September 2010

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National Broadband Plan Reflects the Experiences of Leading Countries, but Implementation Will Be Challenging

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Why GAO Did This Study

Increasingly, broadband Internet service is seen as critical to a nation's physical infrastructure and economic growth. Universal access to, and increased use and adoption of, broadband service are policy goals stated in the National Broadband Plan, which the Federal Communications Commission (FCC) released in March 2010. Some recent studies indicate that despite achieving nearly 95 percent broadband deployment and globally competitive adoption rates, the United States has moved from the top to the middle of the international rankings. Other developed countries, which have made universal access and increased adoption priorities, rank higher than the United States in these areas, and their experiences may be of interest to U.S. policymakers. GAO was asked to address (1) the status of broadband deployment and adoption in developed countries, (2) actions selected countries have taken to increase deployment and adoption, and (3) how recommendations in the National Broadband Plan align with the selected countries' actions.

GAO analyzed relevant information for 30 developed countries that are members of the Organisation for Economic Cooperation and Development (OECD) and visited 7 of these countries selected for their broadband policies and economic or demographic characteristics. GAO also interviewed public- and private-sector contacts in these countries and FCC officials. FCC provided technical comments on this report.

View GAO-10-825 or key components.
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What GAO Found

Broadband infrastructure has been widely deployed in developed countries, but broadband adoption rates are more variable because of cost and other factors. In 27 of the 30 OECD countries, including the United States, broadband has been deployed to 90 percent or more of households, regardless of differences in demographic and geographic factors, while broadband adoption rates are affected by factors such as population, cost, and computer ownership. In the United States, which ranks 15th for both deployment and adoption, broadband has been deployed to 95 percent of households, with 26.4 subscribers per 100 inhabitants—above the OECD average of 23.3.

To increase broadband deployment adoption, the 7 countries GAO selected—Canada, France, Japan, the Netherlands, South Korea, Sweden, and the United Kingdom—have taken actions that stakeholders in these countries considered effective. GAO placed these actions in five categories—(1) instituting plans and policies (2) providing funds through public/private partnerships, (3) increasing competition, (4) expanding online services, and (5) providing digital literacy training, consumer subsidies, or both. All 7 countries have instituted some type of broadband plan. To help increase deployment in areas private enterprise views as unprofitable, national or regional governments in all 7 countries have used public/private partnerships. To help increase usage and thus expand adoption, all 7 have enacted policies to encourage competition and have increased the number of government services available online. Several countries have also offered training or subsidies, often targeting populations with low adoption rates.

The recommendations outlined in the National Broadband Plan reflect actions taken in GAO's 7 selected countries to increase broadband deployment and adoption. The plan contains over 200 recommendations for FCC, other government agencies, and Congress, which the plan's executive summary groups in four broad areas. These four areas are not identical to the five types of actions GAO identified in the selected countries, but both represent similar approaches to expanding broadband deployment and adoption. For example, the plan calls for adopting strategies and long-term goals, while the actions taken by the selected countries include instituting plans that contain strategies and goals. Similarly, the plan advocates policies to promote robust competition, just as the selected countries have taken actions to promote competition. While the United States plans to take actions similar to those of other leading countries to achieve the National Broadband Plan's goals of universal access and increased adoption, achieving these goals will be challenging. Actions will be required by governments at all levels and the private sector. Furthermore, implementing the plan's recommendations will require coordinating the work of multiple stakeholders and obtaining sufficient funding, among other actions. How effectively federal agencies will be able to address these challenges and implement the plan's recommendations, as well as what the private sector will do to further deployment, use and adoption, remains to be seen.

_____ **United States Government Accountability Office**

Contents

Abbreviations

4G	Fourth Generation
ADSL	asymmetric digital subscriber line
BIP	Broadband Initiatives Program
BTOP	Broadband Technology Opportunities Program
BRAND	Broadband for Rural and Northern Development
DSL	Digital subscriber line
FCC	Federal Communications Commission
Gbps	gigabits—one thousand million bits per second
GNA	Glasvezel Amsterdam
GNI	gross national income
GPRA	Government Performance and Results Act of 1993
HDTV	high-definition television
ICT	Information and Communications Technology
IPTV	Internet protocol television
Kbps	kilobits—one thousand bits per second
KT	Korea Telecom
Lifeline	Lifeline Assistance
Link-Up	Link-Up America
Mbps	megabits—1 million bits per second
NTIA	National Telecommunications and Information Administration
NOFA	Notice of Funds Availability
NOI	Notice of Inquiry
OECD	Organisation for Economic Cooperation and Development
Ofcom	Office of Communications
OSTP	Office of Science and Technology Policy within the Executive Office of the President

Recovery Act	American Recovery and Reinvestment Act of 2009
RUS	Rural Utilities Service
UN	United Nations
WiFi	wireless fidelity
WiMax	Worldwide Interoperability for Microwave Access

United States Government Accountability Office
Washington, DC 20548

September 14, 2010

The Honorable Henry A. Waxman
Chairman
Committee on Energy and Commerce
House of Representatives

The Honorable Rick Boucher
Chairman
Subcommittee on Communications, Technology,
    and the Internet
Committee on Energy and Commerce
House of Representatives

Increasingly, broadband Internet service is viewed as a critical component of a nation's physical infrastructure and a key driver of economic growth in the world's most economically developed countries. Both the Organisation for Economic Cooperation and Development (OECD)— which brings together the governments of about 30 developed countries to promote sustainable economic growth and expand world trade—and the Federal Communications Commission (FCC) have recognized the economic and social importance of broadband service today. Ensuring that the infrastructure necessary to provide broadband service is universally available and that all citizens who wish to subscribe are able to do so are policy goals of many governments. Universal availability is, for example, a policy goal set forth in the National Broadband Plan, issued by FCC in March 2010 in response to a congressional mandate.[1] To achieve their policy goals, governments of developed countries around the world have taken actions to increase broadband infrastructure deployment, and to increase usage and adoption, particularly in areas with little or no service.[2] Several recent studies on levels of broadband deployment and adoption across countries allow for international comparisons. Although such studies have limitations, as we noted in an earlier report,[3]

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[1]Pub. L. No. 111-5, 123 Stat. 115 (2009).

[2]For the purposes of this report, we define *deployment* as the number of households to which broadband infrastructure and service have been made available and *adoption* as the number of inhabitants/households that subscribe to broadband service.

[3]See GAO, *Telecommunications: Current Broadband Measures Have Limitations, and New Measures Are Promising but Need Improvement,* GAO-10-49 (Washington, D.C.: Oct. 9, 2009).

stakeholders across countries have agreed that they are useful for alerting policymakers and the public to areas deserving of particular attention in future policy decisions.

Some recent studies show that, as other developed countries have enacted policies to increase their levels of deployment and adoption, the United States has moved lower in the international rankings.[4] Specifically, despite achieving nearly 95% broadband deployment and globally competitive adoption rates, the United States has moved from the top to the middle of the scale in both areas. Hence, the actions of stakeholders in other countries that have achieved higher deployment and adoption rates are of interest and offer examples that could inform future U.S. broadband policy decisions. To obtain a better understanding of these actions, you asked us to examine efforts of other countries. Accordingly, this report addresses the following questions:

1. What is the status of broadband deployment and adoption in developed countries?

2. What actions have selected countries taken to increase broadband deployment and adoption?

3. How do recommendations outlined in the National Broadband Plan reflect the actions of selected countries to increase broadband deployment and adoption?

To address the first question, we obtained information on broadband deployment and adoption in the 30 countries that were members of OECD as of January 1, 2010,[5] through a review of OECD's ranking of broadband

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[4]The Berkman Center for Internet & Society at Harvard University, *Next Generation Connectivity: A review of broadband Internet transitions and policy from around the world*, (Boston, MA: 2010), Yongsoo Kim, Tim Kelly and Siddhartha Raja, *Building Broadband: Strategies and Policies for the Developing World*, (Washington, D.C.: World Bank, 2010), Robert D. Atkinson, Daniel K. Corea and Julie A. Hedlund, *Explaining International Broadband Leadership* (Washington, D.C.: The Information Technology and Innovation Foundation, 2008).

[5]Chile has since become a member, but relevant data were not available for our review.

subscribers per 100 inhabitants,[6] and we analyzed key demographic and socioeconomic data identified by FCC as potentially affecting broadband deployment and adoption in all 30 countries.

To address the second question, we selected 7 countries from the original 30 countries—Canada, France, Japan, the Netherlands, South Korea, Sweden, and the United Kingdom—for further analysis and comparison with the United States, using a case study approach. These countries were among those that had instituted policies or practices credited with increasing broadband deployment, adoption, or both, and had economic or demographic characteristics somewhat similar to those of the United States. To determine the actions these selected countries have taken to increase broadband deployment and adoption, we obtained and analyzed relevant policies, plans, and guidance issued by responsible government agencies, regulatory authorities, and broadband providers in our 7 selected countries and actions taken by these countries' governments and other stakeholders to increase broadband deployment and consumer adoption. We identified these actions through semistructured interviews with public- and private-sector stakeholders in the 7 countries and placed these actions in five categories. Actions in the first two categorizes serve primarily to increase deployment, while those in the remaining three categories are largely intended to increase adoption, although some actions may promote both deployment and adoption. Furthermore, to better understand stakeholders' views on the effectiveness of these actions, we interviewed national and local government officials and representatives of broadband providers and consumer interest groups in each of the selected countries.

To address the third question, we analyzed the National Broadband Plan's recommendations, which the plan's executive summary groups in four broad areas, and compared these areas with the five categories in which we placed the selected countries' actions. We also compared individual recommendations with specific actions taken in the selected countries and

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[6]OECD calculates broadband subscribers per 100 inhabitants to include *connections* to residences and businesses. OECD collects, from telecommunications regulators in each country, the number of "subscriber lines" that operators have in their network(s) in that country. The data give a very good measure of the physical lines in a country. The subscriber data do not, however, provide any information on how the lines are used. Often OECD member governments conduct surveys to find out how broadband is used, particularly by businesses and households. However, these surveys are relatively infrequent, and the dates may not correspond well across countries, so OECD uses the subscriber line data that are available for all OECD countries rather than household survey data that may not be available for all OECD countries.

spoke with relevant FCC officials about how the actions recommended in the plan align with the five identified categories. We did not evaluate the potential impact or effectiveness of the recommendations.

We conducted this performance audit from June 2009 to September 2010, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. See appendix I for more information about our scope and methodology.

Background

During the 1990s, the primary means for residential users to access the Internet was a dial-up connection, in which a standard telephone line is used to make an Internet connection at data transmission speeds of up to 56 kilobits per second (kbps).[7] Broadband access to the Internet became available to residential customers by the late 1990s. Broadband connections offer a higher speed Internet connection than dial-up. For example, some broadband connections in the United States offered over telephone lines can provide speeds exceeding 1 million bits per second (Mbps) both upstream (data transferred from the consumer to the Internet service provider, also known as upload) and downstream (data transferred from the Internet service provider to the consumer, also known as download). These higher speeds enable consumers to receive information much faster and thus access certain applications and content that might be inaccessible with a dial-up connection. Also, broadband typically provides an "always on" connection to the Internet, so users do not need to establish a connection to the Internet service provider each time they want to go online. The higher transmission speeds that broadband offers generally cost more than dial-up, and some broadband users pay a premium to obtain very-high-speed service.

