# Explaining International Broadband Leadership


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**ABOUT THE INFORMATION TECHNOLOGY AND INNOVATION FOUNDATION**

ITIF is a non-profit, non-partisan public policy think tank committed to articulating and advancing a pro-productivity, pro-innovation and pro-technology public policy agenda internationally, in Washington, DC and in the states. Through its research, policy proposals, and commentary, ITIF is working to advance and support public policies that boost innovation, e-transformation and productivity.

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# Executive Summary

It is hard to follow broadband telecommunications policy without hearing almost weekly that the United States ranks 15th out of 30 Organization for Economic Cooperation and Development (OECD) nations in broadband adoption. But it is much less apparent why the United States is behind. Indeed, relatively little work has been done to understand why some nations are ahead, and why some, like the United States, are lagging. By examining OECD nations through statistical analysis and in-depth case studies of nine nations, including the United States, this report attempts to do just that.

In identifying factors that have spurred broadband performance in other nations, we present key findings that government and the technology industry must recognize if we are to find the right course for the United States. And we propose key policy recommendations that will drive greater broadband performance.

**Key Findings and Conclusions:**

- **The United States is behind in broadband deployment, speed and price.** Despite what some advocates and analysts claim, the United States is behind in broadband performance and its rank has been falling since 2001.

- **Don't blame it all on poor policies.** It is tempting, particularly for those seeking a more proactive national broadband policy, to blame all or most of the United States' poor performance on poor or non-existent policies. In fact, our analysis suggests that non-policy factors explain about three-quarters of the difference between nations in broadband performance. For example, the fact that over 50 percent of South Koreans live in large, multitenant apartment buildings makes it significantly cheaper on a per-subscriber basis to roll out fast broadband there compared to the United States, where many people live in single-family suburban homes. Likewise, the fact that the United States has the longest copper loop lengths (among 13 OECD countries where data were available) makes it more expensive to deploy high-quality and low-cost broadband here.

- **Don't ignore the role that good policies can play.** What the "it's all environment" proponents miss is that broadband policies, while not the most important factor, do matter, and nations that ignore policy, assuming that the "market" can do all the heavy lifting, will fare worse than if they had smart broadband policies.

- **One size doesn't fit all.** Too many advocates in the broadband debates look longingly overseas for the perfect broadband model to import, whether it's unbundling from France, structural separation from the United Kingdom, or municipal provision of networks in countries like Sweden and the Netherlands. But given the significant differences in economic, social, geographic and political factors between nations, many of these experiences are not easily transferred from one nation to another. For example, a major reason why Japan leads the world in high speed fiber-optic deployment is that its companies, in particular the partially government-owned incumbent telecom provider Nippon Telegraph and Telephone (NTT), face significantly less pressure from capital markets for short-term profits. As a result, unlike in the United States, it's easier to invest in faster fiber deployment than what market forces alone would generate. But broadband policy can do little to change U.S. capital markets' expectations for short-term financial performance. This means that while we can and should learn from other nations' broadband policies and performance, in the end we have to find our own way and develop policies that fit U.S. needs and conditions.

- **We can learn from best practices in other nations.** While we shouldn't look to other nations for silver bullets, or assume that practices in one nation will automatically work in another, we can and should look to broadband best practices in other nations, particularly from individual programs and initiatives to spur broadband deployment and broadband demand, and where appropriate, emulate those. Doing so will enable the United States to increase our broadband performance faster than in the absence of these proactive policies. These best practices include the following:

    - *Leadership Matters:* Overall, at the broadest level nations with robust national broadband strategies—that is, those that make broadband a priority, coordinate across agencies, put real resources behind the strategy, and promote both supply and demand—fare better than those without. In particular, South Korea, Japan and Sweden established robust national strategies that not only shaped their broadband policies but also helped gain widespread political support for them. And in the case of South Korea and Japan, these strategies had support at the highest level of government and business. In Japan, for example, Prime Minister Yoshiro Mori appointed the Information Technology Strategy Council, headed by Sony Chairman Nobuyuki Idei, which crafted a strategy to make Japan the "world's leading IT nation" by 2005.

    - *Incentives Matter*: Because it is expensive for operators to deploy broadband networks, particularly faster next-generation networks in rural areas, many countries want to increase broadband supply beyond and/or ahead of that which the market alone provides. The role of government financial incentives in spurring broadband deployment in leading broadband nations has largely been underappreciated in the United States, where many analysts have regarded local loop unbundling regulations as the key to the leading broadband nations' success. In fact, a careful analysis suggests that many leading nations have effectively used financial incentives to spur broadband deployment. For example, the Swedish government aggressively used subsidies to spur broadband deployment, particularly in rural areas of the country. It allocated a total of more than $800 million. For the U.S. government to match this investment as a share of GDP, it would need to invest more than $30 billion.

    - *Competition Matters:* Many broadband advocates believe that broadband success in European countries, especially in France, is due in large measure to unbundling regulations, and they claim that if only the United States would adopt unbundling policies to spur *intramodal* competition, it too would rocket ahead. These advocates are right in one sense: competition is important to broadband success. But they overlook several key facts. First, *intermodal* competition between separate physical networks (e.g. between digital subscriber line (DSL) services and cable modem services) also spurs broadband success. Second, intramodal competition is not a panacea. A number of European Union (EU) nations with similar unbundling regimes as France—for example, Italy and Spain—rank below the United States in terms of broadband adoption. Furthermore, most EU nations adopted unbundling regulations because they had almost no intermodal broadband competition—in part because their cable regulations significantly limited investment in cable modem service. Moreover, although proactive unbundling policies may have spurred broadband DSL adoption in some countries, aggressive unbundling policies, particularly of next-generation networks (e.g. fiber and high-speed cable), run the risk of limiting investment by both incumbents and competitors in these networks and may result in what might be termed modest-speed "DSL cul-de-sacs" on their relatively short copper loops.

- *Demand-Side Policies Matter*: Given that only around two-thirds of Americans have a computer at home, even the most robust supply-side policies will not produce universal broadband usage. Other nations have taken the demand side more seriously. The Swedish government subsidized personal computer purchases via tax deductions for companies that bought computers for their employees' personal use; and as a result, almost 90 percent of Swedes can get access to the Internet at home on a PC. The sole mission of South Korea's Agency for Digital Opportunity and Promotion Korea is to promote digital literacy and access to computers, including through training programs to let people buy computers through a low-priced purchase installment system.

- **It's high-speed networks, stupid.** As more and more households subscribe to broadband, the next big challenge is getting faster broadband. The current move to fiber and the impending move to high-speed cable is enabling many U.S. consumers to access broadband at speeds higher than many places in Europe. In fact, it appears that as a share of total households, almost three times as many homes can subscribe to fiber-optic broadband in the United States than in the EU as a whole. However, even in the United States, these rates are relatively low compared to fiber availability in Japan and South Korea. Significantly though, it appears that no nation other than the United States is seeing extensive high speed network (e.g. fiber) deployment in moderate-density areas, in part reflecting America's uniquely suburban nature.

**Building a More Effective Broadband Policy**

If the United States is to maximize its broadband performance, it needs more robust and effective national broadband policies. This process should start with a reformulation of the current debate:

- **End the "either-or" shouting matches**. The U.S. broadband policy environment is characterized on the one hand by market fundamentalists who see little or no role for government, and see government as the problem; and on the other by digital populists who favor a vastly expanded role for government (including government ownership of networks and strict and comprehensive regulation, including mandatory unbundling of incumbent networks and strict net neutrality regulations) and who see big corporations providing broadband as a problem. Given the policy advocacy and advice they are getting, it is no wonder that Congress and the Administration have done so little.

- **Instead, have a pragmatic discussion about how to improve U.S. broadband performance**. Whatever the outcome of these debates, we should be able to agree that the United States can do better on broadband. The most important step the United States can take as a nation to improve our broadband performance may be to move beyond the divisive and unproductive debate over broadband policy that revolves around arguments about whether we are behind or ahead; whether our relative position is due to policy or other factors; whether unbundling is a magic bullet or an investment killer; and of course, whether net neutrality is the greatest threat to the Internet since its inception or something that is an anachronistic concept. It's time to reject the view that somehow this is a zero-sum game between corporate America and government. Both must clearly play a leadership role if we are to make headway on broadband performance. This means shifting the debate to focus on the key issues: how to enact public policies that emphasize the primary goal—getting as many American households as possible using high-speed broadband networks to engage in all sorts of online activities, including education, health care, work, commerce, and interacting with their government. To do that, we recommend several measures.

To encourage the development of broadband infrastructure (supply) in the United States, we recommend that U.S. policymakers take the following steps:

1. **Enact more favorable tax policies to encourage investment in broadband networks, such as accelerated depreciation and exempting broadband services from federal, state, and local taxation.**
2. **Continue to make more spectrum, including "white spaces," available for next-generation wireless data networks.**
3. **Expand the Department of Agriculture's Rural Utilities Service Broadband Program and target the program to places that currently do not have non-satellite broadband available.**
4. **Reform the federal Universal Service Fund program to extend support for rural broadband to all carriers, and consider providing the funding through a reverse auction mechanism.**
5. **Fund a national program to co-fund state-level broadband support programs, such as Connect Kentucky or North Carolina e-NC Authority.**
6. **Promote the widespread use of a national, user-generated, Internet-based broadband mapping system that would track location, speed, and price of broadband.**
7. **State and local governments should take action to make it easier for providers to deploy broadband services, including making it easier to access rights-of-way.**

To encourage the growth of consumer demand for broadband, we recommend that U.S. policymakers take these steps:

8. **Support initiatives around the nation to encourage broadband usage and digital literacy.**
9. **Fund a revitalized Technology Opportunities Program, with a particular focus on the development of nationally scalable Web-based projects that address particular social needs, including law enforcement, health care, education, and access for persons with disabilities.**
10. **Exempt broadband Internet access from federal, state, and local taxes.**
11. **Support new applications, including putting more public content online, improving e-government, and supporting telework, telemedicine, and online learning programs.**

By adopting these recommendations, U.S. policymakers would give broadband providers the economic incentives to invest in broadband infrastructure both in rural and urban areas of the country and give consumers the incentives to subscribe to broadband, particularly higher speed broadband.

# I. Introduction

It's hard to follow broadband telecommunications policy without hearing almost weekly that the United States ranks 15th out of 30 Organization for Economic Cooperation and Development (OECD) countries in broadband adoption. Some people are complacent about our relatively poor national ranking, claiming that broadband adoption is largely determined by demographic, geographic, and other factors that policy cannot easily influence. Others argue that public policies are the key to broadband success, and with little evidence other than correlation, point to other nations' telecommunications policies—especially "unbundling" requirements for incumbent telecommunications providers and policies to promote competition in broadband—as the determining factor in their higher rank.

One thing that is missing in the often heated and polarized debate is a careful, objective, and in-depth analysis of various nations' broadband environments and policies to determine what, if any, role public policies have played in spurring broadband deployment and adoption. Gaining a better understanding of what contributes to broadband deployment and adoption is important, because nations with more and better broadband are better positioned than other nations to reap significant economic and social benefits. If we can identify policy factors that have spurred broadband performance in other nations' higher ranks, U.S. policymakers will have better information on which to base their decisions.

This report offers an in-depth analysis of various nations' broadband environments and policies. The first section of the report summarizes information about where the United States stands in comparison to other OECD nations in terms of broadband penetration and overall broadband performance. Using data from a collection of OECD surveys, ITIF developed a composite measure of three indicators of national broadband performance—namely, household penetration, average speed, and broadband price—and then used this measure to rank OECD nations. On each of the three specific broadband measures, as well as in terms of the composite measure of national broadband performance, the United States ranks at or near the middle of the OECD countries.

In the second section, we consider the importance of non-policy factors, including demographic variables such as age and education, economic variables such as per capita income; and broadband supply variables such as urbanization and competition. First we note some anecdotal examples of the relationship between non-policy factors and broadband performance. Then we review statistical analyses, including our own, of the role of non-policy factors in determining broadband performance. The fact, for example, that over 50 percent of South Koreans live in large, multitenant apartment buildings makes it significantly cheaper on a per-subscriber basis to roll out fast broadband there compared to the United States where many people live in single-family suburban homes. In fact, these and other non-policy factors explain about three-quarters of the difference between nations in broadband performance.

The third section presents lessons from ITIF's in-depth case studies of broadband policies in nine OECD countries—Canada, France, Germany, Japan, the Netherlands, South Korea, Sweden, the United Kingdom, and the United States. We selected these countries in part to represent a variety of levels of broadband penetration, but also to reflect differing global regions and cultures.

In reviewing other nations' broadband performance, it is tempting to be critical of U.S. broadband companies, broadband policies, or both. For after all, if the United States is lagging behind it must be because either our policies or our companies, or both, are deficient. In fact, the reality is much more complicated.

This is not to say that institutional factors and public policies are not important. But some of these factors appear to be unique to individual nations and therefore hard to easily transfer to other nations. For example, a major reason why Japan leads the world in high speed fiber-optic deployment is that its companies, in particular the partially government-owned incumbent telecom provider Nippon Telegraph and Telephone (NTT), face significantly less pressure from capital markets for short-term profits. As a result, unlike in the United States, companies in some of the countries that are leading in broadband penetration may invest in deploying fiber even when the business case is less developed. Observers can legitimately differ over whether the U.S. capital market and business environment are better or worse, but the bottom line is that this is the market in which U.S. broadband providers operate.

Likewise, many broadband advocates believe that broadband success in European countries, especially in France, is due in large measure to unbundling regulations, and they claim that if only the United States would adopt unbundling policies, it too would rocket ahead. Yet it is important to note that a number of European Union (EU) nations with similar unbundling regimes as France—for example, Italy and Spain—rank below the United States in terms of broadband adoption (see Table 1). Furthermore, most EU nations adopted unbundling regulations because they had almost no intermodal broadband competition—in part because their cable regulations significantly limited investment in cable modem service. Moreover, although proactive unbundling policies may have spurred competition and broadband digital subscriber line (DSL) adoption in some countries, unbundling policies run the risk of limiting investment by both incumbents and competitors in next-generation networks (e.g., fiber and high-speed cable[1]) and the result may be a modest-speed "DSL cul-de-sac" on their relatively short copper loops, where providers have less economic incentive to upgrade to fiber so consumers have access only to DSL broadband services

But the fact that non-policy factors are important, or that some policy environments are different than the United States', should not serve, as it does for some, as cause for complacency or worse, smug satisfaction. Clearly the United States can do better and doing so would generate significant economic and social benefits. It is in this regard that public policy matters. For based on our review of studies and documents, discussions with experts in the various nations, and other analysis, it is clear that the right broadband policies can and do have a significant positive influence on broadband performance. Moreover, even though nations differ in institutional and economic environments, there are many policy lessons the United States can productively learn from other nations and many policies that if adopted here, would effectively spur greater broadband performance.

Overall, at the broadest level nations with robust national broadband strategies—that is, those that make broadband a priority, coordinate across agencies, put real resources behind them, and promote both supply and demand—fare better than those without. In particular, South Korea, Japan and Sweden established robust national strategies that not only shaped their broadband policies but also helped gain widespread political support for them. And in the case of South Korea and Japan, these strategies had support at the highest level of government and business. In Japan, for example, Prime Minister Yoshiro Mori appointed the Information Technology Strategy Council, headed by Sony Chairman Nobuyuki Idei, which crafted a strategy to make Japan the "world's leading IT nation" by 2005.[2]

But while not all nine nations developed robust national broadband policies, every nation, including the United States, has put in place at least some effective policies to spur broadband performance. To promote broadband deployment, some nations have established explicit or implicit government mandates; tax incentives, grants, and low cost loans to telecommunications providers; subsidies for rural broadband deployment; and policies to spur intermodel or intramodal competition in the broadband market. To encourage take-up of broadband among residents, nations have adopted policies to encourage the development of broadband demand including promoting broadband in education; establishing digital literacy programs; and migrating government services and content to the Internet (e-government). Overall, nations with more effective and well-funded policies appear to have been able to boost their broadband performance more than nations with less effective or less well-funded policies.

So what should the United States do to improve its broadband performance? There are a number of specific policy recommendations that we propose. But perhaps the most important step the United States can take as a nation to improve our broadband performance may be to move beyond the divisive and unproductive debate over broadband policy that revolves around arguments about whether we are behind or ahead; whether our relative position is due to policy or other factors; whether unbundling is a magic bullet or an investment killer; and of course, whether net neutrality is the greatest threat to the Internet since its inception or something that is an anachronistic concept.

Indeed, it's time for the United States to move beyond free market fundamentalism on the right and digital populism on the left and begin to craft pragmatic, realistic public policies that focus on the primary goal—getting as many American households using high-speed broadband networks to engage in all sorts of online activities, including education, health care, work, commerce, and interacting with their government. In the final section of this report, we recommend several measures that U.S. policymakers can adopt to encourage the development of broadband supply and demand in the United States.

To encourage the development of broadband infrastructure (supply) in the United States, we recommend that U.S. policymakers take the following steps:

1. **Enact more favorable tax policies to encourage investment in broadband networks, such as accelerated depreciation and exempting broadband services from federal, state, and local taxation.**

2. **Continue to make more spectrum available for next-generation wireless data networks, including "white spaces."**

3. **Expand the Department of Agriculture's Rural Utilities Service Broadband Program and target the program to places that currently do not have non-satellite broadband available.**

4. **Reform the federal Universal Service Fund program to extend support for rural broadband to all carriers, and consider providing the funding through a reverse auction mechanism.**

5. **Fund a national program to co-fund state-level broadband support programs.**

6. **Promote the widespread use of a national, user-generated, Internet-based broadband mapping system that would track location, speed, and price of broadband.**

7. **State and local governments should take action to make it easier for providers to deploy broadband services, including making it easier to access rights-of-way.**

To encourage the growth of consumer demand for broadband, we recommend that U.S. policymakers take these steps:

8. **Support initiatives around the nation to encourage broadband usage and digital literacy.**

9. **Fund a revitalized Technology Opportunities Program, with a particular focus on the development of nationally scalable Web-based projects that address particular social needs, including law enforcement, health care, education, and access for persons with disabilities.**

10. **Exempt broadband Internet access from federal, state, and local taxes.**

11. **Support new applications, including putting more public content online, improving e-government, and supporting telework, telemedicine, and online learning programs.**

By adopting these recommendations, U.S. policymakers would give broadband providers stronger economic incentives to invest in broadband infrastructure both in rural and urban areas of the country and give consumers stronger incentives to subscribe to broadband, particularly higher speed broadband.

# II. Where Does the United States Rank in Broadband?

In the OECD rankings of broadband penetration, the United States has steadily fallen in rank—from 4th in 2001 to 15th in 2007 among the 30 OECD countries.[3] As the U.S. rank has plummeted, the chorus of U.S. critics of the OECD methodology has increased.

The OECD data are certainly not perfect, but are more reliable than data obtained using other methods, including the European Commission's E-Communications Household Survey.[4] The principal limitations of the OECD rankings are that they measure penetration on a per capita basis rather than a per household basis. When measured on a household basis, the U.S. rank improves somewhat, to 12th.

The OECD also does not aggregate broadband penetration, speed, and price data into a composite indicator of national broadband performance. Using data from a collection of OECD surveys, we have developed a composite measure of national broadband performance that represents the sum of standard deviation scores for three indicators: household broadband penetration, average speed weighted by percentage of subscribership (in megabits per second (Mbps)), and lowest available price per Mbps (see Table 1).[5]

The top two nations respectively, are South Korea and Japan, with composite scores of 15.92 and 15.05. The next three highest ranking nations are Finland, the Netherlands, and France. The United States, with a composite score of 10.25, ranks 15th.

### A. RANK IN BROADBAND PENETRATION

As shown in Table 1, the OECD countries with the highest levels of household broadband penetration in 2007 were South Korea, Iceland, the Netherlands, Denmark, and Switzerland. In each of these countries, more than two-thirds of households subscribe to broadband.

When considering countries' broadband penetration, it is important to consider changes over time, because viewing broadband penetration statistics in combination with countries' broadband policies may indicate which policies have the greatest effect on broadband penetration. Some nations that had early leads have had relatively slower broadband take up on the last few years. For example, from 2001 to 2007, the number of broadband subscribers per 100 inhabitants in South Korea did not quite double (see Figure 1). During that same period, the number of subscribers per 100 inhabitants in the United States quadrupled.

Many European nations were slower to adopt broadband. As a result, the OECD nations that experienced the fastest growth in broadband subscribership from 2001 to 2007 were in Europe, including the United Kingdom, France, Japan, and Germany. The number of broadband subscribers per 100 inhabitants in the United Kingdom increased by a factor of 39 times, in France by 22 times, in Japan by 9 times, and in Germany by 8 times. Thus, although it is useful to review broadband policies in South Korea, which leads in broadband internationally, it is equally important to understand the significant recent progress made by lower ranked countries such as the United Kingdom, Germany, and France.

There is some evidence that nations with an early lead were those that had stronger cable broadband systems. For example, there is a negative correlation (-0.35) between per-household adoption rank among OECD nations in 2001 and their score on the Herfindahl-

**Table 1: ITIF's Broadband Rankings Among the 30 OECD Countries, 2007**[6]

| Ranking | Nation | Score on Specific Broadband Measures: Household penetration (Subscribers per household) | Score on Specific Broadband Measures: Speed (Average download speed in Mbps) | Score on Specific Broadband Measures: Price (Lowest monthly price per Mbps) (US $ purchasing power parity) | Composite Score |
|---|---|---|---|---|---|
| 1 | South Korea | 0.93 | 49.5 | 0.37 | 15.92 |
| 2 | Japan | 0.55 | 63.6 | 0.13 | 15.05 |
| 3 | Finland | 0.61 | 21.7 | 0.42 | 12.20 |
| 4 | Netherlands | 0.77 | 8.8 | 1.90 | 11.77 |
| 5 | France | 0.54 | 17.6 | 0.33 | 11.59 |
| 6 | Sweden | 0.54 | 16.8 | 0.35 | 11.53 |
| 7 | Denmark | 0.76 | 4.6 | 1.65 | 11.44 |
| 8 | Iceland | 0.83 | 6.1 | 4.93 | 11.20 |
| 9 | Norway | 0.68 | 7.7 | 2.74 | 11.05 |
| 10 | Switzerland | 0.74 | 2.3 | 3.40 | 10.78 |
| 11 | Canada | 0.65 | 7.6 | 3.81 | 10.61 |
| 12 | Australia | 0.59 | 1.7 | 0.94 | 10.53 |
| 13 | United Kingdom | 0.55 | 2.6 | 1.24 | 10.30 |
| 14 | Luxembourg | 0.56 | 3.1 | 1.85 | 10.25 |
| **15** | **United States** | **0.57** | **4.9** | **2.83** | **10.25** |
| 16 | Germany | 0.47 | 6.0 | 1.10 | 10.17 |
| 17 | Belgium | 0.57 | 6.3 | 3.58 | 10.17 |
| 18 | Portugal | 0.44 | 8.1 | 1.24 | 10.15 |
| 19 | New Zealand | 0.42 | 2.5 | 1.05 | 9.68 |
| 20 | Spain | 0.49 | 1.2 | 2.27 | 9.68 |
| 21 | Italy | 0.41 | 4.2 | 1.97 | 9.54 |
| 22 | Austria | 0.45 | 7.2 | 4.48 | 9.37 |
| 23 | Ireland | 0.46 | 2.1 | 4.72 | 9.01 |
| 24 | Greece | 0.18 | 1.0 | 1.41 | 8.26 |
| 25 | Hungary | 0.29 | 3.3 | 4.67 | 8.22 |
| 26 | Poland | 0.23 | 7.9 | 6.47 | 7.83 |
| 27 | Czech Republic | 0.30 | 2.0 | 9.70 | 7.03 |
| 28 | Slovak Republic | 0.22 | 3.5 | 9.38 | 6.77 |
| 29 | Turkey | 0.23 | 2.0 | 15.75 | 5.25 |
| 30 | Mexico | 0.20 | 1.1 | 18.41 | 4.41 |
| | **Average** | **0.51** | **9.2** | **3.77** | **10.00** |

## BOX 1: BROADBAND DEFINITION AND MAJOR BROADBAND TECHNOLOGIES

Broadband is a term applied to transmission media with bandwidths that can carry multiple signals by dividing the total capacity of the medium into multiple, independent channels. The standard broadband technologies in most areas are digital subscriber line (DSL) technologies and cable modems. Depending on the medium and the transmission method, bandwidth is measured in thousands of bits or kilobits per second (Kbps); millions of bits or megabits per second (Mbps); or billions of bits or gigabits per second (Gbps).

The OECD, which provides the most widely cited international rankings of broadband adoption, has defined broadband as a service that enables users to upload or download data or both at a speed of 256 Kbps—and this rate is the most common baseline that is marketed as "broadband" around the world. Until recently, the U.S. Federal Communications Commission (FCC) defined broadband as a service that enables users to upload or download data at speeds of 200 Kbps. Recently, however, the FCC specified the following seven tiers in its broadband definition: *First-generation broadband*—200 Kbps to 768 Kbps; *Basic broadband tier 1*—768 Kbps to 1.5 Mbps; *Basic broadband tier 2*—1.5 Mbps to 3 Mbps; *Broadband tier 3*—3 Mbps to 6 Mbps; *Broadband tier 4*—6 Mbps to 10 Mbps; *Broadband tier 5*—10 Mbps to 25 Mbps; *Broadband tier 6*—25 Mbps to100 Mbps; and *Broadband tier 7*—more than 100 Mbps.

The standard broadband technologies in most areas are DSL technologies and cable modems, which have been gaining ground over an older high-speed digital access method known as integrated service digital network (ISDN) .

- **DSL technologies** transform telephone lines into high-speed digital lines by using the upper level of the frequency of the telephone company's copper wires to the home to deliver data while leaving the lower frequency for analog voice. The term "xDSL" refers to all types of DSL technologies. The two main categories of DSL for home subscribers are asymmetric DSL (ADSL) in North America and symmetric DSL (SDSL) in Europe. Other variants of DSL that offer higher transfer rates include high-speed DSL (HDSL), very high speed DSL (VDSL), ADSL2 and ADSL2+.
- **Cable modems** allow individuals to have a broadband connection that operates over cable TV lines. Cable Internet works by using TV channel space for data transmission, with certain channels used for downstream transmission, and other channels for upstream transmission. Because the coaxial used by cable TV provides much greater bandwidth than telephone lines, a cable modem can be used to achieve extremely fast access to the Internet.

In a few areas not served by cable or ADSL, some residents can get broadband on wireless networks, being served by wireless Internet service providers (WISPs). In addition, most residents regardless of location can subscribe to satellite broadband service, although the speeds are normally lower, and latency and price higher.

Although it is possible to get higher speeds on existing DSL and cable infrastructure in most nations, achieving significantly higher speeds requires new architectures. In the case of cable, this means moving to the next version of data over cable service interface specification (DOCSIS). In the case of telecom, getting higher speeds means rolling out fiber closer to the home. Some telecommunications providers, including Verizon and AT&T, are beginning to roll out either fiber-to-the-home (FTTH) or fiber-to-the-node (FTTN) that can handle TV, voice calls, and Internet access. The newest technology being deployed for mobile and stationary broadband access, worldwide interoperability for microwave access (WiMAX), a technology designed to offer wireless, high-speed broadband connectivity over long distances.

Hirschman Index (HHI—a measure of market concentration) for intermodal broadband competition between telecommunications providers and cable broadband providers. And in an ITIF regression model similar to the ones described later in this paper HHI was negative and significant at the 0.05 level.

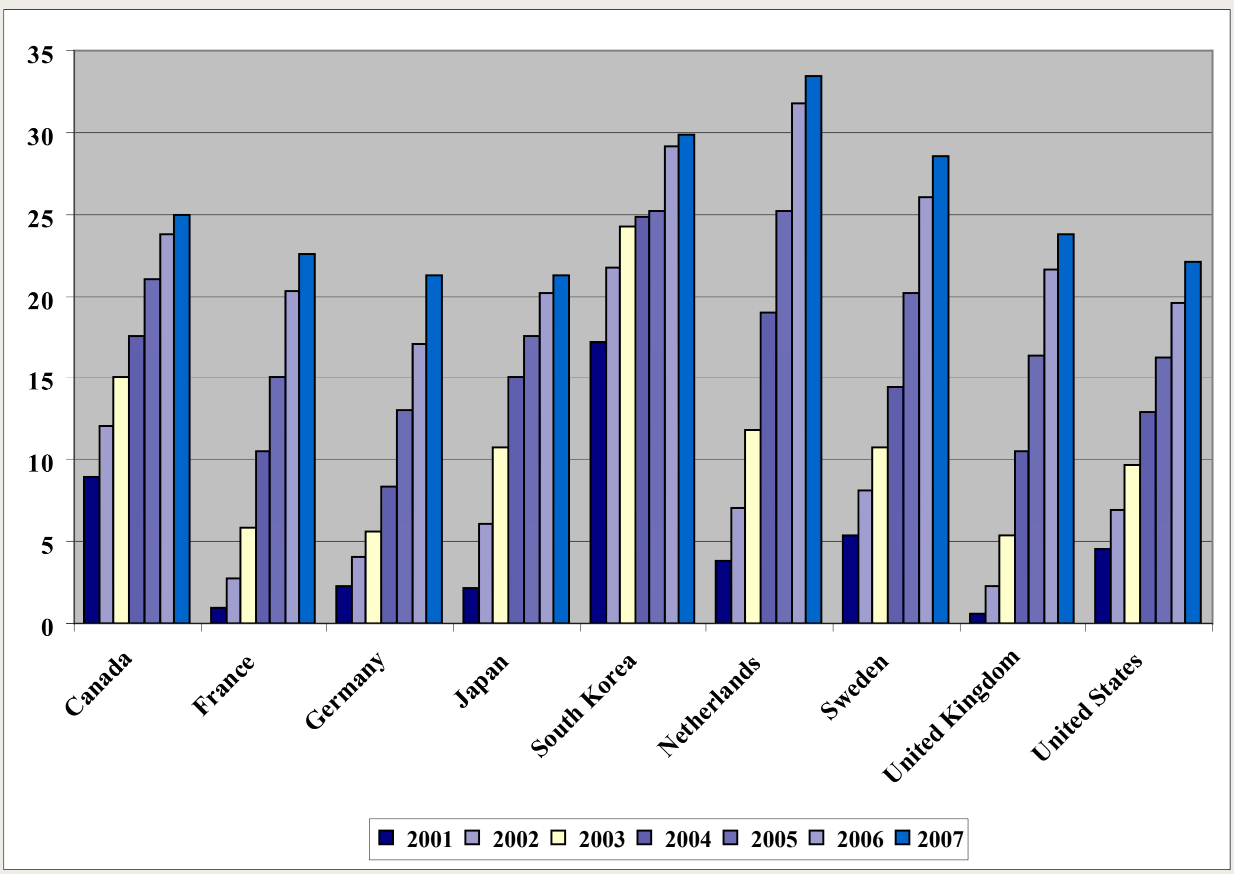
In other words, nations with higher levels of intermodal competition—which, in most nations, means having more cable broadband to compete with telecommunications broadband—jumped out ahead of nations that relied principally on broadband provided over telephone lines—that is, digital subscriber line (DSL) services. In part, this was because cable companies generally deployed broadband first. This is one reason why Canada, South Korea, and the United States were near the top of the OECD broadband rankings in the early part of this decade.

### B. RANK IN BROADBAND SPEED

The most recent OECD statistics show that broadband speeds are increasing as operators continue to upgrade subscriber lines, often to fiber. For example, the average speed of advertised connections increased from 2 Mbps in 2004 to almost 9 Mbps in 2007.[8] Fiber-to-the-home (FTTH) subscriptions have grown modestly, from 7 percent of connections in the OECD nations a year ago to 8 percent today. However, in some countries, including Japan and South Korea, FTTH is responsible for a much larger share of connections. FTTH accounts for 36 percent of broadband subscriptions in Japan and 31 percent in South Korea (including fiber local area networks).

Some operators in the United States, especially Verizon, are making significant investments in FTTH. Partly because of these and other fiber buildouts, the

**Figure 1: Number of Broadband Subscribers per 100 Inhabitants in Nine OECD Countries, 2001-2007[7]**



United States now ties Norway in the fastest available advertised broadband speed—7th among OECD countries at just over 50 Mbps.[9] Yet when we look at average broadband speed weighted according to share of subscribership—that is, taking into account the popularity of slower technologies—the United States drops to 15th with an average broadband speed of 4.9 Mbps.[10]

*Nations with higher levels of intermodal competition—which, in most nations, means having more cable broadband to compete with telecommunications broadband—jumped out ahead of nations that relied principally on broadband provided over telephone lines.*

### C. RANK IN BROADBAND PRICE

As broadband speeds have been rising across most OECD countries, prices per Mbps have been dropping. Between September 2005 and October 2006 the average price per Mbps for a DSL connection fell 19 percent and 16 percent for cable Internet connections. Prices for broadband services also are falling in the United States, where they are a bit lower than the OECD average, bringing the United States to 11th among OECD countries with a broadband monthly price of $12.60 per advertised Mbps.[11] By contrast, Japan has the cheapest advertised price per Mbps of $3.09, followed by France at $3.70. The United Kingdom has the next cheapest at $5.29 per Mbps just ahead of South Korea at $5.96. Of the other OECD countries we consider in this report, Germany comes closest to the United States at $8.44 per Mbps; the Netherlands, Sweden, and Canada fare much worse at $15.26, $18.40, and $28.14 per Mbps, respectively.[12]

Yet considering the lowest available monthly price per Mbps in each country—the measure used in ITIF's Broadband Rankings—yields somewhat different results. According to this measure, which essentially tracks the price per bit of the fastest broadband, Japan, France, Sweden, and South Korea lead the pack, while the United States drops to 18th (see Table 1 above).

The price component of the ITIF Broadband Rankings measures the lowest generally available advertised monthly price per Mbps in order to give an indication of whether the highest quality broadband (plans offering more bandwidth are generally cheaper on a per-bit basis) is an affordable option for consumers.[13] The rankings do not use OECD's average price data because its averages are unweighted and therefore susceptible to outliers. Although a better measure would gauge the actual speeds that consumers experience, as opposed to advertised speeds, reliable data on actual speeds—collected largely from speed test websites such as www.speedtest.net—are not yet available for all OECD countries.

# III. How Do Non-Policy Factors Affect National Broadband Performance?

Both non-policy and policy factors influence broadband penetration performance. For example, it is easier and cheaper to deploy and upgrade broadband if most of a nation's residents live in highly dense urban areas. Conversely, if most of a nation's citizens live in single-family homes in suburbs, exurbs, or rural areas, the cost per-household of deploying broadband will be higher.

### A. ANECDOTAL EVIDENCE ON NON-POLICY FACTORS AND BROADBAND

Anecdotal information suggests that higher population densities spur broadband penetration by lowering the per-customer cost because providers can serve more customers per mile of wire or fiber laid. For example, among OECD countries, Japan, South Korea, and Sweden have much higher levels of urbanicity than the United States.[14] Although the percentage of South Koreans living in urban areas is only slightly greater than in the United States (81 percent versus 80 percent),[15] metropolitan areas in South Korea are much more densely populated than those in America—a fact readily apparent to anyone visiting Seoul. The multitenant apartments that make up more than 50 percent of South Korea's housing are generally 12 to 25 stories high and grouped in tight blocks of about 5 to 15 buildings. A large apartment block of 16 buildings, each 20 to 25 stories tall, might have 1,900 households.[16] Thus, a broadband operator in South Korea can gain access to nearly 2,000 potential subscribers simply by extending a broadband connection to one apartment block.[17]

Sweden's level of urbanicity also is quite high. The majority of Swedes reside in the major cities of the southern part of the country (Stockholm, Göteborg, and Malmö), and about half of Sweden's 4 million households live in apartment buildings.[18] The majority of Americans, by contrast, live in single-family homes, and only 3.2 percent of U.S. housing units are in buildings with more than 50 units.[19] This means that when a company like Verizon lays fiber-optic cable in the suburbs of East Coast metropolitan areas, it's likely to reach less than one-tenth the share of households that a South Korean telecommunications operator would have access to with the same amount of fiber and cost.

