadband availability to 100% of communities in the United Kingdom by the end of 2005. BT say that wireless broadband will be used to connect some of the smallest exchanges and users that reside beyond the distance from an exchange which DSL can serve.

As in a number of OECD countries, the United Kingdom is experiencing a steep increase in the number of wireless ISPs. Many of these wireless ISPs have similar business models and technological platforms to counterparts in other countries and, accordingly, will not be highlighted here. There are, however, several wireless ISPs using significantly different approaches with either their selection of technological platform or business models. For example, WRBB is planning to launch service, in and around Cambridgeshire, in 2004.<sup>290</sup> One aspect that sets WRBB’s plans apart is the proposed use of 802.11g, which the company says can provide services up to 54 Mbps. While a number of wireless ISPs currently use WiFi to provide outdoor services over large areas, they almost all use 802.11b with a maximum capacity of 11 Mbps. WRBB say that, depending on the terrain, they could provide service at a range up to 10 kilometres. What is perhaps even more remarkable was the planned pricing which was announced for this service. The baseline service at 54 Mbps was priced at just under USD 16 per month with a download cap of 1 Gigabyte.<sup>291</sup>

Numerous WISPs with different business models operate using various combinations of fixed and wireless networks in the United Kingdom (Table 3). The UK Radiocommunications Agency (now a part of the Office of Communications (Ofcom)), estimated that broadband wireless access can assist in providing between 7% and 18% of the United Kingdom’s broadband needs.<sup>292</sup> Actions taken by the government include making the 2.4 GHz (*e.g.* 802.11b) band license-exempt, and a “light licencing regime” in the 5 GHz band, as well as auctions for the 3.4 GHz band.<sup>293</sup> In February 2004, Ofcom opened 5.8 GHz Band C for fixed broadband services. The new services are licensed under a regime that requires electronic registration of all transmitting terminals at a nominal licensing cost of USD 1.76 per terminal installed per year (subject to a minimum cost of USD 88 per year). Opening this band is expected to boost the development of fixed wireless access services, such as low cost Internet access, in areas not currently reached by broadband services, and benefit the rural economy. For policy makers, the introduction of broadband services using fixed wireless service has major implications. Based on the available evidence in a number of countries, it is possible to conclude that some of these services provide a higher-performance and lower-priced service in areas that cannot be economically served by an upgraded PSTN. In the United Kingdom it now appears that there will be very few areas not served by DSL by the end of 2005. If this experience can be repeated elsewhere it augurs well for the provision of broadband access, by at least one terrestrial platform, in most parts of the OECD area. To the extent that services live up to expectations and the pricing proves sustainable, fixed wireless also holds out the promise of a choice of platforms being available to service providers and users. This latter development may also alter the traditional model in telecommunications, which held rural areas to be those with higher costs and more challenging in the

delivery of acceptable performance standards. There are, of course, caveats. Several of the WISPs are small start-up companies. In contrast, DSL and cable operators have systems in place (including billing, networks and so forth) that are adding more than 130 000 customers per month. Notwithstanding the differences in scale, WISPs clearly have a role to play in helping to meet the goals set by the United Kingdom government in terms of affordability and availability of broadband service in rural areas. Indeed, the potential of fixed wireless underscores the need for technological and competitive neutrality in all government initiatives in respect to broadband.

The challenges for small start-up WISPs should not, however, be underestimated. One rural WISP that did not succeed financially in the United Kingdom was Invisible Networks. The business model of Invisible Networks was interesting because it addressed one of the key barriers to the development of broadband in rural areas. That barrier is the ongoing challenge posed by providing backhaul from any local access network to a backbone network. The way Invisible Networks approached this problem was through the use of traditional leased lines for backhaul in combination with WiFi (802.11b and 802.11g) for the provision of local broadband access. To receive service from Invisible Networks, a local community needed to pre-register a certain number of users. A leased line was then used to provide a connection between a hub and a backbone network. From the hub, a WiFi antenna located on a suitably high platform provides links to other local nodes, which in turn provide local access.

