



A Blueprint for Big Broadband

An EDUCAUSE White Paper

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January 2008

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Executive Summary

The United States is facing a crisis in broadband connectivity. The demand for bandwidth is accelerating well beyond the capacity of our current broadband networks, especially as video traffic and home-based businesses become more prevalent. In the very near future, a single family will be watching HDTV video at the same that they engage in remote health monitoring, videoconferencing, gaming, distance education class lectures, and social networking. Moore's Law, as well as several studies of future Internet growth, predicts that homes and businesses will need a minimum of 100 megabits per second (Mbps) of capacity within the next three to five years and will need even greater capacity going forward.

While other nations are preparing for the future, the United States is not. Most developed nations are deploying "big broadband" networks (100 Mbps) that provide faster connections at cheaper prices than those available in the United States. Japan has already announced a national commitment to build fiber networks to every home and business, and countries that have smaller economies and more rural territory than the United States (e.g., Finland, Sweden, and Canada) have better broadband services available.

Why is the United States so far behind? The failure of the United States to keep pace is the direct result of our failure to adopt a national broadband policy. The United States has taken a deregulatory approach under the assumption that the market will build enough capacity to meet the demand. While these steps may have had some positive influence, they are not sufficient. The profit/loss statements of individual firms fail to take into account the positive externalities from a widely deployed broadband network, including economic growth, lower-cost health care, and higher-quality education. In contrast, most other nations treat broadband services as necessary infrastructure; their governments adopted explicit broadband stimulus plans at the turn of the century, and their countries are now reaping the benefits.

The United States needs to take aggressive action to significantly expand our broadband connectivity. Now is not the time for incremental improvements; we are behind, and we must adopt a comprehensive strategy this year if we are to address the growing needs of our citizens and our economy. U.S. policy must be forward-looking—we must "skate where the puck is going to be."

For these reasons, this paper proposes the creation of a new federal Universal Broadband Fund (UBF) that, together with matching funds from the states and the private and/or public sector, should be used to build open, big broadband networks of at least 100 Mbps (scalable upwards to 1 Gbps) to every home and business by 2012. U.S. state governors and foreign heads of state have found the resources to subsidize broadband deployment; the U.S. federal government should as well.

Building a local fiber connection past each home and business will cost approximately \$100 billion. The paper recommends the public-private partnership approach followed in Canada, where one-third of the funding would be provided by the federal government, one-third by the states, and the remaining one-third by the private and/or public sector. It thus proposes a federal fund of \$8 billion per year for four years, to be distributed to the states once they provide their matching amount of funding. Each state

would then combine the federal and state funding and award grants to individual entities (public or private) that provide the remaining one-third of the funding to build open, big broadband capacity on a community-by-community basis.

While the initial investment is significant, the returns would be enormous. First, a big broadband network would be less expensive to operate than the existing copper network, resulting in actual cost savings of several billion dollars per year. More important, the availability of broadband capability would generate enormous economic activity (both from building the network and from its use) that would lead to greater tax revenue and economic growth. Furthermore, fiber networks are scalable upwards to an almost unlimited capacity; the investment in building these networks may provide adequate broadband connectivity for several decades. Finally, once the networks are built, the need for additional funding would end, and the private and/or public entity that receives the funding would own and operate the network without the need for ongoing federal subsidies.

A critically important component of this grant program is that the networks built with UBF funding must be open and accessible to all users and content and application providers. The taxpayer is entitled to certain rights in return for providing two-thirds of the funding to build these networks. Thus, the entity chosen to build the network in each community would maintain both an open network for all lawful uses and affordable pricing, and may be required to make a portion of its capacity available on a wholesale basis to competing retail service providers.

While federal funding and openness are fundamental, other components of a comprehensive broadband plan are equally vital. The plan must include the coordinated effort of our elected leaders and must be implemented by a core of federal, state, and local officials, with guidance from an advisory committee of commercial and nonprofit institutions. The plan should include tax incentives to spur private sector broadband investment and should encourage public sector investment by municipalities and states as well. Efforts should also be undertaken to ensure that the public is made aware of the availability of these broadband services. Funding should also be provided to bolster U.S. investment in long-term telecommunications research.

The U.S. broadband crisis is a unique challenge. Unlike past threats to our future competitiveness, the solution to our broadband connectivity crisis is primarily local. The benefits of broadband connectivity are felt directly by every consumer and business, and final decisions must involve our local leaders under a comprehensive federal program. The United States needs to move beyond the rhetoric and begin to adopt a specific action plan for the future. EDUCAUSE looks forward to comment on this proposal and seeks to join with others in improving our national broadband connectivity.

Foreword

Our nation's universities have historically played a special role in the creation and advancement of the Internet—and continue today to push the boundaries of the Internet. The first nodes of the Defense Department's ARPANET were at four universities.¹ Two graduate students designed the universal Internet protocols (TCP/IP). The first million-user scaled-up demonstration of a national IP-based network was deployed among our nation's universities in the late 1980s, thanks to the investment by the National Science Foundation in NSFnet and regional networks. Another graduate student, supported by federal funds, developed the Mosaic Web browser in 1993, later to become Netscape. A few years later, two other university graduate students founded Google.

Today, our nation's research universities are experimenting with advanced Internet protocols that deliver speeds ten thousand times faster than speeds typically available at the home. They are developing and deploying advanced Internet applications that have the potential to transform research, education, health care, entertainment, and business. We see the future on our campuses. In turn, we feel obligated to urge the nation's policymakers to help extend these services beyond the campus to society at large.

EDUCAUSE and its affiliate Internet2 are the primary higher education organizations whose goal is to promote widely available and affordable broadband connectivity. EDUCAUSE represents the chief technology officers of over 2,200 colleges and universities across the United States. Since its founding in 1998, EDUCAUSE has consistently advocated that advanced network capabilities on campuses should also be made available to all Americans, so that the entire nation may benefit from Internet-based access to education, health care, and public safety. More than half the students in U.S. colleges and universities live off campus, as do students in primary, secondary, and continuing education programs. Reaching these millions of Americans for e-learning and a host of emerging applications in education, health care, national security, and other areas requires a national commitment to a truly broadband Internet.

In 2005, as Congress considered rewriting the telecommunications law, EDUCAUSE urged Congress to adopt legislation incorporating the following five principles:

- The United States should adopt as a national goal a broadband Internet that is secure, affordable, and available to all, supporting two-way gigabit-per-second speeds and beyond.*
- All components of the public broadband Internet must remain open to all persons, all applications, and all lawful content. All components must interconnect and interoperate using freely available, international standards.*
- Telecommunications policy must ensure a level playing field for competing technologies so that market forces can drive continued innovation and affordable access.*
- State and local governments must have the right to build and deploy their own public broadband networks to enable full participation of all citizens in Internet-based higher education, workforce development, and telemedicine.*

¹ UCLA, Stanford, the University of California at Santa Barbara, and the University of Utah.

- *The federal government must renew its leading role in funding academic research and development in future Internet technologies and applications in order for America to enjoy the full benefits of the broadband revolution and to remain competitive in the global marketplace.²*

In May 2007, the EDUCAUSE Network Policy Council reiterated its support for a national broadband policy and urged policymakers to adopt the following broadband policy goals:

1. A national policy to create a universal broadband network.

A broadband network that meets America's needs of today and tomorrow requires many important technical and operational features, including:

- *Open, secure, reliable, and scalable infrastructure that continues to be based on freely available, interoperable, technical standards.*
- *Access prices that are reasonable, nondiscriminatory, and universally available on a nationwide basis.*
- *Bandwidth to every home at a minimum of 100 megabits per second (in both upstream and downstream directions) that is easily scalable to gigabits.*
- *Network access that is standardized for the delivery of essential residential and business public services, including police, fire, health, civil defense, and national disaster.*

2. Government policies at all levels that promote innovation and competition in network applications and services while preserving the essential services of the universal telephone network.

America must maximize incentives and rewards for innovation within competitive markets while delivering the universality and affordability of broadband services that were a hallmark of the regulated telephone era. The explosive growth of today's Internet would not have occurred without actions by Congress and government agencies which created a federal policy environment that encouraged and rewarded entrepreneurial business initiatives. This entrepreneurial freedom for the Internet was possible because the universal telephone network, a result of decades of federal and state regulation, provided a stable underlying telecommunications infrastructure that met many necessary social objectives for communications services on which everyone is dependent. We must maintain the balance of encouraging innovation while preserving essential services. America's global competitive advantage is at stake.

3. Expansion of federal R&D programs in network technology, including support for technology transfer to the private sector.

A continuation of the federal government's leading role in sponsoring and funding network and computational research, now collectively known as cyberinfrastructure, is an essential component of an overall plan for restoration of U.S. leadership in networking. This effort—much of it conducted within the university community through basic research, prototyping, and proof-of-concept deployment activities—is a vital part of the R&D "food chain" that leads to commercial products and services and their substantial economic benefits.

² See "Higher Education's Perspective on Telecommunications Reform," <http://www.EDUCAUSE.edu/ir/library/pdf/EPO0516.pdf>.

While the benefits of advanced cyberinfrastructure are already visible in such “big science” fields as physics, astronomy, seismology, and genomics, the potential of technology to infuse and transform many academic fields and other areas such as education and health care has hardly been realized. To achieve its promise as a powerful instrument for educational achievement, and many other social and economic goals, the Internet must continue to be closely linked to communications and computing research endeavors.

4. Federal legislation to preserve open, nondiscriminatory access to network applications and content.

The Internet has grown far beyond its original roots in telephony, and America has richly benefited from its development in an open-access environment. As the telecommunications industry has become less regulated, consumers are no longer guaranteed that their traffic will be carried on a nondiscriminatory basis. The impending digital conversion of broadcast television and ongoing convergence of most communications services onto a broadband Internet infrastructure have created new challenges for public policy. Congress is already considering legislation, under the banner of “net neutrality,” which would ensure nondiscriminatory access to Internet applications and content, thus maintaining the openness that has characterized the Internet since its earliest days.

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I. Introduction

The United States is facing a growing crisis in broadband connectivity. Very few of our nation's businesses and homes have the type of high-speed broadband connection that they need to participate fully in the international economy and society. Current U.S. broadband networks are under stress because of the increasing demand for greater content, especially video. In contrast, the countries of eastern Asia and northern Europe have more widely deployed broadband networks, provide faster Internet access, and offer service at much lower prices than the United States.³ The shortcomings of broadband connectivity in the United States threatens our economic growth, limits our opportunities for health care and telemedicine, constrains educational opportunities for students, retards Internet-based innovation, and limits our nation's potential to compete in the 21st century.

While many have written about the importance of broadband services and the need for the United States to adopt a national broadband policy, few have taken the next step—proposing a specific broadband action plan. With this document, EDUCAUSE offers the outlines of a comprehensive broadband policy and recommends specific steps for policymakers to bring our nation's broadband market into the 21st century.⁴ The proposal is forward-looking; it avoids the wrangling over old regulations and technologies and, instead, addresses the needs of the future. The proposals are aggressive but realistic, and most important, necessary if the United States is to restore its world leadership in the increasingly Internet-based economy.

The paper begins by making the case for a national broadband policy. It summarizes our current broadband market and explains why America's current policy regime is failing to address our broadband needs. Then, by drawing on the successful policies of U.S. state governments and other countries, this paper recommends a specific plan to build big broadband⁵ networks across the United States. One of

³ A summary of the U.S. international rankings is contained in section III below.

⁴ Several EDUCAUSE and Internet2 officials have provided extremely useful guidance in the preparation of this paper. In particular, Wendy Wigen, Mark Luker, and Steve Worona of EDUCAUSE first articulated many of the key concepts in the paper; Gary Bachula of Internet2 provided much of the inspiration and research demonstrating the need for additional capacity; Tim Lance of NYSERNET and Jeff Kuhns of Penn State provided important real-world examples of universities' need for widespread broadband capability; and the entire Network Policy Council provided extremely useful feedback. Thanks also to Susan Gollnick for her expert editing. Any errors are solely those of the author.