Yet, while density helps, policy can facilitate that advantage. To see why, consider the difference between Korea and Sweden. Although in both countries population density and the prevalence of concentrated apartment buildings makes broadband deployment cheaper, South Korea has a specific broadband policy that exploits these characteristics. This is the South Korean government's certification system, implemented in 1999 for broadband Internet-equipped buildings to expedite expansion of broadband Internet services. The government's "Certification Program for Broadband Buildings" requires all newly constructed buildings in South Korea to be designed to enable high-speed broadband connections, such as locating DSL access multiplexers (DSLAMs) or cable head-ends in apartment basements. The program also grades multiple unit buildings of 50 units or more based on the level of high-speed access they support, rating them as 1st, 2nd, 3rd class depending on whether they provide access at speeds of 100 Mbps, 10-100 Mbps, or less than 10 Mbps, respectively.[20] The government provides buildings and apartments that install a certain level of information and communications systems with a certificate and an emblem that the building owner can use to attract potential tenants. The government's certification is a key standard and factor that lets perspective tenants or purchasers know what buildings and apartments in South Korea have the best broadband connections.

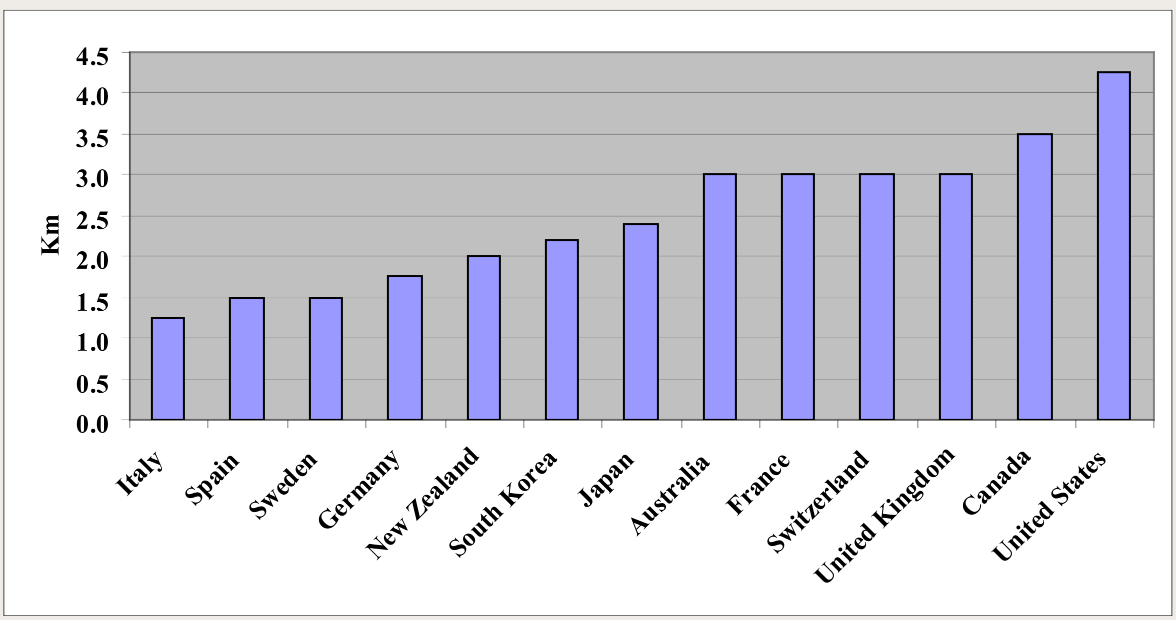
Anecdotal evidence also suggests that shorter local loop[21] lengths help facilitate broadband penetration. The reason is that the distance between a subscriber and the nearest broadband provider's local exchange affects the deployment of broadband technologies. Specifically, the further a subscriber is from the local exchange the more expensive it will be for an operator to deploy higher speed broadband to that subscriber. Moreover, the quality of a DSL connection diminishes as the subscriber's distance from the local exchange increases.

The length of the local loop is generally related to population density, but it also depends on the setup of the existing local telephone central office infrastructure. Shorter local loops should make it cheaper for providers to deploy broadband and to offer higher speeds at lower prices. In turn, the availability of lower priced and faster broadband services should make such services more attractive to subscribers, thus increasing subscribership.

It is important to note that shorter loop lengths alone are not enough to make a country a broadband leader. Italy, for example, has the shortest average loop length, but ranks just 21st in broadband penetration (see Figure 2). Nonetheless, loop lengths are an important factor in determining broadband performance, which may (at least in part) explain why the United States and Canada have lower levels of broadband penetration than countries such as South Korea, Japan, and France, where loop lengths are shorter.

In order to determine whether there is a relationship between loop lengths and broadband penetration, ITIF ran correlations between local loop length and several variables, including broadband price and speed, as well as an HHI score measuring the degree of intermodal competition between cable broadband and telecom-provided broadband (DSL and fiber). The strongest relationship we found was between local loop length and HHI (-0.58). In other words, the longer the loop length, the greater the level of facilities-based competition between cable and telecom-provided broadband. Not surprisingly, cable technology tends to have

**Figure 2: Average Local Loop Lengths in Selected OECD Countries[22]**



greater market share in countries where the competing telecom infrastructure is hindered by longer average loop lengths (a correlation of 0.68). As expected, broadband prices tend to be higher in countries with longer loop lengths (0.41). Likewise, there is a modest negative relationship between longer loop lengths and faster broadband speeds (-0.09). Overall, these correlations suggest that shorter loop lengths are a factor in explaining superior broadband performance.

## B. STATISTICAL ANALYSES OF NON-POLICY FACTORS AND BROADBAND RANKINGS

Several researchers have performed statistical analyses of a host of non-policy variables and policy variables related to national broadband performance, including demographic variables such as age and education; economic variables such as per capita income; broadband supply variables such as urbanization and competition; and policy factors such as local loop "unbundling" (regulations that allow multiple telecommunications providers to use the incumbent telecommunications provider's local loop from its central office to the customer).

These studies generally have found that per capita income, urbanization, and local loop unbundling have significant positive relationships with broadband adoption and that higher broadband prices have a negative relationship.[23] Whereas most analysts have considered policy and non-policy factors related to broadband, Ford, Koutsky, and Spiwak isolated non-policy factors related to household broadband penetration in their statistical analysis to calculate predicted penetration solely on the basis of each country's environmental and demographic endowments. They found that broadband price, gross domestic product (GDP) per capita, income inequality, education, age, population density, phone penetration, and business size were statistically significant (at the 5 percent level or better) in predicting broadband penetration ranks.[24]

Building on these studies, we performed two statistical analyses to better understand the relationships between non-policy factors and broadband rankings among OECD countries (see Table 2), using multiple regressions.[25]

ITIF's first regression model explains approximately 79 percent of the difference in household broadband penetration across the 30 OECD countries. Our second regression model accounts for nearly 75 percent of the differences. Thus, taken together, these analyses suggest that non-policy factors account for roughly three-fourths of a nation's broadband performance.

### 1. Regression 1: Analysis of Variables Related to a Nation's Broadband Penetration

**Method.** In our first regression model, we use data from the 30 OECD countries to examine the effects of several non-policy factors on a nation's household broadband penetration. For this regression, as shown in Table 2 above, we consider three independent variables for broadband supply and seven independent variables for broadband demand. The three independent variables related to broadband supply are: (1) the HHI score for telecom and cable; (2) urbanicity, and (3) homeownership. The seven independent variables related to broadband demand are (1) per capita income; (2) temperature (climate); (3) median age; (4) Internet users; (5) education; (6) income inequality, and (7) price of broadband.

ITIF's expectations about the relationship between each independent variable and a nation's household broadband penetration were as follows:

Variables related to broadband supply. We expected the first supply side variable, the coefficient for HHI for telecom and cable to have a negative sign. Lower HHI scores are a sign of greater intermodal competition, which would plausibly spur greater broadband penetration. We also expected urbanicity to exhibit a positive sign, as broadband can be deployed more easily in nations more densely packed urban populations. For the same reason, we expected homeownership to have a negative impact on broadband penetration if renters are more likely to reside in apartment buildings in urban areas where broadband is less expensive to deploy.

Variables related to broadband demand. On the demand side, we expected nations with higher per capita incomes and in turn, more disposable income, to have

**Table 2: Overview of ITIF's Regression Models of Non-policy Variables and National Broadband Performance in OECD Countries**

| DEPENDENT VARIABLES | Description | |
|---|---|---|
| **Regression 1:Broadband penetration**[26] | Percentage of households subscribing to broadband | |
| **Regression 2: ITIF Broadband Ranking**[27] | A composite measure of household broadband penetration, price, and speed | |
| **INDEPENDENT VARIABLES** | | |
| **Independent Variables for Broadband Supply** | **Description** | **Expected Sign** |
| Herfindahl-Hirschman Index (HHI) for telecom and cable[28] | Index measuring market concentration in telecom and cable | Negative (-) or uncertain |
| Urbanicity[29] | Urban population percentage multiplied by the average density of urban areas | Positive (+) |
| Home ownership[30] | Percentage of population owning homes | Negative (-) |
| **Independent Variables for Broadband Demand** | **Description** | **Expected Sign** |
| Per capita income[31] | Gross domestic product per capita | Positive (+) |
| Temperature[†32] | The average temperature in a nation's capital city | Negative (-) |
| Median age[33] | The median age of the population | Negative (-) |
| Internet users[34] | Internet users as a percentage of the population | Positive (+) |
| Education[35] | A measure of average years of formal schooling and the percentage of the population with postsecondary degrees | Positive (+) |
| Income inequality[36] | Gini coefficient for income dispersion | Negative (-) |
| Price*[37] | Average price of broadband | Negative (-) |

[†] Temperature is not an independent variable in Regression 2.

* Price is not an independent variable in Regression 2 because it is a component of the dependent variable.

greater broadband penetration.[38] We expected average temperature in a country to demonstrate a negative sign, because populations in colder climates might spend more time indoors, where surfing the Web, especially on higher speed connections, would be likely to take up more of their time. Because younger people are usually more tech-savvy, we expect them to adopt broadband more readily, so we expected the median age variable to demonstrate a negative sign. Nations with more Internet users should naturally also have more broadband subscribers, so we expected a positive coefficient for this variable. Similarly, we expected education—measured as a composite of average years of formal education and the percentage of a population with a postsecondary degree—to increase broadband penetration.[39] Just as we would expect greater per capita income to translate into more broadband penetration, we would expect greater income inequality, manifested as a high Gini score, to retard it. Greater income inequality means that, all else equal, a larger share of a nation's population will be lower income. Price should have a negative coefficient, as higher prices mean broadband is affordable for a smaller percentage of the population.

*Broadband penetration will be higher in countries where geography and population density make it cheaper to deploy broadband networks.*

**Results.** As shown in Table 3, ITIF's first regression model explains approximately 79 percent of the difference in national broadband penetration across the 30 OECD countries.[40] The independent variables with the strongest influence on household broadband penetration are price and urbanicity, both of which are significant at the 0.05 level or better. In other words, OECD nations with low prices and high levels of urbanicity have higher broadband adoption than other nations. Per capita income and Internet users are both significant at the 0.10 level. HHI, homeownership, temperature, median age, education, and income inequality are not statistically significant, although all coefficients, except education, demonstrate the expected signs.

The strongest relationship is between broadband price and OECD nations' broadband penetration. It makes sense that lower prices spur greater broadband penetration, although greater broadband penetration could also spur lower prices through greater economies of scale, where more subscribers can cover the same level of fixed costs. As discussed below, the direct and indirect subsidies provided by other nations to lower deployment costs and prices appear to drive penetration. Predictably, urbanicity is nearly as important a factor in influencing a nation's broadband penetration as price. This suggests that broadband penetration will be higher in countries where geography and population density make it cheaper to deploy broadband networks. In this regard, as discussed earlier, the United States is at a disadvantage in comparison to countries like Japan and South Korea because of its less densely populated cities and towns.

**Table 3: Regression 1 Results: Non-Policy Variables Related to Broadband Penetration in OECD Countries**

| | | | |
|---|---|---|---|
| **r-squared** | **0.79** | | |
| **t Statistics** | | | |
| t-critical at 0.1 | 1.73 | | |
| t-critical at 0.05 | 2.09 | | |
| **Independent Variable** | **t Observed Value** | **Significance** | **Expected Direction** |
| Herfindahl-Hirschman Index (HHI) for telecom and cable[41] | -1.29 | | Negative (-) |
| Urbanicity[42] | 2.20 | 0.05 level | Positive (+) |
| Homeownership[43] | -1.02 | | Negative (-) |
| Per capita income[44] | 1.98 | 0.10 level | Positive (+) |
| Temperature[45] | -1.07 | | Negative (-) |
| Median age[46] | -1.52 | | Negative (-) |
| Internet users[47] | 2.05 | 0.10 level | Positive (+) |
| Education[48] | -0.84 | | Positive (+) |
| Income inequality[49] | -0.75 | | Negative (-) |
| Price[50] | -2.41 | 0.05 level | Negative (-) |

Other important variables related to a country's broadband penetration are the extent to which people are Internet users and per capita income. In comparison with most leading nations, the United States appears to suffer from lower levels of digital literacy that limit computer ownership, Internet use, and broadband use.[51] Of 21 OECD nations where data were available on households with computers in 2003, the United States ranked 11th, in comparison to its 10th rank in household broadband penetration (see table 4). If however, the United States had the level of computer usage at home as do the average of the top five nations, it would rank 5th in broadband penetration, not 11th.

In terms of per capita income, the United States compares favorably with other OECD nations, having higher per capita income than all but two OECD nations.

**Table 4: Households with a Computer in 2003 Compared to Broadband Ranking[52]**

| Nation | 2007 ITIF Broadband Ranking | Percentage of Households with a Computer (2003) |
|---|---|---|
| South Korea | 1 | 0.78 |
| Japan | 2 | 0.78 |
| Netherlands | 4 | 0.71 |
| France | 5 | 0.46 |
| Sweden | 6 | (no 2003 data) |
| Canada | 11 | 0.67 |
| United Kingdom | 13 | 0.63 |
| United States | 15 | 0.62 |
| Germany | 16 | 0.65 |

The education variable (a measure of average years of formal schooling and the percentage of the population with postsecondary degrees) defies expectations, appearing to affect broadband penetration negatively, although the relationship is not statistically significant. Actually, the effect of education on a nation's broadband penetration remains unclear. The model tests a composite education variable that is the sum of standard deviation measures of the average level of formal education (years) and the percentage of the population aged 25-64 with a tertiary degree.[53] Replacing the composite education variable with either of its components yields dramatically different findings. The variable representing the average level of formal education has a statistically significant negative effect on broadband penetration, whereas the variable representing the share of the population with a tertiary degree has a positive, though not quite significant, effect on penetration. Although these two components of our composite education variable behave very differently in the model, both measure useful (and distinct) information about the education level of a nation's population. Of the two, the measure of the percentage of the population with a tertiary degree is more precise, tracking a specific population we would expect to be most inclined to be early broadband adopters; the broader average education indicator measures a population's average years of schooling.

*If the United States had the level of computer usage at home as do the average of the top five nations, it would rank 5th in broadband penetration, not 11th.*

Which is more relevant to broadband adoption—the actual number of years of education (i.e., middle school versus high school versus college) or simply a college degree? Interestingly, the United States performs better in comparison with other OECD countries on both of these education measures and better on the composite education measure than it does in broadband penetration. Given the conflicting results, we can only conclude that without additional data, the actual relationship between education and a nation's broadband penetration remains unclear.

### 2. Regression 2: Analysis of Variables Related to a Nation's Rank in ITIF's Broadband Rankings

**Method.** In our second regression analysis, we examine the effects of several non-policy factors on a nation's performance in terms of the composite measure of broadband performance based on penetration, price, and speed in the ITIF Broadband Rankings. For this regression, we consider the same collection of independent variables, excluding price (which is a component of the dependent variable) and temperature (which we expect to affect broadband uptake but not speed or price).

We expect to see the same relationships and—with one exception, HHI for intermodal competition—we expect the coefficients of the independent variables to demonstrate the same signs as in Regression 1. In other words, the same non-policy factors that affect broadband penetration should also help explain why some countries have not just more broadband penetration, but also cheaper and faster broadband. With regard to HHI, more intermodal competition could spur competitive forces leading to higher speeds, and possibly lower prices. On the other hand, more intermodal competition could raise network costs (from building multiple networks that serve the same number of potential customers). As a result, it is not clear how intermodal competition will influence the overall broadband score.[54]

**Results.** As shown in Table 5, ITIF's second regression model accounts for nearly 75 percent of the differences among OECD nations. Median age and Internet users are both significant at the 0.05 level or better, and urbanicity is significant at the 0.10 level. The other variables, including HHI, homeownership, per capita income, education, and income inequality, are not significant. Surprisingly, coefficients for several of the variables (per capita income, and median age) indicate a relationship in the opposite direction from what we expected. These variables may be affected by other omitted variables, including policy variables, in nations.

The strongest relationship is between the number of Internet users and ranking. Nations with large populations of Internet users are, not surprisingly, likely to have more and better broadband. Median age also demonstrated a remarkably strong and surprisingly positive relationship with the dependent variable. Given that, at least in the United States, older residents are less likely to subscribe to broadband, it is a bit surprising that nations with higher median ages have higher scores. But one factor may be that older populations have more disposable income to spend on broadband subscriptions and may be in more stable households where they are willing to make the investment to have broadband installed.

Higher levels of urbanicity lead, as the example of South Korea above illustrates, to higher scores as well. Unlike the case in ITIF's first regression model, education in this regression model has the expected positive effect on a nation's broadband performance, although it is not significant.

Some variables have a weaker observed coefficient value in the ITIF Broadband Rankings regression than for the broadband penetration regression. The effect

**Table 5: Regression 2 Results: Non-policy Variables Related to ITIF's Broadband Rankings of OECD Countries**

| **r-squared** | **0.74** | | |
|---|---|---|---|
| **t Statistics** | | | |
| t-critical at 0.1 | 1.72 | | |
| t-critical at 0.05 | 2.08 | | |
| **Independent Variable** | **t Observed Value** | **Significance** | **Expected Direction** |
| HHI | 0.53 | | Uncertain |
| Urbanicity | 1.77 | 0.10 level | Positive (+) |
| Homeownership | -0.08 | | Negative (-) |
| Per capita income | -0.04 | | Positive (+) |
| Median age | 3.70 | 0.05 level | Negative (-) |
| Internet users | 3.75 | 0.05 level | Positive (+) |
| Education | 0.91 | | Positive (+) |
| Income inequality | 0.25 | | Negative (-) |

of homeownership, for example, is -0.08 versus -1.02 in the penetration regression. Once one controls for urbanicity and per capita income, homeownership alone may simply not be a very important factor.

Similarly, intermodal competition is less significant in the second regression model, and the direction of the sign is opposite of that in the broadband first model. It should be noted that our statistical analysis is limited by the data that are available, and that our measure of broadband competition only measures competition between platforms, not within platforms. Moreover, as stated above, because the price of broadband is such an important aspect of this measure, more intermodal competition could have a modest positive relationship with price because operators would have to pay for two or more networks.

Interestingly, though we concluded previously that per capita income is an important driver of broadband penetration, its effect in the second regression model is surprisingly negligible (-0.04). When the number of Internet users is the dependent variable, however, per capita income is the most important variable. This finding may mean that in the current analysis, the effect of per capita income is captured by the Internet users' variable. Though not all the independent variables in our second regression model behave as we had anticipated, the model nonetheless explains 74 percent of the differences in OECD nations' ITIF Broadband Rankings, with median age and the number of Internet users influencing performance most strongly.

To understand better the effect of statistical outliers on our results, we also conducted regression analysis that excluded them. When per capita income is used as the criteria for removing outliers, Turkey and Mexico are excluded because their income levels fall far below the OECD mean, leaving 28 remaining OECD countries. Regression 1, with household penetration as the dependent variable, yields slightly different results, with the biggest difference being that per capita income is no longer significant (it had been significant at the 0.10 level). Urbanicity, which had been significant at the 0.05 level in Regression 1, drops to the 0.10 significance level, while the Internet users' variable jumps from 0.10 to the 0.05 level. For Regression 2, the findings remain relatively constant when Turkey and Mexico are removed, although median age drops from the 0.05 significance level to the 0.10 level. The results of these outlier analyses, which do not differ significantly from the findings of Regressions 1 and 2, support the conclusion that our results are not dramatically skewed by these outliers.

# IV. How Do Government Policies Affect National Broadband Performance?

The regression models just discussed indicate that non-policy factors account for roughly three-fourths of a nation's broadband performance. Given the importance of non-policy factors in national broadband performance, effective government broadband policies alone can't get a nation the highest rank in broadband. Nevertheless, our review of studies and documents, discussions with experts, and in-depth case studies of nine OECD countries makes it clear that the right broadband policies can and do have a significant positive influence on broadband performance. To assess the contribution of government policies to OECD nations' broadband performance, we performed in-depth case studies of national broadband policies in nine OECD countries with varying levels of broadband performance—Canada, France, Germany, Japan, the Netherlands, South Korea, Sweden, the United Kingdom, and the United States. We chose these countries because of their varying levels of broadband penetration, as well as the fact that they represent differing regions and cultures.

The nations vary in the policies they adopted. But it is possible to learn about best-practice policies from all nine nations. To improve broadband performance, governments can focus policies on encouraging broadband supply or broadband demand, or both.

Before discussing specific broadband policies, it's important to consider the unintended consequences of public policy. In some cases, policies that appeared to have little to do with broadband actually were quite important. In the United States, for example, the Federal Communication Commission's (FCC) program access rules, created by the Cable Act of 1992 and extended in 2002 and 2007, require vertically integrated programmer/cable companies to sell their programming to all multichannel video programming distributors (MVPDs) at nondiscriminatory prices, terms, and conditions. The FCC's rules enabled direct broadcast satellite platform providers to access the same programming as the cable systems. In the face of this new competition, cable companies upgraded their networks, including providing cable modem services. These developments, in turn, spurred U.S. telecommunications network operators to invest in DSL.

Similarly, the Canadian Radio-Television and Telecommunications Commission (CRTC) relaxed entry barriers for new cable providers in 1997 and in 1998 established rate of return regulation for cable companies based on capital expenditures. As a result, there was significant growth in investment in hybrid fiber-cable (HFC) networks in Canada in the late 1990s. From 1998 to 2002, the Canadian cable industry invested $5 billion in network upgrades, technology, and infrastructure to expand channel capacity, enable two-way communications, and support digital applications.[55] In contrast, as discussed below, a number of European nations allowed incumbent telecommunications operators to own cable systems, dramatically reducing investment in cable modem service.

Even some policies that at the time many considered ill-advised have turned out to have positive unintended consequences. Perhaps the best examples are telecommunications regulations in many European and Asian nations that encouraged telecommunications providers to charge for telephone use by the minute. As a result, dial-up Internet initially was extremely expensive in these nations compared to the United States where consumers only paid for their monthly ISP bill and not for per-minute phone charges. As recently as 2001 per-minute pricing plans predominated in Europe and Asia.[56] However, what looked like (at least to many in the United States) as an ill-advised policy, led to faster broadband take-up as consumers did not have to pay per-minute fees for DSL broadband because it was not a dial-up service. This and other examples suggest that telecommunications policies can have unintended consequences that are hard to predict.

### A. NATIONAL BROADBAND STRATEGIES

It is difficult to determine causation when examining qualitative policy factors in different nations. Still, we believe that by reviewing available studies and documents, discussing policies with experts in the various nations, and analyzing other information it is possible to make some inferences about the kinds of policies that appear to have led to greater broadband performance (e.g. higher penetration, lower prices, and higher speeds).

The in-depth case studies of national broadband policies in the nine countries suggest that at the broadest policy level, nations with robust national broadband strategies fare better than those without. We define robust broadband policies as those that make broadband access the focus of a coordinated national policy encompassing multiple government agencies, with well funded incentives to promote both broadband supply as well as demand. Indeed, to spur broadband performance it is important for nations to address both the supply and demand side of the equation.

Canada, South Korea, and Sweden established early robust national broadband strategies and had relatively higher levels of broadband penetration when the OECD began its rankings in 2001. Part of this was cause and effect: The fact that these nations had higher broadband penetration led policymakers to focus on it earlier than in other nations. But a top-level and sustained policy focus also helped spur better broadband performance.

*A number of European nations allowed incumbent telecommunications operators to own cable systems, dramatically reducing investment in cable modem service.*

Given South Korea's place as the leader in broadband penetration, it is perhaps not surprising that the government also was the first to establish a national policy to promote the deployment of information technology (IT) in the public and private sectors with its "Framework Act on Informatization Promotion" of 1987. The Act created the National Information Society Agency (NIA) to oversee the construction of high-speed networks, the use of IT in government agencies, and programs to promote public access to broadband and digital literacy. Consistent with South Korea's initial emphasis on backbone networks as the foundation of its broadband strategy, the NIA established the Korean Information Infrastructure initiative (KII) in 1994 to construct a nationwide optical fiber network.

The government followed KII with a string of 5-year programs that combined government funding with private sector contributions—including Cyber Korea 21 in 1999, e-Korea Vision 2006 in 2002, IT Korea Vision 2007 in 2003 and finally the Broadband Convergence Network (BcN) and IT 839 initiatives in 2004.[57] Through these programs, South Korea invested a substantial amount of money, enacted promotional regulations, and provided incentives to private companies to build networks. It also initiated a number of successful efforts to spur broadband demand and digital literacy.[58]

In addition, South Korea's government established several agencies to promote broadband access in both the public and private sector. The Korean Agency for Digital Opportunity (KADO) works to ensure that all South Korean citizens have the ability to access the Internet. The government created the Korea Information Security Agency (KISA) and the Korea Internet Safety Commission to oversee Internet security and consumer protection. It also established the National Internet Development Agency (NIDA) to promote the Internet society through education and promotional programs. More recently, in 2004, South Korea's Ministry of Information and Communications launched the "u-Korea Master Plan" to create a ubiquitous information infrastructure by 2010.[59]

*The in-depth case studies of national broadband policies in the nine countries suggest that at the broadest policy level, nations with robust national broadband strategies fare better than those without.*

Canada was also one of the first nations to adopt a national broadband policy, although its primary focus was and continues to be increasing rural connectivity. In 1993, the Canadian government established initiatives to spur broadband development and increase Canadian citizens' connectedness. In 2001 the Canadian government's National Broadband Task Force created two programs to provide targeted grants for public-private partnerships in rural communities to create broadband infrastructure. These are the Broadband for Rural and Northern Development (BRAND) in 2002 and the National Satellite Initiative (NSI) in 2003.[60] The government designed BRAND as a pilot program to provide broadband access to 900 rural communities, but it continues to allocate satellite capacity to rural communities via the NSI and, in 2006, created the Ubiquitous Canadian Access Network (U-CAN) program to provide targeted grants to communities to establish broadband access where commercial operators are not providing services.[61] Canada's broadband strategy that focused both on demand and providing broadband access in rural areas may explain why, at the end of 2006 the country's broadband penetration reached nearly 100 percent in urban areas and 78 percent in rural areas.[62]

Sweden also was an early leader in broadband. It became one of the first countries in Europe to develop a broadband policy when the government decided in 1999 to provide funding to municipalities to develop fiber networks.[63] The result was legislation called the "IT Bill," which the government passed in 2000, setting the goal of "an information society for all."[64] The legislation provided generous subsidies for broadband infrastructure development through grants and tax relief, including for rural broadband deployment. In addition to policies to increase broadband supply, the Swedish government addressed demand via digital literacy programs for small and medium-sized businesses, libraries, and schools. The government also provided a generous tax benefit for employees who use employer-supplied computers at home.

In 2003, Sweden broadened its policy approach by creating the IT Policy and Strategy Group to develop a proposed national broadband strategy. In 2006 the Group recommended continued government support to ensure access to broadband in rural areas.[65] Yet, Sweden is coming close to delivering 100 percent broadband access. In 2007 just 145,000 people (1.6 percent of the population) and 39,000 businesses lack access to wireline broadband (i.e., fiber, DSL, or cable) and when considering subscribers who have broadband access either through wireline or wireless service (mobile CDMA2000) just 2,300 households lack access to broadband.[66] Nonetheless, the government considers even current broadband coverage (and speeds) to be inadequate. Specifically, in April 2008 a government-appointed Committee of Inquiry recommended that between 2009 and 2013 the government should provide an additional $500 million in grants to encourage the development of broadband infrastructure (particularly fiber) in areas where none exists.[67]

Japan was a relative latecomer in establishing a national broadband strategy, but its determination to make broadband leadership a point of national pride raised the country quickly up the ranks. As discussed above, Japan created its Information Technology Strategy Council as well as its "Basic IT Law" late in 2000, which was immediately followed by its "e-Japan" strategy in January 2001. This effort included top corporate and government leaders. Since then Japan's combination of subsidies, tax incentives, and low or zero-interest loans for broadband providers has accelerated the development of advanced telecommunications and information networks, triggering 220 projects in 2001 and helping to achieve the goal of offering 30 million households high-speed broadband access by 2004.

In 2003, the government expanded its goal to promoting broadband demand with the "e-Japan strategy II." With the achievement of the goal of getting universal high-speed broadband to almost every Japanese household well within sight, in 2004 the government expanded its focus to ensure that there was widespread use of the network. The "ubiquitous-net Japan" ("U-Japan") strategy added the goal that by 2010 every device (such as mobile phones, personal digital assistants even household appliances) would be connected to the network and able to be managed at any time and in any place.[68] In addition, the Japanese government emphasized the importance of closing the gap between urban and rural areas by establishing the "IT New Reform Strategy" in 2006 with a goal to provide broadband services to every household by 2010. To achieve this goal, the government will support the private sector in the deployment of broadband infrastructure, including fiber to the home (FTTH).[69] The success of Japan's national broadband strategy seems clear. Japan's consumers now enjoy broadband access that is both the fastest and cheapest (per megabit) in the world.[70]

Other nations have done less. For example, while the United Kingdom did establish a national broadband strategy, it has put considerably fewer resources behind it than South Korea, Canada, Sweden, or Japan. So although the U.K. government launched its national broadband strategy as early as 2001 with a target "for the U.K. to have the most extensive and competitive broadband market in the G7 by 2005" the funding to date has been modest.[71] Similarly, in 2001 the French government developed a "Broadband for Everyone" national strategy that focused on promoting broadband access in rural areas, which included a modest amount of low-cost loans from the state-owned bank to municipalities to invest in broadband infrastructure.[72]

Although the government of the Netherlands formed commissions to analyze broadband conditions and policy, it delayed crafting a national broadband policy until 2004 and subsequently did not take a very active role in promoting its policy. The Netherlands established its national broadband plan, "Holland Broadbandland" in 2004 as a national platform to bring together broadband industry, trade organizations, and the government to determine "better and smarter" uses for broadband.[73] Rather than establish a national fund to stimulate broadband demand (as in the United Kingdom) or supply (as in France), the Dutch government saw broadband as part of a larger initiative to stimulate research in broadband technology innovation, and as a result, confined its policy to funding broadband research networks.

The German government, like the Dutch government, has formed commissions to analyze broadband conditions and policy, but it has not taken a great deal of action to promote broadband. It launched a D21 (broadband) initiative in 1999 to support and promote the development of the information society by bringing together national governmental bodies with industry to study broadband strategy, conduct workshops, and prepare policy documents.[74] More recently, in 2003 the German government placed broadband infrastructure at the center of an initiative to foster the information society and followed up with plans in 2005 to increase competition in broadband access technologies, including DSL and cable, as well as in broadband content, with a goal to reach 50 percent residential adoption by 2010 (90 percent for small and medium enterprises).[75] But in Germany as in the Netherlands, few resources were devoted to implementing the strategy, and those that were focused on efforts like supporting research networks[76] or developing national broadband coverage maps.

In the United States, although there has been considerable discussion about the need for a proactive national broadband strategy, efforts to date have been primarily ad hoc, with the focus being on deregulation to spur intermodal broadband competition. The United States has not always taken such an ad hoc approach. The U.S. government did, after all, create the network that gave birth to the Internet. This network was the U.S. Department of Defense's Advanced Research Projects Agency Network (ARPANET), which it created in

1969—the world's first packet-switched network and the predecessor of the global Internet, which was used by both military personnel and civilian scientists.

Similarly, in the 1980s, following ARPANET, a high-speed backbone network called NSFNET was created by the National Science Foundation (NSF) to connect its supercomputer centers. By 1987, the largest users of NSFNET were universities and research organizations. The network expanded as government agencies and private companies developed their own networks using the Transmission Control Protocol/Internet Protocol (TCP/IP) (the networking protocol for the Internet), and by 1995, the NSF decommissioned the NSFNET backbone, beginning the network's transition from the government to the commercial sector, which was completed in 1998.[77]

*Because it is expensive for operators to deploy broadband networks, particularly faster next-generation networks and networks in rural areas, many countries want to increase broadband supply beyond and/or ahead of that which the market alone provides.*

There were no further major U.S. initiatives to promote broadband development until the passage of the Telecommunications Act of 1996. Among other things, the 1996 act led to the establishment of a federally funded E-Rate program in 1997 to provide funding for schools and libraries to connect to the Internet. The 1996 act also included provisions to unbundle the local loop implemented by the FCC to expand intramodal telephone competition, thereby enabling the expansion of the number of competitive DSL broadband providers, which along with growing cable competition, spurred the telecom incumbents to deploy DSL even faster. In 2000, the government initiated the Department of Agriculture's Rural Development Broadband Program, which focused on boosting rural broadband access by providing below-market interest rate loans to rural broadband providers.

A more significant step to craft a more targeted and efficient rural broadband strategy is the recommendation in 2007 by the FCC Joint Board on Universal Service to create three separate universal service funds with distinct budgets and purposes, including a "Broadband Fund" to disseminate broadband Internet services to rural areas.[78] Although none of these recent efforts constitutes a national broadband strategy, the recommendation of the FCC Joint Board on Universal Service comes the closest to efforts in other countries, such as the United Kingdom's Broadband Fund.

The FCC also recently decided to change the way it defines broadband and how broadband providers report on their services.[79] Previously, the FCC defined high-speed broadband as a service that enables users to upload or download data at speeds of 200 Kbps—far slower than the rates provided by the highest speed services. In its recent decision, the FCC identified seven new speed tiers in its broadband definition extending from 200 Kbps to more than 100 Mbps. In addition, the FCC's now requires broadband providers to report the numbers of subscribers at the census-block (rather than zipcode) level. The FCC's move will help U.S. policymakers to get a more accurate picture of broadband penetration.

### B. GOVERNMENT POLICIES TO ENCOURAGE BROADBAND SUPPLY

Because it is expensive for operators to deploy broadband networks, particularly faster next-generation networks and networks in rural areas, many countries want to increase broadband supply beyond and/or ahead of that which the market alone provides. Consequently, as described in detail below, many OECD countries have established policies to encourage broadband providers to develop the broadband infrastructure.

Some governments in OECD countries have used explicit or implicit government mandates to pressure government-owned telecom providers to deploy broadband networks. Others have provided tax incentives, grants, and low cost loans to make it cheaper for broadband providers to build infrastructure. Also, since providing broadband access in less densely populated rural areas is often more costly than in most urban areas, many governments provide specific subsidies for rural broadband deployment. Additionally, some governments have subsidized deployment of broadband by competitors by requiring incumbent providers to lease their networks to competitors at very low rates.

Finally, most governments have focused on spurring competition in the broadband market within the existing telecom networks (intramodal competition) or between separate physical networks (intermodal competition).