While the technology used by Invisible Networks was reported to work well, the company was not able, for whatever reason, to become financially viable. In October 2003, another WISP (Mesh Broadband) announced that it had purchased the business and assets of Invisible Networks, allowing the broadband networks to continue to offer services to the rural communities served.<sup>294</sup> Mesh Broadband plans to integrate Invisible Network's facilities serving rural areas around Cambridgeshire with others that the company is developing in the east of England.

The United Kingdom is one of the leaders in Europe for Wi-Fi. While the estimated number of hotspots varies between 2 000 and 5 000 (depending on source), indications suggest some 50% of all European hotspots currently being located with the United Kingdom. A number of large companies are active in hotspot provision including T-Mobile and BT, but a major provider is "the Cloud", which aimed to have some 3 000 hotspots active in bars and pubs by the end of 2003. The existence of a Wi-Fi hotspot can have additional benefits, particularly in rural areas as the backhaul this requires can be used to facilitate broadband access to the wider population.

There are a growing number of wireless ISPs in the United Kingdom specifically focused on providing broadband access to rural areas. For example, the United Kingdom's Countryside Agency published a review of 13 early community broadband projects in England,<sup>295</sup> in September 2003. A wide variety of technologies have been undergoing trial or deployment such as mesh wireless networks in rural Wales, WiFi with satellite backhaul in rural areas of Yorkshire, and fixed wireless in remote areas such as the Scottish Highlands and Islands.<sup>296</sup> Innovation is also ongoing in respect to the PSTN. For example, BT is trialling new equipment for local exchange DSL upgrades suitable for use with as few as 16 users.<sup>297</sup> In addition, unbundling permits new entrants to serve markets if they believe they can provide an economically viable service. The result is that at least one ISP, in 2003, advertised a threshold of 50 ADSL subscribers or 20 SDSL subscribers to provide service compared to a threshold at that time of 200 subscribers for BT.<sup>298</sup> In addition, another ISP has announced plans to use unbundled local loops as a platform to bid for projects where public demand has been aggregated.<sup>299</sup>

**Table 3: Selected wireless ISPs in the United Kingdom**

Name of WISP	Markets Covered	Service	Baseline price (USD per month)	URL
Active Wireless	Areas of Dumfries & Galloway	Fixed Wirelss	512 kbps for less than USD 60	www.activewireless.co.uk
Aperture Wireless	Rural communities in Northern Ireland	Mesh broadband with Satellite Backhaul	Less than USD 20 for 256 kbps	www.dundrumbroadband.com
DigitalParish	Hayfield, Derbyshire	Mesh Community broadband wireless Network with satellite backhaul	Less than USD 20 per month	www.digitalparish.com
FDM Broadband	Aldbourn, Baydon, Compton, Kintbury, Lambourn, Hungerford, and Ramsbury	Wireless technology based on the IEEE 802.11.	USD 43 for symmetrical 256 kbps	www.fdm broadband.net
Skysurf	Rural Lincolnshire	2.4Ghz	USD 40 to USD 60 for 512 kbps to 1 Mbps	www.skysurf.uk.com
West Norfolk Community Broadband	Dersingham, Heacham, Hunstanton	Fixed Wireless with leased line backhaul	Up to 2 Mbps for less than USD 50 per month	www.wncb.net/index.aspx
WRBB	Planned Service (2004)	802.11g Wireless	Less than USD 20 per month proposed.	www.wrbb.net

Source: OECD, for a larger list refer to <http://www.ispreview.co.uk/broadband/wire.shtml>

### *United States*

In the United States, cable television networks provide the most widely available broadband access platform. The National Cable and Telecommunications Association (NCTA) say that, in April 2003, more than 85 million homes were passed by cable modem service. That is the equivalent of 80% of all households in the United States and some 83% of households passed by cable. The largest cable broadband access provider is Comcast. By June 2003, more than 81% of the homes in Comcast's footprint (some 32.1 million homes), had access to cable modem service.<sup>300</sup> Comcast added 1 million homes to the service's footprint during the second quarter of 2003. Some smaller cable companies have higher rates, with Mediacom marketing high-speed Internet service in cable systems comprising about 95% of its total homes passed.<sup>301</sup>