⁵ The term "big broadband" is used in this paper to distinguish it from "low-speed broadband," which is often used to measure the U.S. broadband capabilities. For purposes of this paper, low-speed broadband will typically refer to broadband services between the FCC standard (over 200 kbps) and 10 Mbps. Services typically falling within this definition include almost all

the principal recommendation is to create a new four-year Universal Broadband Fund (UBF) to provide matching grants for the construction of open broadband networks capable of providing at least 100 megabits per second (Mbps or Mb/s) service to every home and business in America by 2012. This approach can ensure that the broadband Internet of the future is widely available to everyone, fast enough to serve our needs, and open and accessible to all.

II. Why America Needs Big Broadband Connectivity

A. Internet Traffic Growth Trends Demonstrate That 100 Mbps Capacity to the Home and Business Is Realistic and Necessary

On November 20, 2007, Nemertes Research issued a study that models the growth of Internet traffic and capacity. It showed that Internet traffic could surge past available broadband capacity in the next few years. According to one account of the study:

A new research report on the ability of Internet infrastructure to cope with burgeoning demand warns that usage could outstrip network capacity both in North America and worldwide as early as 2010. Described as the first-ever study to independently assess Internet infrastructure and model current/projected traffic patterns independent of one another, the report from Nemertes Research estimates that global investment of \$137 billion is required—primarily in the area of broadband access—to stop services declining. In the United States alone it predicted that [\$]42 billion to \$55 billion is needed to match demand with capacity and this figure is in addition to the \$72 billion service providers are already planning to invest.⁶

The study is one of several to raise concern about the ability of our broadband capability to maintain pace with the continued growth in Internet traffic.⁷ A 2005 study by Jupiter Research concluded that average households will need 57–72 Mbps of bandwidth by 2009 and that “tech savvy” households would consume nearly 100 Mbps.⁸ Another study by Technology Futures charts the future need for

wireless, DSL, and cable modem technologies. Big broadband refers to the services faster than 100 Mbps that are increasingly available in Japan and are in consideration in several other countries.

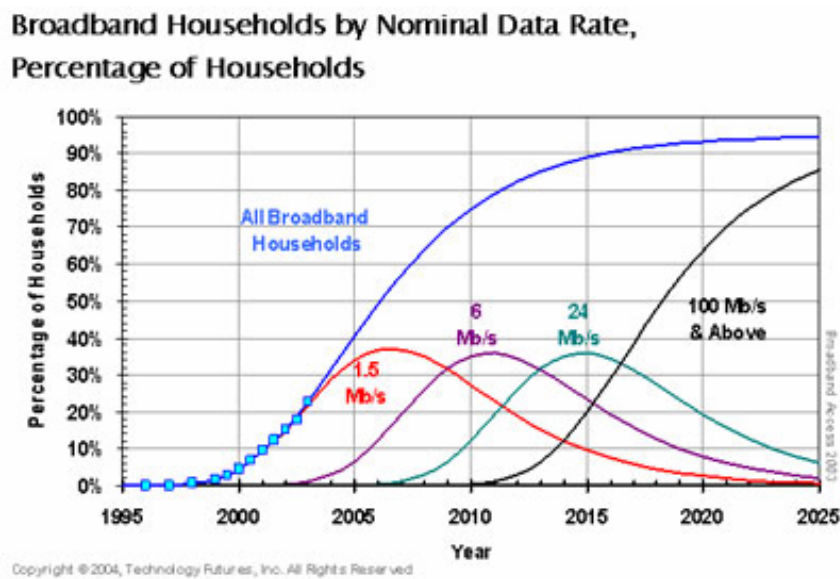
⁶ “Internet demand could outstrip network capacity by 2010,” *gizmag*, November 20, 2007, <http://www.gizmag.com/internet-demand-could-outstrip-network-capacity-by-2010/8379/>.

⁷ A Pew Internet report released on January 11, 2008, found that 48% of Internet users have visited video sharing sites such as YouTube, and that the number of users on a typical day nearly doubled during the past year (see http://www.pewInternet.org/pdfs/Pew_Videosharing_memo_Jan08.pdf). See also Bobby White, “Its Creators Call Internet Outdated, Offer Remedies,” *Wall Street Journal*, October 2, 2007, p. B1, <http://online.wsj.com/public/article/SB119128309597345795.html>.

[There is] growing debate over whether the Internet’s current infrastructure is sufficient to handle the explosion of bandwidth-hungry services such as Internet telephony and video. In a recent report, Cisco calculated that monthly Internet traffic in North America will increase 264% by 2011 to more than 7.8 million terabytes, or the equivalent of 40 trillion e-mail messages. If such Internet traffic continues increasing, many believe networks could crash or at least slow to a crawl.”

⁸ Jupiter Research, “Jupiter Research Predicts That Wireless Home Bandwidth Requirements Could Top 57 Mbps by 2009,” <http://www.iupitermedia.com/corporate/releases/04.11.04-newiupresearch.html>.

bandwidth as follows, showing that each of the current generation of bandwidth speeds (1.5 Mbps, 6 Mbps, and 24 Mbps) will be overtaken by the need for 100 Mbps:⁹



It is important to understand, however, where the potential overload is most likely to occur. The Nemertes study, for instance, found that there was significant capacity in core switching (the “long-haul” or “backbone”) and in the connectivity switching (the “middle mile” connecting the Internet service provider [ISP] to the backbone). The study found that the greatest danger, or the weakest link, is in the broadband access layer (the “last mile” connection between the consumer and the ISP).¹⁰ The Nemertes report found that the providers of local broadband connections were investing less in North America than their counterparts in other countries. “North America is behind the rest of the world in terms of access line investment.... North America is losing ground and one would think that the population and size of North America would drive a much higher access line investment profile when compared with the global picture.”¹¹ The study demonstrates that the choke point in our Internet experience is the poor capacity and high price of our local broadband connections.

Recent news reports confirm that current DSL and cable modem technologies are simply not capable of satisfying the burgeoning Internet demand.¹² Wireless technologies will continue to lag behind wireline

⁹ L. Vanston, R. Hodges, J. Savage, *Forecasts for Higher Broadband Bandwidth Needs*, http://www.tfi.com/pubs/r/r02004_broadband.html.

¹⁰ “The Internet Singularity Delayed: Why Limits in Internet Capacity Will Stifle Innovation on the Web” (Nemertes Study), Nemertes Research, Fall 2007, available at <http://www.nemertes.com>.

¹¹ *Ibid.*, p. 39.

¹² A study by the Office of Technology Policy within the Department of Commerce accurately predicted the inadequacy of these local broadband services over five years ago: “[T]he current generation of broadband technologies (cable and DSL) may prove woeful tomorrow’s traffic jam, and the need for speed will persist as new applications and services gobble up existing bandwidth.” From *Understanding Broadband Demand: A Review of Critical Issues*, September 23, 2002, http://www.technology.gov/reports/TechPolicy/Broadband_020921.pdf.

services.¹³ Today's applications already strain the capabilities of our networks; innovative online services and applications are being developed every day that bump up against the limits of our existing broadband connections (witness the explosion of video clips on corporate websites). Time Warner Cable is testing an approach that would bill Internet subscribers based on their usage in order to reduce congestion on its network.¹⁴ Comcast has admitted to "delaying" some traffic in order to conserve bandwidth.¹⁵ Equipment manufacturers routinely advertising that their routers will help network administrators "manage" their traffic during peak hours. Consumers are using the Internet in ways and in volumes that many experts simply did not anticipate.¹⁶

To solve this problem, we must do a better job of understanding how large these local broadband connections need to be to accommodate future Internet use. It would foolhardy, and inefficient, to build a new network that would be outdated in three years. Given the significant cost of building out broadband infrastructure, its design must anticipate at least a 20-year horizon. How can we estimate the amount of capacity we will need in 20 years?

Recent history can help. Twelve years ago, in 1995, most home users accessed the Internet with dial-up modems at speeds of 28 kilobits per second (Kbps), or 28,000 bits. Today, most cable modem providers and some DSL providers offer 3–10 megabit (3–10 million bit) downstream service—a more than one-hundred-fold increase in capacity, representing a doubling every 18 months.¹⁷ In other words, Moore's Law applies to network technologies as well as circuit boards.¹⁸ If this trend continues, the demand for 3-megabit speeds today would grow to 384 megabits in 10 years and well over a gigabit in 13 years.

These numbers are consistent with trends in the other Internet-related electronics. Many consumer-grade laptops and desktop computers already come equipped with gigabit Ethernet capabilities. For

¹³ "Wireless broadband is expected to be economically deployed on a reasonably large scale—perhaps 20% of households—to offer the types of broadband services that DSL and cable modems offer now: that is, speeds in the range 1 Mb/s and relatively bursty traffic. Over the next 10 years, residential broadband will migrate to very-high-speed (VHS) broadband, with much higher data rates (24Mb/s and above) and much more continuous traffic, such as video. VHS [very high-speed] wireless broadband deployment will likely be limited to niche applications where landline broadband is expensive or not available, and for mobile applications." See Lawrence K. Vanston "Assessment of Wireless Broadband as a Competitor to Wireline Broadband," Technology Futures, Inc., http://www.tfi.com/pubs/r/r02006_awbcwb.html.

¹⁴ Yinka Adegoke, "Time Warner to Test Internet Billing Based on Usage," Reuters, January 18, 2008, <http://www.reuters.com/article/rbssTechMediaTelecomNews/idUSN1639580720080117>.

¹⁵ Brad Stone, "Comcast: We're Delaying, Not Blocking, BitTorrent Traffic," *New York Times*, October 22, 2007, <http://bits.blogs.nytimes.com/2007/10/22/comcast-were-delaying-not-blocking-bittorrent-traffic/>.

¹⁶ It is perhaps useful to recall Bill Gates' review of his own experience in seeing into the future. He predicted in 1981 that no one would need more than 640 kilobits of computer memory. "I have to say that in 1981, making those decisions, I felt like I was providing enough freedom for 10 years. That is, a move from 64k to 640k felt like something that would last a great deal of time. Well, it didn't—it took about only 6 years before people started to see that as a real problem." 1989 speech on the history of the microcomputer industry (source: Wikipedia, http://en.wikiquote.org/wiki/Bill_Gates).

¹⁷ Doubling of the use of Internet2's high-speed Abilene backbone network has also progressed every 18 months.

¹⁸ Moore's Law describes an important trend in the history of computer hardware: the number of transistors that can be inexpensively placed on an integrated circuit is increasing exponentially, doubling approximately every two years. The observation was first made by Intel cofounder Gordon E. Moore in a 1965 paper. Moore's Law was subsequently interpreted to mean that actual performance would double every 18 months.

\$60, a consumer can set up a wireless 802.11g local area network that transmits data at 55 megabits per second. Devices that can send music from computer to family room speakers, or from the downstairs to the upstairs TiVo, routinely use these higher data rates. At the national backbone and wide area network level, 10 gigabit backbones are commonplace. With dense wave division multiplexing technology, a single fiber pair can carry 40, 80, or 160 gigabits of data. Verizon recently announced that it has successfully completed the industry's first field test of 100 gigabits per second (100,000,000,000 bits) optical transmission. Verizon tested the transmission from Tampa to Miami using a live video feed from Verizon's FiOS video service.¹⁹ Verizon concluded that the test "demonstrated that by deploying advanced electronics, an existing network system can *easily* and *quickly* [emphasis added] be upgraded to 100 Gbps."

In short, the other components of an Internet transmission—the computer, the wireless (Wi-Fi) connection in the home, and the backbone network—are today capable of sending and receiving messages at multimegabit or even gigabit per second speeds. Only the local broadband connection is not keeping pace. Perhaps for this reason, the Corporation for Education Network Initiatives in California (CENIC) launched the One Gigabit or Bust initiative in 2003. (CENIC is a nonprofit corporation that serves the networking needs of all of California's educational entities, from K–12 to the research universities.) In May of 2003, CENIC released a report by Gartner finding that the goal of 1 Gbps transmission to the home was going to be essential to support next-generation broadband applications. While the CENIC initiative was perhaps seen as ambitious in 2003, the goal of a gigabit per second local network is understandable when compared to developments in other sectors.

How do we bridge the gap between the current level of local broadband connectivity at 1–10 Mbps and the ultimate need for 1 Gbps to the home? EDUCAUSE submits that a realistic goal is for policymakers to focus on building networks capable of transmitting a minimum of 100 Mbps traffic. Even though a 100 Mbps level is below our expected long-term needs, a network that can carry 100 Mbps can be upgraded later to 1 Gbps by changing the electronics at either end of the "pipe."