### 1. Issuing Government Mandates and Providing Administrative Guidance to Broadband Providers

Some nations, particularly countries in Asia, have used implicit or explicit government mandates and/or administrative guidance to increase the supply of broadband infrastructure. The governments in both South Korea and Japan either own or recently owned significant shares of the incumbent telecommunications companies. Consequently, these governments have been able to pressure the incumbent telecommunications companies to roll out broadband, particularly high-speed broadband, faster than would otherwise be the case.[80]

The South Korean government announced that companies must invest more than $10 billion in the development of high-speed broadband networks.[81] Though not a formal directive, the South Korean government used "official documents asking for cooperation" to ensure that companies did their part to implement the government's strategy.[82] Because of the close relationship between the South Korean government and the telecommunications industry, it is part of the business culture to listen to the government.[83] Moreover, the fact that the government was a major stakeholder in KT (formerly known as Korea Telecom) ensured that the company would implement this mandate. One South Korean telecommunications company executive has suggested that without these governmental directives and if companies had instead based their business decisions purely on market concerns, they would not have deployed broadband as aggressively on a national scale.[84]

In Japan, the government owns more than 30 percent of Japan's incumbent telecommunications provider NTT. The government's adoption of a policy to establish a nationwide fiber network, along with its threat of breaking up NTT, contributed to the company's ongoing investment in fiber-optic networks in Japan.[85]

The South Korean and Japanese governments have also used regulations to ensure that broadband providers to keep prices extremely low. In South Korea, the government opted not to set a minimum tariff (as is common to prevent predatory pricing) that KT could charge for the ADSL broadband service it introduced to compete with Hanaro and Thrunet.[86] The result was that KT could offer its service at a very low price, which forced its competitors to charge even less for their services in order to gain subscribers. Although such a policy may be helpful in spurring consumers to adopt broadband (as it did in South Korea) it may have negative consequences for companies, particularly competitive entrants. For example, artificially low prices for broadband may have forced Hanaro (one of the first broadband service providers) to sell shares to foreign investors in 2003. In part for similar reasons Thrunet went into bankruptcy that same year (and in 2005 Hanaro bought Thrunet, further consolidating the market).[87]

In Japan, Softbank's Yahoo! BB service was able to charge below-market prices for its DSL broadband services because the Japanese government set NTT's local loop prices below cost (about $1.30 per line per month).[88] This arrangement allowed Yahoo! BB to offer the lowest priced service in 2003 at $19.09 per month for 12 Mbps and $20.54 for 26 Mbps.[89] Softbank combined low access prices with an aggressive pricing strategy to earn a strong place in the broadband market (by 2005 NTT and Yahoo! BB each held about one-third), but the result has been that the company struggled with losses and did not begin to show a profit until 2006.[90]

Many European nations also own shares in their incumbent telecommunications providers—for example, the German government owns 38 percent of Deutsche Telecom, the French government owns 32.5 percent of France Télécom, and the Dutch government owns 7.8 percent of Koninklijke PTT Nederland (KPN). The German government's ownership share may explain why, in Germany, Deutsche Telecom voluntarily deployed broadband connections to all German public schools. Similarly, because the Swedish government controlled several other communications infrastructures (power, railroads, and broadcasting), it has long had a strong reason to involve itself in the administration of these networks. Because Svenska Kraftnät was a national electricity utility company, for example, the Swedish government could simply direct it to build a backbone network to link all of Sweden's 290 municipalities beginning in 2000.[91]

*The role of government financial incentives in spurring broadband build out in leading broadband nations has largely been under appreciated in the United States, where many analysts have regarded local loop unbundling regulations as the key to the leading broadband nations' success.*

Another factor related to broadband penetration, particularly in Asian nations, appears to be that there is less pressure from equity holders for short-term and high returns than in the United States. A major reason why Japan leads the world in high speed fiber-optic deployment, for example, is that Japanese companies—in particular, the partially government-owned incumbent telecom provider NTT—face significantly less pressure from capital markets for short-term profits. Two reasons why Japan's NTT has invested so aggressively in fiber deployment ahead of consumer demand may be because first, it sees this as its civic duty and second, the equity markets do not "punish" NTT the way they would companies in the United States.[92] In addition, NTT was able to invest in fiber as aggressively as it did, in part because it used profits from its mobile division, NTT DoCoMo.[93] Such internal cross subsidization is less common in the United States. Furthermore, even though many U.S. IT companies showed no profits during the so-called "Internet bubble," virtually all either became profitable or went out of business. The fact that it took several years for a company like Yahoo! BB in Japan to show a profit suggests that it is easier for companies in Japanese markets to use low prices for longer periods of time to gain market share than it is for U.S. companies.

Although such interventionist broadband policies and practices appear to be effective (in terms of deploying low-cost broadband), it is not clear that they are efficient. But in some ways, this question is moot, because the U.S. market environment is fundamentally different from the environment in a country such as Japan. The U.S. government does not own broadband providers nor are U.S. equity markets as tolerant of long-term investing, particularly that which seeks long-term market share by selling at or below cost. Observers can legitimately differ over whether the U.S. capital market and business environment are better or worse, but the bottom line is that this is the market in which U.S. broadband providers operate.

### 2. Offering Low-Cost Loans, Grants, and Tax Incentives to Broadband Providers

Some governments have spurred broadband providers to increase broadband supply by using financial incentives. The role of government financial incentives in spurring broadband build out in leading broadband nations has largely been under appreciated in the United States, where many analysts have regarded local loop unbundling regulations as the key to the leading broadband nations' success. In fact, a careful analysis suggests that many leading nations have effectively used financial incentives to spur broadband deployment.

The South Korean government's national broadband strategy, for example, includes direct and indirect support for broadband infrastructure development, including loans and other incentives to broadband providers. The first of several initiatives was its Korean Information Infrastructure initiative (KII), which consisted of three sectors and three phases: (1) KII-Government, (2) KII-Private, and (3) KII-Testbed called KOREN (Korea Advanced Research Network). Each phase had its own funding. For example, the government spent $24 billion to construct a national high-speed public backbone network for the KII-Government phase, which service providers could use to deploy broadband services to about 30,000 government and research institutes and around 10,000 schools.[94] Similarly, KOREN provided government test beds for companies to use for research and development.[95] In the KII-Private phase companies used private funding to construct an access network for homes and businesses, aiming to stimulate broadband deployment in the "last mile," supplemented by $1.76 billion in low-cost loans from the government's Public Fund Program. From 2000 to 2006 total funding for the three KII phases was $16.3 billion.

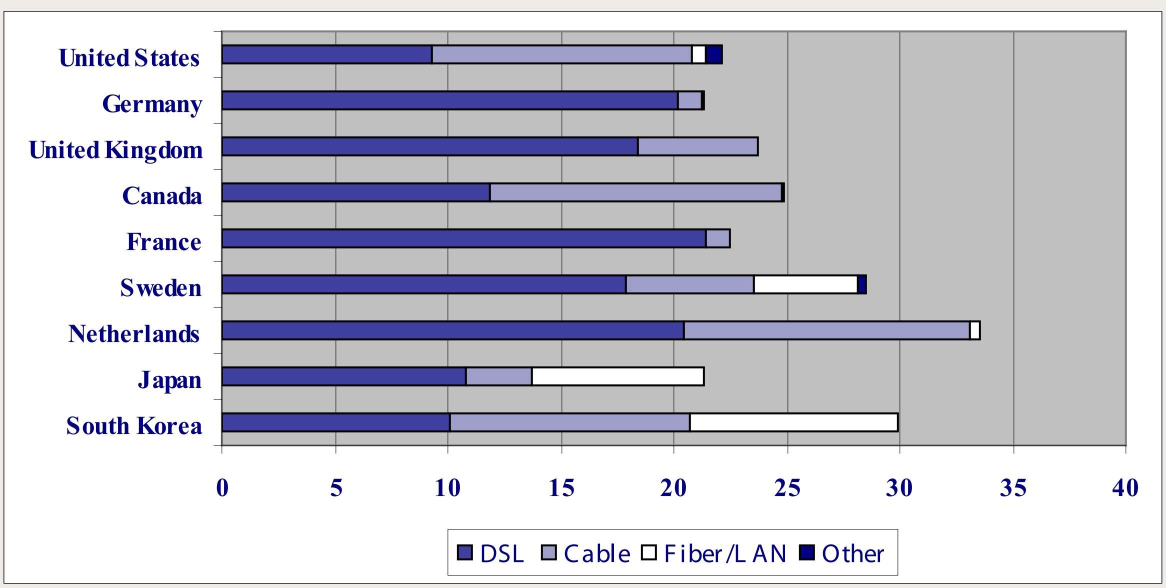
*The Swedish government also aggressively used subsidies to spur broadband deployment, particularly in rural areas. For the U.S. government to match this investment at the same share of GDP, it would need to invest more than $30 billion.*

The strong (and somewhat unusual, by Western standards) relationship between the South Korean government and its private sector ensured that companies such as KT, the incumbent telecommunications service provider, agreed to provide the lion's share of the investment in broadband infrastructure. This pattern continued with the successor programs to the KII—the Broadband Convergence Network (BcN) and the IT839, for which the South Korean government projected it would provide over $70 billion in low-cost loans to broadband providers to build high-speed while they initially pledged to invest an equal amount.[96] While investments have thus far fallen short of these projections, they nonetheless are impressive. Government and industry together have invested roughly $12.8 billion from 2004 to 2005, around $12.8 billion from 2006-2007, and expect to invest perhaps as much as $18.2 billion from 2008 to 2010.[97]

The Japanese government provided similar incentives to Japanese companies to invest in broadband, including more recently in high-speed FTTH. The government allowed providers to depreciate during the first year about one-third of the cost of the broadband capital investments, as opposed to the usual depreciation schedule of up to 22 years for telecommunications equipment. The Bank of Japan (a government bank) also guaranteed Japanese companies' debts, allowing them to borrow money on capital markets more cheaply because these government-backed loans were less risky (no risk of default).[98] In addition, the government reduced fixed asset taxes for designated network equipment.[99]

The Swedish government also aggressively used subsidies to spur broadband deployment, particularly in rural areas of the country. It allocated more than $800 million, more than $89 for every Swedish citizen, or 0.3 percent of GDP. For the U.S. government to match this investment, it would need to invest more than $30

**Figure 3: Distribution of Broadband Subscribers in Nine OECD Countries by Type of Broadband Technology per 100 Inhabitants, 2007[101]**



billion. The funding helped more than 100 local municipalities develop metropolitan networks.[100]

### 3. Promoting Next-Generation Networks to the Home

Until now, broadband adoption rates have been the most meaningful statistic measuring national broadband success. But with broadband take-up rates increasing in most nations and with the advent of a host of next-generation broadband applications that demand faster networks, broadband speeds are becoming just as important when assessing a nation's progress in broadband.

Although it is possible to get higher speeds on existing DSL and cable infrastructure in most nations, achieving significantly higher speeds requires new architectures. In the case of cable, this means moving to the next version of data over cable service interface specification (DOCSIS 3.0). In the case of telecommunications, it means deploying fiber closer to the home.

Globally the percentage of broadband connections delivered over fiber is increasing. Currently, Japan and South Korea have the most extensive fiber buildout and offer the fastest broadband download speeds. Japan was the world leader in FTTH connections in 2007, with 9.7 million subscribers (36 percent of all broadband connections) in June 2007[102] and NTT has the largest FTTH network rollout in the world in terms of homes connected.[103] Thanks to the ubiquity of both fiber and DSL in Japan, consumers have a wealth of high-speed options, the "slowest" of which is ADSL, from 1 Mbps to 50 Mbps, followed VDSL at advertised speeds of 30, 50, and 100 Mbps. But given the fact that FTTH costs about the same as these two options (around $40) and provides advertised speeds of 100 Mbps, it is not surprising that most subscribers in Japan are opting for FTTH services. [104]

In South Korea, 4.5 million customers subscribe to broadband over fiber (31 percent of total broadband connections) as of June 2007[105] at (advertised) speeds of 50-100 Mbps. [106] There the incumbent telecommunications service provider KT and its competitors are rolling out FTTH. As a result, high bit rate DSL (such as ADSL and VDSL) subscriptions are declining, and Ethernet-based connections to optic fiber distribution nodes in or near apartments are increasing. Fiber broadband increased its market share from 9 percent at the end of 2004 to a third of all connections by 2007.[107]

In the United States, fiber-optic service also is increasing. By the end of 2007, around 11 million homes, or 9.6 percent of households, had access, although subscribership was lower.[108] Verizon has the most ambitious rollout plans in the United States, planning to invest $18 billion between 2004 and 2010 to deliver its fiber-optic service FIOS to 18 million premises (a little over half of the 33 million households it serves in 28 states).[109] To date, over 1 million customers subscribe to FIOS. AT&T is deploying a fiber to the neighborhood system, relying on VDSL for connection to the home. Its U-verse video service, which uses an all-IPTV architecture delivered over fiber, plans to reach 18 million homes by the end of 2008. Like AT&T and Verizon, Qwest recently announced that it plans to invest at least $300 million to run fiber-the-node (FTTN) to more than 200,000 homes and businesses in Utah by the end of 2008.[110] In Verizon's case, the company is using FIOS to provide significantly higher broadband speeds (up to 50 Mbps). Similarly, AT&T's upgrade supports modestly higher DSL speeds. Qwest expects its fiber networks eventually will provide services at speeds up to 40 Mbps.

Some U.S. cable providers appear to be responding in kind. They are deploying technologies to reclaim analog bandwidth, such as switched digital video (SDV) technology, splitting optical fiber nodes, and deploying DOCSIS 3.0.[111] For example, in April 2008 Comcast began to upgrade its networks to DOCSIS 3.0 and expects to reach 20 percent of homes in its regions by the end of 2008 offering broadband at speeds up to 100 Mbps (although in some cases up to 10 subscribers may share one pipe at this speed, possibly limiting the available bandwidth). [112] In addition, cable companies are exploring ways to increase spectrum capacity, possibly even by building FTTH.[113]

This move to fiber and high-speed cable is enabling many U.S. consumers to access broadband at speeds higher than many places in Europe—including Germany, Iceland, Italy, the Netherlands, and the United Kingdom—although still lower than those available in Japan and South Korea[114] To date, roll out of FTTH services has been much slower in Europe. As of 2007 nearly 5 million European homes had access to fiber, mostly in Sweden, Italy, Norway, the Netherlands, and Demark.[115] This represents approximately 3 percent of all households. In comparison, almost 10 percent of U.S. households can subscribe to fiber broadband.

Deployment of FTTH lags in France, Germany and the United Kingdom. In France Numericable, the largest cable provider (formerly owned by France Télécom) provides broadband access to 2 million households.[116] By contrast, the number of households with access to FTTH is much smaller, with Illiad/Free's reaching 241,000 homes/buildings, France Télécom/Orange only 146,000, and Neuf Cegetel providing access to 120,000 homes.[117] There has been little fiber build-out in the United Kingdom and the government is deciding whether to support deployment of FTTH services.[118] In Germany Deutsche Telecom has begun to deploy faster speed VDSL services.

There is a wide array of factors influencing deployment of next generation networks. Many companies providing broadband services in new housing developments prefer to put in fiber versus DSL or cable because the public works component (the fixed cost of the facilities) is roughly 70 percent of the total cost.[119] Some nations have worked to ensure that fiber is deployed in new builds. In December 2007 the French government announced measures to require new buildings to be pre-equipped for fiber and to require operators to share the networks they install inside buildings.[120]

Another reason why some providers are deploying fiber is that as broadband demand grows, people are willing to pay for higher speeds. In countries such as Canada and the United States, longer loop lengths have forced some telecommunications providers to invest in FTTH or fiber to the neighborhood in order to exceed the relatively lower speeds they can offer with DSL. Because of shorter loop lengths, European providers can offer relatively fast speeds over DSL, and thereby have less incentive to invest in next-generation networks. This may explain why the current broadband technology of choice in Europe (see Figure 3) continues to be DSL.

Moreover, in some nations competition is spurring some providers to roll out fiber. In the United States strong intermodal competition is forcing providers, such as Verizon and AT&T, to deploy FTTH or fiber-to-the-node services so that they can offer the same "triple play" services (voice, television, and data) as cable providers. In Japan NTT faces competition from subsidiaries of electricity companies, which use their own fiber networks to offer high-speed broadband services to their electricity customers.[121] In addition, competition on its DSL lines spurred NTT to invest in fiber as a way to gain customers that it was more likely to be able to keep. As noted below unbundling requirements for NTT's fiber are more restrictive than for their copper loops.

*This move to fiber and high-speed cable is enabling many U.S. consumers to access broadband at speeds higher than many places in Europe—including Germany, Iceland, Italy, the Netherlands, and the United Kingdom—although still lower than those available in Japan and South Korea*

In contrast, intermodal competition has been lower in Europe, in part because there is much less cable broadband. As a result, incumbents have been much less willing to roll out fiber. However, intermodal competition in France appears to be emerging, in this case competition between France Télécom and Illiad. France Télécom, via Orange, its service provider, offers FTTH in Paris and will expand its services to 1 million homes in 12 other cities by the end of 2008.[122] Meanwhile, since August 2007, France Télécom's primary rival Illiad (via Free, its service provider) is offering 100 Mbps of service through its own fiber-to-the-premises (FTTP) infrastructure but almost exclusively to apartment buildings.

Several policy factors appear to be helping to spur fiber buildout. For example, a key factor in a number of nations has been eliminating or reducing requirements that companies deploying advanced networks must share their networks with competitors.

In Japan, while NTT also is required to unbundle the fiber loop, the price that competitors pay is relatively high (as compared to the price to lease the DSL loop), enabling NTT to obtain an adequate rate of return on its fiber investment.[123] In the United States incumbent telecom and cable operators did not have to unbundle these new or upgraded networks, thereby being assured that they would not have to sell access, particularly at low costs. Hazlett and Calistan found that when the FCC freed U.S. incumbent telecommunications operators from most open access requirements they quickly invested in upgrading their networks to compete with cable broadband providers.[124]

*Significantly, it appears that no nation other than the United States is seeing high speed network (e.g. fiber) deployment in moderate-density areas, in part reflecting America's uniquely suburban nature.*

In Europe, the situation was a bit more complex. In order to encourage Deutsche Telecom to upgrade its existing copper loops to provide high-speed (in this case, VDSL) service, the government exempted the company from unbundling these upgraded loops, for at least two years. However, the European Commission overturned this decision, thereby creating uncertainty for Deutsche Telecom and possibly reducing its incentive to continue VDSL deployment.[125] This may be a factor in the reluctance of other European providers to move to fiber and other high-speed solutions as they face the uncertainty of possible ex ante "remedies," such as requirements to open their fiber local loops to competitors if regulatory authorities determine that they have significant market power status. Even more worrisome for providers is the European Commission's proposal for a European Telecom Market Authority, which would have the power to overrule national regulators, perhaps in favor of fiber unbundling or structural separation. These regulatory uncertainties may make incumbent European telecom operators reluctant to invest in FTTH or to upgrade existing copper networks.[126]

In some nations, municipal government initiatives have spurred modest levels of fiber buildout. In the Netherlands much of the fiber is in municipal fiber networks that are leased out to private sector Internet service providers (ISPs). So, although the Dutch government has determined that the market has the primary responsibility for investment in next generation broadband infrastructure, it is providing support for municipalities to develop fiber networks. One example is the Kenniswijk Broadband Demonstration Center, a government-funded FTTH broadband initiative in the Eindhoven region to provide more than 100 consumer services for 14,000 households.[127] Another is Amsterdam's "CityNet" project, which was launched in 2006 with government funding to provide 100 Mbps connections to 40,000 homes, expanding to 450,000 homes by 2010.[128] The city co-owns (25 percent) the fiber and leases it to BBned (a subsidiary of Telecom Italia), which provides wholesale services.[129] Similarly, the city of Rotterdam piloted fiber connections to 7,000 households in late 2002 and in 2006 launched an open FTTH network via a social housing corporation, Stadswonen, the cost of which is bundled into the monthly rental fees.[130]

Sweden has adopted a similar model but employed it more extensively. In Stockholm, for example, the Stokab project consists of a fiber-optic (dark fiber) network developed in 1999. The City of Stockholm and the Stockholm County Council own the network and lease capacity to ISPs. They offer the fiber-optic infrastructure and leave the services and new service development to telecommunications companies, 60 of which currently lease its capacity.[131] Stockholm's local governments invested $100 million in the project and are generating a small profit. One reason Sweden and some other European nations have adopted this model may be because providers are prohibited from stringing cable above ground on poles, in contrast to the United States, Japan, and South Korea. The cost of laying cable underground is quite high and in many cases borne by governments. The inherent costs in deploying telecommunications infrastructure, including broadband networks, underscores the argument that this is an industry with natural monopoly characteristics. Thus, encouraging deployment in more than one broadband pipe could lead to a waste of resources.[132]

In the United States, some communities have deployed municipal fiber networks or have projects in the planning stages, including Burlington, Vermont; Lafayette, Louisiana; and several communities in Utah (project

Utopia). Many projects are overbuild projects, where the fiber is deployed to homes already served by DSL and/or cable broadband. The goal is to achieve higher speeds than the incumbents provide. But it's not always clear that this strategy works. For example, while Burlington, Vermont's project has successfully deployed fiber to most homes in the city, the cost of the service is quite high (around $70 per month) and the advertised speeds relatively slow for a fiber system (8 mbps a second for symmetrical service). Yet, advertised download speeds for the incumbent cable company appear similar (upload speeds are much slower), as do prices. Likewise, Utah's municipally funded fiber project recently announced that subscribers would have to pay a $1,000 up-front connection fee, along with monthly subscription fees.[133] One challenge for these systems is that because many are overbuild projects, where the fiber is deployed to homes already served by DSL and/or cable broadband, they are unlikely to sign up all of the potential customers because cable and telecommunications broadband services are already available. As a result, covering high fixed costs with fewer potential subscribers makes many of these projects more financially risky. [134]

Finally, as discussed above other factors including subsidies and pressure from governments have spurred roll out of next generation networks. In Japan the government has provided support for the deployment of fiber, including access to the government's public fiber infrastructure, low interest rate loans, and tax deductions.[135] As we discuss above, other factors that may have contributed to NTT's investment in optical networks, include government policy advocating a nationwide network, partial government ownership of NTT, and government threats to break up the company. [136] Without this combination of factors—government policy coupled with competition—it is not clear that NTT would have invested more than $200 billion in optical fiber installations.[137] Likewise getting fiber to the home is one of the goals of two recent initiatives of the South Korean government: the 2006 Broadband Convergence Network (BcN) and its successor the 2007 IT839. In 2004, the government selected three consortia led by KT, DACOM, and SKT and expected them to develop trial BcNs using their own funding. Given the strong relationship between the South Korean government and industry, it is perhaps not surprising that the companies in these consortia agreed to this implicit government mandate. In 2003, for example, KT projected it would invest $58.3 billion in the BcN.[138] Both of these programs focus on creating a ubiquitous network to enable South Koreans to communicate anytime and anywhere through a variety of devices.

Finally, it is worth noting the geographic location of most next generation networks. Because it is cheaper to roll out fiber networks in more densely populated areas (and often only to multitenant apartment buildings) where a larger number of customers can pay for the network, in most nations fiber builds have largely been concentrated in urban centers. For example, France Télécom and Illiad launched their fiber services in Paris. There they can reach many potential subscribers by simply extending fiber to the basement of a multitenant building. Moreover, they are able to deploy fiber relatively inexpensively by running the fiber-optical cables through the city's extensive sewer system.[139] Likewise, in South Korea, for example, KT mostly provides regular DSL service outside major urban centers. Similarly, in Sweden, to the extent that broadband providers offer fiber, they do so almost exclusively to apartment buildings, usually those with at minimum 20 tenants. Any less densely populated neighborhoods make it hard for providers to gain an adequate return on investment.

In contrast, the fiber deployment in the United States appears unique. Most of the fiber deployments, including by Verizon, appear to taking place in suburban areas with single-family homes.

### 4. Encouraging Broadband Deployment in Rural Areas

In most nations, urban areas have more facilities-based competitors and broadband services with higher speeds. This is because higher urban population densities mean that per-subscriber costs can be significantly lower than in many rural areas. As a result, most countries have policies to encourage broadband access in rural, high-cost areas.

In Sweden, the National Rural Development Agency led the effort to bring broadband to rural areas and small towns. It did this through a variety of programs, including tax reductions for broadband access installations in high cost areas, funding to local authorities that establish operator neutral networks in rural and remote areas, and requiring state-owned companies, such as Svenska Kraftnät (a government-owned electricity company), to build a optical fiber backbone infrastructure to 289 municipalities comprising about 70 percent of the country's population.

To spur broadband deployment in these areas, the Swedish government allocated $820 million to stimulate the infrastructure roll out, including $250 million in grants to communities to build local broadband networks, both in the towns and in the surrounding countryside, and another $250 million in tax relief amounting to 50 percent of the cost to build the network to homeowners and businesses to spur development of network infrastructure in homes and buildings. The grants were limited to those communities with no existing broadband providers and the procurement process had to be open and operator-neutral. Moreover, municipalities had to provide at least 10 percent of the cost of building the network with government support limited to a one-time subsidy for 5-year contracts.[140] In addition to government grants, operators themselves estimate that they invested more than $1 billion in these government-supported projects from 2001 to 2007.[141]

Given that TeliaSonera, the incumbent telecommunications operator, owns the majority of Sweden's telecommunications infrastructure, the company had the advantage of being able to bid low for these projects since it could simply upgrade its existing network. Not surprisingly, it won 65 percent of the projects. Other providers were government-owned energy and broadcasting companies, allowing them to also offer lower prices for their services since they did not have to meet the revenue expectations of TeliaSonera, a publicly traded company.

Sweden has made enormous progress. By January 2008 only around 145,000 people and 39,000 businesses in rural areas did not have access to planned or established wired broadband access.[142] While the government wants to eliminate even this relatively minor disparity, its IT Policy and Strategy Group has questioned whether it is economically feasible for even government-supported providers to create parallel high-speed broadband infrastructure in rural areas. Despite this concern, a government-appointed Committee of Inquiry recommended in April 2008 that the government should spend an additional $500 million on grants to municipalities and operators to deploy mainly fiber networks in those rural areas that have no access to broadband services. However, as with previous funding for rural broadband infrastructure, government support would be limited to 50 percent of the costs, with operators and municipalities providing the balance.[143]

South Korea's emphasis on backbone networks as the foundation of its broadband strategy helped to spur broadband development in rural areas by providing an existing government-funded broadband network (KII-Public) for government services (such as post offices) throughout the country. This reduced costs for broadband providers who could reach subscribers in rural areas without having to build the network infrastructure between towns and villages. In addition to funding a backbone network, under "Cyber Korea 21" the government stipulated that KT must extend access to the Internet to rural villages at a speed of 1.5 mbps or higher by 2002.[144] Also, as a condition of privatization in July 2002, KT is legally required to provide universal service, which includes some requirements to provide broadband access to rural areas.[145] To help offset some of these costs, the government provided a modest amount of loans ($926 million from 2001 to 2005) to providers through its "Digital Divide Closing Plan" to extend services to harder-to-reach areas through the construction of a fiber-optic backbone network to connect all 144 telecommunications service districts to the nationwide broadband network.[146]

In Japan, the government ties investments in backbone infrastructure to its goal to provide at least 30 Mbps broadband connections to 90 percent of its households by 2010. Consistent with this goal, in 2004, the Japanese government extended subsidies to municipalities to provide broadband services in rural towns and villages covering about one-third of the cost of building a fiber broadband network. The only stipulation was that they had to allow other providers to lease these municipal networks. A number of municipalities used local and federal government funding to establish FTTH in partnerships with Japan's incumbent telecom provider NTT.[147] In 2006, Japan extended its broadband goal via its "IT New Reform Strategy," which offers low-cost loans and tax incentives to companies that deploy broadband infrastructure in rural areas, particular via fiber. These tax deductions and below-market-rate loans are available to any carrier with a fiber-optic network installation plan.[148] Yet it is unclear whether this policy alone spurred NTT to roll out fiber in rural areas of Japan. As early as 1998, NTT already was committed to deploying nationwide fiber networks (albeit via ISDN at the time).[149] In addition, although NTT is a private company, it is nonetheless influenced by social obligations (which may be related to its partial ownership by the Japanese government). Thus, NTT's roll out of rural fiber networks stems not only from government incentives, but also from NTT's social obligations and commitment to invest in fiber.[150]

Canada's rural broadband policy combined $155 million in subsidies in the form of satellite capacity and towers to deploy broadband services allocated through a license agreement between the government and Telesat Canada (a satellite transmission provider) over a period of 10 years to 400 rural communities.[151] In August 2007 the government extended the NSI, pledging an additional $20.6 million to purchase satellite infrastructure to provide broadband access to 43 remote communities.[152]

Subnational governments in Canada also are establishing public-private partnerships to deploy broadband to rural areas. For example, in an agreement with the province of British Columbia, for example, Telus used government funds to help deploy fiber networks in 113 remote communities in 2006 with speeds of 15 Mbps to 30 Mbps.[153] Similarly, the province of Alberta invested $193 million in the development of the AlbertaSuperNet, a fiber-optic network that connects more than 400 urban and rural communities. The Alberta government leases the network to ISPs who then can offer high-speed services to residential and business subscribers.[154] Another example is the Villages Branches program in the province of Quebec, which provided $50 million in seed funding for fiber companies to deploy fiber networks to various small communities and school boards throughout Quebec.[155]

Most recently, in another effort to spur broadband providers to deploy their services to rural communities, the Canadian government ordered telecommunications providers to invest $300 million out of the $650 million they collected from urban subscribers in "deferral accounts" to provide broadband access to rural communities in British Columbia, Alberta, Manitoba, Ontario and Quebec, and to all persons with disabilities, and to refund the balance—$350 million—to the urban subscribers who paid into the account. The providers must roll out broadband using the least costly technology that will provide speeds of at least 1 Mbps.[156]

The United Kingdom's national and local governments also support broadband infrastructure development in rural areas, but unlike Canada they focus on connecting public entities (such as schools, public agencies, and health institutions) to rural wholesale broadband networks. Specifically, via the Broadband Aggregation Project (BAP), the U.K. government provided more than $2 billion between 2003 and 2006 to provide broadband connections to primary and secondary schools and National Health Service clinics.[157] In addition, from 2001 to 2005, via the Broadband Fund the U.K. government gave grants of around $127 million to more than 13 similar projects.[158] The government of Scotland created a marketplace for wholesale broadband connectivity in rural areas by funding the development in 2003 for a virtual Telecoms Trading Exchange (TTE) using grants from Project ATLAS. Also in Scotland, the 2004 Broadband Pathfinder Project provided grants to communities in remote areas of western Scotland to aggregate public sector demand for broadband infrastructure and wire up schools, libraries, and other public buildings.[159]

The French government's broadband policy initially did not focus on funding broadband infrastructure and services, either in rural or in urban areas. In fact, the government's "e-Europe Plan 2005" envisioned that the private sector would take the lead role in broadband development.[160] Yet the government quickly realized that market forces alone would not provide the level of broadband the government desired. In particular, in 2001 France Télécom stated that it would not upgrade its exchanges to provide broadband services in towns with fewer than 15,000 inhabitants before 2003, leaving a large proportion of the population without access to broadband.[161] The government responded by giving local authorities a greater role in the development of broadband infrastructure and mandating that the Caisse des Dépôts et Consignations (CDC, a government-owned bank) should be able to provide loans at reduced rates to local municipalities for broadband development. Nonetheless, still wary of local government involvement, the government stipulated that in order to receive these loans municipalities had to ensure fair, transparent and non-discriminatory access to rights of way and, while they could establish broadband infrastructure, they could not act as telecommunications operators.[162] This changed in 2003 when the French Parliament passed a law enabling local authorities to be telecommunications operators as long as there were no other available broadband providers.[163] One example in 2005 was the European Commission's co-funding (with the French government) an open broadband infrastructure network in the rural area Limousin that provided services to residential users, businesses, and public authorities.[164] Several local governments (Oise, Pyrénées Atlantiques, Loiret, and Alsace) also have established public network projects by leasing unbundled local loops and installing DSL access muliplexers (DSLAMs) to provide DSL broadband services to residents and businesses.

In the United States, the major explicit rural broadband program is operated by the Department of Agriculture. This Rural Development Broadband Program provides below-market interest rate loans to providers to deploy broadband services in rural areas. Launched in 2000, the program has approved 70 loans in 40 states, totaling over $1.22 billion and serving 1,263 communities of 582,000 subscribing households.[165] However, one limitation of the program was that it funded multiple providers (overbuilding) in a single community instead of focusing on communities that had no existing providers. The result was that only about 40 percent of the communities that received these funds were actually unserved. Another 15 percent had one provider and

### BOX 2: WHAT IS "UNBUNDLING"?

Local loop unbundling is a regulatory policy that requires the incumbent telecommunications provider, also referred to as the incumbent local exchange carrier (ILEC), that owns the local loop to give its competitors access to the local loop—that is, the physical wire connection between customer and company. Government regulators set the tariffs competing providers must pay to the incumbent telecommunications operator for the use of the unbundled network elements. There are two common types of local loop unbundling:

- *Full unbundling* requires the incumbent telecommunications operator to make all copper pair frequencies or fiber networks available to its competitors. The result is that the customer is not connected to the incumbent's equipment, but to the competing operator's equipment.
- *Shared access* (or partially unbundled access) to the local loop is a policy in which the regulator requires the incumbent to make the "high" frequency bands (those that carry data, but not voice) of the copper pair available to its competitors, which the competing operator can then use to offer xDSL broadband service. In this case, the customer may retain the incumbent as a telephone service provider while receiving broadband Internet access from the competing provider.

Sometimes unbundling goes beyond addressing "access to metallic local loops" and stipulates obligations regarding other types of access to local infrastructure. It may require incumbent telecom providers to offer bitstream access—that is, to allow competitors access to equipment in the incumbent telecom provider's local office—or access to fiber local loops. Bitstream access gives competitors resale entry to DSL data provision by buying the complete service for a high-speed link, including delivery to the first data switch in the incumbent's network. The result is that the customer is connected not to the incumbent's equipment but to the competing operator's equipment. Bitstream access requires new operators to invest less in infrastructure because they use the incumbent operators' equipment at the incumbent operator's central office.

the remaining 45 percent had more than one existing broadband provider.[166] In addition, the federal Universal Service Fund (USF) provides implicit support for rural broadband, because funds for rural carriers, although not explicitly to be used for broadband, can be used to upgrade networks. One flaw with the USF is that most big carriers do not get USF funding for rural deployment despite the fact that their costs are the same as those of the smaller rural providers who do qualify for USF support.

### 5. Spurring Competition in the Broadband Market

In addition to funding of high-speed networks and rural broadband deployment, a core component of many OECD nations' broadband policies is spurring competition among broadband providers. Some governments have focused on fostering intermodal competition between separate physical networks (e.g., between DSL and cable) while others have focused on spurring intramodal competition within the existing broadband networks, usually telecom networks.

**Intermodal Competition.** As measured by the HHI measure for telecom and cable, the United States and Canada have more intermodal broadband competition than any other OECD nation. This situation is due in part to the fact that regulators in both prevented telephone companies from acquiring cable companies, in contrast to Europe. In the United States, more than 90 percent of homes have access to cable television, and DSL is available to approximately 80 percent of households where incumbent local-exchange carriers offer local telephone service.[167]

Given the fact that the United States and Canada have strong intermodal competition, it is perhaps not surprising that both nations have moved away from unbundling in favor of promoting intermodal competition in broadband. The Canadian government, which had previously used unbundling regulations to encourage broadband competition,[168] announced in April 2007 that it would not apply unbundling requirements in markets where at least two carriers service 75 percent of residential customers. Similarly, in the United States, the Federal Communications Commission (FCC) determined in 2005—after the Brand X court decision ruled that cable providers did not have to allow competitors access to their networks—that telecommunications service providers no longer had to grant competing Internet service providers "nondiscriminatory" access to their wirelines in order to reach consumers. [169]

In contrast to the U.S. approach, the South Korean government effectively forced cable providers KT and Powercomm to open their networks to competitors via a law that—until 2000—prevented them from offering broadband content over their existing cable infrastructure.[170] This law helped encourage intermodal cable competition by allowing Hanaro, a competing telecommunications provider created in 1998 with government support, and Thrunet to provide broadband Internet services by leasing cable lines from Powercomm and KT.[171] Competition in cable broadband services from Hanaro and Thrunet had the added benefit of spurring KT to offer ADSL broadband services in 1999 over its telecommunications infrastructure.

While South Korea's Ministry of Communications (MIC) initially exempted both KT as well as its facilities-based telecom competitors from regulations to unbundle the local loop, by 2002—in part fearing that fierce facilities-based competition was leading to excessive investment—MIC required KT to open its nationwide copper network to competing local telephony and its ADSL access services providers.[172] Yet, despite early competition from Hanaro and Thrunet offering cable broadband services, by 2005 DSL nonetheless accounted for 53 percent of broadband connections, while cable came in second at 33 percent, and fiber third at 14 percent.[173] Moreover, as of 2007, the market had roughly equalized, with DSL, cable, and fiber each accounting for about one-third of broadband connections. Thrunet now is the major provider of broadband services via cable, but other companies offer services by leasing access from Dacom's Powercomm. Dacom provides its service via cable modems through agreements with cable TV operators and quickly built its subscriber base (having only entered the market in 2005) by launching a high-speed fiber service called "Xpeed," advertising 100 Mbps connectivity for apartments and 10 Mbps for houses and at prices lower than the 4 Mbps services offered by KT and Hanaro.[174]

Unlike South Korea, the fact that in Europe telecommunications providers also could own cable networks (which were not subjected to unbundling regulations) prevented robust intermodal competition from developing. Moreover, because incumbents in many European nations owned cable companies, there was little motivation for them to roll out cable modem services that would compete with their own broadband offerings over telephone lines.[175] For example, until recently France Télécom dominated the French cable market via its cable subsidiary France Télécom Cable (of which it sold the infrastructure only in 2005), as well as through its investments in other large cable companies, including 28 percent of Noos (which it sold in 2004).[176] Similarly in Sweden TeliaSonera has controlled the cable networks through its subsidiary, Com Hem, which it only divested in 2003. In Germany, Deutsche Telecom owned the cable network until 2000. Moreover, regulation meant that local delivery of cable services, provided through third parties, was fragmented. So even though more than 70 percent of German households have access to the cable TV network, fragmentation in the cable market prevented early uptake of cable broadband services. [177]

In Japan, the market—not the government—helped encourage intermodal competition as increasing demand for applications that required high-speed broadband networks, such as Voice over Internet Protocal (VoIP) and IP Television (IPTV) encouraged other companies to enter the broadband market. Specifically, in 2003 power companies in Tokyo and Osaka began offering broadband by adding fiber to their existing power line networks. Other companies followed. For example, in 2007 KDDI offered IPTV over infrastructure it acquired when it bought the broadband division of Tepco, one of Japan's electric companies in 2006.[178] Competition from these companies pressured NTT to deploy fiber in order to retain customers, but government policy also was a catalyst. In particular, the government's initial high fiber interconnection rates (while DSL rates were much lower) enabled the company to recoup its investments in fiber networks.