A precise figure for national DSL availability is not available, for the United States, but it was likely to have been in the range of 65% to 70% at the end of 2002 and 75% by the end of 2003. The three largest providers are SBC, Verizon and Bell South. At the end of 2002, these companies could provide DSL service to the following percentages of their access lines - SBC 66%, Verizon 63% and Bell South 73%. Smaller telephone companies had a similar level of DSL availability. The National Telecommunications Cooperative Association (NTCA) is a national association representing more than 550 small and rural independent local exchange carriers providing telecommunications services throughout rural areas of the United States. The NTCA conducted a survey of their members in 2001 and found that they could serve 60% of their residential customers with DSL. The survey indicated that NTCA members expected to serve 69% of customers by end 2002.<sup>302</sup> By May 2003, the NTCA reported that their survey respondents offered broadband service to an average of 70% of their customers, utilising a variety of technologies.<sup>303</sup>

Telecommunication carriers in the United States are continuing to upgrade their networks to extend the availability of DSL. Verizon, for example, had upgraded exchanges serving 80% of lines to be served by the end of 2003 and SBC plans to reach this target in the first quarter of 2004.<sup>304</sup> Significantly, during 2003, Bell South was upgrading 100% of its lines in the states of Georgia and South Carolina.<sup>305</sup> Qwest, the fourth largest local exchange company in the United States had upgraded 45% of access lines by 2003 and planned to increase that to 60% during 2004. The average for Verizon, SBC, Bell South and Qwest was 75% of lines being DSL-enabled by the end of 2003.

Apart from the threshold population needed to upgrade smaller exchanges one of the barriers to extending DSL beyond 80%, is the typically longer distances people are situated from exchanges in rural areas. Telecommunication carriers will generally only offer DSL services up to 5.5 and 6 kilometres. In many cases this does, of course, mean that rural customers can be served. Some 49% of the NTCA's customers live in locations situated within 3.6 kilometres from an exchange. A further 29% are located at a distance of between 3.6 and 5.5 kilometres. Telecommunication carriers rarely serve customers beyond that distance unless they use repeaters or variants of the technology that are capable of serving longer ranges such as SHDSL. At the end of 2002, however, very few of the 14% of local loops with distances between 5.5 and 9.1 kilometres were served. A further 9% of local loops, of NTCA's members, are longer than 9.1 kilometres.

Some small rural telecommunication carriers in the United States are, however, reaching very high levels of DSL availability. One such company is Waitsfield Champlain Valley Telecom (WCVT) in the state of Vermont. The town of Waitsfield has a population 1 659 and there are 20 000 customers served in the company's area of service. All 52 of Waitsfield Champlain Valley Telecom's telephone switching locations are outfitted with the equipment required to offer DSL service. This meant that, at the end of 2002, more than 92% of WCVT customers in the Central Champlain and Mad River Valleys had access to DSL service. In July 2003 this had been raised to 99% of customers. In addition to upgrading all exchanges WCVT used repeaters to expand the distance requirements of DSL service from 5.5 kilometres to 6.7 kilometres.<sup>306</sup> Other small rural telecommunication carriers are also beginning to achieve very high rates of DSL availability. The Star Telephone Membership Corporation provides a variety of advanced telecommunications services to more than 20 000 customers covering a 1 458 square mile operating area in North Carolina.<sup>307</sup> In May 2003, the NTCA highlighted the fact that Star had extended DSL availability across its entire service area.<sup>308</sup> In California, the Roseville Telephone Company (RTC) serves an 83 square mile territory operating some 135 000 access lines. RTC has been capable of providing DSL service to 100% of its service area since September 2002.<sup>309</sup> Moreover, in September 2003, the company claimed to be the first in the United States to reach a 20% DSL penetration rate in its service area.<sup>310</sup>

For users living outside areas covered by DSL or cable modem, broadband satellite services are available. Operators in the United States introduced the first two-way satellite service in 2001. ISPs such as Earthlink sell two-way services to all areas of the United States except Alaska and Hawaii. Earthlink's price is USD 69.95 for a service operating at 400 kbps downstream.<sup>311</sup> As the price of DSL fell in 2003, the gap between DSL and satellite has widened. What had been a USD 20 difference is now around USD 30 to USD 40. Fixed wireless broadband access also provides an alternative in some areas not served by DSL and cable and is often available at prices comparable to broadband access in urban areas.