Consumers can receive a broadband connection to the Internet through a variety of technologies, including, but not limited to, the following:

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[7]In digital telecommunication, the bit rate is the number of bits (a bit is the smallest unit of data a computer can process, representing either a 1 or a 0) that passes a given point in a telecommunication network in a given amount of time, usually a second. Thus, a bit rate is usually measured in some multiple of bits per second—for example, kilobits, or thousands of bits per second.

Cable modem. Cable television companies first began providing broadband cable modem service in the late 1990s. This service, which is primarily available in residential areas, enables cable operators to deliver broadband service through the same coaxial cables that deliver pictures and sound to television sets. Although the speed of service varies with many factors, download speeds of up to 6 Mbps are typical. Some cable providers are offering even higher download speeds, up to 100 Mbps.

Digital subscriber line (DSL). Local telephone companies provide DSL service, another form of broadband service, over their telephone networks on spectrum unused by traditional voice service. To provide DSL service, telephone companies must install equipment in their facilities as well as installing or providing DSL modems and other equipment at customers' premises; they may also have to remove devices on phone lines that may cause interference. Most residential customers receive older, asymmetric DSL (ADSL) service with download speeds of 1.5 Mbps to 3 Mbps. ADSL technology can achieve speeds of up to 8 Mbps over short distances. Newer DSL technologies can support services with speeds of over 8 Mbps up to 50 Mbps in some areas.

Satellite. Satellites transmit data to and from subscribers from a fixed position above the equator, eliminating the need for a telephone or cable connection.[8] Typically, a consumer can expect to download data at a speed of about 1 Mbps and upload data at a speed of about 200 kbps. Transmission of data via satellite results in a slight lag in transmission, typically one-half to three-fourths of a second, thus rendering this service less suitable for certain Internet applications, such as videoconferencing. While satellite broadcast service may be available throughout the country, its use requires a clear line of sight between the customer's antenna and the southern sky. The equipment necessary for service, the recurring monthly fees, and the installation costs are generally higher for satellite broadband service than for most other broadband transmission modes.

Wireless. Land-based, or terrestrial, wireless broadband service connects a home or business to the Internet using a radio link. Some companies are offering fixed wireless broadband service throughout cities. Also, mobile telephone carriers have begun offering broadband mobile wireless

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[8]There also are low earth orbit satellite providers, such as GlobalStar and Iridium,that provide some level of broadband service. These satellite systems are in non-stationery orbits that range between 450 and 800 miles above the earth. From these orbits, transmission lags are minimal and less than the lag from fixed-position satellites.

Internet service, allowing subscribers to access the Internet with their mobile phones or laptops in areas throughout cities where their provider supports the service. Also, wireless fidelity (Wi-Fi) networks—which provide broadband service in so-called "hot spots," or areas within a radius of up to 300 feet—can be found in cafes, hotels, airports, and offices. Hot spots generally use a short-range technology that provides speeds up to 54 Mbps. In addition, Fourth Generation, i.e., 4G, wireless technology, now in the early stages of deployment, is expected to achieve broadband speeds as fast as 50 to 100 Mbps for a few users over an extended period of time or for short periods of time for many users. Some 4G technologies, such as Worldwide Interoperability for Microwave Access (known as WiMAX), can provide broadband service up to approximately 30 miles, but at that distance, data transmission rates would be low.

Fiber optic. Fiber optic technology converts electrical signals carrying data to light and sends the light through transparent glass fibers about the diameter of a human hair. In countries such as Japan and Korea, the government is encouraging providers to offer, in the next 3-5 years, data transmission speeds exceeding current DSL or cable modem speeds, typically by tens or even hundreds of megabits per second, up to 1 gigabit per second (Gbps) in some areas.[9] Fiber may be provided in several ways, including direct connection to a customer's home or business, or to a location somewhere between the provider's facilities and the customer. In the latter case, the last part of the connection to the customer's premises may be provided over coaxial cable, copper loop, or radio technology. Such hybrid arrangements may be less costly than providing fiber all the way to the customer's premises, but they generally cannot achieve the high transmission speed of a full fiber-to-the-premises connection.

In the United States, FCC is the federal agency principally responsible for broadband but the scope of its authority has not been resolved. In a series of decisions starting in 2002, FCC classified broadband Internet services as "information services" under the Communications Act. "Information services" are not subject to Title II of the Communications Act, which addresses telecommunications services like phone service, but gives FCC authority to regulate these services. However, FCC asserted that it had authority to regulate broadband Internet service using its "ancillary

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[9]A gigabit is one billion bits or one thousand million bits.

authority" under Title I of the Communications Act.[10] A recent decision of the U.S. Court of Appeals for the District of Columbia Circuit called that authority into question. In this case, Comcast Corp. v. FCC, the court reviewed an FCC decision that relied on ancillary authority to address an Internet service provider's network management practices.[11] The court held that the use of ancillary authority must be tied to a specific statutory mandate in the Communications Act and that FCC had not done that in its order. Since that time, FCC has released a Notice of Inquiry (NOI) to seek public comment on its legal framework for regulating broadband Internet services.[12] The NOI suggests that there are at least three legal options for FCC as follows:

1. Maintain the current "information service" framework for broadband Internet service based on the Title I ancillary authority questioned in Comcast.

2. Identify the connectivity portion of broadband Internet service as a "telecommunications service" to which all requirements of Title II of the Communications Act would apply.

3. Following the framework Congress established for cell phone services in 1993, identify the connectivity portion of broadband Internet service as a telecommunications service and simultaneously forbear[13] from applying all but the minimum number of provisions of Title II needed to implement fundamental universal service, competition and market entry, and consumer protections.

The NOI seeks comment on the three legal options and any other approaches that will restore a solid legal foundation for FCC's broadband policies. Public comments were due on July 15, 2010, and replies on August 12, 2010.

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[10]FCC relies on Section 4(i) of the Communications Act of 1934, which authorizes it "to perform any and all acts, make such rules and regulations, and such orders…as may be necessary in the execution of its functions" for its ancillary jurisdiction. See 47 U.S.C. §154(i).

[11]*Comcast Corp. v. FCC*, F. 3d 642 (D.C. Cir. 2010).

[12]*Framework for Broadband Internet Service*, FCC 10-114, Notice of Inquiry, GN Docket No. 10-127 (rel. June 17, 2010).

[13]Under section 10 of the Communications Act, FCC has authority to forbear from applying provisions of the Communications Act to telecommunications carriers or services if certain criteria are met. 47 U.S.C. §160.

Three other federal agencies also have responsibilities for broadband in the United States:

- The Office of Science and Technology Policy (OSTP) within the Executive Office of the President has a broad mandate to advise the President and the federal government on the effects of science and technology on domestic and international affairs and has led interagency efforts to develop science and technology policies and budgets.

- Within the Department of Commerce, the National Telecommunications and Information Administration (NTIA) serves as the President's principal telecommunications and information adviser and works with other executive branch agencies to develop the administration's telecommunications policies.

- Within the Department of Agriculture, the Rural Utilities Service (RUS) provides financial resources for broadband deployment.

    Under the American Recovery and Reinvestment Act of 2009 (Recovery Act), enacted on February 17, 2009, NTIA and RUS have responsibility for distributing federal moneys to expand broadband.[14] The act provided $7.2 billion[15] to extend access to broadband throughout the United States, including $4.7 billion for NTIA and $2.5 billion for RUS. Specifically, the Recovery Act authorized NTIA, in consultation with FCC, to create the Broadband Technology Opportunities Program (BTOP) to manage competitive grants to a variety of entities for broadband infrastructure, public computer centers, and innovative projects to stimulate demand for, and adoption of, broadband. The Recovery Act made up to $350 million of the $4.7 billion available for developing and maintaining a nationwide map featuring the availability of broadband service, as provided in the Broadband Data Improvement Act.[16] In addition, the Recovery Act made some of NTIA's appropriation available for transfer to FCC for the

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[14]Pub. L. No.111-5, 123 Stat. 115 (2009).

[15]While this amount is substantial, it is small relative to the amount private industry invests. According to a major telecommunications association, broadband service providers invest approximately $60 billion a year in broadband.

[16]On July 8, 2009, NTIA published a Notice of Funds Availability (NOFA) and solicitation of applications to announce the availability of funds for the State Broadband Data and Development Grant Program pursuant to the authority provided in the Recovery Act and the Broadband Data Improvement Act, Title I, Pub. L. No. 110-385, 122 Stat. 4096 (2008). 74 Fed. Reg. 32545 July 8, 2009.

development of a national broadband plan to help ensure that all people in the United States have access to broadband. The Recovery Act also authorized RUS to establish the Broadband Initiatives Program (BIP) to make loans and to award grants and loan-grant combinations for broadband infrastructure projects in rural areas. Pursuant to the Recovery Act, all BTOP and BIP funds must be awarded by September 30, 2010.

In May 2009, we reported on the broadband deployment policy of the past administration, the principal federal programs that helped fund broadband infrastructure, and stakeholders' views on the usefulness of those programs.[17] We also compared the policies of some OECD countries, which had higher broadband adoption rates than the United States, and recommended that those agencies responsible for overseeing federal efforts to increase broadband deployment and adoption—FCC, NTIA, and RUS—work together to specify performance goals and measures for broadband deployment and coordinate their efforts in carrying out the plan.[18]

Broadband Deployment Rates Are Generally Comparable across OECD Countries, but Adoption Rates Vary because of Cost and Other Factors

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[17]GAO, *Telecommunications: Broadband Deployment Plan Should Include Performance Goals and Measures to Guide Federal Investment*, GAO-09-494 (Washington, D.C.: May 12, 2009).

[18]The plan was not released until March of the following year.

Broadband Infrastructure Has Been Deployed to Nearly All Households in Developed Countries despite Significant Demographic and Geographic Differences

In 27 of the 30 OECD countries, including the United States, broadband has been deployed to 90 percent or more of households regardless of demographic or geographic differences.[19] High rates of broadband deployment have been achieved despite geographic and financial differences among the OECD countries. However, not all OECD countries have overcome the same challenges in deploying broadband infrastructure. For example, in Denmark, which is one of the smallest and most densely populated OECD countries, with an average of 128 people per square kilometer, broadband has been deployed to 99 percent of households.[20] Yet in the United States, which is 228 times larger geographically, and 56 times more populous, and which has an average of 32 people per square kilometer, broadband has been deployed to more than 95 percent of households.[21] See figures 1 and 2.

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[19]The speeds that countries define as broadband vary. For example, NTIA defines broadband access in the United States for the purposes of mapping broadband deployment as at least 768 kbps, meaning that 95 percent of households have access to at least 768 kbps, whereas Canada defines broadband deployment as 1.5 Mbps (1,500 kbps). Thus, infrastructure has been deployed that provides 93.5 percent of Canadians with at least 1.5 Mbps.