**Intramodal Competition.** Many nations—usually those with little intermodal competition between telecommunications providers offering broadband via DSL and cable providers offering broadband services via cable—have focused on promoting intramodal broadband competition, often via local loop "unbundling." This is a regulatory requirement that incumbent telecommunications operators that own the local loops (the physical wire connection between the customer and company) to give their competitors access to these loops (see Box 2).

The European Commission's 2000 "e-Europe Action Plan" identified local loop unbundling as a short-term priority to foster intramodal competition by requiring incumbent telecom operators to give competitors access to their local loops by 2002.[179] However, this plan only addressed "access to metallic local loops" without stipulating national obligations regarding other types of access to local infrastructure, leaving member states some leeway in as to whether they should limit open access requirements to the local loops or extend them to new infrastructures, such as fiber.[180] While no country currently requires fiber loop unbundling, there is nothing to prevent regulators from taking this step if they determined an incumbent telecommunications operator was exercising significant market power in its fiber local loop.

Sweden required TeliaSonera to unbundle its local loops in 2000. By 2003, after determining that the company was using discriminatory pricing practices, Sweden's Post & Telestyrelsen (PTS) required TeliaSonera to lower its prices for competitors to access its local loops.[181] The next year, PTS decided that TeliaSonera also must give competitors bitstream access (although the decision was suspended on appeal until a decision by the Supreme Administrative Court in 2007).[182] In 2005, the Swedish government determined that even bitstream access was not enough and required TeliaSonera to offer "naked DSL" (allowing customers to take fixed telephony and broadband services from different providers.)

Perhaps because of Sweden's liberal unbundling regulations, little intermodal competition has emerged in Sweden. Cable comprised only 16 percent of the market in the first half of 2007. [183] And some competitive local exchange carriers that appear to be facilities-based competitors are in actuality mostly using the incumbent's or municipal networks. For example, Bredbandsbolaget (called B2), began providing services in 1999 and had the advantage of a strategic partnership with the National Swedish Rail Administration, which allowed B2 to use the railway communications infrastructure.[184] B2 originally provided high-speed Ethernet and VDSL broadband services, beginning with speeds of 10 Mbps and upgrading to 100 Mbps.[185] But it actually uses little of its own network infrastructure and focuses largely on urban apartment dwellings where it can serve a larger number of customers at a low cost.

In France and Germany, resistance from the incumbent operators slowed the pace of unbundling, which may be why intramodal competition also was slow to take root. In France, however, an interim regulatory step enabled early competition. Specifically, when France Télécom began to offer ADSL broadband services in 2000, the French government elected to require partial unbundling, e.g., requiring France Télécom to lease just the copper loop—not its central office equipment—to its competitors. [186] This limited regulatory policy enabled an ISP called Free (created by Iliad, the company that provided the content for France's Minitel proprietary network system) to offer Internet service in 1999 by leasing France Télécom's local loop but placing its own equipment in the local office—a combined modem and DSL access multiplexer (DSLAM)—which allowed it to compete directly with France Télécom's ISP, Wanadoo (later renamed Orange).

Negotiations between the French government and France Télécom delayed full unbundling regulations until 2002, after which competition accelerated. By the end of 2006, France had the third largest number of unbundled lines of any European country.[187] Orange had 49 percent of the broadband market, followed by Free at 19 percent, Neuf Cegetel at 18 percent, Alice and Club Internet with 7 and 5 percent respectively.[188]

As in France, the German government delayed implementation of unbundling regulations, and once they were in place, initially elected not to extend them to Deutsche Telecom's VDSL loops, a decision that the European Commission overturned. Nonetheless, local loop unbundling appears to have encouraged some broadband competition. In early 2007, there were over 80 DSL operators[189] although Deutsche Telecom nonetheless had around 60 percent of all broadband subscribers.[190]

The Dutch government has pursued various policies to force KPN to open its infrastructure to competitors to foster intramodal competition. In addition to requiring KPN to open its local loop to competitors since 2000, the Dutch government also requires it to allow competitors to lease its DSL infrastructure ("naked DSL"). Yet the Netherlands differs significantly from Sweden, France, and Germany because it also has several cable operators that provide strong competition to KPN. The fact that cable companies reach about 98 percent of Dutch households may explain why KPN has aggressively deployed its ADSL broadband network to an equal number of households.[191] Moreover, KPN faces fierce intramodal competition from Versatel, Orange, and BBned who offer broadband services over KPN's network to between 50 to 70 percent of Dutch households.

In Britain, unbundling rules also have eroded British Telecom's (BT) market share, with BT and its main competitor, Virgin Media (a merger of the two largest cable companies, ntl and Telewest), essentially splitting the market in retail broadband connections.[192] Yet, the U.K. government pushed for even more competition in 2005 by requiring BT to set up a separate business unit (called Openreach) to administer its unbundled network lines on a nondiscriminatory basis.[193] This appears to have led to an increase in the number of unbundled lines from 365,000 at the end of 2005 to 1.7 million by February 2007. Apparently satisfied that competition is increasing, in 2007 the U.K. government proposed to deregulate the wholesale broadband market by applying regulation only where there is insufficient competition. This may afford BT some degree of regulatory relief as the government could decide to eliminate its unbundling regulations in markets where BT competes with four or more wholesale broadband providers.[194]

Japan followed the European Union to enact unbundling rules promoting intramodal competition perhaps because, like Germany, its cable industry is highly fragmented, making it difficult for cable companies to invest in network upgrades to provide broadband services. [195] In 2000 Japan required NTT to unbundle its local loops, encouraging several competing service providers to emerge, including KDDI in long distance, Yahoo! BB, and K-Opticom. Yet, the Japanese government went further by setting a very low price for NTT's unbundled loops. Low-cost access enabled Softbank's Yahoo! BB to gain a strong place in the broadband market; competition is split evenly between NTT, Yahoo! BB and KDDI. The increase in competition forced NTT to compete by lowering its prices and offering increased speeds.[196]

Some analysts have observed that many of the OECD leaders require unbundling, arguing that it is a key factor to broadband success.[197] To be sure, competition appears critical to spurring broadband deployment. Until Softbank started using NTT's loops to provide low-cost DSL in Japan, for example, NTT was largely focused on providing ISDN service.

But the role of competition in spurring broadband appears to be much more complicated for several reasons. First, although it is true that some nations at the top of the OECD broadband penetration rankings require unbundling, including France, Japan, the Netherlands, South Korea, and Sweden, so do some nations further down the OECD rankings, such as Ireland, Italy, and Spain—a fact seldom pointed out by proponents of unbundling. In contrast, it was initial intermodal competition in South Korea that contributed to the country's early broadband lead.

Second, some of the countries—or regions in the case of the European Union—that required unbundling of the local loop took this approach because there was little or no intermodal competition: these nations were almost completely dependent on the incumbent telecom company to provide broadband (see Table 6). In a market without intermodal competition, regulators seeking to spur competition in the near term had no choice but to require unbundling of the local loop.[198] Moreover, as mentioned above, regulators in many European countries allowed incumbent telecommunications operators to also own cable infrastructure, which severely limited cable modem service. This at least partly explains why, as early as 2000, the European Commission decided unbundling the local loop was the key to promoting broadband competition.[199]

**Table 6: Market Share of Telecom and Cable Among Selected Nations, 2007[200]**

| Nation | Telecom (DSL and Fiber) | Cable |
|---|---|---|
| Greece | 100% | 0% |
| Italy | 100% | 0% |
| Turkey | 99% | 1% |
| Iceland | 98% | 0% |
| France | 95% | 5% |
| Germany | 95% | 5% |
| Luxembourg | 89% | 11% |
| New Zealand | 89% | 7% |
| Japan | 86% | 14% |
| Finland | 84% | 13% |
| Norway | 82% | 15% |
| Australia | 81% | 15% |
| Spain | 79% | 21% |
| Sweden | 79% | 19% |
| United Kingdom | 78% | 22% |
| Mexico | 76% | 21% |
| Slovak Republic | 73% | 12% |
| Ireland | 72% | 11% |
| Denmark | 70% | 28% |
| Poland | 69% | 30% |
| Switzerland | 67% | 30% |
| South Korea | 65% | 35% |
| Austria | 62% | 35% |
| Netherlands | 62% | 38% |
| Portugal | 62% | 37% |
| Belgium | 61% | 39% |
| Hungary | 58% | 40% |
| Canada | 48% | 52% |
| Czech Republic | 47% | 21% |
| United States | 45% | 52% |

Third, intermodal competition may be helpful in spurring consumer demand for broadband, particularly by driving prices down through requirements that telecom incumbents unbundle at prices below cost. Yet it is important to note that although proactive unbundling policies may have spurred broadband adoption in Europe, such policies may also discourage investment by both incumbent telecom providers and their competitors in next-generation infrastructure—and the result may be a modest-speed "DSL cul-de-sac," where providers have less economic incentive to upgrade to fiber so consumers have access only to DSL broadband services.

Particularly in the United Kingdom, France, and Germany—unbundling may increase investment in DSL to the detriment of alternate high-speed networks, such as FTTH. The reason is that the governments in these countries have set relatively low prices for competitors to lease incumbents' networks that there is diminished incentives for competitors to invest in developing duplicate broadband networks, or for incumbents to upgrade their networks to fiber, which they could expect to be subject to the same unbundling regulations. One indicator of this is the significantly lower levels of fiber deployment in Europe, except in cases where the government has subsidized fiber networks, such as in Sweden and the Netherlands (through municipal provision). Thus it follows that in the United Kingdom, where there is little FTTH competition, BT has no plans to replace its existing copper networks with fiber.[201] Moreover, what fiber BT is deploying is in new housing developments such as 9,500 homes and offices in Ebbsfleet Valley in Kent.[202]

## C. GOVERNMENT POLICIES TO PROMOTE BROADBAND DEMAND

Many OECD nations have policies not just to encourage deployment of broadband infrastructure by broadband providers but also to encourage the demand for broadband by consumers. Demand-side policies such as promoting digital literacy and access to computers, encouraging the use of broadband in education, and promoting the development of broadband applications with e-government and other initiatives are often overlooked in the debate over broadband, with most people emphasizing policies to increase broadband supply.

The fact that most Americans can subscribe to broadband but only about half actually do subscribe suggests that crafting the right policies to promote increased broadband demand will be key to increasing the United States' international broadband performance. Given that only around two-thirds of Americans have a computer at home, even the most robust supply-side policies will not do the job of getting to close to universal broadband usage; nor will supply-side policies allow the United States to catch up to the other nations, particularly those like Sweden, where in part because of proactive policies, 89 percent of Swedes have personal computers at home.

### 1. Promoting Digital Literacy and Access to Computers

One way that some governments are encouraging demand is by giving their citizens low-cost access to computers and teaching them how to use them. Indeed, there is a very strong relationship between computer use at home and a nations' broadband ranking. In fact of the 21 nations for which data are available on percentage of households with a computer, there is a 0.85 correlation with the 2007 household penetration rank.

*But the role of competition in spurring broadband appears to be much more complicated for several reasons. First, although it is true that some nations at the top of the OECD broadband penetration rankings require unbundling, so do some nations further down the OECD rankings.*

Perhaps the nation with the most comprehensive policies in this regard is South Korea. South Korea has digital literacy programs that target population groups that otherwise would be less likely to use the Internet. The "Ten Million People Internet Education Project (2000-2002)" worked to provide Internet education to approximately a fourth of South Korea's citizens. South Korea's government made efforts to provide these free or subsidized training programs for groups like the elderly, military personnel, and farmers.[203]

In addition, the South Korean government provided subsidies to around 1,000 private training institutes over the nation for the purpose of educating housewives, in order to create demand in households. Under this "Cyber 21" program the government offered 20-hour, week-long courses to housewives for only about $30. In just the first 10 days, 70,000 women signed up for the courses.[204] The Korean Agency for Digital Opportunity and Promotion (KADO) also has a variety of programs to promote digital literacy and access to computers. These include establishing 8,263 Local Information Access Centers where the public can access the Internet for free, distributing free used personal computers to the disabled and to those receiving public assistance, and education and training programs for the elderly and disabled.[205]

*Demand-side policies such as promoting digital literacy and access to computers, encouraging the use of broadband in education, and promoting the development of broadband applications with e-government and other initiatives are often overlooked in the debate over broadband, with most people emphasizing policies to increase broadband supply.*

Realizing that broadband demand would not increase if its citizens did not have access to a personal computer at home, the South Korean government also provided subsidies for purchase of personal computers by low-income citizens. The personal computer diffusion promotion established in 1999, aimed to provide personal computers at low-prices, partly through a personal computer purchase installment plan using the postal savings system. The next year the government purchased 50,000 personal computers and provided them to low-income families on a 4-year lease, with full support for broadband free for 5 years.[206]

The Swedish government also created programs to encourage broadband demand, focusing on digital literacy, access to personal computers, and use of broadband for education. For example, the government subsidized personal computer purchases by enabling companies to provide them to their employees' on a pre-tax basis.[207] This program was so successful that the government discontinued it in 2007. Because of the government's support for home personal computer purchases, home personal computer penetration is about 10 percentage points higher than it would be otherwise.[208]

In the United Kingdom, the government's digital strategy, released in 2005, focuses on stimulating broadband by promoting virtual learning, universal access to advanced public services, fostering the creation of innovative broadband content, providing communal access points and providing digital literacy programs for adults, making home computers more affordable, and removing access barriers for people with disabilities.[209] This focus stems from the British government's research, which showed that the number one reason people don't subscribe to broadband when they have access to it is lack of interest, the other relevant factors being a lack of perceived need, lack of knowledge, personal computer cost, and complexity.[210] To address the problem of personal computer cost as a barrier to broadband access—particularly in households with children—the British government established the E-Learning Foundation, which offers parents financing to lease laptops for four years with a delayed payment scheme that begins after 15 months.

Other OECD nations have worked to develop free public access to computers and the Internet. In Canada, for example, Canada's Community Access Program provides daily public access to the Internet to 100,000 Canadians through community technology centers. Others, including Germany and the United Kingdom, are working to help small businesses use broadband. The German government offers free consulting services for small and medium-sized businesses to promote broadband and provides awards for innovative broadband projects.[211] In the United Kingdom, the government provided grants to the municipalities of Cornwall, Hampshire, and Yorkshire for the Remote Area Broadband Inclusion Trial (RABBIT) to promote broadband by giving grants of between $500 to $1,500 to small businesses and organizations in remote areas to cover the first year of their broadband subscriptions.[212]

In the United States, a number of public-private partnerships are working to spur demand for broadband services. For example, ConnectKentucky, a public-private partnership, helps foster demand by providing a variety of services, including the No Child Left

Offline project that provides computers and training to disadvantaged populations. E-North Carolina has also worked to expand digital literacy and broadband take-up, especially in rural areas.[213] At the local level, initiatives such as Chicago's Digital Divide Task Force work to develop and implement comprehensive strategies to address this issue.[214] Other groups focus on helping particular groups like seniors[215] and students[216] learn computer and Internet skills. For example, One Economy Corporation, is a non-profit organization that provides broadband access to people with low incomes, as well as technology and jobs training.[217]

### 2. Encouraging the Use of Broadband in Education

Perhaps the most powerful driver for residential broadband adoption in many nations is education. Many parents see broadband as a key tool for their children's education. As a result, a number of nations have established policies to promote broadband use in education.

South Korea's initiative, Cyber Korea 21, established in 1999, gave schools free personal computers.[218] In addition, as part of the Closing the Digital Divide Act of 2002, the government gave free computers to 50,000 low-income students with good grades. Moreover, because the national government exerts significant control over the education system, it was able to design education to spur broadband demand. For example, schools put assignments and other education programs online, spurring parents to get high-speed access for their children.[219] South Korea's Educational Broadcasting System (EBS) broadcasts high school education programs via the Internet.[220] South Korea also made computer literacy a part of the nation's highly competitive university entrance exams, meaning that many families were now highly motivated not only to have a personal computer at home but to also subscribe to broadband.

Other nations, including Canada, Sweden, the United Kingdom, and Germany, have also worked to link education to Internet and broadband access. Canada's SchoolNet program linked the country's schools and libraries to the Internet. The Swedish government established a $26 million project to raise IT literacy among schoolteachers.[221] In the United Kingdom, there is a government-supported IT and Internet training program, and 84 percent of U.K. elementary and secondary education teachers signed up for the training program. In Germany, Deutsche Telecom provides Internet access at speeds up to 6 Mbps to Germany's schools as part of its T@School infrastructure project to connect all of the country's 28,000 schools, which it began in 2000 by offering all public and state-approved schools free Internet access.[222]

*Perhaps the most powerful driver for residential broadband adoption in many nations is education. Many parents see broadband as a key tool for their children's education. As a result, a number of nations have established policies to promote broadband use in education.*

In the United States, the FCC's E-Rate program, established by the Telecommunications Act of 1996, provides discounted telecommunications services to public schools, nonprofit private schools, and libraries. Up to $2.25 billion annually is available to provide eligible schools and libraries with discounts for authorized services.[223] The program has had considerable success in getting schools and libraries wired. From 1997 to 2002, for example, the E-Rate program helped wire 95 percent of all public libraries for Internet access and more than 87 percent of all public school instructional classrooms.[224] Not only has the program helped schools get online, it appears to have spurred broadband adoption in surrounding neighborhoods of schools getting funding.[225] As of 2005, 97 percent of all U.S. public schools had Internet access.[226]

### 3. Promoting the Development of Applications, Including E-Government Content, for Broadband

Finally, many governments have worked to spur the development of compelling applications that will, among other things, spur broadband demand. South Korea's IT839 project focuses among other things on spurring widespread use of applications like digital broadcasting, home networks, telematics, radio frequency identification (RFID), wide-band code division multiple access (W-CDMA), terrestrial digital television (D-TV), and Internet telephony.[227] Similarly, now that much of Japan can access the high-speed Internet, the ubiquitous-net Japan" (U-Japan) project is working to spur widespread use of applications.[228]

In the United Kingdom, the Technology Strategy Board's Technology Program provides funding to encourage innovation and research in developing broadband content.[229] In Canada, AlphaRoute developed a very effective online literacy training program that is used in hundreds of communities across Canada.[230]

A number of countries, including Japan and the Netherlands, have taken the lead in creating digital content and offering it via online government services. By 2005, the Japanese government had placed 95 percent of its agencies' applications and notification services online, as well as more than 63 percent of other types of administrative procedures.[231] In addition, nearly all local municipal organizations had their own websites. South Korea's initiative promoted the use of electronic documentation by all government agencies, putting all administrative services online, and creating "Sinmoongo," a Web portal to promote public "e-participation" in policymaking, voting, and filing complaints. Similarly, the Dutch government decided to encourage demand by supporting the development of broadband content and applications. For example, in 2006 it announced that it would give all Dutch citizens a personalized Web page—the "Personal Internet Page (PIP) project" where they can access their government documents and social security information, as well as apply for grants and licenses.[232]

In the United States, the E-Government Act of 2002 was intended to streamline government services and make them available online. The U.S. Office of Management and Budget administers the E-Gov program, which requires government agencies to give U.S. citizens access a variety of information and services online. For example, they can determine their eligibility for government benefits online, get information about tax requirements and benefits, and apply for government grants and jobs. Government employees also can get online training and view payroll information.[233] In the United Kingdom, the government launched Directgov in 2004 that allows British citizens to access information from a variety of government agencies, and Government Gateway, a centralized registration point for government services online.[234]

# V. Policy Recommendations

The United States can learn from the broadband policy best practices in other nations. First and foremost, America needs a national broadband strategy that focuses on both broadband supply as well as demand. Some may argue that a national strategy is unnecessary because the United States already has strong intermodal broadband competition. In part because of significant market failures with regard to the provision of broadband, relying on market forces alone will not meet our country's future broadband needs.[235]

The United States needs a national broadband strategy to give companies incentives to upgrade and extend networks and to ensure that there is demand by increasing access to personal computers, encouraging broadband Internet usage in education, and encouraging the development of the types of applications (both government and commercial) that make users demand high-speed access.

### A. POLICIES TO PROMOTE BROADBAND SUPPLY

To promote broadband infrastructure deployment policymakers should take the following steps:

1. **Enact more favorable tax policies to encourage investment in broadband networks, such as accelerated depreciation and exempting broadband services from federal, state, and local taxation.** Although competition can and often does encourage companies to upgrade their broadband networks, competition alone will not be sufficient. Consequently, policymakers should give companies additional incentives by enacting more favorable tax policies. In particular, the federal government should allow companies investing in broadband networks to expense investments in new high-speed broadband networks (capable of delivering considerably faster speeds than today's average DSL or cable networks) in the first year. Currently, companies in the United States must depreciate telecommunications network investments over a period of 15 years. Allowing companies to deduct the investment in the first year reduces the costs of making these investments and spurs faster deployment of higher speed networks.[236] One bill that would do this is the "Broadband Deployment Acceleration Act of 2007." It would allow companies to treat any qualified broadband expenditure as an expense (not chargeable to capital account), which they could then deduct from taxes.[237]

2. **Continue to make more spectrum, including unlicensed, available for next-generation wireless data networks.** Although the U.S. government should not mandate the types of technologies companies may use to provide broadband access, it can help encourage the development of a variety of broadband services. In particular, as Worldwide Interoperability for Microwave Access (WiMAX) is deployed and now that the prime 700 MHz spectrum has been auctioned, more rural places will be able to gain access to wireless broadband. But ensuring that even more spectrum is available will be important. One way to do this is to open up more unlicensed spectrum

in the white spaces between digital TV bands.[238] The original purpose of the white spaces was to prevent interference between broadcasts on adjacent frequencies, but in many markets, there are large gaps that could be used without interference by wireless broadband services. Using this spectrum will enable companies to provide broadband services, particularly in rural areas.

3. **Expand the Department of Agriculture's Rural Utilities Service (RUS) Broadband Program and target the program to places that currently do not have non-satellite broadband available.** It is costly to provide broadband in many rural areas and if there also are few subscribers there is little incentive for companies to do so without government support. In rural and remote areas that may have only one high-speed provider, policymakers should consider whether infrastructure-based competition is a realistic goal. Yet, for those areas that have no access to high-speed broadband, the government can help overcome this obstacle by giving companies incentives such as loans and grants to deploy broadband in rural areas. The Department of Agriculture's RUS is the main federal program for rural broadband and provides loans and grants for rural broadband providers. Because it is harder to make the business case for investing in broadband in less densely populated areas than in more densely populated ones, a significant share of RUS loans and grants subsidize competitive broadband providers in communities where there are already one or more broadband providers. Congress should increase RUS funding and RUS should provide larger subsidies to a smaller number of providers who invest in places where a significant part of the territory has no broadband. This may mean providing more generous loan terms (e.g., lower equity requirements) and/or lower interest rates, and potentially partial grants. To be sure, doing so will mean a higher risk of default, but it makes no sense for federal policy to subsidize activities that the private sector already does a relatively good job of providing. Instead, the federal role should be to fill the gaps where the private sector finds it more risky to do so without assistance. The 2007 Farm Bill (H.R. 2419) has some provisions that address some of the flaws in the RUS, but it does not go far enough. For example, it defines an "eligible community" more narrowly, to avoid funding providers in communities adjacent to large cities or towns, yet it nonetheless allows the RUS to give loans to eligible communities that already have two existing broadband providers.[239]

4. **Reform the federal Universal Service Fund (USF) program to extend support for rural broadband to all carriers, and consider providing the funding through a reverse auction mechanism.** Currently, the federal USF program does not provide explicit support for broadband. In November 2007, however, the Federal Communications Commission (FCC) Joint Board on Universal Service recommended the creation of three separate universal service funds, one of which would support rural broadband deployment.[240] The joint board also recommended using a reverse auction mechanism to allocate the funds. Companies would compete to win funding to provide broadband services in rural areas, which would go to the lowest bidder. The funding would consist of a one-time subsidy and the company would operate on limited contract (perhaps 5 or 10 years) and be required to meet minimum standards of performance.[241] The one-time auctions would cover the higher capital costs and higher capitalized operating costs. These auctions should be open to any provider using any technology.[242]

5. **Fund a national program to co-fund state-level broadband support programs, such Connect-Kentucky or North Carolina e-NC Authority.** Another way to encourage commercial providers to extend broadband networks to high-cost areas in the United States is for Congress to support state and local programs that aggregate demand for broadband services. In particular, state governments, hospitals, schools, and libraries all have many potential broadband subscribers. State and local governments can form cooperatives that aggregate this demand and market it to competing broadband services providers, making it more attractive. One model is ConnectKentucky, a public-

private partnership that focuses not just on assessing where broadband is and is not present, but also helps spur demand for broadband in communities where it is economically feasible.[243] Congress should enact and fund a competitive, community-based broadband access grant program, focused not just on broadband connectivity, but also on digital literacy and computer access.[244]

6. **Promote the widespread use of a national, user-generated, Internet-based broadband mapping system that would track location, speed, and price of broadband.** No national broadband strategy will be useful if a country does not know its true level of broadband penetration. Although the FCC's recent decision to revise its broadband definition and reporting requirements is a step in the right direction, the FCC could do more to collect timely and accurate information. In particular, the FCC and other agencies should supplement current efforts by creating an online interactive tool (in a Wikipedia-type format) that would enable consumers to provide information on their level of broadband access as well as to determine what types of broadband services are available to them.[245]

7. **State and local governments should take action to make it easier for providers to deploy broadband services.** State and local governments can make it easier for providers to roll out broadband. For example, ensuring that standard spare conduit (pipes) are placed in rights-of-way at the time of construction would decrease providers' costs of excavating to put in place broadband lines.[246]

### B. POLICIES TO PROMOTE BROADBAND DEMAND

To encourage the growth of demand for broadband policymakers should take several additional steps:

1. **Support initiatives around the nation to encourage broadband usage and digital literacy.** Given that lack of computer ownership and digital literacy appear to be the major factors limiting broadband take-up, as opposed to unwillingness or inability to switch from dialup, simply providing USF-like subsidies (such as Lifeline and Linkup) may not be enough to get close to universal broadband access. When telephones were first adopted, "telephone illiteracy" was not the major barrier to deployment because phones were relatively easy to use. Notwithstanding constant improvements in usability, computers and the Internet are, in comparison, quite complicated, and difficult to use. Despite the fact that an increasing number of applications rely on broadband, many people who cannot live without a phone feel perfectly comfortable living without the Internet.[247] This suggests that a universal service policy focusing solely on subsidizing costs will not be enough to maximize broadband adoption. Any policy to expand broadband use must begin with efforts to make nonusers comfortable with, and interested in, computers and broadband. In the immediate term, the most effective strategy for expanding broadband access appears to be supporting corporate, nonprofit and government efforts. In support of these endeavors, Congress should enact and fund a competitive grant program, focused not just on broadband connectivity, but also on digital literacy and computer access. Such a program could catalyze the creation and expansion of more local, nonprofit, and voluntary approaches to bringing most, if not all, of a community's residents online.

2. **Fund a revitalized Technology Opportunities Program (TOP).** More compelling public-interest broadband applications will also play a role in encouraging broadband adoption. One programmatic tool used to spur digital adoption was the program known as TOP, which was administered by the National Telecommunications and Information Administration (NTIA).[248] Between 1994 and 2004, TOP made 610 matching grants to state, local and tribal governments, health care providers, schools, libraries, police departments, and community-based nonprofit organizations.[249] In general, TOP grants helped organizations build and deliver technology capability to local residents. TOP accomplished much, but its major limitation was that it funded the development of many community-focused Internet and software projects that were used in that particular community alone. If a program similar to TOP were to be resurrected, it

should focus less on community projects, and more on developing national Web-based tools, applications and content that can be used in any community around the nation, or indeed the world. There are numerous applications that could be developed and be made available on the Internet for all to use. A revived TOP should have as its primary focus the development of nationally scalable Web-based projects that address particular social needs, including law enforcement, health care, education, and access for persons with disabilities.

3. **Exempt broadband Internet access from federal, state, and local taxes.** Internet access is a fundamental building block of the digital economy, a key enabler of many applications and services, and a prerequisite for participating in our digital society. Government should provide unfettered access to this basic public good by eliminating non-USF taxes on Internet access, including broadband. Specifically, Congress should make permanent the current moratorium on Internet access taxes and eliminate the grandfather clause, which allows certain free rider states to tax Internet access. In addition, the ban on Internet taxes should be clarified to include the underlying transport services acquired by ISPs, such as the wire, cable, or fiber used to carry traffic from customers to the Internet. Currently, some states tax the underlying transport for broadband Internet access, a cost that ISPs then pass on to consumers in the form of a tax recovery fee. Given that the average tax on telecommunication services is 13.5 percent, more than twice the average tax rate on all other goods and services, Congress should act to ensure that the short-term fiscal interests of states do not trump the long-term strategic interests of the nation.[250]

4. **Support new applications, including putting more public content online, improving e-government, and supporting telework, telemedicine, and e-learning programs.** As the U.S. economy and society becomes more and more digital, government needs to ensure that it does not fall behind. Government officials at all levels can and should lead by example by leveraging their own information technology efforts to achieve more effective and productive public sector management and administration. Among other things, this means government should not only actively promote e-government but should also look to how IT can be used help solve a wide array of pressing public challenges. Among other things, the government should try to spur e-health, telework, e-government, and e-learning applications.[251] One easy step to spur e-learning would be to fund the Corporation for Public Broadcasting to make its content available online. Imagine if school children studying the Civil War could watch Ken Burns' Civil War series on the Internet. Similarly, the Library of Congress has video content—such as classic films—that are in the public domain and which, if digitized, would likely be extremely popular and drive demand for broadband services.[252]

## ENDNOTES

1. That is, broadband over cable using the Data Over Cable Interface Specifications (DOCSIS) 3.0 standard. The DOCSIS standard, originally released in 1997, enables cable companies to deliver Internet access over their existing hybrid fiber coaxial (HFC) infrastructure. The latest version, DOCSIS 3.0, significantly increases transmission speeds for both uploading and downloading data.

2. Thomas Bleha, "Down to the Wire," *Foreign Affairs*, May/June 2005 <www.foreignaffairs.org/20050501faessay84311/thomas-bleha/down-to-the-wire.html>.

3. OECD, "Broadband Subscribers per 100 Inhabitants," *OECD Broadband Statistics* <www.oecd.org/dataoecd/21/35/39574709.xls>.

4. In particular, the Organization for Economic Cooperation and Development (OECD) estimates more closely matches countries' own statistics and reveals discrepancies in the European Commission's data. "E-Communications Household Survey," Special Eurobarometer 249, European Commission, July 2006 <ec.europa.eu/public_opinion/archives/ebs/ ebs_249_sum_en.pdf>.

5. For a full description of the ITIF Broadband Ranking methodology, see Daniel K. Correa, "Assessing Broadband in America: OECD and ITIF Broadband Rankings" (Washington, DC: Information Technology and Innovation Foundation, 2007): 4.

6. The ITIF Broadband Rankings are a composite measure of the sum of standard deviation scores for three indicators: household broadband penetration, average speed weighted by percentage of subscribership (Mbps), and lowest available price per Mbps. For a full description of the ITIF Broadband Ranking methodology, see Daniel K. Correa, "Assessing Broadband in America: OECD and ITIF Broadband Rankings" (Washington, DC: Information Technology and Innovation Foundation, 2007): 4. The rankings presented here have been updated to include the latest (June 2007) penetration and pricing information from the OECD, both released in October 2007. It should be noted that we have elected not to use the OECD data on average speed and price data released in October 2007 because these data are not weighted by subscribership or availability.

7. OECD, "Broadband Subscribers per 100 Inhabitants," *OECD Broadband Statistics to 2006* <www.oecd.org/document/7/0,3343,en_2649_34223_38446855_1_1_1_1,00.html#TimeSeries> and OECD, "Broadband Subscribers per 100 Inhabitants," OECD Broadband Statistics <www.oecd.org/dataoecd/21/35/39574709.xls>.

8. OECD, "Fastest Advertised Connection Available Among All Surveyed Operators, by Country, October 2007," OECD Broadband Portal <www.oecd.org/dataoecd/11/36/39575235.xls>.

9. Ibid.

10. Daniel K. Correa, "Assessing Broadband in America: OECD and ITIF Broadband Rankings" (Washington, DC: Information Technology and Innovation Foundation, 2007): 4.

11. OECD, "Broadband Average Monthly Subscription Price Per Advertised Mib/s, October 2007, USD PPP," OECD Broadband Portal <www.oecd.org/dataoecd/22/45/39575011.xls>.

12. Ibid.

13. According to the OECD, for price plans to be included in its analysis, they "should be available in the country's largest city – or in the largest regional city for firms with only regional coverage." OECD, "Criteria for the OECD Broadband Price Collection," Oct. 2007 </www.oecd.org/document/1/0,3343,es_2649_33703_39575489_1_1_1_1,00.html>.

14. Urbanicity is a measure of the share of a nation's population living in urban areas multiplied by the population density of those areas.

15. World Bank, *2006 Information and Communications for Development (IC4D): Global Trends and Policies* (Washington, DC: World Bank, 2006): 218

16. Yoonmi Kim, "Broadband Internet in Korea," *FINPRO Korea*, September 30, 2004 <akseli.tekes.fi/opencms/opencms/OhjelmaPortaali/ohjelmat/CONE/fi/Dokumenttiarkisto/Viestinta_ja_aktivointi/Seminaarit/Maaselvsem06/Fixed_Broadband-Korea_-_Kim.ppt >.

17. Another contributing factor is that in South Korea the owners of apartment buildings also own the broadband wiring extending to the individual apartments in their buildings. Because of this, any broadband provider can reach all potential subscribers in the apartment building simply by connecting to the building.

18. Martin Fransman (ed.), *Global Broadband Battles: Why the U.S. and Europe Lag While Asia Leads* (Stanford, California: Stanford Business

Books, 2006): 241.

19. Energy Information Administration, U.S. Department of Energy, "Housing Characteristics Tables," *2001 Residential Energy Consumption Survey* <www.eia.doe.gov/emeu/recs/recs2001/hc_pdf/housunits/hc1-4a_housingunits2001.pdf>.

20. Sung-Hee Joo, "Broadband Internet Adoption in Korea: A Maverick or a Model to Follow?" presented at the 33rd Research Conference on Communication, Information and Internet Policy, Telecommunications Policy Research Conference, Washington, DC, 2005: 6.

21. In telephony, a local loop is the twisted metal pair circuit that connects a telephone company's main facility in a locality to its customers' telephones at homes and businesses. Originally, local loop service carried only telephone service to subscribers. But today, with the use of modems, DSL signals are also able to be transmitted to subscribers through the local loop.

22. As it is particularly difficult to obtain data concerning local loop lengths, this chart reflects only those countries for which data was available.

23. For a review of several statistical analyses of broadband penetration, see John de Ridder, "Catching-Up in Broadband—What Will It Take?" OECD Working Party on Communication Infrastructures and Services Policy (Paris, France: OECD, July 2007): 5.

24. George S. Ford, Thomas M. Koutsky, and Lawrence J. Spiwak, "The Broadband Performance Index: A Policy-Relevant Method of Comparing Broadband Adoption Among Countries" (Washington, DC: Phoenix Center, July 2007): 20.