Today's networks, however, need substantial upgrades to jump from the 10 Mbps level to the 100 Mbps level. While some advances in Asymmetric Digital Subscriber Line (ADSL) technology may be able to squeeze 25 Mbps out of our existing copper networks, there is an inherent limit to the capacity of the traditional twisted copper pair that is currently provided by most telephone companies to the home. Cable providers are working to deploy their new cable modems using DOCSIS 3.0, which are theoretically capable of offering speeds over 100 Mbps.²⁰ While certainly a positive development, these modems will still operate over a shared network, meaning that the actual speed available to the consumer may depend on how many of the consumer's neighbors are using their broadband service simultaneously. And it is not clear that these cable modems, even at the higher speeds, will be able to scale upward to the gigabit level speeds that will eventually be necessary.

¹⁹ See <http://newscenter.verizon.com/press-releases/verizon/2007/verizon-successfully.html>.

²⁰ See <http://www.broadbandinfo.com/news/docsis-3-issued-the-next-generation-of-cable-modem-technology.html>.

Adopting these incremental approaches—pouring millions of dollars of research and investment into technologies that generate only small increases in capacity—could be inefficient and ultimately wasteful.²¹ There is no way to avoid the fact that upgrading our networks to meet the 100 Mbps capacity will require a significant investment to attain our future goals. A national investment in building these networks is especially justified, however, because the ultimate goal is not a particular technology or a particular service; the ultimate goal is the creation of a “platform” that will serve as the foundation for a multitude of technologies and services. For this reason, the next-generation broadband access networks must be considered an issue of “infrastructure” similar to the provision of highways, airports, electricity, and water. As we will see below, other nations have taken on this challenge, and many of our state governments as well. It is time for our federal government to recognize the need for action before we fall further behind.

Despite the evidence that the substantial evidence that Internet traffic is growing well beyond our current capacity, some continue to question what services will require a 100 Mbps connection. The following discussion reviews some of the important uses of broadband technologies that are known today; others are as yet undiscovered.

B. The Aggregation of Multiple, Simultaneous Uses Will Make Big Broadband Networks a Necessity

Many recent studies discuss why broadband is necessary for individual broadband applications (discussed below). While these examples are certainly accurate, the most important point is that consumers will require a multiplicity of these services *simultaneously*. It is the aggregation of several of these applications in the home that will drive the future demand for broadband.

Consider the following real-world scenario: A home in middle America may include dad watching a live HDTV football game; daughter using the computer to access streaming video of a college course lecture; son playing a real-time interactive game; mom engaged in a videoconference for her home-based business; grandma, visiting for the holidays, downloading an episode of *Masterpiece Theatre*; and Grandpa hooked up to an uninterruptable medical video feed to a remote monitoring facility. While all these uses are taking place, the home appliances are being monitored and video home security devices are sending video feeds back to an emergency alarm center. Together, this single home could easily consume 150 megabits of bandwidth²² with only the uses we can imagine today. Homes of the future will likely include even more imaginative products and services.

²¹ One observer has described investments in xDSL technologies as a “cul-de-sac.”

²² Twenty megabits per HDTV stream x 2 HDTV streams, 40 megabits for gaming, 40 megabits for high-definition two-way video conferencing, 20 megabits for a video course lecture, and 20 for home security and home monitoring uses adds up to over 150 Mbps.

C. Current and Future Applications Will Demand High-Bandwidth Capabilities

A variety of applications and services, when taken together, will demand much greater broadband capability than is possible with small broadband:²³

Video: The largest consumer demand for bandwidth will likely come from video. Today, each high-definition television (HDTV) signal over the Internet generally requires a minimum of 20 Mbps (depending on the type of programming). While compression technologies are being developed to reduce the bandwidth required for today's HDTV signals, it is also expected that HDTV transmissions will continue to evolve upward, enhancing the quality and expanding the bandwidth necessary to transmit these "super-HD" signals. Furthermore, most households have three televisions and even more computers in the home, each of which will require its own high-definition transmission sharing the same pipe.

HD video signals will not be restricted to broadcast television or cable signals; as HDTV production equipment becomes more widely dispersed, even educational lectures, videoconferencing and telehealth applications will transition to HD video usage, requiring that homes have significantly larger broadband access even if they do not watch television. Furthermore, if broadband capacity is available on a symmetrical basis (allowing the same upload and download capacity), everyone can become a video producer from the home: your family web page can contain full-screen high-definition family movies; today's bloggers can host tomorrow's version of *Crossfire*; or a next-generation Jon Stewart can get his start from his family basement.

In addition, the demand to download video content (a movie or a TV show) in a reasonable amount of time requires significant bandwidth. The content of a DVD (about 5 gigabytes) takes two hours to download even with today's broadband (dial-up could take days). A high-definition video disc would take four to five times that long. But with a gigabit connection, a DVD could download in less than a minute. Only when consumers have access to that kind of bandwidth will ultimate on-demand television and movie-watching be possible: anything you want to watch at any time you want to watch it.

Telework: Home-based businesses can achieve much greater efficiencies from big broadband capabilities. Video editing, game development and serving, engineering/drafting, scientific sample analysis, software development, and other types of independent content creation can be done remotely with a big broadband network, but not with small broadband. According to one source, the availability of fiber networks has quadrupled the amount of time employees spend working from home.²⁴ Telework eliminates the inefficiency of commuting to an office, improves traffic congestion, reduces highway construction, improves the quality of our air and environment, and reduces our dependence on foreign oil.

Telehealth: Remote radiology, which requires the transmission of extremely detailed pictures with huge amounts of information, can only be done through big broadband networks. Where today many

²³ The uses of broadband networks were also well summarized in a recent report issued by the Center for Creative Voices in Media, "The Case for Universal Broadband in America: NOW!" which cites the following benefits of widely available broadband: Hundreds of Billions of Dollars in New Economic Development; Over a Million New, High-paying Jobs; Increased Homeland Security and Public Safety; Better Health Care at Lower Cost; Enhanced Educational Opportunities; Greater Citizen Participation in Government and Communities; and Greater Access to—and Participation in—Journalism, Culture and Entertainment. Available at <http://www.creativevoices.us/php-bin/news/showArticle.php?id=189>.

²⁴ See slide 18, <http://www.ftthcouncil.org/documents/728478.pdf>.

patients can communicate with their physicians by e-mail, tomorrow they will be able to have video consultations. Patients with serious medical conditions can be “wired” with sensors and monitors that continuously transmit data to care givers, family, or emergency personnel. While not in itself requiring a large amount of bandwidth, remote medical monitoring must be provided over a secure and uninterrupted channel for which a small broadband network susceptible to overload may not be suitable. A generation of baby boomers may be able to delay the move to a nursing home due to daily video contact, from home, with a network of family, friends, neighbors, and medical caregivers.

Education: Distance learning is perhaps the most obvious, but not the only, educational use of bigger bandwidth. Because the majority of today’s students live off campus today, the need for big broadband is important to ensure that they receive the same quality of education as on-campus students. Furthermore, many state colleges, especially those in rural states, have extensive distance learning programs to serve students all across the state. Many community colleges need big broadband to provide their students with the same quality of instruction as larger institutions. There are not enough teachers in enough places to meet the need; while it is not physically possible to provide a teacher of advanced calculus to every community, a high-speed network can extend the boundaries of the classroom anywhere.

College education is no longer confined to sitting in a classroom and taking notes. Increasingly, the educational process involves Internet-based research, online collaboration with fellow students, videoconferences with professors and government officials in other states and countries, real-time video exploration of the galaxies or undersea expeditions. For instance, the California-based Biology Workbench, which supports remote identification and manipulation of protein sequences, has been used by university faculty nationwide in biology courses.

In education, high-quality video can provide meaningful two-way, interactive, real-time educational experiences: a student at home can continue to participate in regular classes; parents can confer with a teacher using a videoconference; study groups can form, with members working on projects together, remotely consulting databases, video libraries, computer simulations, and each other. Virtual field trips can take students and teachers sitting in their classrooms to faraway places, such as touring the Smithsonian National Air and Space Museum, experiencing a tribal dance in Africa, or scouring the depths of the Pacific Ocean in a submarine. Music students can receive lessons from a master instructor hundreds of miles away, who will be able to hear, see, and interact with the student. Homework can be researched using digital archives at the Library of Congress, where 3D objects can be examined from all angles.

Education and gaming technologies are already beginning to merge into learning-based simulations that will demand enormous bandwidth as they approach superrealistic “virtual reality.” Haptic feedback devices are being explored in both gaming and medical applications that can add “feel” to simulations; but to work they require close to zero latency, which means very fast networks.

Social networking: Internet-based social networking has quickly become a principal means of communication, especially for young people. Increasingly popular as a means of posting, viewing, and sending video information, the sudden popularity of these sites is likely to demand greater bandwidth as the services grow in popularity and use, and as high-definition video becomes routine.

Research: Universities are often leaders in using advanced technologies that require higher amounts of bandwidth in a variety of ways. Research required of students in undergraduate and especially graduate studies programs often requires high-end broadband communications. University laboratories

increasingly depend on collaboration among departments and with other universities to solve some of the most data-intensive problems. Faculty and researchers do not work alone; the network removes the barrier of geography. Software development, computer processing, and research in fields such as astronomy, space travel, weather analysis all demand extremely high bandwidth capabilities. A fiber network is necessary to support the needs of high-end research.

Legal distribution of digital media: Academics, graphic artists, emergency personnel, doctors, political leaders, music groups, and others are increasingly using the Internet legally to share video and audio files, which consume a large amount of bandwidth. The popularity of NetFlix and iTunes are encouraging new programming services to enter the marketplace. Some network operators are already claiming that this type of traffic is overloading their networks, yet these uses are likely to increase even further with the spread of computer and production technology in the home and at work. Greater bandwidth capabilities are absolutely essential in order to keep the network from becoming congested with this type of traffic.

D. Big Broadband Networks Promote Economic Development

In addition to these specific applications, a growing body of evidence suggests that big broadband networks stimulate greater economic development. Several communities have decided to build their own fiber-optic networks where the private sector would not. These communities made the bold judgment that, even if the projects could not support themselves in a traditional commercial sense, they were still worthwhile because of the important public benefits the networks bring to the community.

A number of recent studies confirm that these communities made the right decision. The research finds that communities that deployed fiber networks have generally enjoyed greater job growth, economic productivity, and tax revenue. The following summarizes some of the case studies and research that validates the economic benefits of big broadband networks:²⁵

Criterion Economics study: A 2003 study found that ubiquitous adoption of current-generation broadband technologies would result in a cumulative increase in gross domestic product of \$179.7 billion, while sustaining an additional 61,000 jobs per year over the next 19 years. The study projected that 1.2 million jobs could be created if next-generation broadband technology were rapidly and ubiquitously deployed.²⁶

Brookings Institute: A June 2007 report found that for every 1 percentage point increase in broadband penetration in a state, employment is projected to increase by 0.2–0.3% per year. For the entire U.S. private nonfarm economy, the study projected an increase of about 300,000 jobs, assuming the economy is not already at full employment.²⁷

²⁵ Several of these case studies have been conveniently summarized at <http://infodev-study.oplan.org/the-study/2-economic-and-social-development/2-2-case-studies-on-economic-impact-of-broadband/>. SNG Consulting also provides copies of its economic analyses of broadband investments on its website at <http://www.sngroup.com/sngprojects/impact.htm>.

²⁶ Robert W. Crandall et al., *The Effect of Ubiquitous Broadband Adoption on Investment, Jobs, and the U.S. Economy*, conducted by Criterion Economics, L.L.C. for the New Millennium Research Council (September 2003), http://www.newmillenniumresearch.org/archive/bbstudyreport_091703.pdf.

²⁷ Robert Crandall, William Lehr, and Robert Litan, *The Effects of Broadband Deployment on Output and Employment: A Cross-Sectional Analysis of U.S. Data*, June 2007, <http://www3.brookings.edu/views/papers/crandall/200706litan.pdf>.