The United States has a particularly vibrant market in respect to the emerging Wireless ISPs serving rural areas. The major types of wireless broadband networks include fixed point-to-point, mesh, and mobile networks (*i.e.* cellular). The majority of the fixed and mesh providers use unlicensed spectrum, but licensed spectrum, such as MDS in the 2.5 GHz band, is also used to some extent. Mobile networks use licensed cellular and PCS spectrum. Fixed wireless operators include utilities, local telephone companies, and cellular companies, as well as unaffiliated new entrants. In March 2002, the Broadband Wireless Alliance (BWA) surveyed the state of the sector in the United States. They reported 2 673 markets being

served by broadband fixed wireless access which was up from 723 in March 2001.<sup>312</sup> The survey listed the ten largest operators by the number of markets they served (Table 4). The BWA attributed the steep increase in coverage by wireless ISPs to the very low cost in entering the market compared with traditional fixed and wireless networks.<sup>313</sup> Although this is undoubtedly true the relatively low cost of backbone capacity and backhaul to backbone networks are also key ingredients. While it is relatively inexpensive to build wireless access networks, competitively priced backhaul needs to be available and this is the case for the United States.

Wireless ISP's are major contributors to broadband deployment in some states. North Carolina is the state with the second highest number of people living in a rural area in the United States. Notwithstanding this fact North Carolina, by the end of 2002, had a higher take-up rate with broadband than the national average for the United States. Larger telecommunication carriers such as Verizon and Bell South are trialling fixed wireless. BellSouth is undertaking trials of wireless broadband in two rural North Carolina counties. Headquartered in Charlotte, North Carolina, telecommunications operator Fairpoint invested approximately USD 7.6 million to deploy DSL in all 29 of their rural local exchange carriers upgrading 114 out of 142 exchanges. To further extend service FairPoint partnered with KeyOn Communications with the aim of bringing 802.11b-based wireless broadband service to residential and business customers in 20 of FairPoint's US rural markets. KeyOn's approach enables the use of 802.11b equipment in an outdoor wide area network.

- In one of Fairpoint's first deployments, in Pocatello, Idaho, a 1.5 Mbps service is available to residential users for USD 29.95 per month.

In Minnesota, the growing availability of fixed wireless Internet access, along with other broadband platforms is beginning to be reflected in the take-up of broadband in rural areas. Between 2001 and 2003 broadband penetration among those users with an Internet account in rural areas increased from 13% to 27%.<sup>314</sup> These data were reported in the "2003 Rural Minnesota Internet Study".<sup>315</sup>

- Other findings were that the availability of broadband in rural areas had increased to more than 50% and that the average cost of an account fell from USD 49 to USD 41 between 2002 and 2003. A further interesting finding was that at this level the price of broadband in rural areas was the same as the total cost of a dial-up account and a second telephone line.
- Midwest Wireless, a fixed wireless ISP and cellular mobile operator in Minnesota, is another company providing broadband access in rural areas of that state.<sup>316</sup> Midwest offers a 256 kbps service for USD 44.99.<sup>317</sup>

Some wireless systems rely on line-of-sight technology. For example, the Wheatland Electric Co-operative, provider of electricity to rural West Central and South West Kansas,<sup>318</sup> uses existing towers that are typical in many rural areas. These include water towers, grain elevators and so forth.<sup>319</sup> The service range is up to 29 kilometres.<sup>320</sup> Moreover, Wheatland Broadband can typically initiate service within two hours. Wheatland was originally formed to provide energy services in an area that was too sparsely populated to make it attractive to existing providers in other regions. The company says that the same principles apply to current broadband communications. The co-operative's broadband Internet access arm, Wheatland Broadband, currently delivers broadband through more than 1 000 fixed wireless connections to businesses and residents throughout its eleven-county footprint.<sup>321</sup> Wheatland plans to expand its broadband availability to its entire service area by 2004 and then to extend service beyond its traditional region.



- Wheatland's baseline offer is unlimited broadband access at 512 kbps for USD 37 per month. Services at 768 kbps and 1 Mbps are also available.<sup>322</sup> This baseline price is comparable to the price of DSL in some urban areas of the United States.