25. A multiple linear regression models linear relationships between each of several independent variables and a single dependent variable. Every value of the dependent variable has a corresponding value for each of the independent variables, and the model's "residual" for each value of the dependent variable is the difference between its actual value and that which the model predicts. Our analysis employs the standard "least squares" method, which derives an equation that minimizes the sum of the squared residuals.

26. OECD Directorate for Science, Technology, and Industry, "Broadband Statistics to June 2007," Oct. 2007 <www.oecd.org/sti/ict/broadband>.

27. The ITIF Broadband Rankings are a composite measure of the sum of standard deviation scores for three indicators: household broadband penetration, average speed weighted by percentage of subscribership (Mbps), and lowest available price per Mbps. For a full description of the ITIF Broadband Ranking methodology, see Daniel K. Correa, "Assessing Broadband in America: OECD and ITIF Broadband Rankings" (Washington, DC: Information Technology and Innovation Foundation, 2007): 4. The rankings presented here have been updated to include the latest (June 2007) penetration and pricing information from the OECD, both released in October 2007. It should be noted that we have elected not to use the OECD data on average speed and price data released in October 2007 because these data are not weighted by subscribership or availability.

28. OECD Directorate for Science, Technology, and Industry, "Broadband Statistics to June 2007," Oct. 2007 <www.oecd.org/sti/ict/broadband>

29. Urban population data obtained from United Nations, "World Population Prospects: The 2004 Revision," (2004). Population density of largest metropolitan areas obtained from Demographia, "Demographia World Urban Areas," March 2007 <www.demographia.com/db-worldua.pdf>.

30. "Homeownership Rate of Selected Countries," *Photius*, 2003 <www.photius.com/rankings/homeownership_rates.html>; and Eurostat statistics.

31. OECD, "GDP Per Capita," OECDStat, 2008 <www.sourceoecd.org/database/OECDStat>

32. European Institute of Japanese Studies, "Average Yearly Temperature in Capital, OECD Countries," *Economic and Social Data Rankings*, 2004 <www.dataranking.com/table.cgi?TP=ee01-2&LG=e&RG=1>.

33. U.S. Central Intelligence Agency, "Median Age," *CIA World Factbook*, 2007 <www.cia.gov/library/publications/the-world-factbook/>..

34. International Telecommunications Union, "Internet Indicators: Subscribers, Users, and Broadband Subscribers," International Telecommunications Union ICT Statistics Database, 2006 <www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx#>

35. OECD, "Table CO 9.1: Educational Attainment Expressed as Average Number of Years of Successfully Completed Formal Education," 2004 <www.oecd.org/dataoecd/56/9/37863998.pdf>

36. U.S. Central Intelligence Agency, "Distribution of Family Income – Gini Coefficient," *CIA World Factbook*, 2007 <www.cia.gov/library/publications/the-world-factbook/>..

37. OECD Directorate for Science, Technology, and Industry, “Price Ranges, Mbit/s,” Oct. 2007 <www.oecd.org/sti/ict/broadband>

38. John B. Horrigan and Aaron Smith, “Home Broadband Adoption” (Washington, DC: Pew Internet & American Life Project, June 2007): 4.

39. Ibid.

40. We checked the variables used in both regressions for multicollinearity. Two pairs of independent variables—(1) temperature and income equality, and (2) age and price—are highly correlated (defined as a correlation above 0.7). Running the regressions without the temperature variable, however, affects the results only slightly. The highly negative correlation between price and age is partly due to Mexico and Turkey, both of which have very young populations and very high prices in comparison with the rest of the OECD countries. Despite the presence of these two pairs of highly correlated variables, the regression results are similar when highly correlated variables are omitted.

41. OECD Directorate for Science, Technology, and Industry, “Broadband Statistics to June 2007,” Oct. 2007 <www.oecd.org/sti/ict/broadband>

42. Urban population data obtained from United Nations, “World Population Prospects: The 2004 Revision,” (2004). Population density of largest metropolitan areas obtained from Demographia, “Demographia World Urban Areas,” March 2007 <www.demographia.com/db-worldua.pdf>.

43. “Homeownership Rate of Selected Countries,” *Photius*, 2003 <www.photius.com/rankings/homeownership_rates.html>; and Eurostat statistics.

44. OECD, “GDP Per Capita,” OECDStat, 2008 <www.sourceoecd.org/database/OECDStat>

45. European Institute of Japanese Studies, “Average Yearly Temperature in Capital, OECD Countries,” *Economic and Social Data Rankings*, 2004 <www.dataranking.com/table.cgi?TP=ee01-2&LG=e&RG=1>.

46. U.S. Central Intelligence Agency, “Median Age,” *CIA World Factbook*, 2007 <www.cia.gov/library/publications/the-world-factbook/>..

47. International Telecommunications Union, “Internet Indicators: Subscribers, Users, and Broadband Subscribers,” International Telecommunications Union ICT Statistics Database, 2006 <www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx#>

48. OECD, “Table CO 9.1: Educational Attainment Expressed as Average Number of Years of Successfully Completed Formal Education,” 2004 <www.oecd.org/dataoecd/56/9/37863998.pdf>

49. U.S. Central Intelligence Agency, “Distribution of Family Income – Gini Coefficient,” *CIA World Factbook*, 2007 <www.cia.gov/library/publications/the-world-factbook/>..

50. OECD Directorate for Science, Technology, and Industry, “Price Ranges, Mbit/s,” Oct. 2007 <www.oecd.org/sti/ict/broadband>

51. OECD Directorate for Science and Technology, “OECD Key ICT Indicators: Households with Access to the Internet in Selected OECD Countries,” November 2007 <www.oecd.org/sti/ICTindicators> and “OECD Key ICT Indicators: Households with Access to a Home Computer,” November 2007 <www.oecd.org/sti/ICTindicators>.

52. OECD, “Computer and Internet Access by Household,” *OECD Factbook 2008*, April 2008 <puck.sourceoecd.org/pdf/factbook2008/302008011e-07-02-03.pdf>; and ITIF calculations. For ITIF Broadband Ranking sources, see endnote 6 above.

53. The composite education score is the sum of a nation’s standard deviation score on two measures of education: (1) the percentage of the population aged 25-64 with tertiary degrees; and (2) average years of formal education for population aged 25-64. OECD, OECD Factbook 2007: Economic, Environmental, and Social Statistics (Paris, France: OECD, 2007): 179; and OECD, “Educational Attainment by Gender and Average Years Spent in Formal Education,” 2006 <www.oecd.org/dataoecd/56/9/37863998.pdf>.

54. For a discussion of the role of competition on broadband, see Robert D. Atkinson, “The Role of Competition in a National Broadband Policy” (Washington, DC: Information Technology and Innovation Foundation, October 2007) <www.itif.org/files/BroadbandCompetition.pdf>.

55. Canadian Cable Television Association, “Achieving Excellence: Investing in People, Knowledge and Opportunity Canada’s Innovation Strategy—Comments of the Canadian Cable Television Association September 2002,” presented to the Minister of Industry <innovation.gc.ca/gol/innovation /site.nsf/en/in02268.html>.

56. Jörn Altmann and Karyen Chu, "How to Charge for Network Services - Flat Rate or Usage Based?" *Computer Networks* 36(5-6) (August 2001): 519.

57. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, "Korea Broadband Market Report 2005," n.d. <www.broadbandwalesobservatory.org.uk/broadband-3355>.

58. Yoonmi Kim, "Broadband Internet in Korea," *FINPRO Korea*, September 30, 2004 <akseli.tekes.fi/opencms/opencms/OhjelmaPortaali/ohjelmat/CONE/fi/Dokumenttiarkisto/Viestinta_ja_aktivointi/Seminaarit/Maaselvsem06/Fixed_Broadband-Korea_-_Kim.ppt >.

59. Korea's National Information Society Agency, Leading the Construction of u-Korea (Seoul, South Korea: National Information Society Agency, 2006): 9.

60. Canada's Telecommunications Policy Review Panel, op cit.

61. Ibid.

62. Canadian Radio-television and Telecommunications Commission, "CRTC Telecommunications Monitoring Report," July 2007 <www.crtc.gc.ca/eng/publications/reports/policymonitoring/2007/tmr2007.pdf>.

63. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, "Sweden Broadband Market Report 2005," n.d. <www.broadbandwalesobservatory.org.uk/broadband-3045>.

64. Arne Granholm, "The Swedish Commitment to Broadband both in the Cities and in the Countryside," Ministry of Industry, 2000 <www.oecd.org/dataoecd/25/27/2736714.pdf>.

65. Maria Häll and Patrik Fältström, "National Broadband Government Think Tank (Sweden) – An example of Technology Policy Development," Ministry of Industry, Employment, and Communications, April 28, 2006 <www.ripe.net/ripe/meetings/ripe-52/presentations/ripe52-plenary-sweden-think-tank.pdf>.

66. Sweden's Post and Telecom Agency (PTS), "Broadband Survey 2007," January 2008 <www.pts.se/ Dokument/dokument.asp?Sectionid=&Itemid=7679&Languageid=EN>.

67. Swedish Government Committee of Inquiry, "Bredband till hela landet," SOU 2008:40, April 18, 2008 <www.regeringen.se/content/1/c6/10/33/76/d6a4d016.pdf>.

68. Yasu Taniwaki, "Broadband Competition Policy to Address the Transition to IP-Based Networks: Experiences and Challenges in Japan" (Tokyo, Japan: International Foundation for Information Technology, October 2006): 10-11.

69. Ibid: 7-8.

70. Rob Frieden, "Lessons from Broadband Development in Canada, Japan, Korea, and the United States," *Telecommunications Policy* 29 (2005): 606.

71. Hyder Consulting, Ltd., Review of the UK Broadband Fund, report prepared for the U.K. Department of Trade and Industry, London, England, January 7, 2005 <www.berr.gov.uk/files/file13440.pdf>.

72. Paul Budde Communication Pty. Ltd., "France—Broadband Market: Overview, Statistics & Forecasts," *Telecommunications and Information Highways* (Bucketty, Australia: Paul Budde Communication Pty. Ltd., 2007): 9.

73. Ibid.

74. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, "Germany Broadband Market Report 2005" <www.broadbandwalesobservatory.org.uk/broadband-3323>.

75. Paul Budde Communication Pty. Ltd., "Germany—Broadband Market: Overview, Statistics & Forecasts," *Telecommunications and Information Highway* (Bucketty, Australia: Paul Budde Communication Pty, Ltd., 2007): 3.

76. See the Deutsches Forschungsnetz (DFN), the development of a high-bandwidth network for research and educational institutions and the Breitbandatlas in Arsyllfa Band Eang Cymru-Broadband Wales Observatory, "Germany Broadband Market Report 2005," 2005 <www.broadbandwalesobservatory.org.uk/broadband-3323>.

77. National Science Foundation, "A Brief History of NSF and the Internet," Arlington, Virginia, August 13, 2003 <www.nsf.gov/news/

news_summ.jsp?cntn_id=103050>.

78. Federal Communications Commission Federal-State Joint Board on Universal Service, "Federal Communications Commission Joint Board on Universal Service Recommended Decision in the Matter of High-Cost Universal Service," November 20, 2007 < hraunfoss.fcc.gov/edocs_public/ attachmatch/FCC-07J-4A1.pdf>.

79. Wireline Competition Bureau, Federal Communications Commission, "Section 706 Report and Broadband Data Gathering Order," presentation at the March 19, 2008, Open Meeting, Washington, D.C., March 19, 2008 <www.fcc.gov/WCB_031908_open_meeting_slides.pdf>.

80. Sung-Hee Joo, "Broadband Internet Adoption in Korea: A Maverick or a Model to Follow?" op. cit.: 5.

81. Paul Budde Communication Pty. Ltd., "South Korea—Broadband Market: Overview & Statistics" *Telecommunications and Information Highway* (Bucketty, Australia: Paul Budde Communication Pty. Ltd., 2007): 1.

82. Sung-Hee Joo, "Broadband Internet Adoption in Korea: A Maverick or a Model to Follow?" op. cit.: 5.

83. Dong-Hee Shin and Won-Yong Kim, "An Analysis of Korean National Information Strategy of IT839," Proceedings of the 41st Hawaii International Conference on System Sciences, IEEE, 2008 <csdl2.computer.org/comp/proceedings/hicss/2008/3075/00/30750225.pdf>.

84. Sung-Hee Joo, "Broadband Internet Adoption in Korea: A Maverick or a Model to Follow?" op. cit.: 5.

85. Martin Fransman (ed.), *Global Broadband Battles: Why the U.S. and Europe Lag While Asia Leads* (Stanford, California: Stanford Business Books, 2006): 68.

86. Ibid: 32.

87. Ibid.

88. Ibid: 69.

89. Paul Budde Communication Pty. Ltd., "Japan—Broadband: Overview & Statistics," *Telecommunications and Information Highways* (Bucketty, Australia: Paul Budde Communication Pty. Ltd., 2005): 3.

90. Martin Fransman (ed.), *Global Broadband Battles: Why the U.S. and Europe Lag While Asia Leads* (Stanford, California: Stanford Business Books, 2006): 29.

91. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, "Sweden Broadband Market Report 2005," 2005 <www.broadbandwalesobservatory.org.uk/broadband-3045>.

92. Takashi Ebihara, "Understanding the Japanese Broadband Miracle," presented at the Information Technology and Innovation Foundation Policy Forum, April 4, 2007 <www.itif.org/files/Ebihara_Japanese_Broadband.pdf>.

93. Martin Fransman (ed.), *Global Broadband Battles: Why the U.S. and Europe Lag While Asia Leads* (Stanford, California: Stanford Business Books, 2006): 62

94. John Borland and Michael Kanellos, "South Korea Leads the Way," *c/net News.Com*, July 28, 2004 <www.news.com/South-Korea-leads-the-way/2009-1034_3-5261393.html>.

95. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, "Korea Broadband Market Report 2005" <www.broadbandwalesobservatory.org.uk/broadband-3355>.

96. Dong-Hee Shin and Won-Yong Kim, "An Analysis of Korean National Information Strategy of IT839," Proceedings of the 41st Hawaii International Conference on System Sciences, IEEE, 2008 <csdl2.computer.org/comp/proceedings/hicss/2008/3075/00/30750225.pdf>.

97. This information was gathered from South Korean government officials in extensive interviews conducted by Robert D. Atkinson in November 2007.

98. Thomas Bleha, "Down to the Wire," *Foreign Affairs*, May/June 2005 <www.foreignaffairs.org/ 20050501faessay84311/thomas-bleha/down-to-the-wire.html>.

99. Takashi Ebihara, "Understanding the Japanese Broadband Miracle," presented at the Information Technology and Innovation Foundation Policy Forum, April 4, 2007 <www.itif.org/files/ Ebihara_Japanese_Broadband.pdf>.

100. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, "Sweden Broadband Market Report 2005" <www.broadbandwalesobservatory.org.uk/broadband-3045>.

101. OECD, "Broadband Statistics to June 2007," </www.oecd.org/document /7/0,3343,en_2649_34223_38446855_1_1_1_1,00.html>.

102. OECD, "OECD Broadband Statistics: Percentage of Fibre Connections in Total Broadband, June 2007," OECD Broadband Portal <www.oecd.org/dataoecd/21/58/39574845.xls>.

103. OECD, "OECD Broadband Statistics: Fastest Advertised Connection Offered by the Incumbent Operator (Oct 2007)," OECD Broadband Portal <www.oecd.org/dataoecd/10/55/39575114.xls>.

104. Freedom to Connect, "Open Fiber Session Freedom to Connect: Japan," March 31, 2008 <freedom-to-connect.net/#agenda>.

105. OECD, "OECD Broadband Statistics: Percentage of Fibre Connections in Total Broadband, June 2007," OECD Broadband Portal < www.oecd.org/dataoecd/21/58/39574845.xls>.

106. OECD, "OECD Broadband Statistics: Fastest Advertised Connection Offered by the Incumbent Operator (Oct 2007)," OECD Broadband Portal <www.oecd.org/dataoecd/10/55/39575114.xls>.

107. OECD, "Percentage of Fiber Connections to Total Broadband (June 2007)" <www.oecd.org/dataoecd/ 21/58/39574845.xls>.

108. Fiber-to-the-Home Council, "Fiber to the Home Connections Jump to Nearly Three Million as Next-Generation Broadband Deployment Continues" <www.ftthcouncil.org/?t=284>.

109. Verizon, "Verizon FIOS" <newscenter.verizon.com/kit/nxtcomm/Product-sheet-FiOS-1Q07.pdf>.

110. Steven Overbeck, "Clash Between Utopia and Telecom Giants Rages On," *The Salt Lake Tribune*, April 22, 2008 <www.sltrib.com/technology/ci_8984709>.

111. With SDV, cable broadband providers can more efficiently broadcast digital video either via a typical cable TV system or via the Internet, freeing up additional bandwidth. The DOCSIS standard, originally released in 1997, enables cable companies to deliver Internet access over their existing hybrid fiber coaxial (HFC) infrastructure. The latest version, DOCSIS 3.0, significantly increases transmission speeds for both uploading and downloading data. From Warren Communications News, Inc., "Cable Engineers Expect Multiple Tech Fixes for Rising Bandwidth Demand," *Communications Daily*, January 18, 2008 <www.warren-news.com/>.

112. Todd Spangler, "Comcast Debuts 'Wideband' in Twin Cities," *Multichannel News*, April 2008 <www.multichannel.com/article/CA6547304.html?industryid=47199>..

113. Ibid.

114. OECD, "Fastest Advertised Connection Available Among All Surveyed Operators, by Country, October 2007," OECD Broadband Portal <www.oecd.org/dataoecd/11/36/39575235.xls>.

115. IDATE, "IDATE News 407: FTTH Situation in Europe," (February 27, 2008): 1.

116. Ibid.

117. Ibid.

118. Ibid: 2.

119. JP Morgan European Equity Research, "The Fiber Battle," December 4, 2006.

120. Le Journal du Net, "Le Gouvernement Veut Accélérer le Déploiement de la Fibre Optique en France," December 14, 2007 <www.journaldunet.com/ebusiness/telecoms-fai/actualite/0712/071214-comite-de-pilotage-du-haut-debit-herve-novelli.shtml>.

121. Martin Fransman, "Why Japan and Korea Lead the U.S.A. and Europe in Broadband," *International Journal Technological Learning*, Innovation, and Development 1(1) (2007): 122.

122. Kurt Ruderman, "France Telecom Plans Massive FTTH Roll-out in 2009," *Lightwave Europe*, January 2008 < lw.pennnet.com/display_

article/321309/63/ARTCL/none/none/1/France-Telecom-plans-massive-FTTH-roll-out-in-2009/>.

123. See Ema Tanaka, Minoru Sugaya, Sayaka Shiotani, "Evolution of IP Network and Convergence in Japan – Impact of Hard law and Soft Law," presentation at ITS Conference in Beijing, 2006.06.13 and that unbundled fiber loops cost about $50 in slides 23-4 of "Understanding the Japanese Broadband Miracle," presented at the Information Technology and Innovation Foundation Policy Form, April 4, 2007 <www.itif.org/files/Ebihara_Japanese_Broadband.pdf>.

124. Thomas W. Hazlett and Anil Calistan, "Natural Experiments in U.S. Broadband Regulation," (Arlington, Virginia: George Mason University School of Law, February 2008): 15.

125. Light Reading, "EC Threatens Germany with Court Case," Light Reading Europe, February 26, 2007 <www.lightreading.com/document.asp?doc_id+118148&print_true>.

126. Ken Wieland, "FTTH Battles Loom Large in Europe," *Telecommunications Online*, January 24, 2008 <www.telecommagazine.com/article.asp?HH_ID=AR_3900>.

127. Ibid.

128. OPTA (the Dutch Independent Post and Telecommunications Authority), *Annual Report and Market Monitor 2006* (The Netherlands: OPTA, 2006): 24.

129. In line with its focus on promoting the development of broadband infrastructure for research while also providing limited funding to municipalities for residential and business broadband networks, the Dutch government provided grants totaling $155 million for the development of broadband networks for research (similar to the U.S. government's funding of ARPANET and NSFNET). Specifically, the government funded the GigaPort Next-Generation Network, a national infrastructure research network permanently at the disposal of the government, the IT industry, educational and research institutes, and the virtual lab e-science (VLE) for collaboration and testing new technologies. In addition, the Dutch government funded the Freeband Knowledge Impulse, a joint initiative of the government, industry, and academia to increase knowledge of fourth generation telecommunications among Dutch universities and institutes. Ibid.

130. Paul Budde Communication Pty. Ltd., "Netherlands—Broadband: Market Overview," *Telecommunications and Information Highways* (Bucketty, Australia: Paul Budde Communication Pty. Ltd., 2005): 23.

131. Canadian Advanced Network and Research for Industry and Education (CANARIE), "Stockholm's Municipal Fiber Network Stimulates New Business," *CAnet-3-NEWS*, Ottawa, Canada, April 17, 2000 <mail.canarie.ca/MLISTS/news2000/0079.html>.

132. Robert D. Atkinson, "The Role of Competition in a National Broadband Policy," (Washington, DC: Information Technology and Innovation Foundation, October 2007): 3.

133. Steven Overbeck, "Utopia: High Cost, High Speed," *The Salt Lake Tribune*, April 22, 2008 <www.sltrib.com/lottery/ci_8978590>.

134. Robert D. Atkinson, "The Role of Competition in a National Broadband Policy," (Washington, DC: Information Technology and Innovation Foundation, October 2007): 4.

135. Yasu Taniwaki, "Broadband Competition Policy to Address the Transition to IP-Based Networks: Experiences and Challenges in Japan" (Tokyo, Japan: International Foundation for Information Technology, October 2006): 7-8.

136. Martin Fransman (ed.), Global Broadband Battles: Why the U.S. and Europe Lag While Asia Leads, (Stanford, California: Stanford Business Books, 2006): 68.

137. Yasu Taniwaki, "Broadband Competition Policy to Address the Transition to IP-Based Networks: Experiences and Challenges in Japan" (Tokyo, Japan: International Foundation for Information Technology, October 2006): 68.

138. Insung Jun, "Broadband Networks in Korea," KT Presentation to the ITU, December 10, 2003 <www.itu.int/osg/spu/ni/futuremobile/pervasive/KTbroadbandnetworks2.pdf>.

139. Illiad, "Illiad 1st Half 2006 Results Presentation" <www.slideshare.net/samako/free-FTTH>.

140. Sweden's Post and Telecom Agency (PTS), "Broadband in Sweden," presentation to the Information Technology and Innovation Foundation (ITIF) on December 7, 2007.

141. Swedish Government Committee of Inquiry, "Bredband till hela landet," SOU 2008:40, April 18, 2008 <www.regeringen.se/content/1/c6/10/33/76/d6a4d016.pdf>.

142. "Broadband Survey 2007," (PTS, Sweden, January 2008) <www.pts.se/en-gb/Documents/Reports/Internet/2008/Broadband-survey-2007---PTS-ER-20085/>.

143. Swedish Government Committee of Inquiry, "Bredband till hela landet," SOU 2008:40, April 18, 2008 <www.regeringen.se/content/1/c6/10/33/76/d6a4d016.pdf>.

144. OECD Directorate for Science, Technology, and Industry, Committee for Information, Computer and Communications Policy, "Working Party on Telecommunication and Information Services Policies: The Development of Broadband Access in Rural and Remote Areas," (Geneva, Switzerland: OECD, May 10, 2004): 30.

145. Ibid: 31.

146. Yong-Hwan Chung, "Korean National Policies to Close the Digital Divide," Ministry of Information and Communication, August 6, 2002 < unpan1.un.org/intradoc/groups/public/documents /APCITY/UNPAN006369.pdf>.

147. Yonosuki Harada and Keiji Okada, "The Dynamics of Broadband in Japan: Some Best Effort for Broadband Penetration," presentation for NESCAP, June 21, 2007 <www.unescap.org/icstd/events/ RW_JUNE2007/HARADA.pdf>.

148. Yasu Taniwaki, "Broadband Competition Policy to Address the Transition to IP-Based Networks: Experiences and Challenges in Japan" (Tokyo, Japan: International Foundation for Information Technology, October 2006): 7.

149. Tanawaki Ida, "The Broadband Market in Japan: Discussion Paper No. 049 Interfaces for Advanced Economic Analysis (Kyoto, Japan: Kyoto University, December 2004): 4-5.

150. Ibid.

151. Industry Canada, "Government of Canada Announces Broadband Access Via Satellite for 52 Remote Communities," May 20, 2004 <www.ic.gc.ca/cmb/welcomeic.nsf/ cdd9dc973c4bf6bc852564ca006418a0/85256a5d006b972085256e9a00725a04!OpenDocument>.

152. Infrastructure Canada, "Canada Strategic Infrastructure Fund" <www.unescap.org/icstd/events /RW_JUNE2007/HARADA.pdf>.

153. Ibid: 17.

154. Alberta SuperNet Project, "Service Alberta"<www.albertasupernet.ca/The+Project/>.

155. Catherine Allison, "Getting Small Towns Up to Speed," *Capital News Online*, March 7, 2003 <www.carleton.ca/jmc/cnews/07032003/n1.shtml>.

156. CBC News [Canada], "CRTC Orders Rural Broadband Expansion, Phone Rebates," January 17, 2008 <www.cbc.ca/technology/story/2008/01/17/tech-rural-broadband.html>.

157. Broadband Stakeholders Group, "UK National Broadband Strategy" (London: U.K. Department for Business, Enterprise, and Regulatory Reform, 2004): 8

158. Ibid.

159. Ibid: 6.

160. OECD Directorate for Science, Technology, and Industry, Committee for Information, Computer and Communications Policy, "Working Party on Telecommunication and Information Services Policies: The Development of Broadband Access in Rural and Remote Areas," (Geneva, Switzerland: OECD, May 10, 2004):23.

161. Ibid.

162. Ibid.

163. Ibid: 24.

164. Ibid: 10.

165. U.S. Department of Agriculture, *USDA Rural Development: Bringing Broadband to Rural America* (Washington, DC: USDA, May 2007): 4.

166. Ibid.

167. Wireline Competition Bureau, Federal Communications Commission, "High-Speed Services for Internet Access," January 2007 <fjallfoss.fcc.gov/edocs_public/attachmatch/DOC-270128A1.pdf>.

168. Specifically, the Canadian Radio-Television and Telecommunications Commission (CRTC) required telecommunications service providers to give their competitors access to their facilities as required under the 1993 Telecommunications Act.

169. National Cable & Telecommunications Ass'n v. Brand X Internet Services, 125 S. Ct. 2688 (2005).

170. James B. Speta, "Commentary: Policy Levers and Demand Drivers in Korean Broadband Penetration," *Journal of Korean Law*, 4(1) (2004): 15.

171. Ibid.

172. U.K. Department of Trade and Industry, "Exploiting the Broadband Opportunity: Lessons from South Korea and Japan," *Global Watch Mission Report* (London, United Kingdom: UK Department of Trade and Industry, December 2005): 23.

173. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, "Korea Broadband Market Report 2005" <www.broadbandwalesobservatory.org.uk/broadband-3355>.

174. Paul Budde Communication Pty. Ltd., "South Korea—Broadband Market: Overview & Statistics" *Telecommunications and Information Highways* (Bucketty, Australia: Paul Budde Communication Pty. Ltd., 2007): 9.

175. We see this in Australia as well. The Australian government allowed Telstra, the incumbent telecommunications operator, to take over the nascent cable companies in the early 1990s, thereby dramatically limiting cable broadband competition. Consequently Australia has among the lowest cable penetration in the OECD see "OECD Broadband subscribers per 100 inhabitants, by technology, June 2007" <www.oecd.org/dataoecd/21/35/39574709.xls>.

176. Numericable has since bought Noos. Martin Fransman (ed.) *Global Broadband Battles: Why the U.S. and Europe Lag While Asia Leads* (Stanford, California; Stanford Business Books, 2006): 179.

177. Margit A. Vanberg, "Competition in the German Broadband Access Market," ZEW Centre for European Economic Research, Discussion Paper No. 02-80 (October 2002): 12.

178. "KDDI FTTH Takes Big Jump," Telco IPTV View, April 30, 2007 <telcotv-view.blogspot.com/2007_04_01_archive.html>.

179. European Parliament and the Council of the European Union, "Regulation (EC) No 2887/2000 of the European Parliament and of the Council of 18 December 2000 on Unbundled Access to the Local Loop," *Official Journal of the European Communities* < eur-lex.europa.eu/pri/en/oj/dat/2000/l_336/l_33620001230en00040008.pdf >.

180. Ibid.

181. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, "Sweden Broadband Market Report 2005" <www.broadbandwalesobservatory.org.uk/broadband-3045>.

182. Post & Telestyrelsen, *Broadband Prices in the Nordic Countries in 2006* (Stockholm, Sweden: Post & Telestyrelsen, January 2007): 58.

183. Post & Telestyrelsen, "The Swedish Telecommunications market First Half Year 2007," (2007).

184. Martin Fransman (ed.), *Global Broadband Battles: Why the U.S. and Europe Lag While Asia Leads* (Stanford, California: Stanford Business Books, 2006): 47.

185. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, "Sweden Broadband Market Report 2005" <www.broadbandwalesobservatory.org.uk/broadband-3045>.

186. ARCEP, ARCEP's Annual Report 2006, July 2007 <www.art-telecom.fr/uploads/tx_gspublication/rap2006-light-eng.zip>.

187. Paul Budde Communication Pty. Ltd., "France—Broadband Market: Overview, Statistics & Forecasts," *Telecommunications and Information Highways* (Bucketty, Australia: Paul Budde Communication Pty., Ltd., 2007): 1.

188. Ibid: 7.

189. Paul Budde Communication Pty. Ltd., "Germany—Broadband Market: Overview, Statistics & Forecasts," *Telecommunications and Information Highways* (Bucketty, Australia: Paul Budde Communication Pty. Ltd., 2007): 2.

190. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, “Germany Broadband Market Report 2005” <www.broadbandwalesobservatory.org.uk/broadband-3323>.

191. OPTA (the Dutch Independent Post and Telecommunications Authority), *OPTA Annual Report and Market Monitor 2006* (The Netherlands: OPTA, 2006): 1

192. U.K. Office of Communications, *The Communications Market: Broadband: Digital Progress Report* (London, United Kingdom: April 2, 2007): 9.

193. BT Retail is the subsidiary of BT Group which sells telecom services to end users, and Openreach was established to ensure other operators such as those utilizing LLU have equal and fair access to the access network on the same terms as BT Retail. From Wikipedia, “Openreach,” <en.wikipedia.org/wiki/Openreach>.

194. U.K. Office of Communications, “Ofcom Proposes Wholesale Broadband Deregulation in Newly Competitive Markets,” London, England, November 15, 2007 <www.ofcom.org.uk/media/news /2007/11/nr_20071115>.

195. Paul Budde Communication Pty. Ltd., “Japan—Broadband: Market Overview,” *Telecommunications and Information Highways* (Bucketty, Australia: Paul Budde Communication Pty. Ltd., 2005): 5.

196. Ibid: 30.

197. EDUCAUSE, “A Blueprint for Big Broadband: An EDUCAUSE White Paper,” January 2008 <www.educause.edu/ir/library/pdf/EPO0801.pdf>.

198. Ofcom, the UK regulator has stated, “Ideally the competition should be at the infrastructure level, rather than solely at the service level. Since this is likely to deliver the most choice and innovation for consumers.” From Ofcom, “Public Broadband Schemes: A Best Practice Guide,” United Kingdom, February 2007 <www.berr.gov.uk/files/file37744.pdf>.

199. European Parliament and the Council of the European Union, “Regulation (EC) No 2887/2000 of the European Parliament and of the Council of 18 December 2000 on Unbundled Access to the Local Loop,” Official Journal of the European Communities <eur-lex.europa.eu/pri/en/oj/dat/2000/l_336/l_33620001230en00040008.pdf>.

200. OECD Directorate for Science, Technology, and Industry, “Broadband Statistics to June 2007,”October 2007 <www.oecd.org/sti/ict/broadband>

201. “BT Deploys FTTH in Kent,” Screen Digest, February 7, 2007 <www.screendigest.com/online_services/ intelligence/broadband/updates/bi-070207-jg1sj/view.html>.

202. Ibid.

203. Sung-Hee Joo, “Broadband Internet Adoption in Korea: A Maverick or a Model to Follow?” op. cit.: 7.

204. Jack Schofield, “Miracle Workers: In Just Five Years, South Korea has Shown the World What the Broadband Future Looks like,” The Guardian [London, United Kingdom] October 17, 2002 <www.guardian.co.uk/internetnews/story/0,7369,812943,00.html>.

205. “Introduction of KADO,” available at Web site of the United Nations Online Network in Public Administration and Finance (UNPAN) <unpan1.un.org/intradoc/groups/public/documents/ UNPAN/UNPAN028063.pdf>.

206. Kenji Kushida and Seung-Yuon Oh, “Understanding South Korea and Japan’s Spectacular Broadband Development: Strategic Liberalization of the Telecommunications Sectors,” BRIE Working Paper 175 (Berkeley, California: BRIE, University of California, June 29, 2006) <brie.berkeley.edu/publications/wp175.pdf>.

207. Martin Fransman (ed.), *Global Broadband Battles: Why the U.S. and Europe Lag While Asia Leads* (Stanford, California: Stanford Business Books 2006): 243.

208. Ibid.

209. The Prime Minister’s Strategy Unit and the Department of Trade and Industry, “Connecting the UK: the Digital Strategy” (London, United Kingdom: The Prime Minister’s Strategy Unit and the Department of Trade and Industry, March 2005): 8.

210. Ibid: 24.

211. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, “Germany Broadband Market Report 2005” <www.

broadbandwalesobservatory.org.uk/broadband-3323>.

212. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, "United Kingdom Broadband Market Report 2006" <www.bbwo.org.uk/broadband-3277>..

213. See North Carolina's e-NC Authority at <www.e-nc.org/Webpage.asp?page=10> describing North Carolina's program for expanding Internet and technology to rural areas. See also About Connect Kentucky at <www.connect-kentucy.org/about/> explaining the benefits of the Connect Kentucky program.

214. See David Baker et al., Mayor's Advisory Council, The City that Networks: Transforming Society and Economy Through Digital Excellence 3, 2007 <elearning.cps.k12.il.us/docs-/ChicagoDigitalDivide%202007.pdf>.

215. See SeniorNet Membership at <www.seniornet.org/jsnet/index.php?-option=com_content&task=view&id=52&Itemid=65> on providing computer and Internet education for older adults and seniors.

216. See Computers for Youth at <www.cfy.org> on providing computer education to low-income students.

217. See One Economy Corporation, "Company," <www.one-economy.com/company>.

218. James B. Speta, "Commentary: Policy Levers and Demand Drivers in Korean Broadband Penetration," *Journal of Korean Law*, 4(1) (2004): 3.

219. Sung-Hee Joo, "Broadband Internet Adoption in Korea: A Maverick or a Model to Follow?" op. cit.: 7.

220. Krishna Jayakar and Harmeet Sawhney, "Universal Access in the Information Economy: Tracking Policy Innovations Abroad" (Washington, DC: Benton Foundation Universal Service Report, April 19, 2007): 43.

221. Ibid: 248.

222. Paul Budde Communication Pty. Ltd., "Germany—Broadband Market: Overview, Statistics & Forecasts," *Telecommunications and Information Highways* (Bucketty, Australia: Paul Budde Communication Pty., Ltd., 2007): 13.

223. The E-rate provides discounts of 20 percent to 90 percent for eligible telecommunications services, depending on economic need and location (urban or rural). The level of discount is based on the percentage of students eligible for participation the National School Lunch Program or other federally approved alternative mechanisms. From the Department of Education, "E-Rate Program—Discounted Telecommunications Services" <www.ed.gov/about/offices/list/oii/nonpublic/erate.html>.

224. Education Library and Networks Coalition, *E-Rate: A Vision of Opportunity and Innovation*, July 2003 <www.edlinc.org/pdf/ERateReport070803lores.pdf>.

225. Kenneth Flamm and Anindya Chauduri, "An Analysis of the Determinants of Broadband Access," *Telecommunications Policy* 31(6-7), July 2007 <web.si.umich.edu/tprc/papers/2005/485/Broadband.pdf >.

226. The Department of Education, "Public Schools and Classrooms: 1994-2005," NCES 2007-020, </nces.ed.gov/pubs2007/2007020.pdf>.

227. Dong-Hee Shin and Won-Yong Kim, "An Analysis of Korean National Information Strategy of IT839," Proceedings of the 41st Hawaii International Conference on System Sciences, IEEE, 2008 <csdl2.computer.org/comp/proceedings/hicss/2008/3075/00/30750225.pdf>.