MIT: Like the study above, this study found that, between 1998 and 2002, communities in which mass-market broadband was available by December 1999 experienced more rapid growth in (1) employment, (2) the number of businesses overall, and (3) businesses in IT-intensive sectors.²⁸

Cedar Falls, Iowa: In the 1980s, Cedar Falls Utilities built a citywide municipal hybrid fiber/coaxial network and provided specialized broadband telecommunications services including fiber connections to commercial and industrial customers in both the city and the industrial park. In contrast, the neighboring town of Waterloo, served by incumbent cable and telecommunications operators, generally did not have any fiber connectivity. Cedar Falls projected that, by the end of 2003, it would have 130 companies employing over 5,000 people and occupying 4,000,000 square feet of building space. In contrast, Waterloo had a total of 10 businesses in its three industrial parks and has witnessed companies relocating from Waterloo to Cedar Falls, in part because of their need for bigger bandwidth.

South Dundas, Ontario, Canada: In June 2001, the Township of Dundas completed the building of a fiber-optic network to provide fiber access to most of the commercial and community users in the three major villages ranging in size from 800 to 2,400. The system was designed to provide broadband virtual private networks (VPN) and high-speed Internet access for municipal facilities, emergency and public services, businesses, and industrial spaces. It was understood from the beginning of the project that it would never generate sufficient revenue to offset the investment, and the justification was based on the economic improvements it would bring. The end customer makes a one-time payment for the installation of the local loop and then contracts with an ISP for service. Operation and maintenance of the network was contracted to a third party, which also became the ISP, as there were no ISPs that were interested in providing service to such a small market. The network build cost was \$750,000; the monthly network operation and maintenance costs were about \$11,000. According to an evaluation conducted for the U.K.'s Department of Trade and Industry, between June 2001 and April 2003, the fiber network produced 62.5 new jobs, \$2.8 million in commercial/industrial expansion, and \$140,000 in increased revenues and decreased costs.

Lake County, Florida: The City of Leesburg, through its municipal-owned utility, expanded its existing telecommunications network with the deployment of an extensive, fiber-optic broadband network throughout Lake County, Florida. The city provides fiber-optic connections to municipal offices, hospitals, doctor offices, schools, and private businesses throughout Lake County, a service not generally available throughout the rest of Florida. A study performed by Ford and Koutsky concluded as follows:

Our econometric model shows that Lake County has experienced approximately 100% greater growth in economic activity—a doubling—relative to comparable Florida counties since making its municipal broadband network generally available to businesses and municipal institutions in the county.²⁹

²⁸ William H. Lehr, Carlos A. Osorio, Sharon E. Gillett, and Marvin A. Sirbu “Measuring Broadband’s Economic Impact,” revised edition, January 17, 2006, http://cfp.mit.edu/groups/broadband/docs/2005/MeasuringBB_EconImpact.pdf.

²⁹ George Ford and Tom Koutsky, “Broadband and Economic Development: A Municipal Case Study from Florida,” *Applied Economic Studies*, April 2005, http://www.freepress.net/docs/broadband_and_economic_development_aes.pdf.

Fiber to the Home Council: In addition, the U.S. Fiber to the Home Council provides the following examples of businesses that were attracted to locate their headquarters in a particular area because of its widespread fiber deployment.³⁰

PLACE	POPULATION	TYPE	COMPANY
Bristol, VA	17,271	(MUNI)	Northrop Grumman Fort
Wayne, IN	203,369	(RBOC)	Raytheon
Macon, MO	5,283	(ILEC)	Onshore
Mason County, WA	53,000	(PUD)	Louisville Slugger, Sims
Quincy, WA (Grant County)	5,326	(PUD)	MSN (Microsoft)
Salem, IL	7,569	(CLEC)	Midwest Ag Energy Ethanol Plant
Wenatchee, WA (Chelan City)	28,515	(PUD)	Yahoo

E. Big Broadband Networks Are Less Expensive to Operate

Big broadband networks do not require the same amount of maintenance as copper or coaxial networks because they require fewer electronics to be located outside the main switching center. According to Corning:

Given the unsurpassed bandwidth capability of fiber, FTTH [fiber to the home] gives the service provider the flexibility to upgrade the system in the future to provide higher bandwidth with little or no change to the overall architecture. FTTH networks also allow the operator to build the network primarily as a passive system, which requires no power or active elements to be deployed outside of the head end or central office and the customer, thereby drastically reducing in-field maintenance costs....PONs [fiber passive optical networks] will always have lower OPEX [operating expense] costs than HFC [hybrid fiber-coaxial] or DSL networks. This is because a PON has lower maintenance costs due to the lack of active components in the field and the more resilient nature of fiber.³¹

Verizon has been actively deploying fiber to the home, both as a source of additional revenue and as a means of reducing its costs of maintaining the network. At the FTTH Council Conference in Las Vegas, Verizon announced that it would cost about \$22.9 billion to convert its aging wiring to fiber through 2010; however, the cost would be offset by a \$4.9 billion savings in maintenance.³² In an investor slide presentation, Verizon estimates the cost savings from replacing its copper network with a fiber network at \$110 per line, or approximately \$1 billion per year.³³

³⁰ See <http://www.ftthcouncil.org/documents/728478.pdf>.

³¹ See <http://www.ftthcouncil.org/documents/523450.pdf>.

³² See <http://www.ecmag.com/index.cfm?fa=article&articleID=4114>.

³³ See <http://investor.verizon.com/news/20060927/20060927.pdf>.

F. Summary of Findings Regarding Broadband Growth

To summarize, Internet traffic continues to grow by leaps and bounds, and some uses are already causing network congestion problems. Yet the providers of network capacity are not investing enough to handle the demand. The weakest link in the network connection chain is not the computer, the inside wire, or the backbone—it is the low capacity of the local, last-mile connection to the home or business. The shortage of local broadband capacity will likely become worse as new applications are developed and with the advent of high-definition video.

For this reason, EDUCAUSE believes that the United States must take steps to ensure that every home and business has at least a 100 Mbps broadband connection—a big broadband connection. A connection of this size is the minimum necessary to meet the needs of the families of the future. Several members of each household could well engage in gaming, medical monitoring, downloading HDTV signals, and other high-bandwidth needs simultaneously. In addition, big broadband connections are necessary for telehealth, social networking, telecommuting, legal file sharing and other, as yet nonexistent applications. Fiber-optic networks have proven to stimulate economic development, and they are cheaper to operate than existing copper-based networks. For all these reasons, America needs to have a policy to enhance the deployment of big broadband networks.

Before deciding what that policy should be, the paper compares the U.S. broadband marketplace to other nations and then reviews the successful policies they have chosen to follow.

III. U.S. Broadband Capability Lags Behind Many Developed Nations

A variety of measures demonstrate that the United States is falling further behind our principal economic rivals in broadband competitiveness. The following discussion summarizes some of these comparisons.

A. ITU Broadband Rankings

The International Telecommunications Union (ITU) recently opened a new website portal, the ICT “Eye,” containing extensive information on each country’s telecommunications capabilities each year since 1999.³⁴ In comparing the international rankings according to the number of broadband subscribers per 100 people, this information shows that the United States rank dropped every year since 1999:

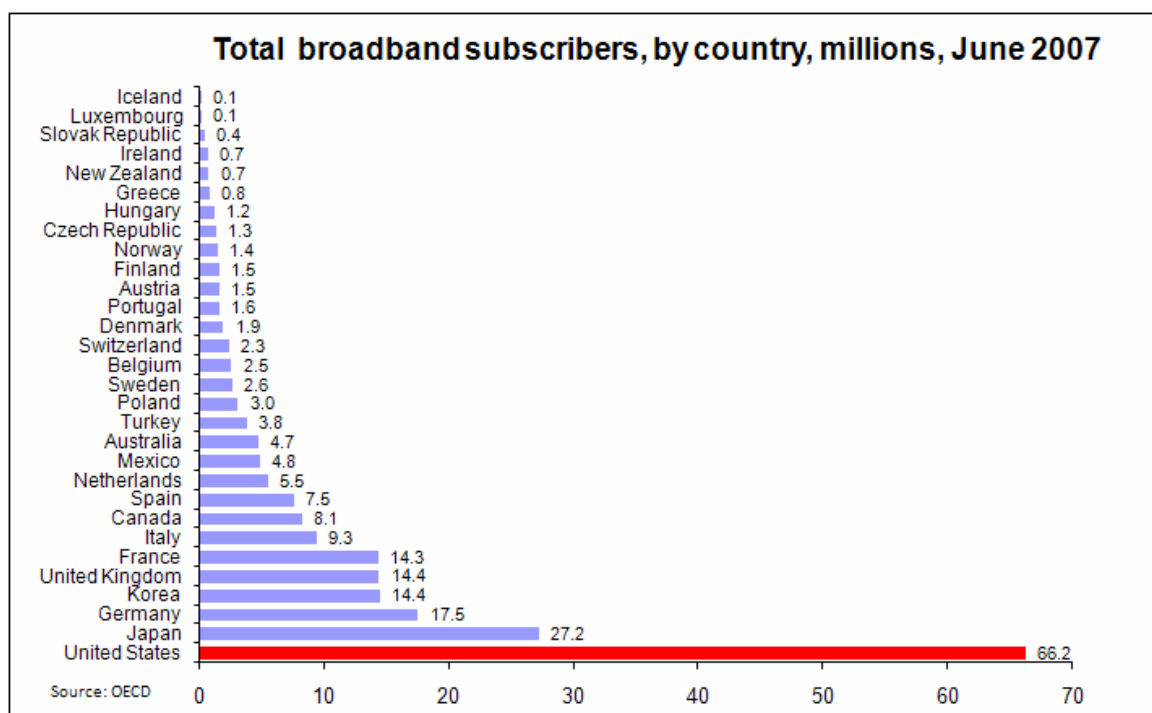
Year	U.S. International Rank— Broadband Subscribers per 100 People:
1999	3 rd
2000	5 th
2001	7 th
2002	11 th
2003	15 th
2004	18 th
2005	19 th
2006	20 th

³⁴ See <http://www.itu.int/ITU-D/ICTEYE/Indicators/Indicators.aspx#>.

B. OECD Broadband Rankings

The Organisation for Economic Co-operation and Development (OECD) recently opened a new broadband data portal containing a wealth of information on broadband statistics among OECD member countries, including graphs that track broadband prices, speeds, and technologies as well as overall penetration.³⁵ The OECD data show that the United States is trailing most of the OECD nations when broadband is measured per capita, per household, per GDP, per dollar, and per megabit of transmission speed.