[20]Population density and land area figures are based on GAO analyses of Central Intelligence Agency data. Broadband availability was calculated by OECD.
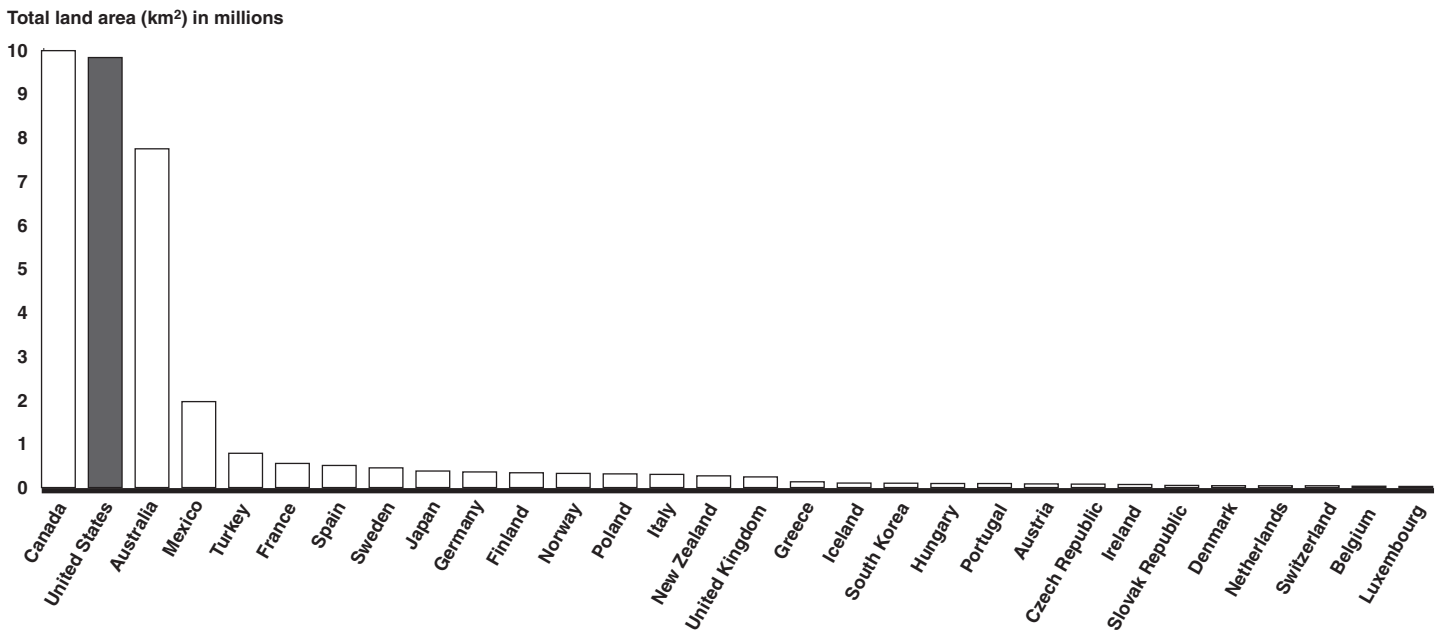
[21]See footnote 20.

Figure 1: Broadband Deployment as a Percentage of Households by OECD Country

Percentage of broadband deployment
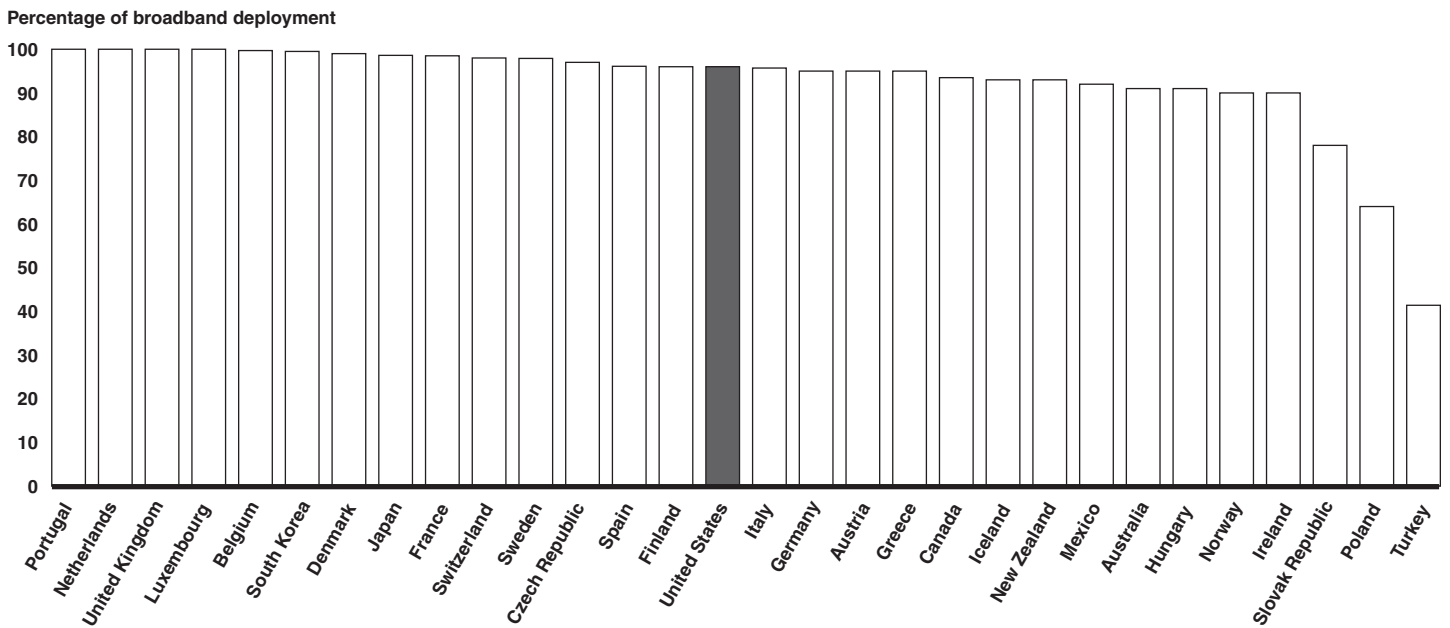
Source: GAO analysis of OECD data.

Figure 2: Land Mass of Each OECD Country

Total land area (km²) in millions

Source: GAO analysis of Central Intelligence Agency data.

Across the 30 OECD countries, average broadband download speeds range from 1.352 Mbps in Mexico to 11.717 Mbps in South Korea, and the majority of countries have average broadband speeds of 3 Mbps to 8 Mbps, according to Akamai Technologies, a global Internet content provider that issues reports assessing broadband download speeds in approximately 71 countries. The United States, with assessed average speeds of 3.808 Mbps, ranks 14th among the OECD countries.[22] However, broadband speeds can exceed averages under certain conditions. For example, in the United States, three localities—Berkeley, California (18.730 Mbps); Chapel Hill, North Carolina (17.483 Mbps); and Stanford, California (16.956 Mbps)—offer the highest average broadband speeds in the world. In addition, 21 of the 100 top cities Akamai evaluated are in the United States.

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[22]Akamai Technologies, Inc., *The State of the Internet Report, Q4 2009* (Boston, Mass.: 2010). Four OECD countries were not included in the report (Hungary, Poland, Slovak Republic, and Turkey). Akamai defines "broadband" connections as download speeds of greater than 2 Mbps, and "high broadband" as connections of 5 Mbps or greater. In contrast, the "narrowband" data included below are for connections slower than 256 Kbps.

The quality of broadband infrastructure is often characterized by the speed it is capable of providing to users. Greater broadband speeds enable the use of more services over the Internet. For example, the United States and Japan lead the world in demand for high-definition television (HDTV), which can consume up to 18 Mbps if broadcast over the Internet. Current Internet-based video requires 1-4 Mbps; if these speeds grow over time and demand for Internet-based HDTV is combined with demand for other broadband-based services, such as Web browsing and online gaming, a household's demand for broadband speeds could exceed 20 Mbps or more.[23] See table 1. However, since most HDTV today is carried on dedicated infrastructure, the impact on demand for Internet broadband speeds is small.

Table 1: Range of Speed Requirements for Various Digital Content Applications

Application type	Speed
High-definition television	10 Mbps to 18 Mbps
Online games	2 Mbps to 14 Mbps
Video on demand	1.5 Mbps to 12 Mbps
Internet protocol television (IPTV)	1.5 Mbps to 12 Mbps
Videoconferencing	1 Mbps to 12 Mbps
Virtual worlds	1 Mbps to 8 Mbps
Web browsing	64 kbps to 4 Mbps
Audio streaming	128 kbps to 1 Mbps
Voice calls	64 kbps to 512 kbps

Source: OECD Information Technology Outlook 2008, Figure 5.5.

Broadband Adoption Rates Are Variable and Are Affected by Cost and Demographic Factors

A number of demographic factors, such as population, cost, and computer ownership, affect broadband adoption rates. Seventeen OECD countries have broadband adoption rates that exceed the average of 23.3 subscriber lines per 100 inhabitants,[24] including the United States, at 26.4 subscriber lines. Furthermore, the United States has more subscribers than any other

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[23]Darrell West, *An International Look at High Speed Broadband,* Brookings Institution (Washington, D.C.: February 2010).

[24]OECD's calculated average includes the broadband adoption per 100 inhabitants for Chile (9.6).

OECD country—81 million, or more than twice as many as Japan, which has 31 million, the second highest number of subscribers.[25]

Population is an important factor to consider when analyzing broadband adoption rates. For example, 7 of the 10 countries with the highest adoption rates are also among the 10 countries with the smallest populations. Because the population of the United States is significantly larger than that of the other OECD countries, a 1-unit[26] increase in the broadband adoption rate in the United States requires more than 3 million new U.S. broadband subscriber lines. By contrast, the Netherlands would need another 160,000 subscriber lines to achieve a 1-unit increase. Assuming all other factors are equal, the cost of a 1-unit increase in broadband subscriber lines per 100 inhabitants is considerably higher in the United States than in any other country. See figures 3 and 4.

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[25]OECD, December 2009.

[26]*1-Unit* refers to one additional subscriber line per 100 inhabitants.