228. Yasu Taniwaki, "Broadband Competition Policy to Address the Transition to IP-Based Networks: Experiences and Challenges in Japan" (Tokyo, Japan: International Foundation for Information Technology, October 2006): 7.

229. Technology Strategy Board, "Collaborative Research and Development," February 27, 2008 <www.innovateuk.org/deliveringinnovation/collaborativeresearchanddevelopment.ashx>

230. AlphaRoute, "About AlphaRoute," <www.ressources.alpharoute.org/about.asp>.

231. Japan's Ministry of Internal Affairs and Communications, *Information and Communications in Japan* (Tokyo, Japan:, 2006): 41.

232. Paul Budde Communication Pty. Ltd., "Netherlands—Broadband: Market Overview," *Telecommunications and Information Highways* (Bucketty, Australia: Paul Budde Communication Pty. Ltd., 2005): 11.

233. U.S. Office of Management and Budget, "Report to Congress on the Benefits of E-Government Initiatives" <www.whitehouse.gov/omb/egov/g-10-Section_841.html>.

234. U.K. Prime Minister's Strategy Unit and U.K. Department of Trade and Industry, *Connecting the UK: The Digital Strategy* (London: March 2005): 8.

235. Robert D. Atkinson, "The Case for a National Broadband Policy" (Washington, DC: Information Technology and Innovation Foundation, June 2007) <www.itif.org/files/CaseForNational BroadbandPolicy.pdf>.

236 See Yorman Margalioth, The Case for Tax Indexation of Debt, 15 Am. J. Tax Pol'y 205, 220–22 (1998).

237. H.R. 1818, 110th Cong. (2007).

238. See "ITIF Forum: There is a Free Lunch—How Opening Up Unused 'White Spaces' on the Airwaves Will Drive Broadband Innovation" (Washington, DC: Information Technology and Innovation Foundation, October 2, 2007) <www.itif.org/index.php?id=81>.

239. 2007 Farm Bill, Title VI: Rural Development (H.R. 2419).

240. Federal Communications Commission Federal-State Joint Board on Universal Service, "Federal Communications Commission Joint Board on Universal Service Recommended Decision in the Matter of High-Cost Universal Service," November 20, 2007 <hraunfoss.fcc.gov/edocs_public/ attachmatch/FCC-07J-4A1.pdf>.

241. Federal Communications Commission Federal-State Joint Board on Universal Service, "Federal Communications Commission Joint Board on Universal Service Recommended Decision in the Matter of High-Cost Universal Service," November 20, 2007 <hraunfoss.fcc.gov/edocs_public/ attachmatch/FCC-07J-4A1.pdf>.

242. While we do not believe it makes economic sense to provide urban-grade broadband to all rural and remote areas, it is nonetheless important for high-cost areas to have access to the fastest broadband technology that is economically feasible.

243. See ConnectKentucky.org, Message From Our Steering Committee Chairman: "More impressive than the positive publicity generated by ConnectKentucky are the non-profit group's results that have sparked a technology and economic development turn-around for the Commonwealth. ConnectKentucky connects people to technology in a way that helps improve their lives. Previously declining Kentucky communities are now connected to high-speed Internet (broadband) and it is making a difference." <www.connectkentucky.org/about_us/Message_from_Our_Steering_Committee_Chairman.ph>.

244. For example, the "Connect America Act," introduced by Senator Richard Durbin (D-IL) in 2007, would create a State Broadband Data and Development Grant Program to award grants to eligible entities for the development and implementation of statewide initiatives to identify and track the availability and adoption of broadband services within each State. S. 1190, 110th Congress (2007).

245. See "ITIF Comments on the FCC Broadband Notice of Proposed Rulemaking" at <www.itif.org/files/ITIF_Comments_on_FCC_Broadband_NPRM.pdf> and also the Virginia Tech eCorridors program at <www.ecorridors.vt.edu/>.

246. See The California Broadband Task Force, "The State of Connectivity: Building Innovation Through Broadband," (Sacramento, California: January 2008): 63.

247. See generally, the Pew/Internet report Digital Divisions at <www.pewinternet.org/pdfs/PIP_Digital_Divisions_Oct_5_2005.pdf>.

248. See Technology Opportunities Program, About TOP at <www.ntia.doc.gov/top/about.html>.

249. Ibid.

250. Daniel Castro, "The Case for Tax-Free Internet Access: A Primer on the Internet Tax Freedom Act" Information Technology and Innovation Foundation, 2007 <www.itif.org/files/ITFA.pdf>.

251. Daniel Castro, "Improving Health Care: Why a Dose of IT May be Just What the Doctor Ordered" Information Technology and Innovation Foundation, 2007 <www.itif.org/files/HealthIT.pdf>.

252. Robert D. Atkinson, Shane Ham, and Brian Newkirk, "Unleashing the Potential of the High-Speed Internet" (Washington, DC: Progressive Policy Institute, 2002) <www.ppionline.org/documents/Broadband_0902.pdf>.

# Appendix A: Canada

## Overview

**ITIF Rank: 11**

| | | | |
|---|---|---|---|
| **Subscribers per Household[1]** | **0.65** | **Incumbent Government Owned** | **0%** |
| **Internet Users in Millions[2]** | **22** | **Local Loop Unbundling:[3]** | |
| **Internet Users per 100 Inhabitants[4]** | **67.89** | **Full Copper Loop** | **Yes** |
| **Average Speed in Megabits per Second (Mbps)[5]** | **7.6** | **Shared Copper Loop** | **Yes** |
| **Price Per Month of 1 Mbps USD PPP[6]** | **6.5** | **Bitstream** | **Yes** |
| **Percent of Urban Population[7]** | **81** | **Cable** | **Yes** |
| **Population Density per sq. km[8]** | **3** | **Fiber** | **No** |

## Geography and Demography

Canada has a population density of only 3 people per square kilometer (as compared to 31 in the United States).[9] Yet, the majority of its citizens are clustered in the major metropolitan centers of Vancouver in the west, Toronto in the Midwest, and Ottawa and Montreal in the east, with the percentage of urban population nearly equal to the United States (80 percent versus 81 percent, respectively).[10] At the end of 2006 the country's broadband penetration reached nearly 100 percent in urban areas and 78 percent in rural areas.[11]

## Policy

In 1993 the Canadian government established initiatives to spur broadband development and increase Canadian citizens' "connectedness." From 1996 to 2006 the Canadian government invested nearly $250 million each year[12] to promote on-line access, adopting incentives for companies to create indigenous Internet content, expediting e-commerce, and promoting cross-agency e-government services.[13] In 2001 the government's National Broadband Task Force created two programs to provide targeted grants for public-private partnerships in rural communities to create broadband infrastructure. These are the Broadband for Rural and Northern Development (BRAND) in 2002 and the National Satellite Initiative (NSI) in 2003.[14] The Canadian government designed BRAND as a pilot program to provide broadband access to 900 rural communities, but it continues to allocate satellite capacity to rural communities via the NSI and, in 2006, created the Ubiquitous Canadian Access Network (U-CAN) program to provide targeted grants to communities to establish broadband access where commercial operators are not providing services.[15]

## Rural Access

In 2002 the government charged the Communications Research Centre Canada (CRC), part of Industry Canada, with researching, developing, and testing innovative broadband technologies that would be best suited to providing

**Rural Access (*continued*)**

access in rural areas.[16] In its 2006 report Industry Canada's Telecommunications Policy Review Panel determined that 1.5 million Canadians would be left without broadband connectivity without further government support and that the government should set a goal of providing broadband access to 98 percent of Canadian households by 2010.[17] It recommended that the government must complement market forces with well-targeted government initiatives, particularly focusing on communities in areas that the market is unlikely to serve.[18]

Some examples of the government's support for rural access include BRAND funding of $80 million to eligible communities for broadband infrastructure projects, such as British Columbia's SPAN/BC (Shared Provincial Access Network); Alberta's SuperNet, a public-private partnership to link schools, libraries, healthcare facilities, and government offices; Saskatchewan's CommunityNet, a public-private partnership to provide broadband service to public sector institutions; Manitoba's "Rural and Northern Telecommunications Infrastructure" and "High-Speed Internet Access for Public Institutions" programs, Ontario's "Rural Economic Development (RED) and "Connect Ontario: Broadband Regional Access (COBRA)" programs; and Québec's "Villages branches du Québec" program to deploy broadband to schools and municipalities.[19] In another example, in 2004 the Canadian government gave $155 million of satellite capacity to the government of British Columbia, Broadband Communications North (a broadband service provider), Grassy Narrows First Nations, and the Kativik Regional Government to deploy broadband services allocated through a license agreement between the government and Telesat Canada.[20]

In addition, in 2006 Inukshuk Wireless, a joint venture between Bell Canada and Rogers Communications, launched the first phase of a WiMAX network covering over 5 million households in selected areas across Canada. Bell and Rogers used their existing cell towers to install the network with spectrum the government had previously licensed to them. The government's licensing arrangement stipulated that the provider had to make the service available to at least 25 unserved rural areas by 2007 and to 50 by mid-2008. Bell Canada is offering the service as "Sympatico High Speed Unplugged" for $45 CAN per month for 512Kbps downstream (or, for $15 CAN more, 3 Mbps). Rogers is calling its service "Portable Internet" and is charging $49.95 CAN per month for 1.5 Mbps. These prices are relatively high for broadband in the Canadian market, but are targeted to rural areas where broadband might otherwise not be available.[21]

**Competition**

Although the Canadian government has continued to focus on promoting broadband access to rural communities through the use of targeted subsidies, it also relies on market forces. Until recently, to ensure competition in the market, the Canadian Radio-Television and Telecommunications Commission (CRTC) required telecommunications service providers to give their competitors access to their facilities. However, in 2006 the Canadian Telecommunications Policy Review Panel recommended relaxing the open access regulations of the 1993 Telecommunications Act to limit regulation only to essential facilities. Thus, in April 2007 the government announced that it would continue to deregulate the telecommunications market, including allowing incumbent providers to set prices in markets where competitors are providing fixed telephony services via other facilities (such as wireless or cable). The government also would not regulate (forebear from regulation) in markets where at least 2 carriers service 75 percent of residential customers. Accordingly, the major telecommunications service providers – Bell Canada, Aliant, Telus, and SaskTel, asked the CRTC to forebear from regulating their services.[22]

Cable broadband subscribers are increasing in Canada and cable is most popular in the Western provinces and territories and in large communities. Cable is providing strong facilities-based competition to digital subscriber

## Competition (*continued*)

line (DSL) and cable companies provided cable modem services as early as 1996.[23] By 2007 cable continued to lead DSL in percentage of broadband subscribers (52 to 48 percent, respectively).[24] From 2005 to 2006 cable modem subscribers increased by 15 percent for all four major cable companies.[25] Although the CRTC has mandated both resale and third-party access to cable and DSL facilities, the primary competitors are the incumbent cable and telephony carriers.[26] The four major cable service providers are Shaw Cablesystems, with 36 percent of the cable broadband market in 2006, Rogers Cable, with 34 percent, Vidéotron with 21 percent, and Cogeco, with 9 percent.[27]

## Fiber

The rollout of fiber-to-the-home (FTTH) has been slow in Canada, perhaps because of the high penetration of both cable and DSL broadband services.[28] However, in an agreement with British Columbia, Telus deployed fiber networks in 113 remote communities in 2006 with speeds of 15-30 mbps.[29] In addition, Bell partnered with the Alberta government to build the AlbertaSupernet, a broadband network for government offices, schools, health-care facilities, and libraries using fiber-optic technology.[30]

## Demand

Of the many programs funded by the government, two that have been most successful are the SchoolNet program, which linked all of the country's schools and libraries to the Internet, and the Community Access Program (CAP), which provides daily public access to the Internet to 100,000 Canadians. In addition to government programs, the popularity of high-bandwidth Internet activities also is generating demand. Internet users in Canada reported increasing interest in several online activities that require broadband access, including online gaming (24.4 percent), music downloads (23.3 percent), and education and training (22.9 percent).[31] Consequently, all of the major providers are increasing bandwidth as well as offering content to further spur demand. Bell Canada is deploying very high speed digital subscriber line (VDSL) in Toronto and will extend high-speed Internet services to rural and remote areas of Ontario and Quebec, which will allow it to offer digital television service to these subscribers. In 2006, Bell had approximately 1.8 million subscribers to its video services. Bell also offers subscribers access to one of the most popular portals in Canada – the Sympatico.MSN.ca portal – in collaboration with Microsoft.[32] Telus is expanding into triple play services and rolled out Telus TV and Pay Per View in 2006, along with integrated digital wireless voice, data, and Internet.[33] The regional telephony providers also are moving into triple play, such as MTS Allstream – the main provider in Manitoba – and SaskTel, the telecommunications provider in Saskatchewan.[34] Not surprisingly, cable providers, which already offer their customers television content, also are offering triple play offerings. For example, Shaw and Vidéotron offer bundled services with high-speed Internet, digital television, and video-on-demand (VoD), and Shaw also providers Direct-to-Home (DTH) satellite broadband.[35] Similarly, Rogers and Cogeco both offer voice telephony over cable as well as VoD.[36]

## ENDNOTES

1. OECD measures penetration on a per capita basis because comprehensive data on household penetration is generally unavailable. ITIF has used average household size as a multiplier to convert June 2007 OECD per capita penetration data to household penetration data. It should be noted that one problem with this method is that the OECD data likely also includes some DSL business subscribers.

2. International Telecommunications Union, "Internet Indicators: Subscribers, Users, and Broadband Subscribers," *International Telecommunications Union ICT Statistics Database*, 2006 <www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx#>.

3. Unbundling is a policy by which regulators require incumbent telecommunications operators (those with dominant market status who control access to the telecommunications infrastructure) or cable companies to give their competitors access to raw copper pairs, fiber, or coaxial cable networks so that they can install their own transmission equipment at the incumbent's central office (local exchange). *Full unbundling* requires the incumbent to make all copper pair frequencies or fiber networks available to competitors. *Shared access* to the local loop requires the incumbent to make the "high" frequency bands (those that carry data, but not voice) of the copper pair available to its competitors, allowing them to offer xDSL broadband services. *Bitstream access* requires incumbent operators to allow competitors access to the incumbents' equipment at their central office. *Cable access* enables competitors to use cable companies' coaxial cable local loops and *fiber access* requires telecommunications operators to give competitors access to their fiber local loops.

4. International Telecommunications Union, "Internet Indicators: Subscribers, Users, and Broadband Subscribers," *International Telecommunications Union ICT Statistics Database*, 2006 <www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx#>.

5. Our methodology for calculating broadband speed in the ITIF Broadband Rankings involves averaging the speeds of the incumbent DSL, cable and fiber offerings provided in the OECD's April 2006 "Multiple Play," report, with each assigned a weight according to that technology's respective percentage of the nations overall broadband subscribership, as reported in the OECD's "Broadband Statistics to December 2006."

6. USD price per bit (PPP) of the fastest available technology is calculated from the broadband offerings examined in the OECD's "Multiple Play: Pricing and Policy Trends" report.

7. The World Bank, "Information and Communications for Development 2006," (2006): 172.

8. United Nations, "World Population Prospects: The 2006 Revision Population Database," 2007 <esa.un.org/unpp/>.

9. Ibid.

10. The World Bank, "Information and Communications for Development 2006," (2006): 172.

11. Canadian Radio-television and Telecommunications Commission, "CRTC Telecommunications Monitoring Report," July 2007 <www.crtc.gc.ca/eng/publications/reports/policymonitoring/2007/tmr2007.pdf>.

12. Robert D. Atkinson, "Unsatisfactory Progress: The Bush Government's Performance on E-Government Initiatives," (Washington, DC: The Progressive Policy Institute, October 2004): 3.

13. Rob Frieden, "Lessons from Broadband Development in Canada, Japan, Korea, and the United States," *Telecommunications Policy 29* (2005): 605.

14. Industry Canada, "Chapter 8: Connectivity: Completing the Job," *Telecommunications Policy Review Panel Final Report 2006* (2006): 3.

15. Industry Canada, *Telecommunications Policy Review Panel Final Report 2006*: <www.telecomreview.ca/epic/site/tprp-gecrt.nsf/en/rx00062e.html#T4>.

16. Paul Budde Communication Pty Ltd, "Canada - Broadband Market - Overview, Statistics & Forecasts," *Telecommunications and Information Highways* (Bucketty, Australia: 2007): 3.

17. Industry Canada, "Chapter 8: Connectivity: Completing the Job," *Telecommunications Policy Review Panel: Final Report 2006* (2006): 6-8.

18. Ibid: 7.

19. Ben Veenhof, Prabir Neogi, and Bryan van Tol, "High-Speed on the Information Highway: Broadband in Canada," (Statistics Canada: September 2003): 20.

20. Industry Canada, "Government of Canada Announces Broadband Access Via Satellite for 52 Remote Communities," May 20, 2004 <www.ic.gc.ca/cmb/welcomeic.nsf/cdd9dc973c4bf6bc852564ca006418a0/85256a5d006b972085256e9a00725a04!OpenDocument>.

21. Eric Bangeman, "Canadian WiMAX Network Launched," *ars technica* April 2, 2006 <arstechnica.com/news.ars/post/20060402-6507.html>.

22. Paul Budde Communication Pty Ltd, "Canada - Broadband Market - Overview, Statistics & Forecasts," Telecommunications and Information Highways, (Bucketty, Australia: 2007): 4-5.

23. Industry Canada, Chapter 8: Connectivity: Completing the Job," *Telecommunications Policy Review Panel Final Report 2006* (2006): 3.

24. Paul Budde Communication Pty Ltd, "Canada - Broadband Market - Overview, Statistics & Forecasts," *Telecommunications and Information Highways* (Bucketty, Australia: 2007): 2.

25. Ibid: 8.

26. Ben Veenhof, Prabir Neogi, and Bryan van Tol, "High-Speed on the Information Highway: Broadband in Canada," (Statistics Canada: September 2003): 16.

27. Paul Budde Communication Pty Ltd, "Canada - Broadband Market - Overview, Statistics & Forecasts," *Telecommunications and Information Highways* (Bucketty, Australia: 2007): 8.

28. Ibid: 16.

29. Ibid: 17.

30. Ibid.

31. Ben Veenhof, Prabir Neogi, and Bryan van Tol, "High-Speed on the Information Highway: Broadband in Canada," (Statistics Canada: September 2003): 10.

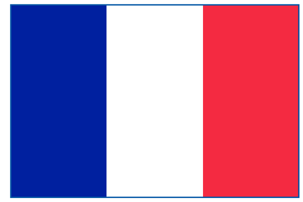
32. Paul Budde Communication Pty Ltd, "Canada - Broadband Market - Overview, Statistics & Forecasts," *Telecommunications and Information Highways* (Bucketty, Australia: 2007): 13.

33. Ibid: 14.

34. Ibid: 15.

35. Ibid: 8.

36. Ibid: 8-11.



# Appendix B: France

## Overview

**ITIF Rank: 5**

| | | | |
|---|---|---|---|
| **Subscribers per Household[1]** | **0.54** | **Incumbent Government Owned** | **32.5%** |
| **Internet Users in Millions[2]** | **30.1** | **Local Loop Unbundling:[3]** | |
| **Internet Users per 100 Inhabitants[4]** | **49.57** | **Full Copper Loop** | **Yes** |
| **Average Speed in Megabits per Second (Mbps)[5]** | **17.6** | **Shared Copper Loop** | **Yes** |
| **Price Per Month of 1 Mbps USD PPP[6]** | **1.64** | **Bitstream** | **Yes** |
| **Percent of Urban Population[7]** | **76** | **Cable** | **No** |
| **Population Density per sq. km[8]** | **111** | **Fiber** | **No** |

## Geography and Demography

France is a large country with a varied terrain of plains, valleys, hills, and large mountain ranges in the South and East. The country is more densely populated than the United States, at 111 people per square kilometer compared to 31,[9] but its percentage of urban population is not much less than in the United States (76 compared to 80 percent, respectively).[10] Yet, France has the second highest population in Europe, with 60 million people, second only to Germany, with 82.6 million people.[11]

## Policy

Initially, the French government did not focus on funding broadband infrastructure and services, either in rural or in urban areas. In fact, the government's "e-Europe Plan 2005," established in 2000, envisioned that the private sector would take the lead role in broadband development.[12] Yet, by 2001 the government realized that market forces alone would not provide the level of broadband the government desired. Thus, the French government gave local authorities a greater role in the development of broadband infrastructure and mandated that the Caisse des Dépôts et Consignations (CDC, a government-owned bank) should be able to provide loans at reduced rates to local municipalities for broadband development. Nonetheless, the government at first stipulated that in order to receive these loans municipalities had to ensure fair, transparent and non-discriminatory access to rights of way and, while they could establish broadband infrastructure, they could not act as telecommunications operators.[13] In 2003, however, the French Parliament passed a law enabling local authorities to be telecommunications operators as long as there were no other available broadband providers.[14]

## Rural Access

Several local governments in France have used loans from the CDC to develop broadband infrastructure in areas where there were no existing broadband providers. These include the governments of Oise, Pyrénées

### Rural Access (*continued*)

Atlantiques, Loiret, and Alsace, which have established public network projects by leasing unbundled local loops and installing Digital Subscriber Line Access Muliplexers (DSLAM) to provide DSL broadband services to residents and businesses. In addition, in 2005 the European Commission co-funded with France an open broadband infrastructure network in Limousin that provided services to residential users, businesses, and public authorities. The Commission agreed to fund the project because it mainly – but not entirely – included rural and remote areas.[15]

### Competition

When France Télécom launched asymmetric digital subscriber line (ADSL) broadband Internet access in 1999, the French regulator, the Authorité de Régulation des Communications Électroniques et des Posts (ARCEP) required the company to allow Internet service providers (ISPs) to lease its copper loops so that they could market their own broadband services (albeit with their own central office equipment).[16] One of the first companies to take advantage of this rule was an ISP created by Iliad (the company that provided the content for France's Minitel proprietary network system), called Free, which began offering Internet service in 1999 by leasing France Télécom's infrastructure, which allowed it to compete directly with France Télécom's ISP, Wanadoo (later renamed Orange). Unbunding followed in 2002 after protracted negotiations between the French government and France Télécom. By the end of 2004 France Télécom had unbundled 1.6 million lines (more than 25 percent of the 6.1 million ADSL lines in service).[17] Yet by 2006 the company still dominated the market with Orange at 49 percent of the broadband market, followed by Free at 19 percent, Neuf Cegetel at 18 percent, Alice and Club Internet with 7 and 5 respectively, and other small providers with 2 percent.[18] Moreover, France Télécom is working to gain more subscribers by adapting its local loop network for higher-speed broadband access by installing nodes closer to subscribers who otherwise would have been too far from the central office to get broadband.[19]

Unbundling appears to have fostered lower prices for consumers. While broadband pricing in France is within the EU average of $35-$40 per month, higher speed services using ADSL2+ offering around 20 mbps have gotten cheaper and can be found for as little as $20 (by neuf Cegetel – as opposed to a more common rate of $40-$55 per month.[20] Because of these price reductions, subscribers' average broadband Internet bills decreased by $2 from 2005 to 2006, going from $36 to $34.[21]

In addition to ordering France Télécom to unbundle the local loop, in 2005 ARCEP also required the company to give competitors bitstream access (allowing them to use France Telecom's ADSL equipment rather than investing in their own).[22] While France Télécom has extended DSL broadband access to 98 percent of French residents, only about 26 percent have access to broadband via cable.[23] Cable broadband services have lagged behind ADSL perhaps because until recently France Télécom dominated the French cable market via its cable subsidiary France Télécom Cable (of which it sold the infrastructure only in 2005), as well as through its investments in other large cable companies, including 28 percent of Noos (which it sold in 2004).[24]

### Fiber

The French government encouraged fiber rollout by proposing measures in December 2007 to require new buildings to be pre-equipped for fiber and to require operators to share the networks they install inside buildings.[25] Yet, providers—particularly France Télécom and Illiad—are driving fiber deployment in France. There France Télécom, via Orange, its service provider, offers fiber-to-the-home (FTTH) in Paris and will expand its services to 1 million homes in 12 other cities by the end of 2008.[26] Moreover, since August 2007, France Télécom's primary

## Fiber (*continued*)

rival Illiad (via Free, its service provider) is offering 100 Mbps of service through its own fiber to the premises (FTTP) infrastructure but almost exclusively to apartment buildings. As of 2007 Illiad/Free offered FTTH to 241,000 homes versus 146,000 for France Télécom/Orange.[27] Neuf Cegetel provides access to 120,000 homes.[28] Numericable, the largest cable provider (formerly owned by France Télécom) provides broadband access via cable to 2 million households.[29]

## Demand

The French government has not been directly involved in supporting the development of broadband content to spur demand. However, the growing ubiquity of broadband access has encouraged providers to bundled services, particularly telephony, Internet access, and television. In addition, many residential users have been able to access video-on-demand (VoD) and TV over broadband since 2004.[30] The popularity and availability of these services has, in turn, driven demand for higher rates of broadband access.

## ENDNOTES

1. OECD measures penetration on a per capita basis because comprehensive data on household penetration is generally unavailable. ITIF has used average household size as a multiplier to convert June 2007 OECD per capita penetration data to household penetration data. It should be noted that one problem with this method is that the OECD data likely also includes some DSL business subscribers.

2. International Telecommunications Union, "Internet Indicators: Subscribers, Users, and Broadband Subscribers," International Telecommunications Union ICT Statistics Database (ITU, 2006) <www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx#>.

3. Unbundling is a policy by which regulators require incumbent telecommunications operators (those with dominant market status who control access to the telecommunications infrastructure) or cable companies to give their competitors access to raw copper pairs, fiber, or coaxial cable networks so that they can install their own transmission equipment at the incumbent's central office (local exchange). *Full unbundling* requires the incumbent to make all copper pair frequencies or fiber networks available to competitors. *Shared access* to the local loop requires the incumbent to make the "high" frequency bands (those that carry data, but not voice) of the copper pair available to its competitors, allowing them to offer xDSL broadband services. *Bitstream access* requires incumbent operators to allow competitors access to the incumbents' equipment at their central office. *Cable access* enables competitors to use cable companies' coaxial cable local loops and fiber access requires telecommunications operators to give competitors access to their fiber local loops.

4. International Telecommunications Union, "Internet Indicators: Subscribers, Users, and Broadband Subscribers," International Telecommunications Union ICT Statistics Database (2006) <www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx#>.

5. Our methodology for calculating broadband speed in the ITIF Broadband Rankings involves averaging the speeds of the incumbent DSL, cable and fiber offerings provided in the OECD's April 2006 "Multiple Play," report, with each assigned a weight according to that technology's respective percentage of the nations overall broadband subscribership, as reported in the OECD's "Broadband Statistics to December 2006."

6. USD price per bit (PPP) of the fastest available technology is calculated from the broadband offerings examined in the OECD's "Multiple Play: Pricing and Policy Trends" report.

7. The World Bank, "Information and Communications for Development 2006," (2006): 172.

8. United Nations, "World Population Prospects: The 2006 Revision Population Database," 2007 <esa.un.org/unpp/>.

9. Ibid.

10. The World Bank, "Information and Communications for Development 2006," (2006): 194.

11. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, "An Overview of the Broadband Market: France," (Wales, United Kingdom: 2005): 1.

12. OECD, "Working Party on Telecommunication and Information Services Policies: The Development of Broadband Access in Rural and Remote Areas," Directorate for Science, Technology, and Industry, Committee for Information, Computer and Communications Policy (Geneva, Switzerland: May 10, 2004): 23.

13. Ibid.

14. Ibid: 24.

15. Ibid: 10.

16. Ibid.

17. Ibid: 47-49.

18. Ibid: 7.

19. Ibid: 285.

20. Ibid: 5.

21. Authorité de Régulation des Communications Électroniques et des Posts, ARCEP's Annual Report 2006 (July 2007): 173.

22. Ibid: 61.

23. Ibid: 2.

24. Numericable has since bought Noos. Martin Fransman (ed.) *Global Broadband Battles: Why the U.S. and Europe Lag While Asia Leads* (Stanford, California; Stanford Business Books, 2006): 179.

25. Le Journal du Net, "Le Gouvernement Veut Accélérer le Déploiement de la Fibre Optique en France," December 14, 2007 <www.journaldunet.com/ebusiness/telecoms-fai/actualite/0712/071214-comite-de-pilotage-du-haut-debit-herve-novelli.shtml>.

26. Kurt Ruderman, "France Telecom Plans Massive FTTH Roll-out in 2009," *Lightwave Europe*, January 2008 <http://lw.pennnet.com/display_article/321309/63/ARTCL/none/none/1/France-Telecom-plans-massive-FTTH-roll-out-in-2009/>.

27. IDATE, "FTTH Situation in Europe," *IDATE News 407* (February 27, 2008): 1.

28. Ibid.

29. Ibid.

30. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, "An Overview of the Broadband Market: France" (2005): 1.

# Appendix C: Germany

## Overview

**ITIF Rank: 16**

| | | | |
|---|---|---|---|
| **Subscribers per Household**[1] | **0.47** | **Incumbent Government Owned** | **38.02%** |
| **Internet Users in Millions**[2] | **38.6** | **Local Loop Unbundling:**[3] | |
| **Internet Users per 100 Inhabitants**[4] | **46.67** | **Full Copper Loop** | **Yes** |
| **Average Speed in Megabits per Second (Mbps)**[5] | **6.0** | **Shared Copper Loop** | **Yes** |
| **Price Per Month of 1 Mbps USD PPP**[6] | **5.2** | **Bitstream** | **Yes** |
| **Percent of Urban Population**[7] | **88** | **Cable** | **No** |
| **Population Density per sq. km**[8] | **232** | **Fiber** | **No** |

## Geography and Demography

Germany has the largest population in Europe of 82.6 million people with a population density of 232 people per square kilometer.[9] The country also has a very high percentage of its citizens living in cities – 88 percent – higher than the United States (81 percent) and nearly as high as the United Kingdom (89 percent).[10]

## Policy

As early as 1999, to support and promote the development of the information society the German government launched Initiative D21. The goal was to bring local and national governmental bodies together with industry to study broadband strategy, conduct workshops, and prepare policy documents.[11] In 2003 the German government placed broadband infrastructure at the center of an initiative to foster the "Information Society" and followed up with plans in 2005 to increase competition in broadband access technologies, including DSL and cable, as well as in broadband content, with a goal to reach 50 percent residential penetration by 2010 (90 percent for small and medium enterprises).[12] Initiatives under the government's broadband strategy include the Deutsches Forschungsnetz (DFN), the development of a high-bandwidth network for research and educational institutions and the Breitbandatlas, a map showing broadband coverage for the country. The government also offers free consulting services for small and medium size businesses to promote broadband and provides awards for innovative broadband projects.[13]

## Rural Access

The main thrust of Germany's broadband policy has been to foster competition. Although its programs have not singled out rural access as a priority, presumably such access is included in its Initiative D21 to raise broadband penetration throughout the country. In addition, rural areas with educational institutions benefited from the governments emphasis on building broadband networks for research. Moreover, rural residents could use the Breitbandatlas to determine broadband coverage in their communities.

## Competition

In 2001 the regulator RegTP (Regulierrungsbehörde für Telekommunikation und Post – as of 2005 the Bundesnetzagentur or Federal Network Agency (FNA)) required Deutsche Telecom to provide non-discriminatory access to shared local loop lines in accordance with EU directive 2887/2000. Although Deutsche Telecom appealed this decision, the German courts upheld it and by August 2001 the company offered its first line-sharing contract.[14]

Yet, competitors found Deutsche Telecom's rates for leasing unbundled loops to be too high and it wasn't until 2004 (under pressure from the European Commission) that the FNA forced Deutsche Telecom to reduce its charges for its T-digital subscriber line (T-DSL) wholesale product by a third (which allows ISPs to offer T-DSL customers Internet services) and also required the company to further reduce it monthly local loop rental charge by 10 percent.[15] After Deutsche Telecom further reduced prices in 2005 the number of competitors in the market increased and Germany now has one of the highest shares of unbundled local loops (24 percent) in Western Europe.[16] By 2006 Internet service providers (ISPs) purchasing Deutsche Telecom's T-DSL lines accounted for 80 percent of all resale lines and there were over 80 DSL operators in early 2007.[17] Nonetheless, in 2006 Deutsche Telecom dominated the broadband market with 67 percent of all subscribers (although that may gradually change as Deutsche Telecom reduced the prices it charges resellers between 28 to 27 percent in late 2006).[18] In 2006, the FNA determined that Deutsche Telecom should not have to open up its very high speed DSL (VDSL) network to competitors for three years—a decision that the European Commission overturned. However, the FNA has required Deutsche Telecom to offer its competitors bitstream access beginning in April 2008. Another reason Deutsche Telecom may still dominate the broadband market may be because its ISP—T-Online—has tremendous brand recognition and is the leading European ISP.[19] Competitors' market shares increased from 33 percent in October 2005 to 47 percent less than a year later in July 2006, although this mostly reflects an increase in DSL resale lines, as opposed to facilities-based competition – such as cable, which had only 2.9 percent of the broadband market in October 2006.[20] Deutsche Telecom's largest DSL network competitor is Arcor with 1.3 million subscribers compared to Deutsche Telecom's 6.4 million, or 12.5 percent of the total broadband market (as compared to Deutsche Telecom's 62 percent). Other broadband service providers comprise the remaining 25.5 percent of the market, including the country's second largest ISP – United Internet, with 2.36 million subscribers (2007), and Versatel with 390,000 subscribers (2006), with the remainder divided up among Debitel, QSC, and Tropolys.[21] While these services are mainly reselling Deutsche Telecom's DSL offering, one company – Freenet – developed its own asymmetric DSL2+ (ADSL2+) broadband network, which it was offering to 40 percent of German households by mid-2006.[22] Arcor also began to offer ADSL2+ services in 300 cities in 2006 and in 2007 Telefónica rolled out ADSL2+ services. Tiscali invested euro 200 million in its own DSL infrastructure in 2005 and rolled out unbundled telephony services in 2006.[23] In addition, Quality Service Communications (QSC) also is expanding its ADSL2+ network.[24]

As of 2006 the primary broadband technology continued to be DSL (98.4 percent of subscribers) and the main provider Deutsche Telecom.[25] Although in 2002 nearly 70 percent of German households had access to the cable TV network, fragmentation in the cable market prevented early uptake of cable broadband services.[26] One reason may be because Deutsche Telecom originally held 80 percent of the cable broadband backbone infrastructure and about 30 percent of the links to customers' residences and only began to divest its holdings in 2001.[27] In fact, the cable provider offering the fastest speeds (up to 100 mbps) is not even originally a cable company – NetCologne started as a municipal network in Cologne, Bonn, and Aachen that in 2006 upgraded its network to compete with Deutsche Telecom's high-speed VDSL offering (although the majority of Deutsche Telecom's subscriptions are still ADSL).[28] The market continues to be fragmented, with around 30 cable network operators in 2006, many of which are too small to upgrade their networks to provide broadband services.[29]

## Fiber

NetCologne began offering fiber-to-the-home (FTTH) in July 2006 to compete with Deutsche Telecom's VDSL network. Yet, this service is limited to the Cologne market, where NetCologne already has 45 percent of subscribers.[30] The only other providers of FTTH are the Dutch incumbent, KPN, which teamed with WINGAS, Germany's natural gas company, to offer 5,000 km of fiber networks in Germany in 2007, interconnecting through points-of-presence (PoPs) in several large cities.[31]

## Demand

Deutsche Telecom has, to a certain extent, taken up the role of encouraging broadband demand by deploying its services to public facilities. For example, in 2006 it began to provide Internet access at speeds up to 6 Mbps to Germany's schools as part of its T@School infrastructure project to connect all of the country's 28,000 schools – which it began in 2000 by offering all public and state-approved schools with free Internet access.[32] Yet, the initial low prices Deutsche Telecom offered and the recent increase in DSL competition are only two of the drivers of Germany's broadband penetration. The popularity of music and video downloads also is driving demand, as well as online shopping. Revenues from digital music downloads increased by 33 percent in 2006 over 2005 and sales of online products exceeded $10 billion in the first half of 2006.[33]

## ENDNOTES

1. OECD measures penetration on a per capita basis because comprehensive data on household penetration is generally unavailable. ITIF has used average household size as a multiplier to convert June 2007 OECD per capita penetration data to household penetration data. It should be noted that one problem with this method is that the OECD data likely also includes some DSL business subscribers.

2. International Telecommunications Union, "Internet Indicators: Subscribers, Users, and Broadband Subscribers," International Telecommunications Union ICT Statistics Database, 2006 <www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx#>.