Broadband subscribers: The following graph shows that the United States leads the OECD in the total number of broadband subscribers. However, this graph does not reflect the growth of China, which is growing quickly and may overtake the United States in the next year or two.³⁶



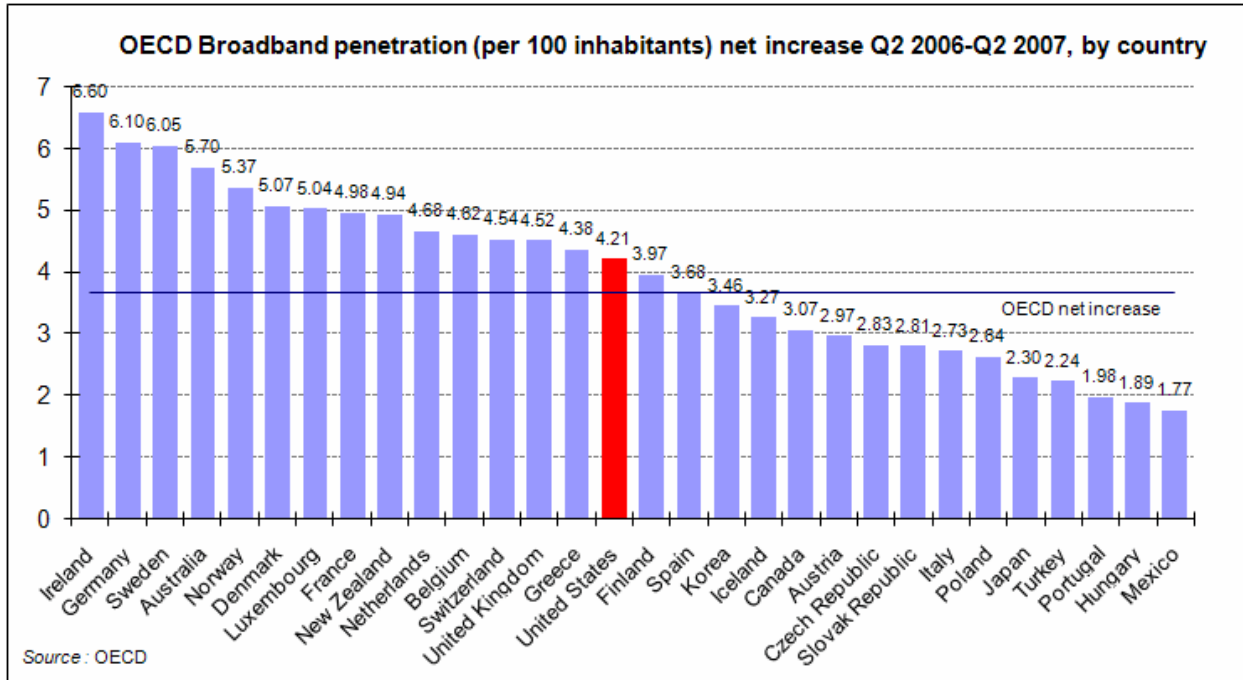
Broadband adoption per capita: While the United States leads in raw numbers of broadband subscribers, it also has a much larger population than most of these countries. Perhaps a more relevant statistic is the number of broadband subscribers per person (per capita). The OECD publishes just such an annual report ranking its 30 member countries on broadband subscribership per capita.³⁷ When the OECD first collected this data in 2001, the United States ranked 4th; at the end of 2006, it ranked 15th. Denmark, the Netherlands, Switzerland, Korea, Norway, and Iceland lead the OECD in broadband penetration.

³⁵ See http://www.oecd.org/document/54/0,3343,en_2649_33703_38690102_1_1_1_1,00.html.

³⁶ <http://gigaom.com/2007/06/22/broadband-subscribers-300-million-strong/>.

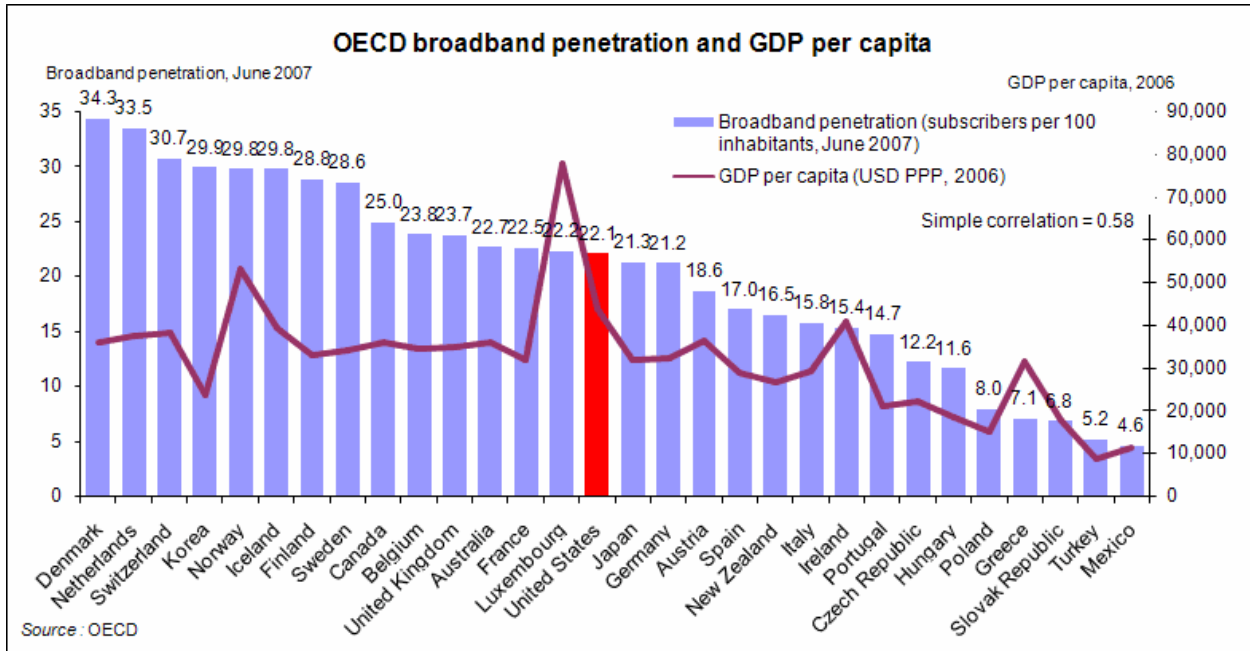
³⁷ OECD Directorate for Science, Technology, and Industry, "Broadband Statistics to December 2006" (April 2007), <http://www.oecd.org/sti/ict/broadband>.

The following chart of growth rates indicates that the U.S. broadband ranking is keeping pace with the average growth of OECD countries over the past year. At the same time, it is also interesting to note that some of the countries that already have a relatively high broadband subscribership also have high growth rates. For instance, Sweden, Norway, Denmark, Luxembourg, France, the Netherlands, Belgium, Switzerland, and the U.K. are adding broadband subscribers at a faster rate than the United States, despite having a higher broadband penetration per capita. This indicates that the growth of broadband has not “flattened out” and that the United States may fall even farther behind these countries in the future.³⁸



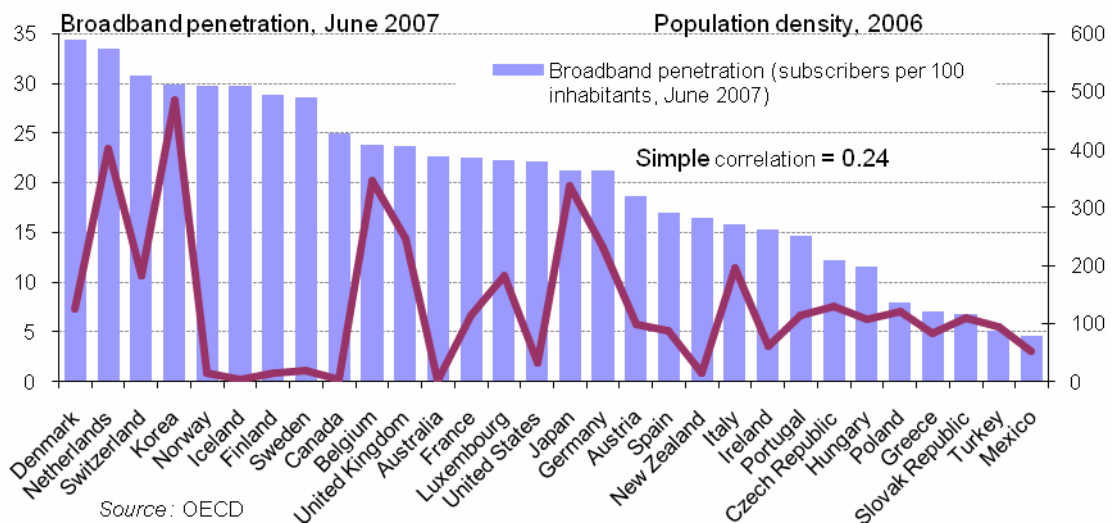
Per GDP: Broadband adoption appears to have little relationship to the size of the country’s economy. The Gross Domestic Product (GDP) measures a country’s total economic output. The United States has one of the highest GDP among all OECD members when measured on a per capita basis (succeeded only by Norway and Luxembourg). Yet, as noted above, the United States ranks only 15th in broadband penetration per capita. In other words, countries whose economies are significantly smaller (on a per capita basis) than the economy of the United States nonetheless have a significantly higher adoption of broadband services.

³⁸ According to one theory, the nations that are ahead of the U.S. are likely to hit a plateau as they near the top of the “S” curve, and the U.S. will catch up to these countries over time as U.S. growth continues. The data, however, appear to demonstrate that at least some developed countries, have not yet reached the top of that curve.

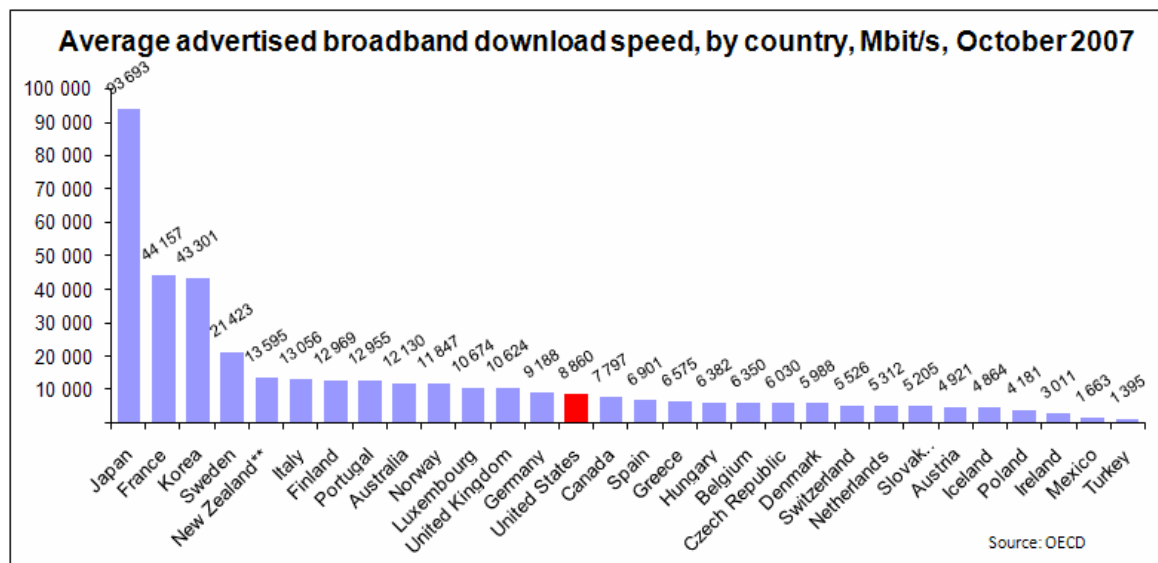


Population density: It is sometimes alleged that the relatively low U.S. adoption rate can be explained by the large amount of rural territory in the U.S. This argument is flawed in a couple of respects. First, these charts measure the rate of subscribership (adoption), not deployment. According to the industry, broadband services are already available to over 90% of the country’s homes. It is not clear how the large rural territory in the U.S. would explain the relatively low levels at which consumers are choosing to purchase broadband. (In fact, one could argue that large rural areas should see even greater subscribership of broadband services.) Second, a comparison of other countries’ “rurality” reveals that there are many nations with more rural territory than the U.S. that still have higher adoption rates. The following graph shows that Norway, Iceland, Finland, Sweden, Canada and Australia have lower population density than the U.S. and yet still have a higher level of broadband penetration.