Wireless systems that do not rely on line-of-sight are also being deployed in rural areas. The Wireless Communications Association International (WCAI) has observed that the service penetration in Pocahontas, Iowa, at 22% of households, is higher than the national average for the United States.<sup>323</sup> In December 2001, the first plug-and-play, fast non line of sight (NLOS) wireless service was offered to the 2 000 residents of Pocahontas. Since then Evertek, a subsidiary of the United Farmer's Telephone Company, has signed up 200 of the 900 households in the town.<sup>324</sup> Evertek extended its offering into five additional Iowa communities and adjacent rural areas: LeMars, Kingsley, Sheldon, Holstein, and Ida Grove, and by 2003 was offering service to 17 000 additional residents in surrounding towns. Following the success of the service in Pocahontas, the WCAI reports that nearby communities sought similar service and some local governments offered financial and marketing participation.

- Evertek offers service at 512 kbps for USD 29.95 per month in Pocahontas which is comparable or lower than DSL prices in many urban areas.
- In Kingsley, Evertek offers the 512 kbps service at USD 34.95 per month.

Evertek has a special business model.<sup>325</sup> Following a referendum to authorise the project the municipal authority purchases the base stations and Evertek manages the system on a five-year contract. The local council keeps 15% of the revenue from each customer and provides free use of infrastructure such as water towers. The municipal authority also does the billing for the service with other utility services it offers. In respect to Pocahontas, Evertek report a fibre-to-the-home system was also priced by the municipal authority. The cost of the wireless system was just 2% of the fibre network with a four-year pay back based on 120 customers.<sup>326</sup> The pay back period for the fibre network was 15 to 20 years. Service can be provided up to 8 kilometres with 99% availability and to some points up to 29 kilometres.<sup>327</sup>

A second business model is to focus on enterprise customers. Another provider highlighted by the WCAI is Dynamic Broadband, a company which offers fast wireless Internet service within 12 communities in Iowa, Nebraska and Illinois to both businesses and residences.<sup>328</sup> Dynamic Broadband commenced service in a town of 10 000 inhabitants. Some 50% of the local businesses had subscribed to the service by July 2003 and the new service prompted the cable television provider in the town to launch broadband access. In a smaller rural town of 500 inhabitants in their service area, 15% of residents subscribed to Dynamic Broadband's service by mid-2003. In July 2003, Dynamic Broadband served a total of just under 1 000 subscribers

- Of these 1 000 subscribers, about 60% are businesses, at prices up to USD 350 per month; about 40% are residences, at prices of about USD 45 per month. The business subscribers generate about 85% of the company's total revenue.

Broadband Central has a different business model. Broadband Central provides an 802.11b based service in the Western part of the United States.<sup>329</sup> Each 'Blue Zone' deployed by Broadband Central allows residents within a 1.6 kilometre diameter area to connect wirelessly to the Internet at speeds from 128 kbps to 1 Mbps. The service was launched in Northern Utah in early 2003. The company partners with sponsors of local 'Blue Zones'. This co-operative business model allows both individuals and organisations to enter into profit-sharing agreements with Broadband Central for each 'Blue Zone' they choose to sponsor. The company focuses on markets that are underserved by other forms of broadband access including rural areas. By August 2003, BlueZone had increased the number of states in which it was

operating to 22 but had decided not to enter into new partnership arrangements, for the remainder of 2003, while the company endeavoured to meet demand from existing agreements.

- Broadband Central's 256 kbps service is USD 29.95 per month but the company also offers a product designed to compete with dial up (*i.e.* USD 19.95 per month for 128 kbps).

Another important aspect of wireless ISP services is their ability to provide service over long distances.

- Broadband Central's antennas are capable of providing service to a distance of 20 kilometres, but they have achieved greater customer satisfaction by concentrating their signal strength to no more than a 0.8 kilometre radius around each cell site.
- By way of contrast other wireless ISPs are serving much larger areas with multiple cell sites and longer ranges. For example, Clearwave uses unlicensed spectrum to provide broadband access in a radius of 160 kilometres around Jonesboro, Arkansas.<sup>330</sup> Speeds vary depending upon signal quality at the user's location but Clearwave say that most subscribers get between 400 kbps and 3 Mbps.
- Clearwave's service is priced at USD 59.95 per month.<sup>331</sup>
- Beamspeed a WISP based in Yuma Arizona, can provide service up to 32 kilometres.<sup>332</sup> Accordingly, commercial service providers aiming at one market may provide service to adjacent areas.