3. Unbundling is a policy by which regulators require incumbent telecommunications operators (those with dominant market status who control access to the telecommunications infrastructure) or cable companies to give their competitors access to raw copper pairs, fiber, or coaxial cable networks so that they can install their own transmission equipment at the incumbent's central office (local exchange). *Full unbundling* requires the incumbent to make all copper pair frequencies or fiber networks available to competitors. *Shared access* to the local loop requires the incumbent to make the "high" frequency bands (those that carry data, but not voice) of the copper pair available to its competitors, allowing them to offer xDSL broadband services. *Bitstream access* requires incumbent operators to allow competitors access to the incumbents' equipment at their central office. *Cable access* enables competitors to use cable companies' coaxial cable local loops and fiber access requires telecommunications operators to give competitors access to their fiber local loops.

4. International Telecommunications Union, "Internet Indicators: Subscribers, Users, and Broadband Subscribers," International Telecommunications Union ICT Statistics Database, 2006 <www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx#>.

5. Our methodology for calculating broadband speed in the ITIF Broadband Rankings involves averaging the speeds of the incumbent DSL, cable and fiber offerings provided in the OECD's April 2006 "Multiple Play," report, with each assigned a weight according to that technology's respective percentage of the nations overall broadband subscribership, as reported in the OECD's "Broadband Statistics to December 2006."

6. USD price per bit (PPP) of the fastest available technology is calculated from the broadband offerings examined in the OECD's "Multiple Play: Pricing and Policy Trends" report.

7. The World Bank, "Information and Communications for Development 2006," (2006): 172.

8. United Nations, "World Population Prospects: The 2006 Revision Population Database," 2007 <esa.un.org/unpp/>.

9. Ibid.

10. The World Bank, "Information and Communications for Development 2006," (2006): 198.

11. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, “Germany Broadband Market Report 2005” <www.broadbandwalesobservatory.org.uk/broadband-3323>.

12. Paul Budde Communication Pty Ltd, “Germany - Broadband Market - Overview, Statistics & Forecasts,” Telecommunications and Information Highways (Bucketty, Australia: 2007): 3.

13. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, “Germany Broadband Market Report 2005” <www.broadbandwalesobservatory.org.uk/broadband-3323>.

14. Margit A. Vanberg, “Competition in the German Broadband Access Market,” ZEW Centre for European Economic Research, Discussion Paper No. 02-80 (October 2002): 11.

15. Paul Budde Communication Pty Ltd, “Germany - Broadband Market - Overview, Statistics & Forecasts,” Telecommunications and Information Highways (Bucketty, Australia: 2007): 3.

16. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, “Germany Broadband Market Report 2005” <www.broadbandwalesobservatory.org.uk/broadband-3323>.

17. Ibid: 2.

18. Ibid.

19. Martin Fransman (ed.), *Global Broadband Battles: Why the U.S. and Europe Lag While Asia Leads* (Stanford, California: Stanford Business Books, 2006) 197.

20. Paul Budde Communication Pty Ltd, “Germany - Broadband Market - Overview, Statistics & Forecasts,” Telecommunications and Information Highways (Bucketty, Australia: 2007) 3.

21. Ibid: 14.

22. Ibid: 15.

23. Ibid: 16.

24. Ibid: 17.

25. Margit A. Vanberg, “Competition in the German Broadband Access Market,” ZEW Centre for European Economic Research, Discussion Paper No. 02-80 (October 2002): 6.

26. Ibid: 12.

27. Ibid: 13.

28. Ibid: 1.

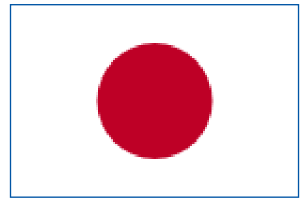
29. Ibid: 10.

30. Ibid: 9.

31. Paul Budde Communication Pty Ltd, “Germany - Broadband Market - Overview, Statistics & Forecasts,” Telecommunications and Information Highways (2007): 19.

32. Ibid: 13.

33. Ibid: 4.



# Appendix D: Japan

## Overview

**ITIF Rank: 2**

| | | | |
|---|---|---|---|
| **Subscribers per Household**[1] | **0.55** | **Incumbent Government Owned** | **33.7%** |
| **Internet Users in Millions**[2] | **87.54** | **Local Loop Unbundling:**[3] | |
| **Internet Users per 100 Inhabitants**[4] | **68.27** | **Full Copper Loop** | **Yes** |
| **Average Speed in Megabits per Second (Mbps)**[5] | **63.6** | **Shared Copper Loop** | **Yes** |
| **Price Per Month of 1 Mbps USD PPP**[6] | **.27** | **Bitstream** | **Yes** |
| **Percent of Urban Population**[7] | **66** | **Cable** | **No** |
| **Population Density per sq. km**[8] | **338** | **Fiber** | **Yes** |

## Geography and Demography

Although Japan is more densely populated than the United States (338 people per square kilometer versus 31 in the United States)[9], it has a lower percentage of urban population (66 versus 80 percent).[10] This may explain why Japan's broadband policy continues to focus on providing access to rural areas, which still lag behind urban areas in broadband penetration, particularly in access to fiber.

## Policy

In 2000 Japan created its Information Technology Strategy Council and also established its "Basic IT Law," which was immediately followed by its "e-Japan" strategy in January 2001. In 2003, the government expanded its goal to promoting broadband demand with the "e-Japan strategy II." These programs provided a combination of subsidies, tax incentives, and low or zero-interest loans for broadband providers, triggering 220 projects in 2001 and helping to achieve the goal of offering 30 million households high-speed broadband access by 2004. The government followed with its "ubiquitous-net Japan" ("U-Japan") strategy of 2004, with the added goal that by 2010 every device (such as mobile phones, personal digital assistance, even household appliances) would be connected to the network and able to be managed at any time and in any place.[11] In addition, the Japanese government emphasized the importance of closing the gap between urban and rural areas by establishing the "IT New Reform Strategy" in 2006 with a goal to provide broadband services to every household by 2010. The Japanese government's tax incentives included allowing providers to depreciate during the first year about one-third of the cost of the broadband capital investments, as opposed to the usual depreciation schedule of up to 22 years for telecommunications equipment. Moreover, the government reduced fixed asset taxes for designated network equipment.[12] With respect to subsidies, the Bank of Japan (a government bank) guaranteed companies' debts, allowing them to borrow money on capital markets more cheaply because these government-backed loans were less risky (no risk of default).[13]

### Rural Access

In 2004 the Japanese government extended subsidies covering about one-third of the cost of building a fiber broadband network to rural towns and villages. The only stipulation was that these municipalities would have to allow other providers to lease their networks. A number of municipalities used local and federal government funding to establish fiber-to-the-home (FTTH) in partnerships with NTT.[14] In addition, under its "IT New Reform Strategy" the government provided low-cost loans to any carrier with a fiber optic network installation plan for rural areas and tax deductions for broadband investments.[15]

### Competition

Unlike in the United States, Japan did not dissolve its incumbent telecommunications service provider, Nippon Telegraph and Telephone (NTT), although after many political battles it was reorganized under a holding company system in 1999 and was restructured in 2002. The holding company is NTT, and its five major businesses include NTT East, NTT West (local telephone companies), NTT Communications (long distance), NTT DoCoMo (mobile), and NTT Data (information services). Some of the government's reluctance to curtail NTT's market power may be due to the fact that the government still owns more than a third of the company. Yet, the government's requirements for local loop unbundling and collocation in 2000 enabled several competing service providers to emerge, including KDDI, Yahoo! BB and K-Opticom. However, local loop unbundling is not the only reason competition took off. The government also set a very low price for competitors to access NTT's unbundled loops, which allowed them to set low prices for their services. Softbank's Yahoo! BB service initially led the market by offering low price, high speed services. As of 2003, Yahoo! BB had the lowest priced service at $19.09 per month for 12 Mbps and $20.54 for 26 Mbps.[16] While this aggressive approach was successful in earning a strong place in the broadband market (by 2005 NTT and Yahoo! BB each held about one-third) it also contributed to the company's continuing losses (it only began to be profitable beginning in 2006).[17] Nonetheless, this strategy had a significant effect on NTT – forcing it to compete by lowering its prices and offering increased speeds.[18] Japan's cable TV industry is highly fragmented, which makes it difficult for providers to upgrade their networks for two-way (broadband) service.[19]

### Fiber

In Japan several factors have driven fiber roll out. First, government support, including access to the government's public fiber infrastructure, low interest rate loans, and tax deductions, has spurred fiber build out.[20] Second, because NTT was required to unbundle its copper loops at relatively low prices to allow competitors to provide digital subscriber line (DSL) services, NTT invested in fiber as a way to gain customers that it was more likely to be able to keep. NTT also faces competition from subsidiaries of electricity companies, which are using their own fiber networks to offer high-speed broadband services to their electricity customers.[21] K-Opticom began offering its optical broadband service as early as 2002, using its own networks (as part of the Kansai Electric Power Company), which drove down prices for FTTH.[22] While NTT is also required to unbundle the fiber loop, the price that competitors pay is quite high, enabling NTT to obtain an adequate rate of return on its fiber investment.[23] As a result, NTT has invested more than $200 billion in optical fiber installations.[24] NTT has pledged to provide FTTH service to 30 million users (half of the 60 million households subscribing to its phone service) by 2010.[25] Nonetheless, despite aggressive rollouts of FTTH by NTT and its competitors, it is more commonly available in urban areas, such as Tokyo, Osaka, and Nagoya, and is largely absent in rural and more sparsely populated areas.[26]

| Demand |
| --- |
| Video applications, such as video-on-demand (VoD) and broadcasting over broadband, are key drivers of broadband demand. Major providers, including NTT, KDDI, and Softbank (Yahoo! BB) all are providing Internet Protocol television (IPTV) services. NTT's internet service provider (ISP) unit provides Internet broadcasting with VoD and multi-channel TV broadcasts. KDDI broadcasts over fiber to multiple dwelling units and Softbank offers TV-over-DSL through BB Cable, the first Japanese company to receive a license to broadcast video over the telecommunications network (in 2002).[27] Another significant driver of broadband take up in Japan is Voice over IP (VoIP), with subscribers expected to grow to 27.9 million in 2007.[28] Yet the real impetuous has been an explosion of broadband content – particularly from the entertainment industry. NTT began offering Walt Disney content in 2003 and multi-channel broadcasts over ADSL in 2004. In addition, online gaming is increasingly popular and Softbank launched an online gaming Web portal called BB Games in 2003. KDDI followed with its own broadband network game system.[29] The government also has driven demand by putting all administrative agencies online, with the result that in 2005 Japanese citizens completed more than 95 percent of government applications and notifications online, and more than 63 percent of other types of administrative procedures.[30] In addition, nearly all local municipal organizations had their own websites. |

## ENDNOTES

1. OECD measures penetration on a per capita basis because comprehensive data on household penetration is generally unavailable. ITIF has used average household size as a multiplier to convert June 2007 OECD per capita penetration data to household penetration data. It should be noted that one problem with this method is that the OECD data likely also includes some DSL business subscribers.

2. International Telecommunications Union, "Internet Indicators: Subscribers, Users, and Broadband Subscribers," International Telecommunications Union ICT Statistics Database, 2006 <www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx#>.

3. Unbundling is a policy by which regulators require incumbent telecommunications operators (those with dominant market status who control access to the telecommunications infrastructure) or cable companies to give their competitors access to raw copper pairs, fiber, or coaxial cable networks so that they can install their own transmission equipment at the incumbent's central office (local exchange). *Full unbundling* requires the incumbent to make all copper pair frequencies or fiber networks available to competitors. *Shared access* to the local loop requires the incumbent to make the "high" frequency bands (those that carry data, but not voice) of the copper pair available to its competitors, allowing them to offer xDSL broadband services. *Bitstream access* requires incumbent operators to allow competitors access to the incumbents' equipment at their central office. *Cable access* enables competitors to use cable companies' coaxial cable local loops and fiber access requires telecommunications operators to give competitors access to their fiber local loops.

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5. Our methodology for calculating broadband speed in the ITIF Broadband Rankings involves averaging the speeds of the incumbent DSL, cable and fiber offerings provided in the OECD's April 2006 "Multiple Play," report, with each assigned a weight according to that technology's respective percentage of the nations overall broadband subscribership, as reported in the OECD's "Broadband Statistics to December 2006."

6. USD price per bit (PPP) of the fastest available technology is calculated from the broadband offerings examined in the OECD's "Multiple Play: Pricing and Policy Trends" report.

7. The World Bank, "Information and Communications for Development 2006," (2006): 172.

8. United Nations, "World Population Prospects: The 2006 Revision Population Database," 2007 <esa.un.org/unpp/>.

9. Ibid.

10. The World Bank, "Information and Communications for Development 2006," (2006): 214.

11. Yasu Taniwaki, “Broadband Competition Policy to Address the Transition to IP-Based Networks: Experiences and Challenges in Japan,” (Tokyo: International Foundation for Information Technology, October 2006): 10-11.

12. “Understanding the Japanese Broadband Miracle,” presentation at the Information Technology and Innovation Foundation, April 4, 2007 <www.itif.org/files/Ebihara_Japanese_Broadband.pdf>.

13. Thomas Bleha, “Down to the Wire,” *Foreign Affairs,* May/June 2005 <www.foreignaffairs.org/20050501faessay84311/thomas-bleha/down-to-the-wire.html>.

14. Yonosuki Harada and Keiji Okada, “The Dynamics of Broadband in Japan: Some Best Effort for Broadband Penetration,” presentation for NESCAP, June 21, 2007 <www.unescap.org/icstd/events/RW_JUNE2007/HARADA.pdf>.

15. Yasu Taniwaki, “Broadband Competition Policy to Address the Transition to IP-based Networks: Experiences and Challenges in Japan,” (Tokyo: International Foundation for Information Technology, October 2006): 7.

16. Ibid: 3.

17. Martin Fransman (ed.), *Global Broadband Battles: Why the U.S. and Europe Lag While Asia Leads* (Stanford, California: Stanford Business Books, 2006): 29.

18. Ibid: 30.

19. Paul Budde Communication Pty Ltd, “Japan - Broadband - Market Overview,” Telecommunications and Information Highways (Bucketty, Australia: 2005): 5.

20. Yasu Taniwaki, “Broadband Competition Policy to Address the Transition to IP-Based Networks: Experiences and Challenges in Japan,” (Tokyo: International Foundation for Information Technology, October 2006): 7-8.

21. Martin Fransman, “Why Japan and Korea Lead the U.S.A. and Europe in Broadband,” *International Journal Technological Learning, Innovation, and Development*, Vol. 1, No. 1 (2007): 122.

22. Martin Fransman (ed.), *Global Broadband Battles: Why the U.S. and Europe Lag While Asia Leads* (Stanford, California: Stanford Business Books, 2006): 66.

23. See Ema Tanaka, Minoru Sugaya, Sayaka Shiotani, “Evolution of IP Network and Convergence in Japan – Impact of Hard law and Soft Law,” presentation at ITS Conference in Beijing, 2006.06.13, slides 23-4 of PowerPoint presentation, states that unbundled fiber loops cost about $50.

24. Yasu Taniwaki, “Broadband Competition Policy to Address the Transition to IP-Based Networks: Experiences and Challenges in Japan,” (Tokyo: International Foundation for Information Technology, October 2006): 68.

25. Ibid: 78, 83.

26. Takanori Ida, “Discussion Paper No. 049: The Broadband Market in Japan,” Interfaces for Advanced Economy Analysis (Kyoto University, Kyoto: December 2004): 16.

27. Ibid: 10-11.

28. Ibid: 8.

29. Ibid: 9.

30. Ministry of Internal Affairs and Communications, Information and Communications in Japan (2006): 41.

# Appendix E: The Netherlands

## Overview

**ITIF Rank: 4**

| | | | |
|---|---|---|---|
| **Subscribers per Household**[1] | **0.77** | **Incumbent Government Owned** | **7.8%** |
| **Internet Users in Millions**[2] | **14.54** | **Local Loop Unbundling:**[3] | |
| **Internet Users per 100 Inhabitants**[4] | **88.87** | **Full Copper Loop** | **Yes** |
| **Average Speed in Megabits per Second (Mbps)**[5] | **8.8** | **Shared Copper Loop** | **Yes** |
| **Price Per Month of 1 Mbps USD PPP**[6] | **4.31** | **Bitstream** | **Yes** |
| **Percent of Urban Population**[7] | **66** | **Cable** | **Yes** |
| **Population Density per sq. km**[8] | **393** | **Fiber** | **No** |

## Geography and Demography

The Netherlands has one of the highest population densities – 393 people per square kilometer.[9] Yet, its percent of urban population, 66 percent, is lower than the United States and many other European countries.[10] This may be offset by the geographic advantage conveyed by its position in Europe as the landing point for submarine cables from North America, giving the country a sophisticated telecommunications infrastructure that includes the Amsterdam Internet Exchange (AMS-IX), one of the major European telecommunications traffic exchanges.[11]

## Policy

In 2004 the Dutch Ministry of Economic Affairs released a broadband paper in which it stated that it expected the Netherlands to achieve the highest broadband penetration rates in the world by 2010 with connection speeds of at least 10 Mbps.[12] In this paper, the government envisioned broadband as one piece of a larger initiative to stimulate research in broadband technology innovation, particularly high-speed networks for business, consumers, and research. While the Dutch government believes that the market is primarily responsible for development of next generation broadband infrastructure, its policies focus on the government's role in stimulating competition and new service development, as well as on public-private partnerships to determine how the government may provide aid and incentives for social sectors. Accordingly, following the 2004 paper, the government established "Holland Broadbandland" (Nederland BreedbandLand) as a national platform to bring together broadband industry, trade organizations, and the government to determine "better and smarter" uses for broadband.[13]

Consistent with its goal to promote high-speed networks for research, the government provided $155 million in grants for three projects: the GigaPort Next Generation Network, a national infrastructure research network permanently at the disposal of the government, the IT industry, educational and research institutes; the Virtual lab e-science (VLE) for collaboration and testing new technologies; and Freeband Knowledge Impulse, a joint initiative of the government, industry, and academia to increase knowledge of fourth generation telecommunications.[14] In addition, the government has provided limited funding for municipal networks, such as $66 million for the Kenniswijk Broadband Demonstration Center, a fiber-to-the-home (FTTH) broadband initiative in the Eindhoven region to provide more than 100 consumer services for 14,000 households.[15]

## Rural Access

The goal of the Netherland's broadband strategy is to achieve the highest broadband penetration rates in the world by 2010, extending access to both rural and urban areas.

## Competition

The Netherlands has robust intramodal competition, following a variety of regulations the Onafhankelijke Post en Telecommunicatie Autoriteit (OPTA) placed on Koninklijke PTT Nederland (KPN), the Netherlands' incumbent telecommunications service provider, including local loop unbundling (as of 2000). These regulations allow companies to provide competing broadband services in two ways. First by investing in their own equipment to provide digital subscriber line (DSL) services to their customers, and second by leasing KPN's DSL infrastructure (called "naked DSL"). While unbundling regulations lowered barriers to entry in the retail broadband market KPN is, nonetheless, by far the largest DSL broadband service provider with more than 65 percent of the asymmetric DSL (ADSL) broadband market, although its share of the overall broadband market (including cable and other technologies) is about 40 percent.[16] KPN helped to kick off the strong growth in ADSL subscriptions by offering "ADSL Lite" in 2002 and 2003, a cheaper product that was so popular it accounted for 73 percent of new connections in 2002. KPN uses ADSL to provide its own Internet services as well as through its Internet service providers (ISPs): Planet Internet, Het Net, XS4ALL, Tiscali, Speedlinq, and Demon.[17] The rest of the DSL market is distributed among a few competitors, including Tele2 and Orange Breedband, as well as ISPs that lease DSL including Versatel, BBned, and Wanadoo.

The Netherlands also has a high level of intermodal competition. Although 59.8 percent of broadband connections as of June 2006 were via ADSL, cable is a strong second at 38.5 percent and other technologies at 1.8 percent. Canada is the only other country in the world with a higher number of cable connections for 100 inhabitants.[18] Interestingly, cable infrastructure also is open to non-discriminatory access – but voluntarily, not via regulation. In 2003 a committee of cable operators agreed to lease their networks and to separate their network operations from their services. The cable companies, although they operate regionally instead of nationally, together provide strong competition to KPN in broadband services. These companies are UPC (via its broadband service, Chello), Essent Kabelcom (via its @home service), and Casema.[19]

## Fiber

Both national and local governments now are focusing on support for the development of FTTH. The national government allocated nearly $9 million for local and regional tests of FTTH and initiated the "smart city" project in Eindhoven (see above).[20] In 2006, the city of Amsterdam used government funding to launch its "CityNet" project to provide 100 Mbps connections to 40,000 homes, expanding to 450,000 homes by 2010.[21] The city co-owns (25 percent) of the fiber and leases it to BBned (a subsidiary of Telecom Italia), which provides wholesale services. Similarly, the city of Rotterdam piloted fiber connections to 7,000 households in late 2002 and in 2006 launched an open FTTH network via a social housing corporation, Stadswonen, the cost of which is bundled into the monthly rental fees.[22] In addition to local governments and communities, developers, housing corporations, and telecommunications companies also are investing in fiber-optic networks. By the end of 2006 more than 111,000 Dutch homes had a fiber-optic connection.[23] This follows KPN's announcement in 2005 that it would extend fiber throughout its network, into the local exchanges, and to houses in subdivisions.[24] As of 2007 around 25 municipalities were preparing to launch broadband fiber networks and 2 percent of all connections were via fiber.[25]

| Demand |
| --- |
| KPN's strategy of offering a wide variety of services with a range of prices also has helped encourage demand, as has the company's decision to sell "naked" DSL, which allows consumers to choose a broadband subscription without also having to subscribe to fixed telephony services from the same provider.[26] While bundling services appears to have spurred demand, the Dutch national government also decided to intervene by supporting the development of broadband content and applications. For example, in 2006 the Dutch government announced that it would give all Dutch citizens a personalized web page – the "Personal Internet Page (PIP) Project" where they can access their government documents, tax and social security information, as well as apply for grants and licenses.[27] The increasing availability of broadcast over the Internet (IPTV) also is driving demand for broadband. So, although analog cable is still the most common platform for television and radio broadcasts, as broadband performance continues to increase, digital broadcasts (often bundled as triple play options with voice and Internet access) are beginning to become more popular. This becomes a virtuous cycle because as the number of digital broadcast options increase this in turn drives demand for higher speed broadband services. Cable providers also are upgrading their networks to provide higher speeds to compete with ADSL2+ and to provide their own triple play options, and KPN also upgraded to ADSL2+ to launch IPTV services.[28] Both KPN and Tele2 offer video-on-demand services on a fee-per-program basis.[29] |

## ENDNOTES

1. OECD measures penetration on a per capita basis because comprehensive data on household penetration is generally unavailable. ITIF has used average household size as a multiplier to convert June 2007 OECD per capita penetration data to household penetration data. It should be noted that one problem with this method is that the OECD data likely also includes some DSL business subscribers.

2. International Telecommunications Union, "Internet Indicators: Subscribers, Users, and Broadband Subscribers," International Telecommunications Union ICT Statistics Database, 2006 <www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx#>.

3. Unbundling is a policy by which regulators require incumbent telecommunications operators (those with dominant market status who control access to the telecommunications infrastructure) or cable companies to give their competitors access to raw copper pairs, fiber, or coaxial cable networks so that they can install their own transmission equipment at the incumbent's central office (local exchange). *Full unbundling* requires the incumbent to make all copper pair frequencies or fiber networks available to competitors. *Shared access* to the local loop requires the incumbent to make the "high" frequency bands (those that carry data, but not voice) of the copper pair available to its competitors, allowing them to offer xDSL broadband services. *Bitstream access* requires incumbent operators to allow competitors access to the incumbents' equipment at their central office. *Cable access* enables competitors to use cable companies' coaxial cable local loops and fiber access requires telecommunications operators to give competitors access to their fiber local loops.

4. International Telecommunications Union, "Internet Indicators: Subscribers, Users, and Broadband Subscribers," International Telecommunications Union ICT Statistics Database, 2006 <www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx#>.

5. Our methodology for calculating broadband speed in the ITIF Broadband Rankings involves averaging the speeds of the incumbent DSL, cable and fiber offerings provided in the OECD's April 2006 "Multiple Play," report, with each assigned a weight according to that technology's respective percentage of the nations overall broadband subscribership, as reported in the OECD's "Broadband Statistics to December 2006."

6. USD price per bit (PPP) of the fastest available technology is calculated from the broadband offerings examined in the OECD's "Multiple Play: Pricing and Policy Trends" report.

7. The World Bank, "Information and Communications for Development 2006," (2006): 172.

8. United Nations, “World Population Prospects: The 2006 Revision Population Database,” 2007 <esa.un.org/unpp/>.

9. Ibid.

10. The World Bank, “Information and Communications for Development 2006,” (2006): 241.

11. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, “The Netherlands Broadband Market Report 2005”<www.broadbandwalesobservatory.org.uk/broadband-3052>.

12. Ministry of Economic Affairs, “Broadband and Grids Technology in the Netherlands,” Innovation, 2005 < http://www.ez.nl/content.jsp?objectid=143637&rid=142410>.

13. Ibid.

14. Ibid.

15. Ibid.

16. Ibid: 84.

17. Ibid: 2.

18. OPTA Annual Report and Market Monitor 2006 (2006): 82.

19. Ibid: 84.

20. Ibid: 21.

21. Ibid: 24.

22. Paul Budde Communication Pty. Ltd, “Netherlands—Broadband: Market Overview,” Telecommunications and Information Highways (Bucketty, Australia: 2005): 23.

23. OPTA, Annual Report and Market Monitor 2006 (2006): 90.

24. Ibid: 20.

25. Ibid.

26. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, “The Netherlands Broadband Market Report 2005” <www.broadbandwalesobservatory.org.uk/broadband-3052>.

27. Paul Budde Communication Pty Ltd, “Netherlands - Broadband - Market Overview,” Telecommunications and Information Highways, (Bucketty, Australia: 2005): 11.

28. Ibid.

29. OPTA Annual Report and Market Monitor 2006 (2006): 87.

# Appendix F: South Korea

## Overview

**ITIF Rank: 1**

| | | | |
|---|---|---|---|
| **Subscribers per Household**[1] | **0.93** | **Incumbent Government Owned** | **0%** |
| **Internet Users in Millions**[2] | **34.9** | **Local Loop Unbundling:**[3] | |
| **Internet Users per 100 Inhabitants**[4] | **72.75** | **Full Copper Loop** | **Yes** |
| **Average Speed in Megabits per Second (Mbps)**[5] | **49.5** | **Shared Copper Loop** | **Yes** |
| **Price Per Month of 1 Mbps USD PPP**[6] | **.45** | **Bitstream** | **Yes** |
| **Percent of Urban Population**[7] | **81** | **Cable** | **No** |
| **Population Density per sq. km**[8] | **481** | **Fiber** | **No** |

## Geography and Demography

Although South Korea has a much higher population density than the United States (481 inhabitants per square mile as compared to 31)[9] the percentage of the population living in urban areas is nearly the same (81 percent in Korea versus 80 percent in the United States).[10] Yet, there is a key difference in the way that Korea's population is distributed compared to the United States: apartments make up more than 50 percent of Korea's housing.[11] However, this would not be as much of an advantage if the South Korean government had not created in 2000 "The Certification Program for Broadband Buildings," which requires all buildings to be designed to enable high-speed broadband connections, such as locating digital subscriber line (DSL) access multiplexers (DSLAMs) or cable head-ends in apartment basements. The program grades multiple unit buildings of 50 units based on the level of high-speed access they support, rating them as 1st, 2nd, 3rd class based on whether they provide access at speeds of 100 Mbps, 10-100 Mbps, or 10 Mbps, respectively.[12] The result of this combination of urban density, architectural preference, and government initiative is that 90 percent of South Korean households are within a radius of 4 km from a local exchange, which helps keep down the costs of the "last mile" to the home.[13]

## Policy

The South Korea government established a national policy to promote the deployment of information technology in the public and private sectors with its "Framework Act on Informatization Promotion" of 1987. This act created the National Information Society Agency (NIA) to oversee the construction of high-speed networks, the use of information technology in government agencies, and programs to promote public access to broadband and digital literacy. The NIA established the Korean Information Infrastructure initiative (KII) in 1994 to construct a nationwide optical fiber network. The government followed KII with a string of 5- year programs that combined government loans with private sector contributions, including Cyber Korea 21 in 1999, e-Korea Vision 2006 in 2002, IT Korea Vision 2007 in 2003 and finally the Broadband Convergence Network (BcN) and IT 839 initiatives in 2004.[14] Through these programs, South Korea not only invested a substantial amount of money from the government budget, enacted promotional regulations, and provided incentives to private companies to build networks, it also enacted a number of successful efforts to spur broadband demand and digital literacy.[15] In addition to the NIA, the South Korean government established several agencies to promote broadband access in

**Policy (*continued*)**

both the public and private sector including the South Korean agency for Digital Opportunity (KADO), which ensures that all South Korean citizens have the ability to access the Internet, including the elderly and those with disabilities through targeted training programs.

The government created other agencies to spur demand for broadband access by ensuring that consumers know how to access the Internet (digital literacy), and that they feel secure while using it (Internet security and privacy). Accordingly, it created the Korea Information Security Agency (KISA) and the Korea Internet Safety Commission to oversee Internet security and consumer protection, as well as the National Internet Development Agency (NIDA) to promote the Internet society through education and promotional programs. These include the "PC for Everyone" program in 1996, a computer literacy drive in 1998, and the Cyber Korea 21 initiative in 1999 to promote digital literacy and e-commerce. The NIA also implemented programs to promote e-government. In 2004 the Ministry of Information and Communications (MIC) launched the IT839 strategy (also called the "u-Korea Master Plan") to create a ubiquitous information infrastructure by 2010.[16] It is named for its eight services (Wi-Bro, digital broadcasting, home networks, telematics, radio frequency identification (RFID), W-CDMA, terrestrial D-TV, and Internet telephony), three pillars (services, infrastructure, and new growth engines), and nine new growth engines (mobile handsets, digital televisions, home network equipment, system-on-chip products, next generation personal computers, embedded software, digital content, vehicle-based information equipment, and intelligent robot products). Also in 2004 the government launched the "Basic BcN Establishment Plan" to develop a next generation integrated network to allow seamless secure broadband access anytime, anywhere to convergent multimedia services, including telecommunications, broadcast, and Internet services.

The South Korean government's national broadband strategy includes direct and indirect support for broadband infrastructure development, including loans and other incentives. The KII consisted of three sectors and three phases: KII-Government, KII-Private, and KII-Testbed called KOREN (Korea Advanced Research Network). KII-Government spent $24 billion to construct a national high-speed public backbone network, which service providers could use to deploy broadband services to about 30,000 government and research institutes and around 10,000 schools.[17] The KOREN initiative also provided government test beds for companies to use for research and development.[18] Meanwhile, KII-Private worked to spur private funding to construct an access network for homes and businesses, aiming to stimulate broadband deployment in the "last mile." The KII provided a combination of government support and private sector investment. Specifically, the government provided $1.76 billion in government low-cost loans between 2000 and 2005 from its Public Fund Program while the private sector invested $14.5 billion for a total public-private investment of $16.3 billion. In addition, to stimulate demand for broadband, the South Korean government gave small and medium-sized businesses a tax exemption equal to 5 percent of their total investment in broadband communications systems. The lopsidedness of the percentage of government to private funding reflects the fact that the South Korean government expects its private companies to drive the investment in broadband infrastructure with government support in the form of loans and tax subsidies as their incentive. This pattern continued with the successor programs to the KII – the Broadband Convergence Network (BcN) and the IT839, though which the Korean government provided broadband service providers incentives of over $70 billion in low-cost loans to build high speed broadband networks while broadband providers pledged to invest an equal amount.[19]

**Rural Access**

In South Korea, as a condition of privatization, the government required KT (formerly Korea Telecom) to provide broadband access at speed of 1 Mbps or higher to all homes in villages.[20] To help offset some of these costs, the government provided a modest amount of loans ($926 million from 2001 to 2005) to providers through its "Digital Divide Closing Plan" to extend services to harder-to-reach areas through the construction of a fiber-optic backbone network to connect all 144 telecommunications service districts to the nationwide broadband network.[21]

### Competition

In South Korea, there is intense competition between the three main broadband providers, KT, Dacom Powercomm, and Hanaro Telecom. This is because the government has been directly involved in promoting competition. For example, even though KT was government-owned until 2003, in 1997 the South Korean government licensed a new telecommunications service provider to compete directly with KT. So, in 1998 seven South Korean conglomerates provided funding to create Hanaro Telecom and by 1999 the new company began offering broadband services.[22] But Hanaro was not the first broadband provider in South Korea. That distinction goes to Thrunet, a cable provider that launched its service via cable modem in 1998. KT followed by offering its own asymmetric DSL (ADSL) service later in 1999. The government's encouragement of facilities-based competition (both Hanaro and Thrunet initially offered their services by leasing cable lines from KT and Powercomm) while exempting KT from regulation (the government didn't introduce local loop unbundling until 2002) provided the impetus for competition in pricing, infrastructure development, and quality of service.[23] Hanaro launched very high speed DSL (VDSL) service in 2002, with 20 Mbps downstream speeds and 6 Mbps upstream. KT followed with its own VDSL service in 2003 with 50 Mbps downstream and 4 Mbps upstream. Competitors have a further advantage because for multi-unit dwellings the landlords, not KT, own the local loop infrastructure. So Hanaro can simply extend fiber to the local exchange and then contract with landlords (not KT) for use of the local loop.[24] Not surprisingly, landlords would have an incentive to contract with Hanaro since broadband access would make their apartments more attractive.