OECD broadband penetration and population densities



Per megabit: The average connection offered in OECD countries is 13.7Mbps, and the United States is slightly below that average. The fastest average advertised download speeds are in Japan (93 Mbps), France (44 Mbps), Korea (43 Mbps) and Sweden (21 Mbps). While the growth rate of broadband subscribers in Japan has leveled off in the past year, Japan's transmission speeds are booming largely because the country is putting significant resources into the deployment of fiber. Several studies, including one from the OECD, point out that 100 Mbps connections are widespread in Japan, a rate that is 10 times faster than the average of the 30 OECD countries.³⁹ Consumers in Sweden, Korea, and Finland can also receive 100 Mbps broadband in locations that have switched to fiber-optic networks. The telephone companies' broadband speeds have increased as they upgraded their copper wire networks from ADSL to ADSL2+. ADSL2+ doubles the amount of data that can be downloaded and can provide up to 24 Mbps, which still remains far short of the 100 Mbps that fiber can deliver.⁴⁰

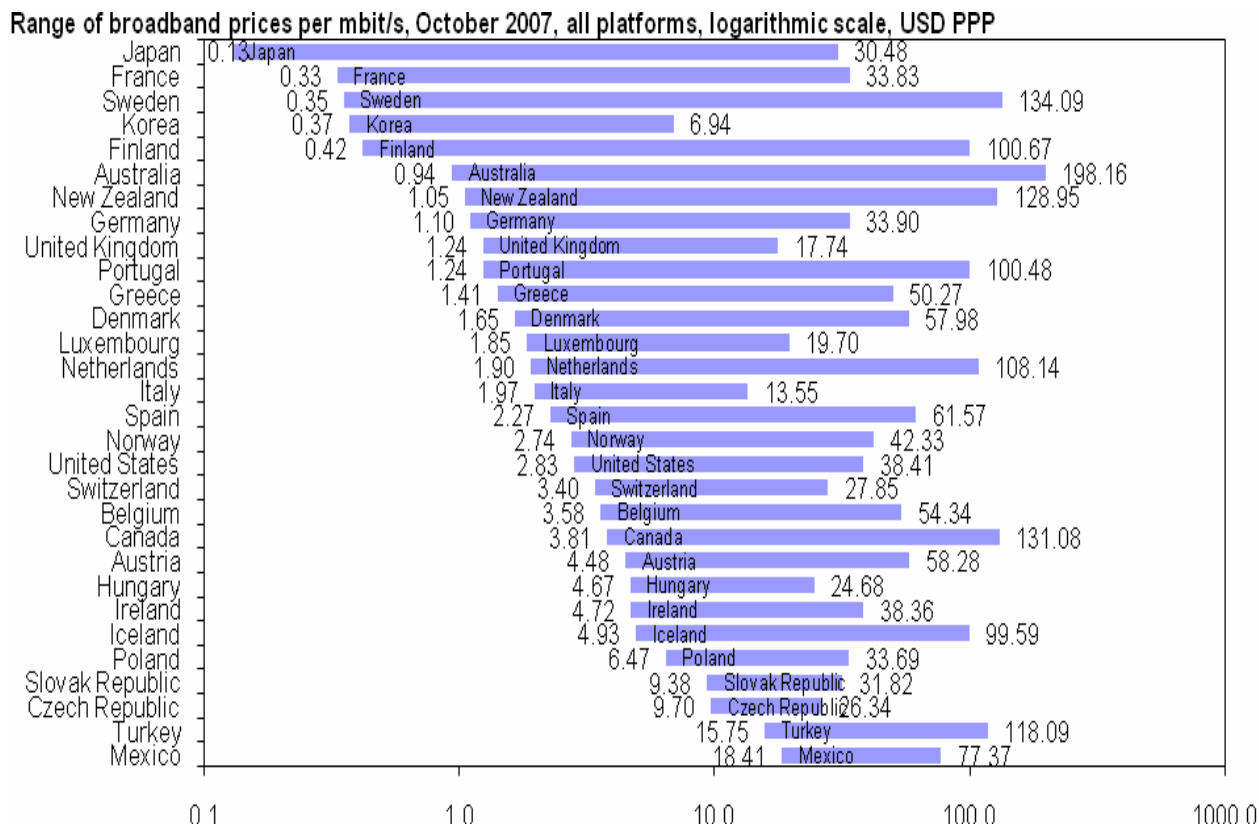


Per dollar: The average price of a broadband connection among OECD countries is US\$49. When measured per megabit, the countries' prices vary substantially. The countries with the lowest price per megabit are Japan (\$0.13), France (\$0.33), Sweden (\$0.35), Korea (\$0.38), and Finland (\$0.42) having the lowest cost broadband per Mbps. The U.S. ranks 18th when comparing the lowest price per megabit of advertised service. In general, the OECD notes that countries that have switched to fiber also have the lowest prices. FTTH connections are almost five times less expensive per Mbps than DSL, cable, or wireless.⁴¹

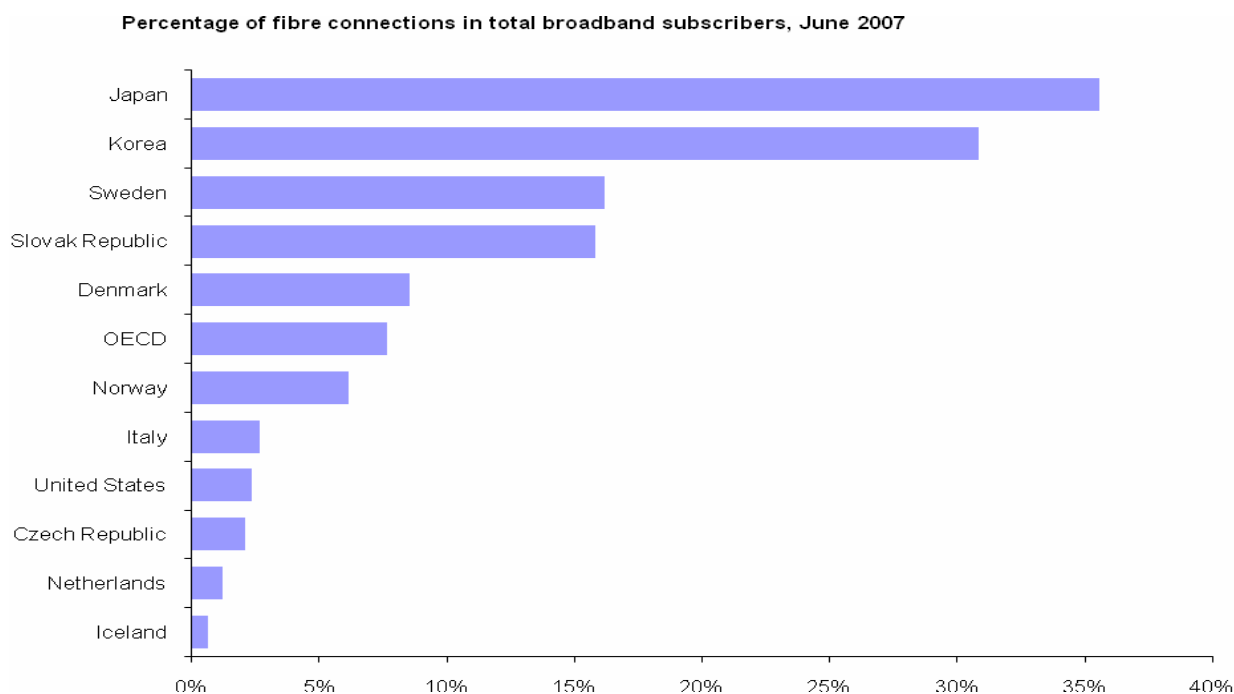
³⁹ OECD Directorate for Science, Technology, and Industry, "Multiple Play: Pricing and Policy Trends" (April 2006), <http://www.oecd.org/dataoecd/47/32/36546318.pdf>.

⁴⁰ See http://www.theregister.co.uk/2007/07/31/oecd_broadband_report/. July 31, 2007.

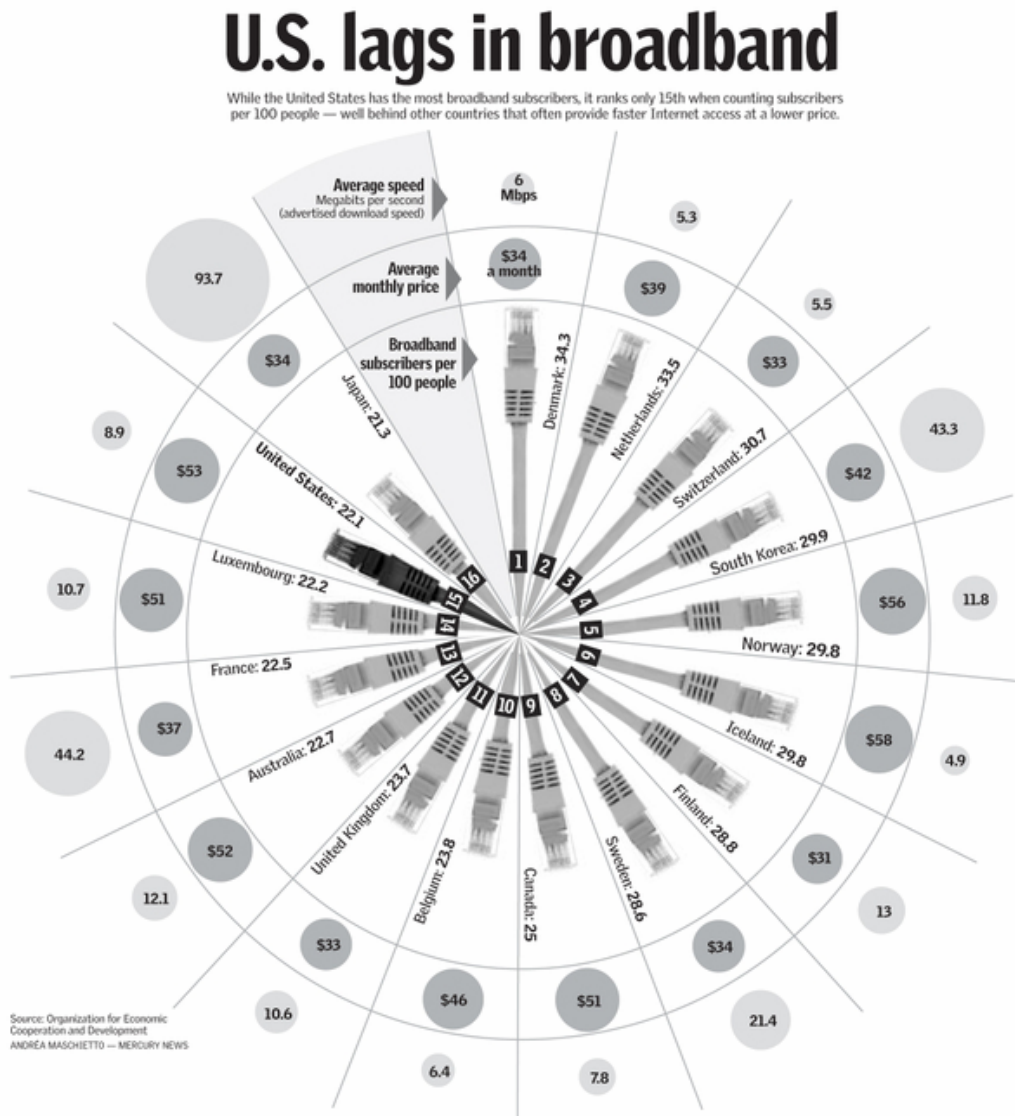
⁴¹ See http://www.oecd.org/document/54/0,3343,en_2649_33703_39575670_1_1_1_1,00.html.



Fiber: The United States also lags behind many other countries in fiber to the home deployment, as the following chart shows:



Overall picture: Below is an additional graphic from the OECD that summarizes much of the data in one picture:⁴²



IV. Current U.S. Broadband Policies Have Not Sufficiently Improved the Broadband Market

In 2004, President Bush recognized the need to enhance U.S. global position in broadband services. In March of that year, during the 2004 presidential campaign, he first articulated his goal that the United States should have universal and affordable broadband by 2007.⁴³ He elaborated on this goal three months later:

⁴² See <http://www.fiberevolution.com/2007/11/us-lags-in-grap.html>.

⁴³ President George W. Bush, remarks by the president on homeownership at Expo New Mexico, March 26, 2004, <http://www.whitehouse.gov/news/releases/2004/03/20040326-9.htm>.

What we're interested in is to make sure broadband technology is available in every corner of America by the year 2007. I mean, all over the nation is what we're interested in.... [O]n a per capita basis, America ranks 10th amongst the industrialized world. That's not good enough. We don't like to be ranked 10th in anything. The goal is to be ranked 1st when it comes to per capita use of broadband technology. It's in our nation's interest. It's good for our economy. The spread of broadband will not only help industry, it'll help the quality of life of our citizens. This country needs a national goal for broadband technology, for the spread of broadband technology. We ought to have a universal, affordable access for broadband technology by the year 2007...⁴⁴

Despite the president's statement that 10th place is "not good enough," the United States' international position has fallen to 15th since. Despite the fact that more consumers are purchasing broadband today than ever before, it is difficult to say that the president's goal of universal and affordable broadband service availability has been met. The cable industry maintains that it provides broadband service to 92% of homes,⁴⁵ and telephone companies generally assert that they provide DSL coverage to 80–90% of all homes. While these figures are impressive, they fall short of "universal." Satellite broadband service is available to the 48 contiguous states from two providers (WildBlue and HughesNet), but only to homes and apartments that have a southern exposure without an obstruction, such as a tree or a building. Even if the satellite service is available, it is generally not considered "affordable" (WildBlue charges \$250 for the equipment and \$80 for installation, and the monthly fee starts at \$50 for the slowest tier of service [512 kbps]). Satellite service also suffers from latency (due to the time it takes for signals to travel 22,000 miles up to the satellite and back), which causes performance difficulties for VoIP, videoconferencing or real-time online gaming.⁴⁶

It thus appears that the United States has not reached the president's goal.⁴⁷ When combined with the evidence in section III above concerning the declining U.S. global ranking in broadband penetration, there is reason to question whether our current policies to promote broadband are satisfying our need for greater broadband coverage. The following discussion reviews the policies the United States has pursued over the past few years and assesses their success.