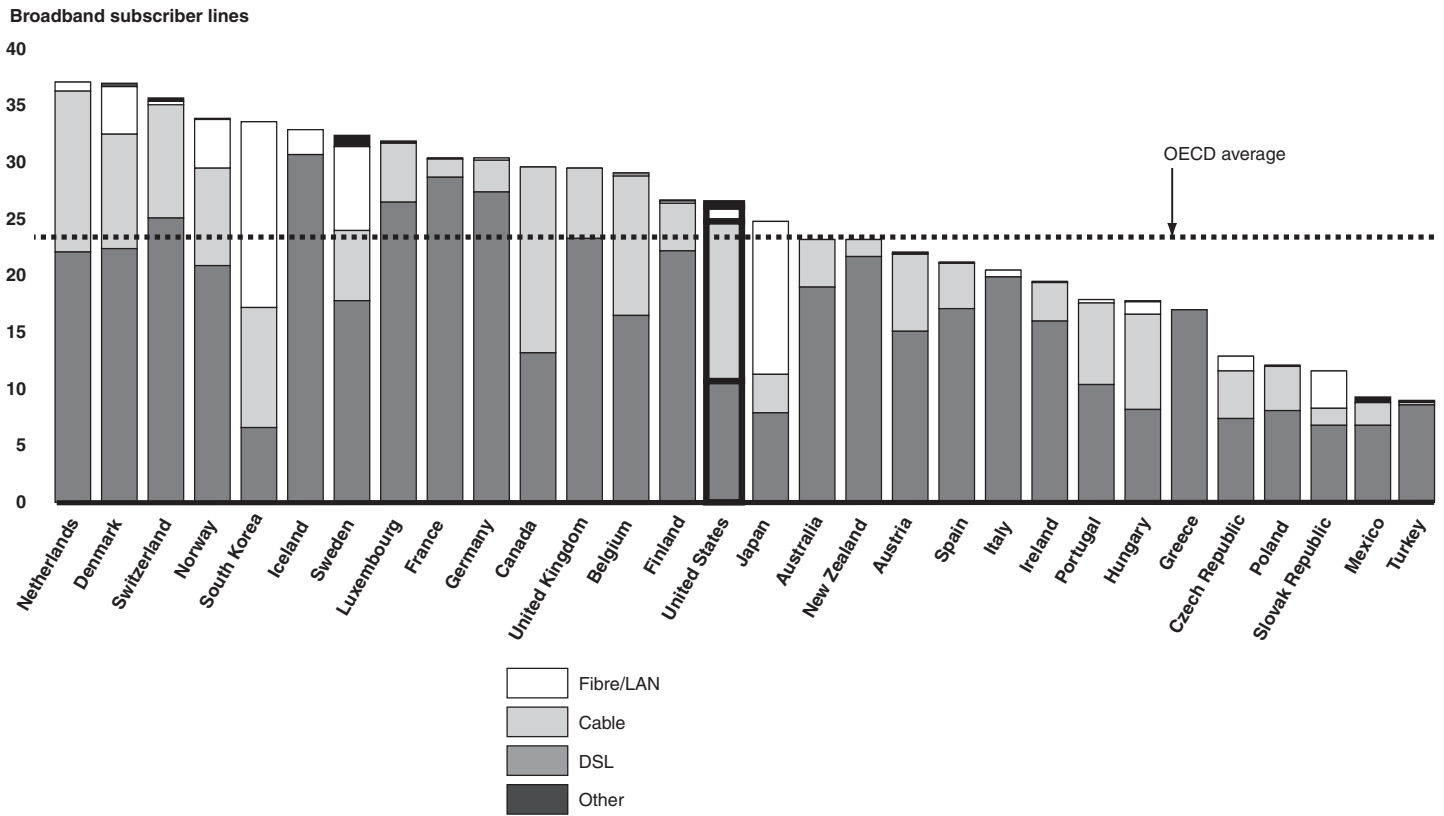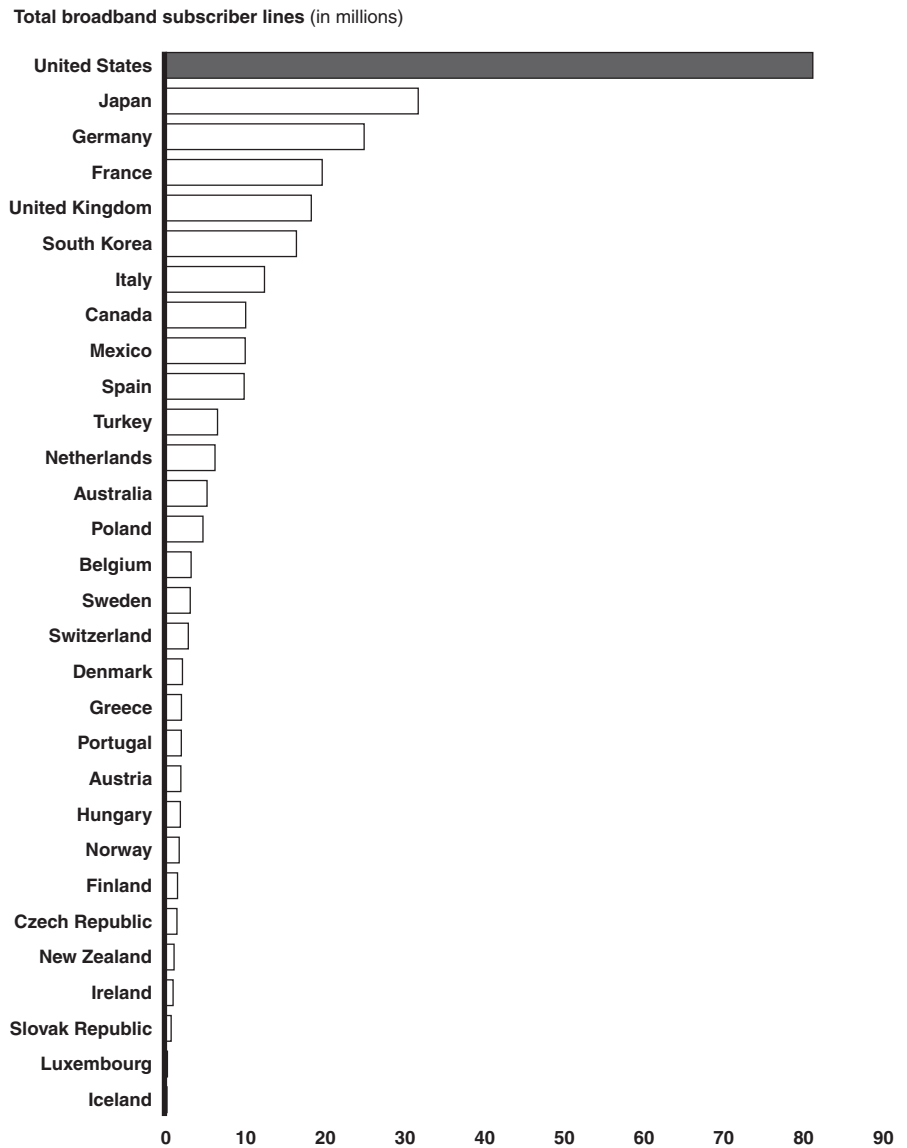**Figure 3: Number of OECD Broadband Subscriber Lines per 100 Inhabitants**

Broadband subscriber lines

OECD average

Fibre/LAN

Cable

DSL

Other

Source: OECD.

Figure 4: Total Number of Broadband Subscriber Lines, by Country

Total broadband subscriber lines (in millions)

Country	
United States	
Japan	
Germany	
France	
United Kingdom	
South Korea	
Italy	
Canada	
Mexico	
Spain	
Turkey	
Netherlands	
Australia	
Poland	
Belgium	
Sweden	
Switzerland	
Denmark	
Greece	
Portugal	
Austria	
Hungary	
Norway	
Finland	
Czech Republic	
New Zealand	
Ireland	
Slovak Republic	
Luxembourg	
Iceland	

0   10   20   30   40   50   60   70   80   90

Source: OECD.

Cost and Demographic Factors Affect Broadband Adoption Rates

Cost—including a monthly broadband subscription price and the price of a computer or other device for accessing the Internet—is another key factor affecting broadband adoption rates. A 2009 survey conducted for FCC determined that 65 percent of American adults use broadband at home, although another 12 percent use the Internet, either through a dial-up

connection or at a place other than their home.[27] However, this study also surveyed nonadopters in the United States and determined that more than one-third identified cost as the main factor affecting their decision not to subscribe to broadband service. Additionally, subscription costs generally increase with speed, making higher-speed services typically more challenging for users to adopt. As a result, cost concerns may limit the level of Internet-based applications consumers can access.[28]

Broadband service prices can be assessed along several criteria, such as the average price per megabit or the price for a given "speed tier."[29] As table 2 shows, prices for broadband service in the United States are below OECD averages except for very-high-speed service.

Table 2: Comparison of U.S. and OECD Average Broadband Prices, as of October 2009

	Average price per megabit/second	Average monthly price for low-speed tier	Average monthly price for medium-speed tier	Average monthly price for high-speed tier	Average monthly price for very-high-speed tier
United States	$8.06	$23.74	$36.90	$60.13	$122.45
OECD average	$8.75	$30.23	$41.94	$67.43	$72.85

Source: GAO analysis of OECD data.

In the United States, several demographic factors, including education and income, are also thought to affect broadband adoption. For example,

[27]John Horrigan, *Broadband Adoption and Use in America* (Washington, D.C.: FCC, Feb. 23, 2010). As part of its data collection efforts to inform the National Broadband Plan, in October and November 2009, FCC sponsored a telephone survey of a nationally representative sample, beginning with over 100,000 telephone numbers, resulting in 5,005 responses from adults living in the United States. The survey data were collected from two samples: landline telephone numbers and cellular telephone numbers. The response rate for the landline sample was 22 percent, and the response rate for the cellular sample was 19 percent. The data were weighted to correct for known demographic discrepancies. At the 95 percent confidence level, the sampling error does not exceed +1.6 percent for estimates based on the entire sample, and the sampling error does not exceed +2.4 percent for estimates based on nonadopters. The results of this study are similar to results published by NTIA in February 2010 based on data collected from 54,000 households in October 2009 through a special Internet Use Supplement to the U.S. Census Bureau's Current Population Survey, *Digital Nation: 21st Century America's Progress toward Universal Broadband Internet Access*. U.S. Department of Commerce, NTIA (Washington, D.C.: February 2010).

[28]Berkman Report and OECD.

[29]"Speed Tier" refers to ranges of speed such as "low" (256 kbps to 1.9 Mbps), "medium" (2 Mbps to 11.9 Mbps), "high" (12 Mbps to 32 Mbps), and "very high" (greater than 35 Mbps). Berkman Report.

having a child in school and having a higher income are associated with higher broadband adoption levels.[30] According to FCC's 2009 survey, 75 percent of parents with a minor child have broadband services at home, as do 91 percent of households with annual incomes of more than $75,000. Conversely, 40 percent of households with annual incomes of less than $20,000 have broadband services at home. See table 3.

Table 3: Broadband Adoption Rates among Certain U.S. Demographic Groups

Demographic group	Current adoption rates, in percent
National average	65
Rural Americans	50
Low income (under $20,000/year)	40
Older Americans (65+)	35
Less educated (no high school degree)	24

Source: FCC Connect America: The National Broadband Plan (Washington, D.C.: Mar. 17, 2010).

Note: Data presented are measured at the household level, not per capita.