Telesea is providing a WiFi-based service to a growing number of coastal locations in the United States.<sup>333</sup> The commercial service is aimed at boat owners and can provide broadband access at ranges of up to 50 kilometres. While the Telesea service is currently aimed at a premium clientele, and has a relatively high price level compared to land-based services, the company plans to connect much of the coast of the United States.<sup>334</sup> Telesea's baseline service is USD 200 per month for unlimited access. But in many ways this should be seen as akin to the prices business users pay for broadband access. Experience shows that offers aimed at consumers develop once the infrastructure is in place to provide service.

Offering service over even more expansive areas, Coastal Wave provides a variety of Internet solutions, including a broadband wireless network consisting of over 20 tower sites spread over more than 160 kilometres, creating one of the largest 802.11b networks in northwest Ohio.<sup>335</sup> In May 2003, Coastal Wave announced a partnership with Luckey Farmers to bring high speed wireless Internet services to many rural markets throughout northwest Ohio. Luckey Farmers is a grain and supply farm co-operative serving a six county area in northwestern Ohio and Michigan.<sup>336</sup> Coastal Wave is in the process of placing wireless equipment at all of Luckey Farmers' locations. Each location offers an antenna height of over 60 metres. Coastal Wave has deployed wireless access to most marinas in the Port Clinton, Marblehead, and Sandusky areas which border Lake Erie.

- Marine wireless access is USD 299.95 for the boating season or USD 59.95 per month.<sup>337</sup> At the same time inland wireless services, for residential users, are charged at USD 39 per month for 384 kbps by Coastal Wave.<sup>338</sup>

Wireless carriers in the United States are also using technologies such as CDMA 1xEV-DO to provide access to mobile broadband services.<sup>339</sup> Verizon Wireless currently offers mobile broadband service at speeds ranging from 300 to 500 kbps in San Diego and Washington, D.C. using cellular and PCS spectrum. The company plans to expand its 1xEV-DO service across its nationwide network during 2004. Extend

America is a cellular carrier operating in rural markets and the company plans to begin offering mobile broadband service by mid-2004.<sup>340</sup> The first markets will be in Bismarck and Mandan in North Dakota. Extend America, in partnership with Nextel, a cellular operator, plans to then expand the network coverage in North Dakota and into parts of South Dakota, Wyoming, Nebraska and Montana.

Using a mesh-like network technology, Xtratyme is a wireless ISP that covers more than 17% of the geographical area of Minnesota.<sup>341</sup> Xtratyme uses 802.11b technology but relies on frequency hopping instead of the direct sequence technique used by most public hot-spot wireless local area networks.<sup>342</sup> Radio towers are mounted on water towers, grain elevators and so forth with a coverage of 11 kilometres. The towers form a mesh across the service area with each connected by microwave radio instead of using leased lines to provide backhaul.<sup>343</sup> An Xtratyme subscriber can ‘roam’ anywhere in the coverage area. Moreover, Xtratyme say that a user with a laptop or PDA travelling in an automobile can access the Internet at speeds of over 800 kbps.

For wide area wireless networks, such as Xtratyme, developments in wireless technology may in themselves provide economical backhaul. In other cases satellites may be used to provide backhaul with fixed wireless providing access. However, in many cases, traditional leased lines will provide the backhaul to even the most innovative wireless access networks. One example comes from the town of Vivian, Louisiana. Frustrated by the lack of DSL and cable modems local entrepreneurs implemented a meshed wireless access network in the town of 4 000 inhabitants.<sup>344</sup>

- Baseline broadband, from ‘Fastline’, at up to 11 Mbps, starts at USD 24.95 per month.<sup>345</sup>

Moreover the mesh network enables Fastline to offer discounts for users with mesh connections who provide connections to other users. If a further eight users within a three or four block radius connect using the customers ‘meshbox’ then they receive a free connection.<sup>346</sup> The local cable company responded by launching a cable modem service, in mid 2003, such that the town now has two broadband providers neither of which is the incumbent local exchange carrier. Fastline was able to link its network in Vivian to the Internet because it could get economical access to a leased line to provide backhaul.