⁴⁴ President George W. Bush, remarks by the president on innovation at U.S. Department of Commerce, June 24, 2004, <http://www.whitehouse.gov/news/releases/2004/06/20040624-7.html>.

⁴⁵ See <http://www.ncta.com/IssueBrief.aspx?contentId=3024>.

⁴⁶ "Satellite Broadband Access Slow, Expensive, Necessary," Friday, May 11, 2007, *FOXNews*, <http://www.foxnews.com/story/0,2933,271014,00.html>.

⁴⁷ It should be noted that some officials believe that the goal set by President Bush has been met. NTIA chief John Kneuer said in mid-2007 that the United States was well on its way to achieving the president's goal:

The Bush administration's top telecommunications official said today he expects that the President's deadline of universal broadband service availability throughout the country by the end of 2007 to be largely realized, even as he confirmed that there are still pockets of the country where advanced services are not available. John Kneuer, head of the National Telecommunications and Information Administration, told NXCComm conference attendees here during a panel discussion that the state of competition within the U.S. broadband marketplace has never been better, and it is a testament to the pro-innovation policies instituted by both the Bush administration and the FCC. "I'm very confident that we will meet the president's goal, which was universal, affordable access by the end of this year," Kneuer said. "If you look at the activities in the marketplace, with that investment, there is more access, it is cheaper, consumers have choices...all of the things you want to see indicative of a very competitive marketplace."

Ted Gotsch, *TRDaily*, June 20, 2007.

The United States has adopted a variety of measures to promote broadband, but it is not clear that these policies and programs have significantly improved the U.S. broadband market. Most of these measures rely on the marketplace to address the nation's need for broadband connectivity. Unfortunately, the microeconomic motivations of the private industry do not take into account the macroeconomic and social welfare needs of the nation. Gartner Consulting described the situation well in a report that it prepared for CENIC's Gigabit or Bust initiative:

In order for market demand alone to drive ubiquitous deployment of broadband service, providers and investors require strong evidence of demand.... Gartner believes that one of the weaknesses of this logic is the view that broadband is an optional service beyond traditional voice communications services. It is not.... Taking the view that broadband is the next generation communications platform, we believe the "killer app" enabled by integrating [voice, video, and data] services can be described as enhanced personal communications. A next generation broadband platform for today's basic telecommunications creates both a lower incremental cost structure for today's services as well as an efficient platform for new video and data applications.⁴⁸

Rob Atkinson, president of the Information Technology and Innovation Foundation (ITIF), makes a similar argument that the private sector will not provide the optimum level of broadband services:

[B]roadband is unique in that the social returns of broadband investment exceed the private returns to companies and consumers.... [The] most important way that broadband is different from other unregulated consumer products is the significant positive externalities generated by its adoption. The notion of externalities is straightforward: it is a divergence between private costs and social costs (or benefits). Externalities occur when one market participant's action affects others without compensation being paid or received. In a competitive equilibrium with the presence of costs (or benefits) that do not accrue to the individual economic actor, the competitive markets alone will not achieve optimal outcome—what economists refer to as Pareto optimality.... [T]here is considerable reason to believe that there are significant externalities from high-speed broadband, and that if left to themselves, market forces alone will lead to less investment in broadband than is societally optimal.⁴⁹

The following discussion describes in greater detail the five principal strategies used by the United States to promote broadband services over the past few years and explains why they have not been as effective as hoped.⁵⁰

- i. Removing barriers to competition: The Bush administration has sought to eliminate several barriers to the use of rights-of-way by broadband providers. To promote video competition, the FCC threatened to preempt state and local governments that impose unreasonable

⁴⁸ Available at <http://www.broad-band.gr/content/modules/downloads/GbORBustGartnerFull.pdf>.

⁴⁹ Robert D. Atkinson, "Framing a National Broadband Policy," <http://www.itif.org/index.php?id=118>.

⁵⁰ The FCC has not issued a Report to Congress on the Deployment of Broadband Services in three and a half years. Until now, the FCC had issued these reports every two years (2000, 2002, and 2004). The FCC opened a new proceeding to gather information in the spring of 2007 and may issue a new report in early 2008.

requirements on competing video providers as a condition to using their rights-of-way.⁵¹ The FCC also ruled that building owners may not prevent competitive cable providers from entering the building to serve its tenants.⁵² The FCC is now considering a similar directive to ensure that telecommunications providers can obtain the same access to buildings as video providers.

Assessment: The FCC's efforts to remove barriers to use of rights-of-way could eventually prove significant. However, local governments and cable operators are challenging these decisions in court, and it is not clear that the FCC's decisions will hold up.⁵³ Until the legal challenges are resolved in favor of the FCC, these decisions are unlikely to have much impact on companies' investment decisions.

Furthermore, removing the impediments to using rights-of-way is certainly laudable, but that action alone does not mean that companies will make the investment necessary to provide big broadband. Removing the barriers to entry is just one of several economic factors in the calculation over whether to make the investment worthwhile.

- ii. Making additional spectrum available: The FCC has made the Advanced Wireless Services (AWS) spectrum available and has streamlined the rules for the 3650 GHz spectrum for rural areas.⁵⁴ It is currently auctioning licenses to use the 700 MHz spectrum, which is being vacated by the broadcasters as a part of the transition to digital television.⁵⁵

Assessment: Making more spectrum available for broadband services is certainly worthwhile. The question is whether there is enough spectrum available to provide adequate capacity for big broadband. Generally speaking, wireless broadband speeds lag behind wireline services speeds. Three G mobile services, for instance, generally cannot exceed 1 Mbps. While the technologies for fourth-generation mobile (4G) promise speeds of 100 Mbps, the standards are still being developed and it may be a few years before it is available in the marketplace.⁵⁶ There is great hope that the services in the AWS spectrum and the 700 MHz spectrum will lead to a more competitive mobile services marketplace. The amount of spectrum allocated to each licensee (5–22 MHz per license) places an inherent limitation on the capacity, however.⁵⁷

⁵¹ *Implementation of Section 621(a)(1) of the Cable Communications Policy Act of 1984 as amended by the Cable Television Consumer Protection and Competition Act of 1992, Report and Order and Further Notice of Proposed Rulemaking (MB Docket No. 05-311);* (FCC 06-180) December 20, 2006; http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-269111A1.pdf.

⁵² *See Exclusive Service Contracts for Provision of Video Services in Multiple Dwelling Units and Other Real Estate Developments, Report and Order and Further Notice of Proposed Rulemaking, MB Docket No. 07-51, FCC No. 07-189 at ¶¶ 61-66 (rel. Nov. 13, 2007);* http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-07-189A1.pdf.

⁵³ "Municipalities Take FCC to Court in Video Franchising Fight," <http://www.xchangemag.com/articles/525/74h510454312361.html>; "Cities Seek Stay of FCC Video Franchise Changes," <http://www.broadcastingcable.com/article/CA6454291.html>; and "NCTA begins Challenge of FCC MDU Order," December 11, 2007, <http://www.multichannel.com/article/CA6511782.html>.

⁵⁴ An excellent summary of the AWS auction begins here: <http://www.phonescoop.com/articles/aws/index.php?p=i>.

⁵⁵ The 700 MHz spectrum auction scheduled to begin in January 2008 is explained here: <http://gigaom.com/2007/03/14/700mhz-explained/>.

⁵⁶ One report suggests that 4G services may be rolled out in 2012 and beyond. See <http://www.4g.co.uk/PR2007/3061.htm>.

⁵⁷ According to one technologist, wireless services are constrained to approximately 2bits per hertz and will be "too little, too late." See presentation of Stagg Newman at the State of Telecom 2007 conference at the Columbia Institute of TeleInformation (CITI), available at http://www4.gsb.columbia.edu/null/download?&exclusive=filemgr.download&file_id=10267.

- iii. Deregulating broadband infrastructure: The FCC has eliminated the common carriage obligations of several types of broadband Internet access providers (cable modem,⁵⁸ wireline broadband,⁵⁹ wireless broadband,⁶⁰ and broadband over power lines⁶¹), under the theory that these firms will increase their investment in broadband if burdensome regulations are removed. In a series of three orders, the FCC also removed the “unbundling” obligations on certain fiber facilities deployed by the telephone companies (meaning that the telephone companies were no longer obligated to provide access to these facilities to competitors at regulated rates).⁶²

Assessment: Whether or not eliminating the network sharing requirements on incumbent broadband facilities promotes additional investment is uncertain. On the one hand, incumbents might have a greater incentive to invest in broadband facilities if they do not have to share the potential profits with new entrants and are thus able to capture more of the profits from that investment for themselves. On the other hand, firms operating in a competitive market often have greater incentives to invest in new services and technologies than firms operating in a duopoly. In France, new entrants first entered the market by reselling the incumbent’s facilities. Now that they have gained subscribers and attracted investors, they are beginning to deploy their own fiber facilities. Whether network sharing promotes investment may also depend on the price paid by the new entrants for use of the network.

In any case, as mentioned earlier, even if deregulating a telephone company removes a disincentive to invest, it does not necessarily mean that investment will occur. Many other factors also affect the decision to invest. Note that even though the FCC removed the unbundling obligations for all the incumbent telephone companies, only Verizon has chosen to deploy fiber to the home.

- iv. Allowing the USF to be used for broadband: Technically, the FCC defines the set of services eligible to receive universal service subsidies to include basic voice telephone services but not broadband services.⁶³ In practice, however, carriers are allowed to use the USF to cover the

⁵⁸ Appropriate Regulatory Treatment for Broadband Access to the Internet Over Cable Facilities, *Declaratory Ruling and Notice of Proposed Rulemaking*, 17 FCC Rcd 4798, (2002) (*Cable Modem Declaratory Ruling*), *aff’d*, *Nat’l Cable & Telecomms. Ass’n v. Brand X Internet Servs.*, 125 S. Ct. 2688 (2005) (*NCTA v. Brand X*).

⁵⁹ Appropriate Framework for Broadband Access to the Internet over Wireline Facilities, *Report and Order and Notice of Proposed Rulemaking*, 20 FCC Rcd 14853, (2005) 22 F.C.C.R. 5901 (2007); http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-05-150A1.pdf.

⁶⁰ Appropriate Regulatory Treatment for Broadband Access to the Internet over Wireless Networks, *Declaratory Ruling*, released March 23, 2007, WT Docket No. 07-53.

⁶¹ In the Matter of United Power Line Council’s Petition for Declaratory Ruling Regarding the Classification of Broadband over Power Line Internet Access Service as an Information Service, WC Docket No. 06-10, *Memorandum Opinion and Order*, 21 FCC Rcd 13281 (2006); http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-06-165A1.pdf.

⁶² See http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-231344A2.pdf, http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-250545A1.pdf, and http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-253127A1.pdf.

⁶³ The FCC voted in 1997 to include the following services in the definition of universal service: voice grade access to and some usage of the public switched network; single line service; dual tone signaling; access to directory assistance; emergency service such as 911; operator services; access and interexchange (long distance) service. This list has not changed since then. Even though the Telecommunications Act states that the definition of universal services should be an “evolving” one and authorizes the FCC to “periodically” revisit the definition, the FCC has not changed the list of services supported by the USF since 1997.

costs of high-cost loops used to carry both voice and broadband traffic (the so-called dual-use policy).⁶⁴

Assessment: The USF has likely had some positive impact on the deployment of broadband services by smaller, rural telephone companies. In general, rural consumers served by small rural telephone companies have better access to DSL than consumers served by one of the large Bells. This may be because these small rural companies obtain a relatively high share of the total USF high-cost subsidies. But the majority of rural consumers are served by the large Bells,⁶⁵ which receive relatively small amounts of universal service support per subscriber.