Personal computer ownership has also been linked to broadband adoption, since computers enable users to access Internet-based services. Of the 30 OECD countries, the United States ranks fifth in personal computer ownership, with 80.6 per 100 inhabitants—a rate considerably above the average of 52.3 per 100 inhabitants. Yet despite this high personal computer ownership rate, FCC's 2010 survey indicates that 10 percent of U.S. individual nonadopters surveyed cited the cost of computer ownership as one of the main reasons for nonadoption.
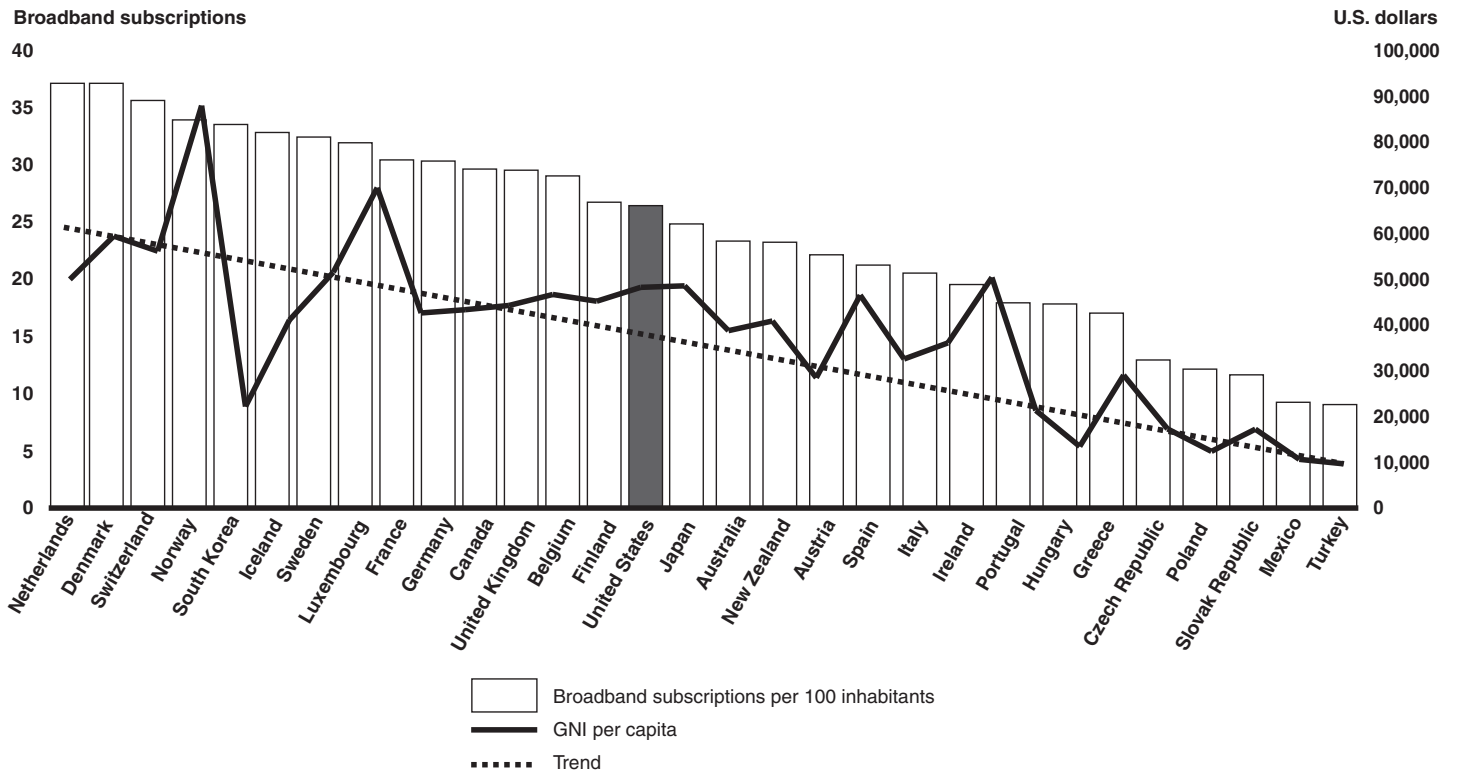
According to our analysis of OECD and World Bank data, income is a factor that drives broadband adoption across the OECD countries. For example, Turkey, which has the lowest adoption rate (9.0 subscribers per 100 inhabitants), also has the lowest gross national income (GNI)[31] per capita ($9,020) of the OECD countries, while the United States, which ranks 15th in adoption (with 26.4 subscribers per 100 inhabitants), ranks eighth in GNI per capita ($47,930). Norway, which ranks third in adoption

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[30]John Horrigan, *Home Broadband Adoption 2009*, 2009.

[31]GNI is defined as the total value produced within a country (i.e., its gross domestic product), together with its income received from other countries (notably interest and dividends), less similar payments made to other countries, divided by the country's population.

(with 33.9 subscribers per 100 inhabitants), has the highest GNI per capita ($87,340). As figure 5 shows, broadband adoption generally declines as income declines, although outliers do exist.

Figure 5: Broadband Subscriptions per 100 Inhabitants and Gross National Income per Capita Compared

Broadband subscriptions per 100 inhabitants

GNI per capita

Trend

Sources: GAO analysis of OECD and World Bank data.

Stakeholders in Selected Countries Have Taken a Wide Variety of Similar Actions to Increase Broadband Deployment and Adoption

The seven countries we selected as case studies, all of which had achieved higher levels of either broadband deployment or broadband adoption than the United States as of the fourth quarter of 2009, have taken similar actions to increase deployment and adoption—actions that stakeholders in these countries told us they considered effective. Through our case studies, we identified five overall categories of actions: (1) establish plans and policies to guide deployment and provide leadership support, (2) provide government funding through public/private partnerships, (3) promote competition, (4) implement strategies to make broadband services more available and useful to consumers, and (5) provide digital literacy training and consumer subsidies.

All Seven Selected Countries Have Instituted Broadband Plans, and Leaders Have Emphasized Broadband Initiatives

All seven selected countries have instituted broadband plans. Generally, these plans include some mix of short- and long-term goals, action plans, and performance metrics. Such attributes align with the framework set forth by the Government Performance and Results Act of 1993 (GPRA),[32] which stresses the importance of having clearly stated objectives, performance plans, goals, and measures to improve a program's effectiveness. Some stakeholders told us that the adoption of such plans, with their accompanying goals and action items, helped focus national efforts to increase the deployment and adoption of broadband. The following are examples:

- Japan adopted a plan in 2001 with the goal of providing speeds of up to 30 Mbps to at least 30 million households and speeds of up to 100 Mbps to at least 10 million households by 2005 and achieved this goal by 2003. In 2009, Japan adopted the e-*Japan Strategy 2015* and set new target speeds of 1 Gbps for fixed networks, more than 100 Mbps for mobile networks, and 100 percent adoption of broadband services by approximately 2015.

- In 1997, Canada started the Government On-Line program to organize service and information around the needs of its people and businesses. Since 2002, through such programs as Broadband for Rural and Northern Development (BRAND) and Connecting Canadians, Canada has brought connectivity to rural and remote areas and achieved the goal of connecting public institutions, including schools and libraries, in all of Canada's 4,000

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[32]Pub. L. No. 103-62, 107 Stat. 285 (1993).

communities. In 2009, Canada adopted Broadband Canada, a program that will provide $225 million over 3 years to deploy broadband infrastructure to residents in unserved rural and remote areas.

- In 2009, the United Kingdom issued the Digital Britain plan, which calls for 100 percent availability of a connection capable of download speeds of at least 2 Mbps by 2012.

- In Sweden, from 2001 to 2007, the government adopted a policy of deploying broadband to rural areas lacking access, and, in 2008, 99 percent of households had access to some form of broadband. In 2009, the Swedish government adopted the Broadband Strategy for Sweden with the goal of ensuring that 90 percent of households have access to broadband speeds of at least 100 Mbps by 2020.

In addition to goals, leadership is recognized as important in helping to increase broadband deployment and adoption. In Korea, government officials cited their President's constant emphasis on broadband initiatives as a factor that has helped to increase broadband adoption. In addition, the country's ministries emphasize e-government services and often compete with each other to develop new Internet applications. In France, the government created the Office of the Digital Development Minister in March 2008 and made it responsible for crafting a national broadband strategy known as Digital France 2012. The goal of this strategy is to achieve 100 percent broadband access by 2012 and to facilitate coordination among the various ministries with authority over information technology.

In All Seven Countries, National or Regional Governments Have Provided Funds for Public/Private Partnerships to Deploy Broadband Infrastructure

Case study governments, at the national or regional levels or both, have used public/private partnerships to help fund broadband deployment in unserved and underserved areas.[33] Whereas private enterprises have deployed broadband infrastructure in high-density urban areas where there is a strong business case for such investment, they have independently invested less in low-density rural areas or isolated communities, where deployment costs more per household and offers less opportunity for profit. Officials in both the public and private sectors of several of the countries we visited acknowledged that some areas are unprofitable to serve and some incentive, usually in the form of government funding, is required to motivate private investment and achieve universal access. The public/private partnerships in our case-study countries range from local authorities and private companies that have shared the cost of building a network to municipalities that own broadband networks and contract with private companies to operate and maintain them. The following are examples:

- Japan's Ministry of Information and Communications told us that, although 98.6 percent of households have broadband access, the government has instituted a public/private partnership program to support the establishment of broadband infrastructure in rural and remote areas where broadband service is not available and hopes to eliminate all areas without broadband access by the end of March 2011. Under this arrangement, the national government provides one-third of the total cost of installing broadband networks, requiring that the local government formulate plans in collaboration with the private sector and help create demand for broadband. Local governments in Japan maintain ownership

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[33]The term public/private partnership generally refers to any enterprise in which both government and private enterprise have a financial interest. Such a partnership can be any arrangement from one of shared risk and reward to a contractual arrangement in which the public entity makes the investment and hires the private company to operate the enterprise for a specified fee. An *unserved area* is one in which at least 90 percent of households cannot subscribe to the minimum broadband speed and service. An *underserved area* is one in which (1) 50 percent or less of households have access to the minimum broadband speed, (2) no provider offers service speeds of at least 3 Mbps, or (3) 40 percent or less of the households choose to subscribe to a broadband service. The availability of, or adoption rates for, satellite broadband service is not considered in determining whether an area is unserved or underserved. The definitions of unserved and underserved were part of a Notice of Funds Availability announced by NTIA and designed to implement grant programs under the American Recovery and Reinvestment Act of 2009 75 Fed. Reg. 3792, January 22, 2010.

of the network and attract the private sector by selecting one company to provide service for the area.

- From 2001 to 2007, Sweden initiated a broadband funding initiative to expand broadband to rural and remote areas using a public/private partnership model. Financing was provided through state funds, local authorities, and broadband operators, and, in order to participate, a local authority had to provide at least 5 percent of the funding. A government evaluation of the funding program determined that broadband had been deployed to more remote areas than would have received broadband without the funding.