There are a number of programmes at Federal and State levels supporting rural broadband in the United States. The largest such programme is the Federal Rural Broadband Access Loan and Loan Guarantee Program. On 29 January 2003, the Secretary of Agriculture announced funding for the financial year 2003. Under this scheme the Rural Utility Service has made available USD 1.4 billion in loans and loan guarantees to provide broadband services in rural communities.<sup>347</sup> These loans will facilitate deployment of new and innovative technologies to provide two-way data transmission of 200 kbps or more, in communities with populations up to 20 000. The previous Broadband Pilot Program was a loan program designed specifically to increase the rate of deployment of technology to small towns in rural areas. The USD 100 million in loans designated for this pilot programme was used in its entirety.

The Rural Utilities service also administers a pilot grant programme for the provision of broadband transmission service in rural America. For fiscal year 2002, USD 20 million in grants was available through a national competition to applicants proposing to provide broadband transmission service on a “community-oriented connectivity” basis.<sup>348</sup> The “community-oriented connectivity” approach targets rural, economically challenged communities and offers a means for the deployment of broadband transmission services to rural schools, libraries, education centres, health care providers, law enforcement agencies, public safety organisations as well as residents and businesses.<sup>349</sup>

At the State level the Telecommunications Industry of America (TIA) has compiled an extensive list of State initiatives in respect to broadband.<sup>350</sup> They range from grants, tax credits and low interest loans through to action on rights of way. Many of these initiatives specifically target rural communications. In

addition, some rural communities use funding from more general state programmes and federal programmes. One example is state grants to schools for technology being used together with funding from E-Rate. The E-rate – the Schools and Libraries Universal Service Support Mechanism – is a federal programme that allows schools and libraries to realise savings in purchasing telecommunications services, internal connections, and Internet access.<sup>351</sup> For example, a number of schools have been connected by wireless ISP Sting Communications in areas where DSL and cable modem service were not available. State grants provided the funding for equipment with E-Rate financing part of the ongoing connection cost.<sup>352</sup> In turn the Wireless ISP then offered inexpensive broadband access to the community if they could find a threshold of 100 subscribers.

In September 2003 the FCC adopted a Notice of Proposed Rulemaking (NPRM) proposing ways to amend its spectrum regulations and policies in order to promote the continued rapid and efficient deployment of quality spectrum-based services in rural America.<sup>353</sup> This action follows the Commission's Spectrum Policy Task Force which, in 2002, recommended that the Commission explore ways of promoting spectrum access and flexibility in rural areas. The FCC is seeking input on various questions related to eliminating unnecessary regulatory barriers, minimising regulatory costs, and increasing licensee flexibility in a manner that will facilitate the deployment of wireless services in rural areas. Significantly, for broadband access development, the FCC also proposes to allow providers in rural areas to operate at higher power levels so as to cover larger geographic areas with a given amount of equipment. In addition, the Commission proposes to remove the eligibility restrictions on the use of spectrum for Rural Radiotelephone Service ("RRS") and Basic Exchange Telephone Radio Systems ("BETRS"), thus expanding and promoting the use of these services that are focused on helping rural areas.

The United States Commerce Department's National Telecommunications and Information Administration (NTIA) has recently taken steps to promote the expansion of broadband, for example by spearheading an effort to bring the Defense Department and the United States technology industry together to permit devices using Wi-Fi technologies to co-exist with sensitive military radar systems in the 5 GHz frequency band. In a proceeding launched in January 2004, NTIA intends to facilitate advanced, low-cost wireless broadband deployment in rural areas by making the 3650-3700 MHz band for unlicensed devices available with appropriate regulatory provisions to protect against operational interference with Federal users. The agency has requested public comments on policy, mitigation, and technical issues, and expects to issue a report in 2004