By 2006 the market began to consolidate. Although South Korea had 79 Internet Service Providers (ISPs), the three largest providers control 85 percent of the broadband market via their affiliated ISPs: KT (KORNET) with 51 percent of the market, Dacom Powercomm (BORANET) with 22 percent, and Hanaro Telecom (HANANET) with 10 percent. Thrunet is the major provider of broadband services via cable, but other companies offer services by leasing access from Dacom's Powercomm (a subsidiary of South Korea's electronic appliance giant – Lucky Goldstar (LG)), which provides its service via cable modems through agreements with cable TV operators. Thrunet has built its subscriber base rather quickly, having only entered the market in 2005.[25] The company began by launching a high-speed fiber service called "Xpeed," advertising 100 Mbps connectivity for apartments and 10 Mbps for houses at prices lower than the 4 Mbps services offered by KT and Hanaro.[26] Intense competition in an increasingly saturated market also has forced providers to compete on price, with some negative results. For example, by 2003 Hanaro was facing huge financial difficulties and sold a controlling stake of 40 percent to a consortium lead by Newbridge Capitol and American International Group (AIG). In addition, Thrunet went bankrupt in 2003 and Hanaro bought the company in 2005 (beating out Dacom Powercomm).[27]

### Fiber

South Korea is evolving toward fiber-to-the-home (FTTH), which is better suited to providing triple play services (telephone, Internet, and television), but the high cost of extending fiber to each household initially slowed development of these services. Nonetheless, high bit rate DSL (such as ADSL and VDSL) subscriptions are declining and Ethernet-based connections to optic fiber distribution nodes in or near apartments are increasing. Fiber broadband increased its market share from 9 percent at the end of 2004 to a third of all connections by 2007.[28] Getting fiber to the home also is one of the goals of the government's two recent initiatives, the Broadband Convergence Network (BcN) and IT839 programs. Both of these focus on creating a ubiquitous network combining wireline, wireless, and RFID technology to enable South Koreans to communicate anytime and anywhere through a variety of devices, including fixed line and mobile phones, personal computers, and via home networks and appliances. In 2004 the government selected three consortia led by KT, DACOM and SKT and expected them to develop trial BcNs using their own funding. Given the strong relationship between the South Korean government and industry, it is perhaps not surprising that the companies in these consortia agreed to this implicit government mandate. For example, in 2003 KT projected it would invest $58.3 billion in the BcN.[29]

**Demand**

As the market becomes saturated, companies are likely to move away from using low prices to gain subscribers and instead focus on other ways to increase demand. In South Korea, there is much available local content, such as games, South Korean music and movies, that have driven demand for broadband access. Television over Internet Protocol (IPTV) has lagged in South Korea as the government has not established regulations for Internet broadcasting. Yet KT, Hanaro, and Powercomm all are offering high-definition television via their broadband networks and bundling this with Internet and voice services in "triple-play" services. Koreans are willing to spend twice as much of their household income on broadband than U.S. consumers.[30] They seem to see broadband as a superior good and thus place a higher value on it. This may be because South Korea has a wide variety of broadband content, and the more services consumers can access using broadband, the greater its value to them.[31] For example, in the late 1990s Internet cafes providing high-speed access – called "PC-bang" – became popular with young people. Once these users had a taste of this level of access they wanted it at home, particularly as online games became more popular. By December 2005, more than 33 million Koreans over the age of 6 (about 73 percent of the population) had online access.[32] Online music services also are popular, such as SK Telecom's "Melon" and the "Melon Shop," which allows users to purchase almost everything related to music, including MP3 players, CDs, music tickets, and musical accessories.[33] Such services drive user demand for high-speed broadband connections. One example is an online service with millions of followers, "Cyworld." In 2005 SK Telecom was making up to $1 million per day on the site by charging small amounts for users to decorate their spaces, to play games, and to play roles.[34] Another example is "OhmyNews," a website that allows the public to general and post content with more than 10 million people using the service.[35]

Nearly all South Korea students are online, with a rate of Internet usage of over 99 percent.[36] Driving this rate of Internet usage are South Korean government programs that require teachers to encourage students' Internet usage by giving online assignments and communicating with them via e-mail. In addition, as part of the Closing the Digital Divide Act of 2002, the government provided free computers to 50,000 low-income students with good grades.[37] Also, the Educational Broadcasting System (EBS) broadcasts high school education programs via the Internet. Because students need broadband access in order to get their assignments and access education programs, these schemes encourage parents to get high-speed access for their children.[38]

The government's digital literacy programs also target groups that otherwise would be less likely to use the Internet. For example, the "Ten Million People Internet Education Project (2000-2002)" worked to provide Internet education to approximately a fourth of South Korea's citizens. Similarly, the government provided subsidies to around 1,000 private training institutes over the nation for the purpose of educating housewives, in order to create demand in households. Under this "Cyber 21" program the government offered 20-hour, week-long courses to housewives for only about $30. In just the first 10 days, 70,000 women signed up for the courses.[39] KADO also has a variety of programs to promote digital literacy and access to computers. These include establishing 8,263 Local Information Access Centers throughout Korea where the public can access the Internet for free, distributing free used PCs to the disabled and to those receiving public assistance, and education and training programs for the elderly and disabled.[40]

In addition, the government realized that broadband demand would not increase if its citizens did not have access to a PC at home. As a result, the PC diffusion promotion established in 1999 aimed to provide PCs at low-prices, partly through a PC purchase installment plan using the postal savings system. Through this program the government purchased 50,000 PCs, providing them to low-income families on a four-year lease with full support for broadband free for five years.[41]

## ENDNOTES

1. OECD measures penetration on a per capita basis because comprehensive data on household penetration is generally unavailable. ITIF has used average household size as a multiplier to convert June 2007 OECD per capita penetration data to household penetration data. It should be noted that one problem with this method is that the OECD data likely also includes some DSL business subscribers.

2. International Telecommunications Union, "Internet Indicators: Subscribers, Users, and Broadband Subscribers," International Telecommunications Union ICT Statistics Database, 2006 <www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx#>.

3. Unbundling is a policy by which regulators require incumbent telecommunications operators (those with dominant market status who control access to the telecommunications infrastructure) or cable companies to give their competitors access to raw copper pairs, fiber, or coaxial cable networks so that they can install their own transmission equipment at the incumbent's central office (local exchange). *Full unbundling* requires the incumbent to make all copper pair frequencies or fiber networks available to competitors. *Shared access* to the local loop requires the incumbent to make the "high" frequency bands (those that carry data, but not voice) of the copper pair available to its competitors, allowing them to offer xDSL broadband services. *Bitstream access* requires incumbent operators to allow competitors access to the incumbents' equipment at their central office. *Cable access* enables competitors to use cable companies' coaxial cable local loops and fiber access requires telecommunications operators to give competitors access to their fiber local loops.

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5. Our methodology for calculating broadband speed in the ITIF Broadband Rankings involves averaging the speeds of the incumbent DSL, cable and fiber offerings provided in the OECD's April 2006 "Multiple Play," report, with each assigned a weight according to that technology's respective percentage of the nations overall broadband subscribership, as reported in the OECD's "Broadband Statistics to December 2006."

6. USD price per bit (PPP) of the fastest available technology is calculated from the broadband offerings examined in the OECD's "Multiple Play: Pricing and Policy Trends" report.

7. The World Bank, "Information and Communications for Development 2006," (2006): 172.

8. The United Nations, "World Population Prospects: The 2006 Revision Population Database," 2007 <esa.un.org/unpp/>.

9. Ibid.

10. The World Bank, "Information and Communications for Development 2006," (2006): 218.

11. Martin Fransman (ed.), *Global Broadband Battles: Why the U.S. and Europe Lag While Asia Leads* (Stanford, California: Stanford Business Books, 2006): 62.

12. Sung-Hee Joo, "Broadband Internet Adoption in Korea: A Maverick or a Model to Follow?" paper presented at the 33rd Research Conference on Communication, Information and Internet Policy, Telecommunications Policy Research Conference, Washington, DC (2005): 6.

13. Ibid: 10.

14. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, "Korea Broadband Market Report 2005" <www.broadbandwalesobservatory.org.uk/broadband-3355>.

15. Yoonmi Kim, "Broadband Internet in Korea," FINPRO Korea, September 30, 2004 <akseli.tekes.fi/opencms/opencms/OhjelmaPortaali/ohjelmat/CONE/fi/Dokumenttiarkisto/Viestinta_ja_aktivointi/Seminaarit/Maaselvsem06/Fixed_Broadband-Korea_-_Kim.ppt >.

16. National Information Society Agency, Leading the Construction of u-Korea, (Seoul, Korea: 2006): 9.

17. John Borland and Michael Kanellos, "South Korea Leads the Way," *c/net News.Com* (July 28, 2004) <www.news.com/South-Korea-leads-the-way/2009-1034_3-5261393.html>.

18. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, "Korea Broadband Market Report 2005" <www.broadbandwalesobservatory.org.uk/broadband-3355>.

19. Dong-Hee Shin and Won-Yong Kim, "An Analysis of Korean National Information Strategy of IT839," Proceedings of the

41st Hawaii International Conference on System Sciences, IEEE, Hawaii, 2008 <csdl2.computer.org/comp/proceedings/hicss/2008/3075/00/30750225.pdf>.

20. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, "Korea Broadband Market Report 2005" <www.broadbandwalesobservatory.org.uk/broadband-3355>.

21. Yong-Hwan Chung, "Korean National Policies to Close the Digital Divide," Ministry of Information and Communication, August 6, 2002 <unpan1.un.org/intradoc/groups/public/documents/APCITY/UNPAN006369.pdf>.

22. Martin Fransman (ed.), *Global Broadband Battles: Why the U.S. and Europe Lag While Asia Leads* (Stanford, California: Stanford Business Books, 2006): 31.

23. United Kingdom Department of Trade and Industry, "Exploiting the Broadband Opportunity: Lessons from South Korea and Japan," *Global Watch Mission Report* (December 2005): 23.

24. Ibid.

25. Paul Budde Communication Pty Ltd, "South Korea – Broadband Market – Overview & Statistics," Telecommunications and Information Highways (2007): 9.

26. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, "Korea Broadband Market Report 2005" <www.broadbandwalesobservatory.org.uk/broadband-3355>.

27. Martin Fransman (ed.), *Global Broadband Battles: Why the U.S. and Europe Lag While Asia Leads* (Stanford, California: Stanford Business Books, 2006): 32.

28. OECD, "Percentage of Fiber Connections to Total Broadband (June 2007)," OECD Broadband Portal <www.oecd.org/dataoecd/21/58/39574845.xls>.

29. Insung Jun, "Broadband Networks in Korea," KT Presentation to the ITU, December 10, 2003 <www.itu.int/osg/spu/ni/futuremobile/pervasive/KTbroadbandnetworks2.pdf>.

30. James B. Speta, "Commentary: Policy Levers and Demand Drivers in Korean Broadband Penetration," *Journal of Korean Law*, Vol. 4, No. 1 (2004): 10.

31. Ibid: 11.

32. National Internet Development Agency of Korea, "Korea Internet White Paper," (2006): 31.

33. Ibid: 34.

34. United Kingdom Department of Trade and Industry, "Exploiting the Broadband Opportunity: Lessons from South Korea and Japan," *Global Watch Mission Report* (December 2005): 35.

35. Ibid: 36.

36. Ibid: 33.

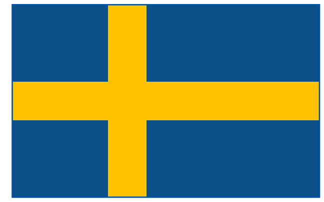
37. Krishna Jayakar and Harmeet Sawhney, "Universal Access in the Information Economy: Tracking Policy Innovations Abroad," (Benton Foundation Universal Service Report, April 19, 2007): 43.

38. Sung-Hee Joo, "Broadband Internet Adoption in Korea: A Maverick or a Model to Follow?" paper presented at the 33rd Research Conference on Communication, Information and Internet Policy, Telecommunications Policy Research Conference, Washington, DC (2005): 7.

39. Jack Schofield, "Miracle Workers: In Just Five Years, South Korea has Shown the World What the Broadband Future Looks like," *The Guardian*, October, 17, 2002 <www.guardian.co.uk/internetnews/story/0,7369,812943,00.html>.

40. Korea Agency for Digital Opportunity and Promotion, "Introduction of KADO," <unpan1.un.org/intradoc/groups/public/documents/UNPAN/UNPAN028063.pdf>.

41. Kenji Kushida and Seung-Yuon Oh, "Understanding South Korea and Japan's Spectacular Broadband Development: Strategic Liberalization of the Telecommunications Sectors," BRIE Working Paper 175, BRIE, University of California, Berkeley, California: June 29, 2006 <brie.berkeley.edu/publications/wp175.pdf>.



# Appendix G: Sweden

## Overview

**ITIF Rank: 6**

| | | | |
|---|---|---|---|
| **Subscribers per Household[1]** | **0.54** | **Incumbent Government Owned** | **45.3%** |
| **Internet Users in Millions[2]** | **6.98** | **Local Loop Unbundling:[3]** | |
| **Internet Users per 100 Inhabitants[4]** | **76.97** | **Full Copper Loop** | **Yes** |
| **Average Speed in Megabits per Second (Mbps)[5]** | **16.8** | **Shared Copper Loop** | **Yes** |
| **Price Per Month of 1 Mbps USD PPP[6]** | **.63** | **Bitstream** | **Yes** |
| **Percent of Urban Population[7]** | **83** | **Cable** | **No** |
| **Population Density per sq. km[8]** | **20** | **Fiber** | **No** |

## Geography and Demography

Sweden is a large country (slightly larger than California) with a relatively small population (9 million compared to California's 35 million). It has one of the lowest population densities in Europe (only 20 people per square kilometer)[9] and the majority of its population is clustered in the south of the country and in coastal areas (in the cities of Stockholm, Göteborg, and Malmö). About half of Sweden's 4 million households are located in apartment buildings. Its percentage of urban population (83 percent) is comparable to the United States and even to South Korea.[10]

## Policy

Sweden was the first country in Europe to develop a broadband policy. As early as 1999 the government recommended that the state should take action in rural and remote areas with no market deployment.[11] While the government generally allows the market to determine how to deliver broadband service, it believes that it is the government's responsibility to ensure access in rural areas where government support may be necessary.[12] So, it is perhaps not surprising that a 2007 government survey found that Sweden is coming close to delivering 100 percent broadband access. When considering subscribers who have access to broadband services either through wireline or wireless service (mobile CDMA2000) just 2,300 households lack access to broadband.[13] This success is largely due to the fact that the Swedish government has been actively involved in promoting broadband access from the beginning. Despite this success, in April 2008 a government-appointed Committee of Inquiry determined that because 145,000 people and 39,000 businesses still lack access to wireline broadband (i.e., fiber, digital subscriber line (DSL), or cable) between 2009 and 2013 the government should provide $500 million in grants to encourage the development of broadband infrastructure (particularly fiber) in areas where none exists.[14] The government subsidized broadband infrastructure development through a variety of programs, including tax reductions for broadband access installations in high cost areas, funding to local authorities that establish operator neutral networks in rural and remote areas, and requiring state-owned companies to build a high-speed backbone infrastructure for emergency services.[15] The government allocated a total of $820 million to stimulate the infrastructure roll out.

**Policy (*continued*)**

There are also some 200 metropolitan networks in more than 100 towns owned and run by the local authorities. In addition, the government assigned Svenska Kraftnät, a national electricity utility company, to build a backbone network to link all of Sweden's 290 municipalities on commercial grounds.[16]

Despite its already high level of broadband penetration, in February 2007, the Swedish regulator – Post & Telestyrelsen (PTS) – announced a "Proposal for Swedish Broadband Strategy," for all Swedish customers to have broadband access (at least 2 Mbps) by 2010 and for most if not all to have a choice of several operators.[17] To achieve this, the PTS proposes government support of $180 million to rollout broadband infrastructure (with EU structural funds of roughly $90 million); minimum broadband requirements for infrastructure supported by government funds, regulations to ensure networks are open to competition, encouraging municipalities to work together to roll out broadband networks, treating broadband as a universal service, and investigating the use of power lines for broadband.[18]

Sweden's broadband regulatory policy is influenced by the fact that it had a government monopoly – Telia (now TeliaSonera) – for fixed telephony. In addition, because Telia was state-owned and the Swedish state also controlled several other communications infrastructures (power, railroads, and broadcasting) the government has long had a strong reason to involve itself in the administration of these networks. However, Sweden has since deregulated these markets but still keeps an ownership of some infrastructure, subject to competition through access regulation or parallel privately owned infrastructures. Even as recently as 2003 the government owned 78 percent of the high-speed network infrastructure.[19] Although Telia merged with the Finnish incumbent operator, Sonera Oyi, in 2002 to create TeliaSonera, the Swedish government still owns 45.3 percent of the company (and Finland owns 13.7 percent).[20]

**Rural Access**

To spur broadband deployment in rural areas, the Swedish government allocated $820 million to stimulate the infrastructure roll out, including $250 million in grants to communities to build local broadband networks, both in the towns and in the surrounding countryside, and another $250 million in tax relief amounting to 50 percent of the cost to build the network to homeowners and businesses to spur development of network infrastructure in homes and buildings. The grants were limited to those communities with no existing broadband providers and the procurement process had to be open and operator-neutral. Moreover, municipalities had to provide at least 10 percent of the cost of building the network with government support limited to a one-time subsidy for 5-year contracts.[21] In addition to government grants, operators themselves estimate that they invested more than $1 billion in these government-supported projects from 2001 to 2007.[22]

Given that TeliaSonera, the incumbent telecommunications operator, owns the majority of Sweden's telecommunications infrastructure, the company had the advantage of being able to bid low for these projects since it could simply upgrade its existing network. Not surprisingly, it won 65 percent of the projects. Other providers were government-owned energy and broadcasting companies, allowing them to offer lower prices for their services since they did not have to meet the revenue expectations of TeliaSonera, a publicly traded company.

A government-appointed Committee of Inquiry recommended in April 2008 that the government should spend an additional $500 million on grants to municipalities and operators to deploy mainly fiber networks in those rural areas that have no access to broadband services. However, as with previous funding for rural broadband infrastructure, government funding would be limited to 50 percent of the costs, with operators and municipalities providing the balance.[23]

### Competition

Government ownership of TeliaSonera is a key consideration in Sweden's broadband strategy.[24] This is because broadband competition requires competing DSL providers to be able to access TeliaSonera's network at the local loop. Thus, the Swedish government's strategy includes policies to ensure that TeliaSonera's broadband competitors can get access to the company's network on terms that don't favor TeliaSonera's retail organizations and at reasonable interconnection rates.[25] So, PTS requires it to unbundle its local loop to allow non-discriminatory access to competing broadband service providers. In 2003, PTS required TeliaSonera to lower its prices for competitors to access its local loops because it argued that the company had been using discriminatory pricing practices – favoring some operators over others.[26] The next year, the PTS determined that TeliaSonera had significant market power and required it to meet all reasonable requests from competing operators for bitstream access. TeliaSonera, however, appealed this decision in court, which suspended the obligation while it considered the appeal.[27] In February 2007 the matter was settled by the Supreme Administrative Court and the decision has been in force ever since. In 2005, PTS determined that TeliaSonera must offer naked DSL, allowing customers to take fixed telephony and broadband services from different providers.

As a result of the Swedish government's strong regulatory stance, the country has one of the most active markets in unbundled local loops.[28] The first major broadband competitor to TeliaSonera was Bredbandsbolaget – called B2 – which began providing services in 1999. It had the advantage of a strategic partnership with the National Swedish Rail Administration because it could use the railway communications infrastructure.[29] B2 has concentrated mainly on providing high-speed Ethernet and very high speed DSL (VDSL) broadband services, beginning with speeds of 10 Mbps and later upgraded to 100 Mbps.[30]

The other major competitor was Bostream, which established its service in 1999 by leasing TeliaSonera's network.[31] It launched asymmetric DSL (ADSL) and VDSL services in 2003, but B2 acquired the company in 2004, which gave it a 23 percent of the market.[32] By 2007, TeliaSonera's private broadband market share in the private broadband market shrank to 38 percent, B2 had 18 percent, Com Hem followed with 17 percent, and Glocalnet had 7 percent.[33] Asymmetric DSL (ADSL) still is the technology of choice for broadband providers with 45 percent of the market (up from 39 percent in 2006).[34] Traditional dial up access came at 26 percent, followed by cable at 16 percent, and fiber LANs at 13 percent. While the numbers of dial up connections are still high, this may be because many Swedish residents keep their dial up account – which often is very cheap if not free – even when they also are subscribing to higher speed access.

There is less competition from cable, which comprises only 16 percent of the market, but ahead of fiber at 13 percent, perhaps because TeliaSonera owned the cable infrastructure until 2003, when it divested its cable subsidiary, Com Hem, which has not modified the majority of its cable lines for broadband access.[35]

### Fiber

As noted in the policy section above, the Swedish government provides support to municipalities to procure networks to rollout fiber broadband services, which may be operated by private companies.[36] In fact, municipalities, housing associations, and local utility providers have built many of Sweden's fiber networks and then opened these up to service suppliers such as Internet service providers (ISPs), TV and telephone companies.[37] For example, in Stockholm, the Stokab project consists of a fiber-optic (dark fiber) network developed in 1999 in the commercial districts and large industrial areas. The City of Stockholm and the Stockholm County Council own the network and lease capacity to ISP's. They offer the fiber-optic infrastructure and leave the services and new service development to telecommunications companies leasing their capacity.[38] Stockholm's local governments invested $100 million in the project and are generating a small profit. These fiber networks may contribute to the fact that Sweden has a

**Fiber (*continued*)**

higher percentage than the other Nordic countries of broadband subscribers with rapid connections, of which more than half deliver speeds of at least 2 Mbps, yet prices per megabit are lower in Sweden than in the other Nordic countries.[39]

**Demand**

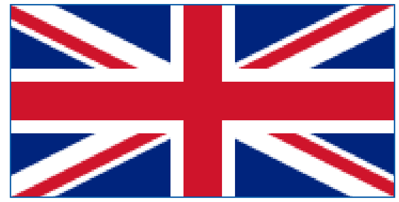
The Swedish government, in addition to supporting broadband infrastructure development, also created programs to encourage broadband demand. The primary focus of these programs has been increasing digital literacy, access to personal computers, and use of broadband for education. Accordingly, the government subsidized personal computer purchases via tax deductions for companies that bought computers for their employees' personal use.[40] In addition, to increase demand the government introduced a $25 million project to raise IT literacy among schoolteachers.[41] In the private sector, service providers are increasingly recognizing that broadband content will help drive demand when high-speed networks also are in place. Consequently, all four Swedish broadband operators offer combined broadband and fixed telephony, while Com Hem (the broadband cable provider) also offers a "triple play" package.[42] In addition, B2 launched an IPTV service for its FTTH subscribers in 2005 and for its DSL subscribers is 2005, along with a video-on-demand (VoD) service.

## ENDNOTES


1. OECD measures penetration on a per capita basis because comprehensive data on household penetration is generally unavailable. ITIF has used average household size as a multiplier to convert June 2007 OECD per capita penetration data to household penetration data. It should be noted that one problem with this method is that the OECD data likely also includes some DSL business subscribers.
2. International Telecommunications Union, "Internet Indicators: Subscribers, Users, and Broadband Subscribers," International Telecommunications Union ICT Statistics Database (ITU, 2006) <www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx#>.
3. Unbundling is a policy by which regulators require incumbent telecommunications operators (those with dominant market status who control access to the telecommunications infrastructure) or cable companies to give their competitors access to raw copper pairs, fiber, or coaxial cable networks so that they can install their own transmission equipment at the incumbent's central office (local exchange). *Full unbundling* requires the incumbent to make all copper pair frequencies or fiber networks available to competitors. *Shared access* to the local loop requires the incumbent to make the "high" frequency bands (those that carry data, but not voice) of the copper pair available to its competitors, allowing them to offer xDSL broadband services. *Bitstream access* requires incumbent operators to allow competitors access to the incumbents' equipment at their central office. *Cable access* enables competitors to use cable companies' coaxial cable local loops and fiber access requires telecommunications operators to give competitors access to their fiber local loops.
4. International Telecommunications Union, "Internet Indicators: Subscribers, Users, and Broadband Subscribers," International Telecommunications Union ICT Statistics Database (ITU, 2006) <www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx#>.
5. Our methodology for calculating broadband speed in the ITIF Broadband Rankings involves averaging the speeds of the incumbent DSL, cable and fiber offerings provided in the OECD's April 2006 "Multiple Play," report, with each assigned a weight according to that technology's respective percentage of the nations overall broadband subscribership, as reported in the OECD's "Broadband Statistics to December 2006."
6. USD price per bit (PPP) of the fastest available technology is calculated from the broadband offerings examined in the OECD's "Multiple Play: Pricing and Policy Trends" report.
7. The World Bank, "Information and Communications for Development 2006," (2006): 172.
8. The United Nations, "World Population Prospects: The 2006 Revision Population Database," 2007 <esa.un.org/unpp/>.
9. Ibid.
10. The World Bank, "Information and Communications for Development 2006," (2006): 271.
11. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, "Sweden Broadband Market Report 2005"<www.broadbandwalesobservatory.org.uk/broadband-3045>.

12. Post & Telestyrelsen, “Broadband Survey 2007,” January 2008 <www.pts.se/Dokument/dokument.asp?Sectionid=&Itemid=7679&Languageid=EN>.
13. Ibid.
14. Swedish Government Committee of Inquiry, “Bredband till hela landet,” SOU 2008:40, April 18, 2008 <www.regeringen.se/content/1/c6/10/33/76/d6a4d016.pdf>.
15. Martin Fransman (ed.), *Global Broadband Battles: Why the U.S. and Europe Lag While Asia Leads* (Stanford, California: Stanford Business Books, 2006): 248.
16. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, “Sweden Broadband Market Report 2005”<www.broadbandwalesobservatory.org.uk/broadband-3045>.
17. Post & Telestyrelsen “Broadband Prices in the Nordic Countries in 2006,” (January 2007): 16.
18. Ibid: 10.
19. Martin Fransman (ed.), *Global Broadband Battles: Why the U.S. and Europe Lag While Asia Leads* (Stanford, California: Stanford Business Books, 2006): 247.
20. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, “Sweden Broadband Market Report 2005”<www.broadbandwalesobservatory.org.uk/broadband-3045>.
21. Sweden’s Post and Telecom Agency (PTS), “Broadband in Sweden,” presentation to the Information Technology and Innovation Foundation (ITIF) on December 7, 2007.
22. Swedish Government Committee of Inquiry, “Bredband till hela landet,” SOU 2008:40, April 18, 2008 <www.regeringen.se/content/1/c6/10/33/76/d6a4d016.pdf>.
23. Ibid.
24. Post & Telestyrelsen “Proposal for Swedish Broadband Strategy,” (February 15, 2007): 19.
25. Ibid.
26. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, “Sweden Broadband Market Report 2005”<www.broadbandwalesobservatory.org.uk/broadband-3045>.
27. Post & Telestyrelsen, “Broadband Prices in the Nordic Countries in 2006,” (January 2007): 58.
28. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, “Sweden Broadband Market Report 2005”<www.broadbandwalesobservatory.org.uk/broadband-3045>.
29. Martin Fransman (ed.), *Global Broadband Battles: Why the U.S. and Europe Lag While Asia Leads* (Stanford, California: Stanford Business Books, 2006): 47.
30. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, “Sweden Broadband Market Report 2005”<www.broadbandwalesobservatory.org.uk/broadband-3045>.
31. Martin Fransman (ed.), *Global Broadband Battles: Why the U.S. and Europe Lag While Asia Leads* (Stanford, California: Stanford Business Books, 2006): 48.
32. Post & Telestyrelsen, “The Swedish Telecommunications Market First Half Year 2007” (2007).
33. Ibid.
34. Ibid: 33.
35. Ibid: 39-40.
36. Ibid: 39.
37. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, “Sweden Broadband Market Report 2005”<www.broadbandwalesobservatory.org.uk/broadband-3045>.
38. “Stockholm’s Municipal Fiber Network Stimulates New Business,” CAnet-3-NEWS, April 17, 2000 <mail.canarie.ca/MLISTS/news2000/0079.html>.
39. Post & Telestyrelsen, “Broadband Prices in the Nordic Countries in 2006” (January 2007): 39-40.
40. Martin Fransman (ed.), *Global Broadband Battles: Why the U.S. and Europe Lag While Asia Leads* (Stanford, California: Stanford Business Books, 2006): 243.
41. Ibid: 248.
42. Post & Telestyrelsen, “Broadband Prices in the Nordic Countries in 2006” (January 2007): 54-55.

# Appendix H: United Kingdom



## Overview

**ITIF Rank: 13**

| | | | |
|---|---|---|---|
| **Subscribers per Household[1]** | **0.55** | **Incumbent Government Owned** | **0%** |
| **Internet Users in Millions[2]** | **33.53** | **Local Loop Unbundling:[3]** | |
| **Internet Users per 100 Inhabitants[4]** | **56.03** | **Full Copper Loop** | **Yes** |
| **Average Speed in Megabits per Second (Mbps)[5]** | **2.6** | **Shared Copper Loop** | **Yes** |
| **Price Per Month of 1 Mbps USD PPP[6]** | **11.02** | **Bitstream** | **Yes** |
| **Percent of Urban Population[7]** | **89** | **Cable** | **No** |
| **Population Density per sq. km[8]** | **248** | **Fiber** | **No** |

## Geography and Demography

The United Kingdom is comprised of four nations: England, Scotland, Wales, and Northern Ireland. While the population density varies throughout, overall it is high at 248 people per square kilometer.[9] The United Kingdom also has a highly urban population with 89 percent of the people living in cities, as compared to 81 in the United States.[10] Nonetheless, it has many rural areas, particularly in the north and west of Scotland and in western Wales.

## Policy

In 2001 the UK government established its national broadband strategy through its white paper: "Opportunity for All in a World of Change," with a target "for the UK to have the most extensive and competitive broadband market in the G7 by 2005."[11] Accordingly, from 2003 to 2006 the government spent more than $2 billion on building public sector networks.[12] The funding was made available via the Broadband Aggregation Project (BAP), which is focused on providing key public services with broadband connectivity, including primary and secondary schools and National Health Service clinics.[13] The project's concept is to aggregate demand for broadband connectivity, thus making it more attractive for broadband providers because it will deliver a large number of guaranteed subscribers. The UK government's digital strategy, released in 2005, also focuses on the demand side of broadband by promoting virtual learning, universal access to advanced public services, fostering the creation of innovative broadband content, providing communal access points and providing digital literacy programs for adults, making home computers more affordable, and removing access barriers for people with disabilities.[14]

## Rural Access

The UK national and local governments support broadband infrastructure development in rural areas, and also focus on helping public entities to build networks and aggregate demand–thus guaranteeing a subscriber base for broadband providers. Specifically, via the BAP, the UK government provided more than $2 billion between 2003 and 2006 to build public sector networks providing key public services with broadband connectivity, including

**Rural Access (*continued*)**

primary and secondary schools and National Health Service clinics.[15] In addition, from 2001 to 2005, via the Broadband Fund the UK government gave grants of around $127 million to more than 13 projects.[16] The government of Scotland funded the development in 2003 for a virtual Telecoms Trading Exchange (TTE) to provide a marketplace for wholesale broadband connectivity in rural areas using grants from Project ATLAS. Also in Scotland, the 2004 Broadband Pathfinder Project provided grants to communities in remote areas of western Scotland to aggregate public sector demand for broadband infrastructure and wire up schools, libraries, and other public buildings.[17]

In England, the municipalities of Cornwall, Hampshire, and Yorkshire have set up broadband initiatives. One early project was the UK Broadband Fund-supported Remote Area Broadband Inclusion Trial (RABBIT) to promote broadband for businesses and organizations in remote areas.[18] In Northern Ireland local government programs are giving financial aid to small businesses that need broadband connectivity; connecting public libraries; and providing e-mail, messaging systems, web publishing, and other services for schools.[19]

**Competition**

The UK government recognized early that it needed a regulatory framework that encouraged competition. British Telecom (BT) owns the majority of the fixed line telecommunications infrastructure and—most importantly—the last mile between the exchange and residences or businesses. This allows BT to control who has access to its network and without government intervention it would be unlikely to allow competitors to use its network or equipment. Accordingly, the government required BT to unbundle its local loops in 2000. In addition to offering unbundled local loops, beginning in 2000 BT also offered non-discriminatory access to a wholesale end-to-end asymmetric digital subscriber line (ADSL) product and a bitstream product.[20] Initially, demand for unbundled local loops was nonetheless very low. So, at the end of 2004 the Office of Communications (Ofcom) – Britain's telecommunications regulator – required BT to reduce its charges for unbundled local loops by up to 70 percent.[21] In addition, in 2005, after the government determined that competition still was insufficient, it required BT to set up a separate business unit (called Openreach) to administer its unbundled network lines on a non-discriminatory basis. The result was a dramatic increase in the number of unbundled lines from 365,000 at the end of 2005 to 1.7 million by February 2007.

A majority of UK residents and businesses receive broadband access via ADSL, supplied primarily by BT since 2000, but also by a variety of competitors because of the government's requirement for BT to unbundle its local loop.[22] BT and its main competitor—Virgin Media (a merger of the two largest cable companies, ntl and Telewest)—account for half of all retail broadband connections.[23] As the UK's incumbent fixed telecommunications operator and owner of a majority of the country's infrastructure, BT also is the UK's largest wholesale broadband provider, its second largest supplier of retail broadband connections, and it has 24 percent of retail broadband subscribers.[24] The primary alternate service is the cable modem, which comprised nearly a quarter of the United Kingdom's broadband connections by the end of 2006—a distant second to DSL broadband despite its debut as the pioneer broadband service in 1999.[25] This is because cable's share of the broadband market has declined significantly from 60 percent in 2001 as most new subscribers have chosen ADSL.[26] Yet Virgin Media is nonetheless the UK's largest broadband provider, with 26 percent of the market.[27] The country's third largest broadband provider, after Virgin Media and BT, is Carphone Warehouse, which began its service only in 2006 after it bought AOL UK with 1.5 million broadband customers and then migrated its TalkTalk fixed telephony customers over to its broadband service.[28] The remainder of the market includes Tiscali, one of the largest pan-European ISPs;

**Competition (*continued*)**

Orange Home UK – a subsidiary of the French incumbent telecommunications operator (formerly France Telecom); Pipex, primarily through the acquisition of Cable and Wireless' broadband subsidiary, Bulldog in 2006 (via LLU and wholesale); and BSkyB/Easynet, through unbundled local exchanges.[29]

**Fiber**

BT is only just now beginning to roll out fiber via BT Openreach, its network access business. It is deploying a fiber network in Ebbsfleet Valley, a new housing development of 9,500 homes and offices in Kent in a deal between BT Openreach, Land Securities and BSkyB. BT also has done trials of FTTH in a number of locations including Suffolk, Milton Keynes, and London's Docklands, as well as in South Wales. Despite these investments, BT currently has no plans to replace its existing copper networks with fiber.[30]

**Demand**

The UK government's digital strategy includes several programs to promote broadband demand. These include Directgov, launched in 2004, that allows British citizens to access information from a variety of government agencies, and Government Gateway, a centralized registration point for government services online.[31] Demand evidently is important to encourage take-up of broadband services, as the British government's research shows that the number one reason its citizens do not subscribe to broadband when they have access to it is lack of interest, and the number two reason is lack of perceived need.[32] Other important factors are lack of confidence and knowledge, PC cost, and software application complexity.[33] To address the problem of PC cost as a barrier to broadband access – particularly in households with children – the UK government established the E-Learning Foundation, which offers parents financing to lease laptops for four years with a delayed payment scheme that begins after 15 months. To stimulate interest in the Internet, the government's Department of Trade and Industry has created the Technology Program, which provides funding to encourage innovation and research in developing broadband content.[34]

In addition to the national programs, each nation has its own initiatives funded both locally and with national funds. For example, with over $5 million of the UK Broadband Fund, the Welsh government set up the Broadband Wales Program in 2002 aimed at stimulating demand for broadband and encouraging supply, including satellite access subsidies; local ICT support centers called "Try Before You Buy;" projects to aggregate public sector demand; the Lifelong Learning Network to deliver connectivity to schools, libraries, and learning centers; and initiatives to bring "second generation" infrastructure to businesses and business parks.[35]

The availability of increased broadband speed also has fueled demand as it facilitates a wider variety of Internet services, including video downloads (such as YouTube), streaming television (such as Choose andWatch.com and Beelinetv.com), and Internet Protocol television (IPTV – such as BT Vision and Tiscali TV). The majority of broadband subscribers use the service as a source of information, but half use it to download music or videos and more than a third play online games.[36] Increasing upload speeds also are spurring the growth of online content, particularly among young people, with 44 percent of users uploading pictures or photos to a website and 15 percent uploading videos.[37] Demand also is increasing as providers offer bundles of services to encourage subscribers to get telephone, broadband, cable TV, and other options from the same company at a combined price.

**Demand (*continued*)**

Cable operators first began offering bundled cable and telephony services after 2000 and now 37 percent of UK homes subscribe to more than one service from the same provider.[38] Triple-play packages (telephony, broadband, and TV) are the most common, with some operators adding mobile phone service (quad-play). Bundling may offer a way for providers to raise broadband prices by including broadband services in a competitively priced package that also includes telephony and TV.

## ENDNOTES

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7. The World Bank, "Information and Communications for Development 2006," (2006): 172.

8. The United Nations, "World Population Prospects: The 2006 Revision Population Database," 2007 <esa.un.org/unpp/>.

9. Ibid.

10. The World Bank, "Information and Communications for Development 2006," (2006): 285.

11. Department of Trade and Industry, Review of the UK Broadband Fund, 2005 <www.berr.gov.uk/files/file13440.pdf>.

12. Broadband Stakeholders Group, "UK National Broadband Strategy," (2004): 8.

13. Ibid: 10.

14. The Prime Minister's Strategy Unit and the Department of Trade and Industry, "Connecting the UK: the Digital Strategy," (March 2005): 8.

15. Broadband Stakeholders Group, "UK National Broadband Strategy," (2004): 8.

16. Ibid.
17. Ibid: 6.
18. Ibid: 5.
19. Ibid: 7.
20. Ibid: 15.
21. United Kingdom Office of Communications, The Communications Market: Broadband: Digital Progress Report, (April 2, 2007): 13.
22. Broadband Stakeholders Group, “UK National Broadband Strategy,” (2004): 8.
23. United Kingdom Office of Communications, The Communications Market: Broadband: Digital Progress Report, (April 2, 2007): 9.
24. Ibid: 9.
25. Ibid: 5-7.
26. Ibid: 7.
27. Ibid: 9.
28. Ibid: 10.
29. Ibid: 10-11.
30. “BT Deploys FTTH in Kent,” Screen Digest, February 7, 2007 <www.screendigest.com/online_services/ intelligence/broadband/updates/bi-070207-jg1sj/view.html>.
31. Ibid: 18.
32. Ibid: 24.
33. Ibid.
34. Ibid: 41.
35. Arsyllfa Band Eang Cymru-Broadband Wales Observatory, “UK Broadband Market 2005,” (2005): 4.
36. Ibid: 20.
37. Ibid: 23.
38. Ibid: 34.

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