- In 2006, in order to stimulate economic growth, a large suburb of Paris, France, Hauts-de-Seine, issued a request for proposal; in 2007, Hauts-de-Seine hired a private company to deploy a fiber network to all its residents, enterprises, and public sites within 6 years and to operate the network as a shared fiber network, one open to all competitors. Regional officials told us they entered into this arrangement to prevent the creation of a digital divide, which would have occurred without the involvement of the municipality because no commercial provider was expected to deploy infrastructure equally to all areas, both rich and poor, urban and suburban. Public officials of Hauts-de-Seine told us that the public/private partnership arrangement would optimize the implementation of the network by reducing the cost of deployment of a fully open infrastructure and allowing service providers to increase their customer base. In addition, after 25 years, ownership of the network will revert to Hauts-de-Seine.

- In Canada, in 2001, the City of Ottawa was amalgamated with several of its surrounding municipalities, and, within the new boundaries, 90 percent of the city's landmass and 10 percent of its residents were rural. At that time in the rural areas, 2 percent of the residents had access to broadband. To bring broadband to the entire amalgamated area, in 2007, Ottawa entered into a partnership with a private broadband provider. Ottawa issued a request for proposal, set a goal of 100 percent availability, and selected a company that provided both fixed wireless and satellite service. A city official told us that some satellite coverage was necessary because Ottawa's uneven terrain would have made it too costly to erect enough towers to provide wireless connections for all residents. The city official told us that the private company had given the city more than it had asked for and its bid did not request the maximum contribution from the city. Currently, broadband service is available to 100 percent of the

amalgamated area's residents, with 98 percent of rural areas served by terrestrial wireless and the last 2 percent served by satellite.[34] Adoption rates range from 80 percent in the city to 50 percent in the rural areas.

- In Korea, officials told us they have used public/private partnerships to help reduce the digital divide between urban and rural areas. For example, rural villages with more than 50 households are receiving broadband service at speeds of up to 50 Mbps from Korea Telecom (KT) in partnership with the Korean government. When KT transitioned from government to private ownership in 2002, it had to commit to providing infrastructure to rural areas. However, since 2005, the government has shared the cost, with KT contributing 50 percent, the central government 25 percent, and the local government 25 percent.

Localities Have Also Used Public/Private Partnerships to Deploy Fiber to Gain Greater Broadband Speed

Private enterprise has been slow to deploy fiber directly to customers' premises in several countries. While fiber can provide the highest speeds, it is costly to deploy, and consumer demand for speeds above 50 Mbps is limited. Moreover, some existing DSL and cable networks can provide speeds in excess of 50 Mbps. Nevertheless, some municipalities have determined that fiber is necessary for their future well-being and have decided to deploy it despite private companies' unwillingness to bear the full investment costs. To finance the deployment of fiber in their area, some of these municipalities have established public/private partnerships and examples of some of these are as follows:

- Stokab, a municipally-owned fiber network, was founded in 1994. Stokab officials told us that the municipality of Stockholm had determined that fiber appeared to be the most viable technology for the foreseeable future, although the local telephone provider did not express any interest in deploying fiber infrastructure at that time. In addition, city officials told us they knew that if, in the future, multiple companies chose to provide fiber to the city, the streets could be dug up several times, causing disruption and damaging Stockholm's historic buildings and cobblestone streets. To avoid such a scenario, Stockholm officials set up Stokab, which deploys and maintains the physical infrastructure and leases dark fiber[35] to multiple businesses, which may use the fiber for their own business or to provide service to others. Stokab is thus a wholesaler to other business

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[34]Although 100 percent of rural areas can receive broadband through satellite service, for 2 percent of rural residents, satellite service is the only provider of broadband.

[35]Dark fiber is fiber not yet used but available for future use.

entities. Stokab officials told us that many municipalities in Sweden have adopted models similar to Stokab.

- In Amsterdam, the Netherlands, in 2000, broadband service was widely available over cable and telephone lines, but there was no fiber to the home. Officials said they believed fiber would protect the city's future competitiveness, although commercial companies did not want to invest in fiber at that time. Accordingly, in 2006, Amsterdam formed Glasvezel Amsterdam (GNA) to finance a fiber network in conjunction with private investors to provide broadband services throughout the city. The city is not a majority shareholder in GNA, and it is treated like any other private investor. GNA has deployed infrastructure to multiple dwelling units comprising 43,000 apartments and began a new roll out to another 100,000 homes in 2009.

Public/Private Partnerships Raise Some Concerns

Although public/private partnerships have provided both public and private benefits, they have nevertheless raised some concerns. For example, some providers have expressed reservations about using public funds to support businesses in competition with private enterprise. Two providers told us that they think it is unfair to use public funds to finance wireline broadband to compete with a company providing broadband over a satellite or wireless network in rural areas because there is not enough business in such areas to support one unsubsidized company. In addition, officials at companies in Japan and Canada questioned the sustainability of government-funded projects and expressed concern about who would be responsible for maintaining government-funded infrastructure once the government funding is gone. The European Commission has placed some limitations on the use of public funds to establish businesses in competition with private enterprise.[36]

Public officials have also expressed concern about the interoperability of municipal networks and have identified a need to provide some guidance to municipal personnel. Public officials in Sweden, the United Kingdom, and the Netherlands have suggested that uniform standards or some form of guidance from the central or national government would be helpful when localities are forming public/private partnerships to deploy broadband infrastructure. The following are examples:

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[36]European Commission, "Community Guidelines for the Application of State Aid Rules in Relation to Rapid Deployment of Broadband Networks," communication from the European Commission, *Official Journal of the European Union* C 235 (Sept. 30, 2009), 7.

- Officials in Sweden told us that although the national government's provision of funds to municipalities from 2001 through 2007 helped to deploy broadband to rural and remote areas, it also led to a profusion of incompatible networks. If they were to support future efforts, the officials said, they would impose more requirements and draw up standards applicable to all municipal systems.

- Officials in the United Kingdom told us that the government recognized it would not achieve universal broadband deployment without the cooperation of municipalities, but that municipalities needed guidance on how to set up a municipal broadband network to receive state aid. The government has provided such guidance.

- Officials in the Netherlands told us that the ministry is publishing guidelines for municipalities that contain best practices to give towns ideas of how to set up and manage broadband networks.

Government Officials Say Actions to Increase Competition in Broadband Markets Have Helped to Increase Broadband Adoption by Increasing Consumer Choice and Reducing Prices

In all seven of our case-study countries, from 93.5 percent to 100 percent of households have access to broadband, and those in the urban areas have a choice of at least two broadband providers. In some of the countries we visited, such as Canada and the Netherlands, the two main providers of broadband service for the majority of urban and suburban populations are the telephone company and the cable company, both of which provide service over their own networks. However, in other countries, such as France and Sweden, wireline cable service has not been universally deployed, and there is no cable provider that is competing nationwide with the telephone company. To ensure a national competitive market for wireline broadband services, six of seven countries have increased the level of competition in the provision of wireline broadband service through laws, regulations, or both, which require the incumbent telephone carrier to open its copper networks (the legacy infrastructure used to provide telephone service) and provide access to competitors at wholesale prices. This activity is commonly referred to as "unbundling." Unbundling has been credited with giving most urban residents in France, the United Kingdom, Sweden, the Netherlands, and Japan a choice of three or more providers. Government officials in some countries told us that requiring companies to unbundle has provided several consumer benefits, such as greater competition, higher speeds, more services, and lower prices. Examples from some of those countries are as follows:

- Swedish authorities credit network unbundling with relatively low consumer prices and good service quality.

- Officials in the Netherlands told us that unbundling the local loop has stimulated competition, resulting in the deployment of DSL to more than 99 percent of the country's households.

- In the United Kingdom, officials of the Office of Communications (Ofcom), the telecommunications regulator, told us that, since unbundling, at least four additional operators have entered the British broadband market.

- In Korea, although unbundling has not increased competition, several companies are competing with incumbent providers by building their own networks. One company official attributed the limited success of unbundling in South Korea to difficulties in getting access to the incumbent's network. Another company official said several competing telecommunications infrastructures had developed because competition for customers is based on speed. If a company is using another company's network, it cannot provide faster service than the company whose network it is leasing. Consequently, in most urban areas of Korea, residents have a choice of four providers, each of which offers service over its own infrastructure.

  To further encourage competition and ensure that incumbents do not stifle competition by charging prohibitively high prices for access to their infrastructure, all seven countries also regulate the price the incumbent carrier can charge competitors for network access.[37]

  The majority of our case-study countries have benefited from requiring the incumbent telecommunications carrier to unbundle its copper telephone lines, but the benefits of fiber unbundling are less clear. Both the Netherlands and Japan have required fiber unbundling, and Great Britain has proposed virtual unbundling[38] of fiber; however, officials in some case-study countries cited concerns about the effect of requiring unbundling, pointing out that overregulation too early in the fiber rollout will hamper investment.

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[37]In the United Kingdom, access to the infrastructure of BT (formerly British Telecommunications) is required to be provided at cost-based rates nationally. A formal price control is imposed for the most frequently used services.

[38]Ofcom has defined virtual unbundling as a process that will allow rival operators to access the incumbent's new fiber optic network via a dedicated virtual link over new lines.

Furthermore, industry representatives in Japan told us that although the unbundling of copper lines has increased competition, the unbundling of fiber has had less effect, because of the high cost of accessing a competitor's fiber network. These industry representatives explained that G-Pon, the most cost-effective and most widely used architecture for deploying fiber, is currently cost-prohibitive to unbundle and technological limitations restrict the profitability of leasing an incumbent's fiber infrastructure. Representatives of OECD also voiced similar concerns and told us that they have advocated using a network architecture other than G-Pon in order to facilitate competition. Thus, the manner in which fiber is most often deployed could affect future efforts to foster competition over fiber networks.

All Seven Countries Have Expanded Online Services to Increase the Usefulness of Broadband

Although from 90 percent to 100 percent of households in all seven of our case-study countries have access to some form of broadband, approximately 30 percent of households do not subscribe to wireline broadband service. Increasing usage is important to policymakers because, as OECD has stated, "Broadband not only plays a critical role in the workings of the economy, it connects consumers, businesses, and governments and facilitates social interaction.[39]" Governments in all seven of our case-study countries have attempted to increase usage through strategies for making broadband services more available and more useful to consumers. Examples are as follows:

- All seven countries have provided funding to deploy broadband to schools, and some have made computers available to students either free or at low cost. Japan's Ministry of Education provides one computer per student at the elementary school level. Korea provided free Internet service to all primary, middle, and high schools throughout the country. In the Netherlands, the Ministry of Economic Affairs told us that every town was subsidized in some way, to encourage broadband use in schools and in new buildings. One subsidy was for people to buy personal computers for the home, since the children were learning about the Internet in the schools.

- In all seven countries, to increase the usefulness of broadband to citizens, governments have made services for citizens available over the Internet,

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[39]Taylor Reynolds and Sacha Wunsch-Vincent, *Broadband Growth and Policies in OECD Countries* (Paris, France: Organisation for Economic Cooperation and Development, 2008), 3.

commonly referred to as e-government services. For example, in the United Kingdom, the government is planning to introduce a service, Tell Us Once, that will allow a person to register a birth or death online with just one rather than multiple organizations, as is done currently. In Korea, taxes can be filed online, and the government offers a rebate for using this method of filing. The Netherlands has provided all citizens access to government documents, including tax and social security information.