**Table 4: Selected wireless ISPs in the United States**

Name of WISP	Markets covered	Service	Baseline price (USD per month)	URL
Prairie Inet	Headquartered in West Des Moines, Iowa, providing service to businesses and residents in 120 communities located throughout Iowa and Illinois	WiFi, line-of-sight	49.95 for 512kbps	www.prairieinet.net
Xtratyme	Xtratyme Technologies, based in Hutchinson, Minnesota, has built a wide area network that serves more than 100 rural markets in Minnesota and Iowa	WiFi including roaming throughout coverage area	Xtratyme's business strategy is to partner with local communities, sharing both the cost of the infrastructure and the revenue. Partners use their own brand and are typically offering services for USD 30 to USD 40	www.xtratyme.com
DTN Speed.Net	DTN SpeedNet, headquartered in Omaha, NE, is an affiliated company of Data Transmission Network Corporation (DTN). 54 markets in Illinois, Indiana, Nebraska, Ohio, Oklahoma, Texas	Fixed Wireless - 13 to 16 km radius from antenna	39.95 for 20 times dial-up speed 49.95 for 1.5 Mbps	www.dtnspeed.net
Sting Communications	Sting Communications has over 46 points of presence servicing Northwestern, Central, Eastern Pennsylvania, and Eastern New Jersey	802.11, line-of-sight	29.95 for 256 kbps (USD 10 per month for residents in some surrounding areas where company connects schools)	www.stingcomm.com
NetBeam (Peak Speed Communications)	34 markets in Arizona, Colorado and Utah	Agere's ORiNOCO Outdoor Router with 8 km distance	49.95 for 384 kbps	www.netbeam.net
Prime Companies	32 markets in California, New York and Pennsylvania	LMDS		www.primecompanies.com
Fairnet	28 markets in Indiana	Line-of-sight	59.95 for 2 Mbps	www.fairnetwireless.com
West Coast Wireless	26 markets in California			www.westcoastwireless.com
Wireless Town	23 markets in Illinois	32 km distance	39.95/69.95 for 384 kbps	www.wirelesstown.com
InvisiMax	18 markets in Minnesota		31.97 for 256 kbps	www.invisimax.com

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## APPENDIX 1: SELECTED DATA FOR OECD COUNTRIES

	Population, (000) (2001)	Population per Square Kilometre (2001)	Rural Population as % of Total (2001) (1)	DSL Availability (Refer Table 1, 2003)	Total Households passed by Networks upgraded for Cable Modem Access (%) (Refer Table 2, 2003)
Australia	19 485	3	8.9	75.0	37.0
Austria	8 128	97	32.6	80.0	38.0
Belgium	10 263	335	2.6	98.0	80.0
Canada	31 082	3	21.1	75.4	85.0
Czech Republic	10 287	130	25.4	44.0	9.0
Denmark	5 359	124	14.9	95.0	47.0
Finland	5 195	15	41.0	85.0	25.0
France	59 191	108	24.5	79.0	25.0
Germany	82 311	228	12.3	85.0	10.0
Greece	10 623	80	39.6	...	0.0
Hungary	10 185	110	35.2	45.0	
Iceland	285.1	3	7.4	86.0	18.0
Ireland	3 839	55	40.7	62.0	4.0
Italy	57 348	190	32.9	80.0	9.0
Japan	127 210	337	21.1	90.0	27.0
Korea, Rep. of	47 343	476	17.6	93.0	57.0
Luxembourg	441	170	8.2	90.0	38.0
Mexico	99 109	50	25.4	...	...
Netherlands	15 987	392	10.4	85.0	79.0
New Zealand	3 850	14	14.1	84.8	11.0
Norway	4 514	14	25.0	65.0	28.0
Poland	38 641	124	37.4	69.0	11.0
Portugal	10 061	112	34.4		60.0
Slovak Republic	5 379	110	42.4	...	...
Spain	40 266	80	22.2	92.0	40.0
Sweden	8 896	20	16.7	78.0	23.0
Switzerland	7 231	175	32.5	95.0	76.0
Turkey	68 610	88	33.8	5.0	14.0
United Kingdom	60 012	244	10.5	85.0	45.0
United States	285 023	30	22.6	75.0	80.0
OECD	1 136 056.1	33	22.9	77.2	42.0

(1) The population of areas defined as rural (*i.e.* non-urban) in each country, as reported to the United Nations. No attempt has been made to harmonise these definitions so cross-country comparisons should be treated with caution.

Source: OECD, UNDP.