- In the United Kingdom, Ofcom established a voluntary code of practice for service providers to give the public information about and create accountability for advertised broadband speeds. Ofcom took this step because consumers were choosing service providers without knowing the capabilities of various Internet speeds, why service speeds were important, or whether they were receiving the advertised speeds they had purchased. All the leading Internet service providers enrolled in the code of practice, and Ofcom is now amending the code so that if a customer gets below a certain estimate of speed, the customer can change providers with no penalty. Ofcom also supported a research program to identify actual broadband speeds and compare the different providers' speeds and services. Ofcom has published its research and made the results available to the public on its Web site.

- Korea instituted a voluntary premise certification program to encourage building owners to upgrade their broadband access facilities. Once a building is certified, the owner can display one of four emblems indicating the speed or type of access provided or both, with speeds ranging from 10 Mbps (Class 3) to 1 Gbps (Special Class). Building owners have found that offering faster broadband speeds allows them to charge higher rents.

Countries have also funded research to promote the use of broadband. For example, in the Netherlands, the government provided grants for three projects to promote high-speed broadband use to facilitate infrastructure deployment and service. Canada sponsors the Scientific Research and Experimental Development program, which provides federal tax incentives for Canadian businesses to conduct research and development in Canada that will lead to new, technologically advanced products or processes, including broadband technologies.

To Increase Broadband Usage among Targeted Populations, Governments in Several Countries Have Provided Digital Training or Offered Subsidies or Both

Research in the United States has shown that portions of the population do not use and have not adopted broadband Internet for various reasons, including lack of knowledge, lack of interest, lack of access to a computer, or inability to pay for broadband service. Governments of several of the countries we studied determined that some initiatives are necessary to increase broadband usage among these groups.

- In South Korea, the government has provided classes to more than 10 million residents, including those living in rural areas, the elderly, and housewives, to make them more comfortable with accessing and using the Internet. The government has also provided Internet service at reduced monthly subscription rates for the economically disadvantaged and offers free Internet access to many rural communities through community access points.

- The United Kingdom expects to spend £300 million[40] to provide reduced-cost broadband access to low-income subscribers.

- The Ministry of Economic Affairs in the Netherlands has developed a digital literacy program for the elderly to make them more comfortable with the Internet.

- From 1998 to 2007, Sweden implemented a measure to increase the availability of personal computers to the home. The program offered a tax deduction to all persons who were gainfully employed, regardless of income, and resulted in purchases of some 2.1 million personal computers.

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[40]Around $454,500,000 as of July 9, 2010.

Recommendations in the National Broadband Plan Generally Reflect Selected Countries' Actions to Increase Broadband Deployment, Usage, and Adoption

The National Broadband Plan includes over 200 recommendations, which the plan's executive summary groups into four areas—(1) designing policies to ensure robust competition; (2) managing government assets, such as rights-of-way, to encourage network upgrades; (3) using government funds to help subsidize both deployment in high-cost areas and adoption among low-income groups; and (4) maximizing the benefits of broadband in the sectors government influences significantly, such as education, health care, and government operations. These four areas are not identical to the five types of actions we identified in our case-study countries, but the areas and the types of actions overlap and represent similar approaches to expanding broadband deployment and adoption. In addition, FCC acknowledges that findings from its own international research, conducted in part to implement the Broadband Data Improvement Act, influenced aspects of the plan.[41] Implementing the plan's recommendations will be challenging, requiring the coordination of multiple public- and private-sector entities.

Table 4 compares the five types of actions taken in our case-study countries with the plan's four areas.

Table 4: Comparison of Actions Taken by Selected Countries to Increase Broadband Deployment and Adoption with Actions Recommended by the National Broadband Plan

Action taken by some or all of the selected countries	National Broadband Plan's action area/recommendation
Establish plans and policies to guide deployment and provide leadership support	Adopt strategies and long-term goals, take actions to measure effects over time, and ensure leadership commitment through the establishment of an interagency council accountable for implementing the plan's recommendations.
Provide government funding through public/private partnerships	Manage government assets, such as rights of way, to encourage network upgrades. Use Universal Service Funds as well as other government funds to help subsidize deployment in high-cost areas.
Promote competition	Design policies to ensure robust competition.
Implement strategies to make broadband services more available and useful to consumers	Maximize the benefits of broadband in sectors the government influences significantly, such as education, health care, and government operations.
Provide digital literacy training and consumer subsidies	Use government funds to help support efforts to boost adoption and use and subsidize adoption among low-income groups.

Source: GAO.

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[41]The Broadband Data Improvement Act mandated FCC to conduct a review of international broadband policies and actions. (Pub L. No. 110-385, title I, §103(b), 122 Stat. 4096, 4097 (2008)).

Establish Broadband Plans and Provide Leadership to Guide Deployment of Infrastructure

Just as the governments of our seven selected countries established plans and policies to guide their efforts to expand broadband deployment and adoption, the National Broadband Plan contains recommendations to FCC, Congress, and federal agencies designed to guide future federal efforts. The plan also calls for a number of actions to facilitate measurement of its effects over time. These actions include collecting more data to support benchmarking against goals and tasking FCC to create a Broadband Performance Dashboard on its Web site to display key indicators aligned with the plan's long-term goals. The purpose of the dashboard is to promote public understanding of important broadband performance metrics and to clearly communicate the progress and effectiveness of efforts to implement the plan. Specifically, the dashboard is expected to detail the types of metrics that FCC should collect and analyze in order to track progress toward the plan's goals. Table 5 illustrates the dashboard information for one performance goal set forth by the National Broadband Plan.

Table 5: Broadband Goals and Performance Dashboard Sample

Broadband Performance Dashboard		
Goal for 2020	**Metrics**	**Sources**
At least 100 million U.S. homes should have affordable access to world-class actual download speeds of at least 100 Mbps and actual upload speeds of at least 50 Mbps.	The nationwide, and per-provider, average actual upload and download speeds of broadband networks	FCC network performance measurements and provider disclosures
	Number of households with access to broadband networks with sufficient speed	Future revisions to Form 477 data[a]
	The nationwide, and per-provider, minimum price for a broadband subscription with sufficient speed	Future revisions to Form 477 data[a]

Source: GAO analysis of FCC data.

[a]FCC requires that broadband providers complete Form 477, which contains information about companies' provision of broadband by census tract.

In addition to plans and policies, senior governmental leadership was important for other countries to achieve or progress toward their broadband goals. Similarly, the National Broadband Plan identifies leadership commitment as a key to its success by recommending that the executive branch create a Broadband Strategy Council consisting of senior White House, National Economic Council, and Office of Management and Budget officials, as well as high-level officials from FCC, NTIA, and other agencies with a role in the plan's implementation. The recommended council would coordinate and implement the National Broadband Plan's recommendations across executive branch agencies.

Provide Government Funding through Public/Private Partnerships	In all seven selected countries, governments have provided funding through various mechanisms, such as grants and loans, to help pay for the deployment of infrastructure in areas private enterprise deems unprofitable. Similarly, the National Broadband Plan proposes various national funding strategies and mechanisms that are consistent with a federal role in ensuring equal access to broadband services. For example, to help accelerate the rate of broadband deployment to unserved areas, the plan recommends that Congress consider providing funding to areas where no business case exists for private-sector investment.

In all seven of our selected countries, public/private partnerships have helped fund the deployment of broadband infrastructure. These partnerships often help maximize government resources and minimize risk for the private investors. Although the National Broadband Plan recognizes the value of public/private partnerships in efforts to increase adoption, it does not explicitly recommend their use to help fund broadband deployment. However, it does recommend that Congress make clear that tribal, state, regional, and local governments can build broadband networks. Specifically, the plan says that when all other options for meeting residents' broadband needs are exhausted, it should be clear that local authorities can build broadband networks. Stakeholders from some of our selected countries, as well as in the United States, commented on the advisability of providing some guidance to aid municipalities in forming such partnerships and building broadband networks, although we did not assess the need for such guidance.

Promote Competition	Each of our case-study countries found that competition had been a key component of increasing innovation and, for several of the countries, reducing prices. Six of our seven case-study countries found that promoting competition by unbundling the telephone networks allowed competitors to provide broadband service using existing DSL technology, often avoiding the need for repeated and costly deployment of additional telephone infrastructure. The National Broadband Plan has also identified competition as a key component, noting that "Competition is crucial for promoting consumer welfare and spurring innovation and investment in broadband access networks. Competition provides consumers the benefits of choice, better service and lower prices."[42] However, according to FCC, it is unclear whether the broadband "ecosystem" in the United States is

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[42]National Broadband Plan, p. 36.

competitive, so the government needs to continue to study the current competitive environment and the future implications of the current competition structure in America.[43] To promote competition in the wholesale market, the plan calls for FCC to "comprehensively review its current policies and develop a cohesive and effective approach to advancing competition through its wholesale access policies."[44] One specific recommendation is for FCC to establish an analytical approach to resolving disputes to ensure that the rates, terms and conditions that incumbent local exchange carriers charge to competitors for special access services are just and reasonable, since the plan recognizes that the adequacy of the existing regulatory regime has been subject to much debate.[45] However, the plan does not recommend that FCC oversee the prices incumbent carriers charge competitors to make certain they are cost-based, as is done by several countries, including the United Kingdom and France.

In addition, the plan finds that expanding wireless broadband infrastructure by increasing the availability of wireless spectrum would help spur competition in the United States. Currently, consumers who value high download and upload speeds would not consider wireless broadband to be a substitute for wireline service. However, additional spectrum would make faster download speeds possible, allowing companies to offer wireless services that would compete more effectively with the capabilities of wireline broadband services.

Implement Strategies to Increase the Usefulness of the Internet to the Public

All seven of our selected countries have taken actions to increase the number of government services available to the public on the Internet, as has the United States. According to the United Nations (UN), e-government is a powerful tool and essential to the achievement of internationally agreed-upon development goals, including the Millennium Development Goals.[46] In 2010, the United States ranks second, behind

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[43]National Broadband Plan defines the broadband ecosystem as networks, devices, content, and applications.

[44]National Broadband Plan, p 48.

[45]Special access is a dedicated line from a customer to a long-distance company provided by a local phone company.

[46]Adopted by world leaders in 2000 for achievement by 2015, the Millennium Development Goals are specific goals that provide a framework for the entire international community to work together toward a common end—making sure that human development reaches everyone, everywhere.

South Korea, in advanced e-service delivery, up from fourth place in 2008. In fact, according to the UN, the United States has been a leader in the provision of e-government services. The National Broadband Plan would continue to strengthen this leadership by enhancing the availability and capability of e-government services across the federal government. Specifically, the plan calls for the Office of Science and Technology Policy within the Executive Office of the President to develop a 5-year strategic plan for online service delivery.

In addition, to advance the provision of e-government services, the plan includes more than a dozen recommendations aimed at making a wider array of citizen-based services available online to promote the use of digital media content across government. For example, one recommendation calls for executive branch and independent agencies to make all responses to Freedom of Information Act requests available online. Currently, there are no guidelines on the format to be used in responding to such requests.

Provide Digital Literacy Training and Consumer Subsidies

Finally, several of our case-study countries have provided digital literacy training or consumer subsidies or both to increase broadband usage, some targeting certain subgroups, such as the elderly and the poor. Digital literacy generally refers to a variety of skills associated with using information and communications technology (ICT) to find, evaluate, create, and communicate information. It also includes the ability to communicate and collaborate using the Internet—through blogs, self-published documents and presentations, and collaborative social networking platforms. The National Broadband Plan recommends digital literacy training as a means of expanding broadband adoption, pointing out that, according to an FCC survey conducted in 2009, 22 percent of nonadopters in the United States identified lack of digital literacy as a main barrier to adoption, second only to cost. Describing digital literacy as a necessary life skill, much like the ability to read and write, the plan recommends that the federal government create a Digital Literacy Corps to conduct training and outreach. According to the plan, the corps would help nonadopters overcome discomfort with technology and fears of getting online while also helping people become more comfortable with the content and applications relevant to them.

To further increase broadband adoption, the National Broadband Plan identifies several options available to the government. For example, to encourage adoption among low-income groups, the plan recommends that FCC expand the Lifeline Assistance (Lifeline) and Link-Up America (Link-

Up) programs to make broadband more affordable for low-income households. Currently, Lifeline lowers the cost of monthly service for eligible consumer households by providing support directly to service providers on behalf of those households, and Link-Up provides a one-time discount on the initial installation fee for telephone service but not for broadband. The plan also recommends that FCC consider providing free or very-low-cost wireless broadband service as a means to address or reduce the cost barrier to adoption by offering a band of wireless spectrum dedicated to free or low-cost broadband service as a complement to Lifeline.

Implementing the National Broadband Plan Will Be Challenging

While the United States plans to take actions similar to those of other leading countries to achieve the National Broadband Plan's goals of universal access and increased usage and adoption, implementing the plan will be challenging. Action will be required by governments at all levels and the private sector to deploy broadband infrastructure to the last 5 percent of households at a reasonable cost and to promote broadband usage and adoption by increasing digital literacy and making broadband services more affordable for certain populations, especially the elderly and the economically disadvantaged. Furthermore, as the Chairman, FCC, has acknowledged, implementing the plan will require obtaining sufficient funding and coordinating the work of multiple federal, state, local, and private entities, among other actions. It remains to be seen whether and how effectively federal agencies will be able address these challenges and implement the plan's recommendations, as well as what the private sector will do to further deployment and adoption.

Agency Comments

We provided a draft of this report to FCC for review and comment. FCC provided technical comments, which we incorporated as appropriate.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies of this report to the appropriate congressional committees, the Secretary of Commerce, the Secretary of Agriculture and the Chairman of the Federal Communications Commission. The report will also be available at no charge on the GAO Web site at http://www.gao.gov.

If you or your staff members have any questions about this report, please contact me at (202) 512-2834 or goldsteinm@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Contact information and major contributors to this report are listed in appendix II.

Mark L. Goldstein
Director, Physical Infrastructure Issues

Appendix I: Scope and Methodology

To determine the status of broadband deployment and adoption in developed countries, we reviewed data collected by the Organisation for Economic Co-operation and Development (OECD) for the 30 countries that were members of OECD as of January 1, 2010. Chile has since become a member, but relevant data were not available for our review. Specifically, we considered broadband wireline infrastructure coverage by country, total subscriptions by country, and subscriptions per 100 inhabitants. To understand demographic and socioeconomic factors associated with broadband deployment and adoption, we considered information obtained from several sources, including the World Bank for income levels by country and numbers of personal computers per 100 inhabitants; the Central Intelligence Agency (CIA) World Factbook for population and land mass statistics; and the Federal Communications Commission (FCC) for demographic information on current broadband adoption levels in the United States. For analysis of broadband speeds, we obtained and reviewed data from Akamai Technologies, Inc. For analysis of average broadband prices, we obtained and reviewed data from OECD.

We assessed the reliability of OECD and Akamai Technologies, Inc., data by (1) reviewing existing information about the data and the systems that produced them; (2) interviewing agency and company officials knowledgeable about the data; and (3) performing manual testing for missing data, outliers, and obvious errors in required data elements. We determined that these data were sufficiently reliable for the purposes of this report. We assessed the reliability of the World Bank, CIA, and FCC data by (1) reviewing existing information about the data and the systems that produced them and (2) performing manual testing for missing data, outliers, and obvious errors in required data elements. We determined that these data were sufficiently reliable for the purposes of this report.

To better understand the status of broadband deployment in the United States, we interviewed relevant federal government officials at FCC, the Department of Commerce's National Telecommunications and Information Administration (NTIA), and the Department of Agriculture's Rural Utilities Service (RUS). We also interviewed officials of companies that provide broadband service in multiple states—Verizon, AT&T, Comcast, and Windstream—and representatives of a national consumer welfare organization, Consumers Union. To help inform our analysis of public/private partnerships, we interviewed officials of a public/private partnership in Bristol, Virginia, which was highlighted in the National Broadband Plan, as well as representatives of other public/private partnerships recommended to us. These included a consortium of public/private partnerships in Utah, an official of ECFiber in Burlington,

Vermont, and a former Motorola executive working on a public/private partnership in Massachusetts. To better inform our understanding of the deployment of fiber infrastructure, we interviewed representatives of the Fiber-to-the-Home Council.

To determine the actions stakeholders in selected countries have taken to increase broadband deployment and adoption in the last decade, we first chose 7 countries for case-study analysis. We limited our potential field of countries to those that were members of OECD and were ranked among the top 20 in broadband subscriptions per 100 inhabitants as of the first quarter of 2009. We used OECD's list of country rankings as our basis for selecting countries because it is the only annually updated report that offers a comprehensive analysis of data provided by governments.

We analyzed the demographic profile of each of these countries, including its land area, population and population density, gross national income (GNI), and actions its government had taken to increase broadband deployment and adoption. Actions taken included, but were not limited to, national broadband plans, broadband deployment plans, specific adoption strategies, and e-government services. We chose countries that were in some way similar to the United States and recognized as being particularly successful in increasing broadband deployment or adoption. To determine if a country's government had taken action to increase the deployment of broadband infrastructure to rural or underserved areas, we performed a literature search of publicly available government documents, as well as of international documents that provided country-specific information about broadband deployment, including reports from OECD, the European Union, the International Telecommunication Union (ITU), and the World Bank. Furthermore, to understand each country's broadband adoption strategies, we conducted literature reviews and reports from government agencies and OECD. We also reviewed the United Nations' (UN) E-Government Survey 2010 to understand and compare OECD countries' efforts to deliver citizen-based services over the Internet. We assessed the reliability of the UN data by (1) reviewing existing information about the data and the system that produced them and (2) performing manual testing for missing data, outliers, and obvious errors of required data elements. We determined that these data were sufficiently reliable for the purposes of this report.

The seven countries we selected for case-study analysis were Canada, France, Japan, the Netherlands, South Korea, Sweden, and the United Kingdom. Before visiting these seven countries, we identified key contacts though research and agency contacts. To learn what actions governments

and broadband providers have taken to increase broadband deployment and consumer adoption, and how those actions are viewed by various stakeholders, we visited each of the seven countries, conducted other in-person research, and collected documents. Using a semistructured interview instrument, we obtained information from key contacts in each country (see fig. 3), including government officials, representatives of broadband service providers (both incumbents and competitors), officials of localities involved in providing broadband services through public/private partnerships, and representatives of groups dedicated to protecting consumers. Following our visits to these seven countries, we reviewed and analyzed the information collected, including current policies, plans, and guidance issued by responsible government agencies, regulatory authorities, and broadband providers.

Figure 6: List of Contacts by Country

	National government	Local government	Broadband providers	Consumer/ provider groups	Other
Canada	• Canadian Radio-television and Telecommunications Commission (CRTC) • Industry Canada • Communications Research Centre Canada (CRC)	• City of Ottawa	• Bell Canada • Rogers Cable • North Frontenac Telephone Company	• Public Interest Advocacy Center	
France	• Office of the Digital Development Minister • Autorité de Régulation des Communications Électroniques et des Postes (ARCEP)	• Conseil Général des Hauts de Seine	• France Telecom • Numéricable	• Fédération Française des Telecoms • Renaissance Numérique	• Caisse des Dépôts et Consignations (CDC) • OECD
Japan	• Ministry of Economy, Trade, and Industry (METI) • Ministry of Internal Affairs and Communications (MIC) • Cabinet Secretariat for Information Technology		• Softbank • KDDI		• Professor Jiro Kokuryo • Center for Global Communications (GLOCOM)
Netherlands	• Ministry of Economic Affairs • Independent Post and Telecommunications Authority (OPTA) • The Netherlands Competition Authority (NMa)	• City of Amsterdam	• KPN • NLKable	• Consumentenbond	
South Korea	• National Information Society Agency (NIA) • Korea Communications Commission (KCC) • Ministry of Knowledge and Economy (MKE)		• Korea Telecom (KT) • SK Broadband	• Korea Consumer Agency • Fiber-to-the-Home (FTTH) Council (Asia)	• Korea Information Society Development Institute (KISDI)
Sweden	• Ministry of Enterprise, Energy and Communications • Swedish Post and Telecom Agency (PTS)	• City of Stockholm (Stokab)	• Telia Sonera • Bredbandsbolaget	• Swedish Urban Network Association • Konsumenternas	• Ericsson • U.S. Ambassador to Sweden Matt Barzun
United Kingdom	• Department of Business, Innovation, and Skills (BIS/BERR) • Ofcom		• BT	• Community Broadband Network • Communications Consumer Panel • Internet Service Providers Association (ISPA)	

Source: GAO.

To determine how recommendations outlined in the National Broadband Plan reflect the actions of selected countries to increase broadband deployment and adoption, we analyzed the results of our case studies and placed the actions of the 7 countries in five categories. We placed the actions to increase deployment in two categories—(1) instituting plans and policies and (2) providing government funding through public/private

partnerships—and the actions to increase adoption in three categories—(3) increasing competition, (4) implementing strategies to increase the usefulness of the Internet to citizens, and (5) providing digital literacy training and consumer subsidies. We then analyzed relevant recommendations outlined in the National Broadband Plan and interviewed relevant individuals at FCC to determine how actions recommended in the plan align with the five identified categories. However, we did not evaluate the potential impact or effectiveness of the recommendations made in the plan.

We conducted this performance audit from June 2009 to September 2010, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: GAO Contact and Staff Acknowledgments

GAO Contact

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Staff Acknowledgments

In addition to the individual named above, Dave Sausville, Assistant Director; Pedro Almoguera; Elizabeth Curda; Bess Eisenstadt; Muriel Forster; Dave Hooper; Hannah Laufe; SaraAnn Moessbauer; Josh Ormond; Madhav Panwar; Sandra Sokol; Spencer Tacktill; and Nancy Zearfoss made key contributions to this report.