More fundamentally, the high-cost portion of universal service provides ongoing annual support to the companies, rather than subsidizing the one-time investment in additional broadband facilities. The current USF is thus not designed for large, one-time, capital investments. Furthermore, the use of these funds is not audited, so policymakers generally do not know how these funds are used. The USF is thus not an appropriate option for funding broadband deployment on a nationwide basis.

- v. Awarding grants and low-interest loans through the Department of Agriculture's Broadband Program: Congress and the Bush administration in 2002 authorized a loan and loan guarantee program to provide funds for the costs of the construction, improvement, and acquisition of facilities and equipment for broadband service in eligible rural communities. The program is administered by the Rural Utilities Service (RUS) within the U.S. Department of Agriculture. This program operates alongside the preexisting Community Connect Grant Program. The RUS claims to have awarded over \$5.7 billion in loans to companies serving two million households since the program's inception in 2004.

Assessment: While the RUS broadband programs were well-intentioned and have had some impact, they have fallen short of the expectations. The program was intended to fund broadband investments in rural areas. But the *Washington Post* reported that since 2001 more than half the money has gone to metropolitan regions or communities within easy commutes of a midsize city.⁶⁶

But the program's principal flaw is that it primarily provides loans, not grants. The RUS understandably declines to grant loans unless the applicant can demonstrate sufficient financial resources and a business plan that will enable the applicant to repay the loan. The unfortunate result is that loans are awarded to those firms that already have strong financial backing and for areas that have positive economics. In other words, many loans are granted to firms who may not need them. This policy does not address the needs of high-cost or low-income communities that may desperately need broadband but where the returns may not satisfy traditional commercial criteria. The RUS has had trouble finding qualified applicants that meet its financial

⁶⁴ See Recommended Decision of the Federal-State Joint Board, WC Docket No. 05-337 and CC Docket No. 96-45, released Nov. 20, 2007, p. 15, note 55.

⁶⁵ According to one estimate, 74.2% of rural households are located in areas served by AT&T, Verizon, or Qwest. Daniel J Ryan, "Universal Telephone Service and Rural America," http://papers.ssrn.com/sol3/papers.cfm?abstract_id=563122.

⁶⁶ Dan Morgan and Gilbert Gaul, "Lawmakers May Refocus Rural Internet Financing," *Washington Post*, May 2, 2007, p. A05, <http://www.washingtonpost.com/wp-dyn/content/article/2007/05/01/AR2007050101919.html>.

criteria, and it has denied about 60% of applications. In fact, one RUS official recently admitted that the program was not meeting the needs of the most rural and unserved areas.⁶⁷

V. The Decline of U.S. Telecommunications Research

In the past, AT&T provided the majority of telecommunications research through its ownership of Bell Laboratories, the world-famous research facility that discovered the transistor, the laser, radar and sonar, digital signal processors, cellular telephone technology, and data-networking technology. Bell Labs played a critical role in shaping today's digital era, including information theory, pulse code modulation, UNIX, and digital art and music. Entire industries resulted from many of the innovations created within Bell Labs, such as cellular mobile telephony, satellite communications, hi-fi audio, and semiconductor electronics. The payoffs of the research at Bell Labs were new knowledge and also new industries—with many discoveries commercially incorporated into the Bell System and others donated to society. Indeed, much of the research conducted by Bell Labs in data-networking today forms the basis of the 21st-century Internet.⁶⁸

Today, however, America is not making the same commitment to basic research as in the past. Wall Street pressure on short-term profits is driving companies to focus on immediate earnings at the expense of long-term investments in research. Bell Labs, now owned by Lucent Technologies, has shifted its emphasis to commercializing technologies rather than basic research. According to a front page article in the *Wall Street Journal*, the leader of Bell Labs is aiming to speed the transformation of technology into products within six months by seeking corporate partners and venture capital.⁶⁹ Bell Labs' employee count dropped from 3,000 in 1999 to about 1,000 in 2007.

In general, American telecommunications firms can no longer afford to invest in basic, fundamental telecommunications research with project horizons beyond 5 years. Unless the United States can reverse this trend, the United States may fall permanently behind in the telecommunications innovation race. This would harm the economic position of the United States as a whole. The telecommunications industry alone accounts for approximately 3% of this country's gross domestic income and employs over 1.25 million U.S. workers. The industry is a critical driver of U.S. economic growth and innovation, and

⁶⁷ "As with any young program, there have been bumps in the road," Curtis Anderson, deputy administrator for the Agriculture Department's Rural Utilities Service, told the House Appropriations Agriculture Subcommittee. One of those bumps has been a dearth of loans to promote the build-out of broadband infrastructure to unserved areas. Anderson conceded that few companies seek assistance for that purpose because it is difficult to craft viable business models for repayment. He also said the RUS does not always dispense all of its annual funding. Lamenting that the United States has dropped from fourth to 15th in worldwide per capita broadband subscriptions, Subcommittee Chairwoman Rosa DeLauro, D-Conn., expressed frustration that any RUS money would go unused. "There's something wrong with this picture," she admonished during an exchange with Anderson. But he countered that evolving technologies and complex loan structures have forced the RUS to go slow at times.

David Hatch, "Official: Rural Internet Program Is Flawed," *National Journal*, October 23; posted October 30, 2007, http://www.njtelecomupdate.com/2007/10/rural_internet_program_is_flaw.html#more.

⁶⁸ Two examples: The substitution of plastic for lead sheathing of telephone cables saved the Bell System billions, lowered installation costs and had a positive environmental impact. The discovery of polarized radio waves doubled the capacity of long-distance microwave radio systems. "The Future of Telecommunication Research in the United States," A. Michael Noll, Professor Emeritus of Communication, Annenberg School at USC, Senior Affiliated Research Fellow, CITI, November 17, 2006. Available at http://www.citi.columbia.edu/conferences/telecomRD/NOLL_Presentation.pdf.

⁶⁹ Sara Silver, "With Its Future Now Uncertain, Bell Labs Turns to Commerce," *Wall Street Journal*, August 21, 2006, p. A1, http://online.wsj.com/article/SB115612298786340693.html?mod=todays_us_page_one.

maintaining the United States' leadership position in telecommunications research is an important component of our overall economic competitiveness. According to Jake MacLeod, Bechtel Communications chief technology officer, the U.S. government spends far less on telecom R&D funding than Europe. The European Union (EU) spends almost \$13.5 billion a year; the United States spends \$250–350 million, he said. The funding gap is “chasing research offshore” and killing jobs for Americans, MacLeod said. The government must “make policies that attract development” in the United States.⁷⁰

The National Research Council (NRC) recently documented the crisis in American telecommunications research in a report⁷¹ that presents substantive evidence of the declining role of industrial research in telecommunications. The following summarizes the primary finding of the study:

[Telecommunications] is not a mature industry, and major innovation and change—driven by research—can be expected for many years to come. Without an expanded investment in research, however, the nation's position as a leader is at risk. Strong competition is emerging from Asian and European countries that are making substantial investments in telecommunications R&D. For many telecommunications products and services that are now commodities, the United States is at a competitive disadvantage compared with countries where the cost of doing business is lower. Continued U.S. strength in telecommunications, therefore, will require a focus on high-value innovation that is made possible only by a greater emphasis on research. Expansion of telecommunications research is also necessary to attract, train, and retain research talent.

Federal funding of long-term research has not increased to cover the decline in industry support. No systematic efforts, such as took place for the semiconductor industry with SEMATECH, have emerged. Because the benefits of much telecommunications research cannot be appropriated by individual firms, therefore, public funding of such research appears necessary.

The NRC report recommends creation of an Advanced Telecommunications Research Activity (ATRA) to stimulate and coordinate research, along with roadmapping and centralized planning:

A strong, effective telecommunications R&D program for the United States will require a greater role for government-sponsored and university research, and more funding of long-term research by industry.... ATRA would be a hybrid of activities of the sort historically associated with DARPA (which through the ARPANET program managed a research portfolio, developed a vision, and convened industry and academia to build what would become the Internet) and SEMATECH (which brought the semiconductor industry together, initially with some federal support to complement industry dollars, to fund joint research, development, and road-mapping activities).

The report also recommended that DARPA, NSF, and the private sector work with ATRA to increase their annual spending on telecommunications research.

⁷⁰ *Communications Daily*, November 29, 2007, at 8.

⁷¹ National Research Council, *Renewing U.S. Telecommunications Research*, http://www.citi.columbia.edu/conferences/telecomRD/lucky_report.pdf.

VI. Several U.S. States and Municipalities Have Adopted Plans to Enhance Broadband Deployment

As the previous sections indicate, the United States is not keeping pace with either the demand for greater Internet capacity or with the broadband market in other countries. This situation demonstrates that our current policies are not sufficient to meet our nation's broadband needs of the future. What lessons can the U.S. learn from the broadband plans of other governments? The following discussion summarizes some of the steps taken by U.S. states and other countries.

Many state governors recognize that the availability of big broadband facilities is an important driver of economic growth and social welfare, and states often cite the need to keep up with each other as a reason for adopting new broadband programs.⁷²

There appear to be several common actions taken by state governors; some states have adopted one of these strategies, while others have adopted a combination:⁷³

- a. Setting a goal for broadband adoption/availability: California, Kentucky, Maine, New York, North Carolina, and Vermont.
- b. Creation of a new body focusing on broadband: California, Illinois, Kentucky, Maine, Maryland, Michigan, New York, North Carolina, Ohio, South Carolina, and Vermont.
- c. Funding broadband access with grants or low-interest loans: California, Georgia, Idaho, Kentucky, Maine, Maryland, Michigan, Minnesota, North Carolina, South Carolina, and Vermont.
- d. Regulatory bargains: telephone companies have been required to deploy greater broadband in return for reduced regulatory requirements: California, Illinois, Maine, and Vermont.
- e. Statewide video franchise legislation: 14 states (see below).
- f. Streamlining uses of rights-of-way (both state and municipal): California, Maine, and Maryland.
- g. Public-private cooperation: California, Kentucky, Maryland, Minnesota, New York, North Carolina, and Virginia.
- h. Mapping of broadband facilities: California and Kentucky.
- i. E-awareness: educating communities of the importance and/or availability of broadband to increase adoption: California, Maine, New York, and North Carolina.

⁷² According to the Leichtman Research Group, New Jersey has the highest home broadband penetration rate among the 50 states at 48.6%; Hawaii was a close second at 48.5%, followed by Connecticut at 47.7%, Massachusetts at 45.9%, and California at 44.8% (see below). These residential penetration rates are well above the national average of 35.1%. Mississippi trails all states with 14.4% broadband penetration, followed by South Dakota at 16.1%, North Dakota with 17.3%, Kentucky at 20.9%, and Louisiana at 21.3%. <http://www.websiteoptimization.com/bw/0608/>.

⁷³ Note: Several of these states have also announced important initiatives to extend wireless coverage or to extend broadband networks to schools, libraries, higher education institutions, or health care institutions. The wireless initiatives could be extremely useful to those residents who do not currently receive adequate wireless coverage, and of course the other programs will be of great benefit to the citizens who use those institutions. The only reasons these initiatives are not included in this summary are the space in this paper and the fact that this report is focused primarily in bringing big broadband connectivity to the home and to businesses generally.

- j. Tax credits for investments in broadband facilities: California and Idaho.
- k. Focus on extending middle-mile fiber connectivity: Maryland, Ohio, and Virginia.

State video franchise laws: Before discussing individual state broadband initiatives, it is worth noting that at least 14 states have enacted statewide video franchising laws in the past few years (California, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Michigan, Missouri, New Jersey, North Carolina, Ohio, South Carolina, and Texas). Typically, the Bell operating in the state has made a commitment to invest a certain amount of money in that state if the franchise bill is enacted.⁷⁴ Although this paper does not review each and every one of these state statutes, most if not all of them also contain some form of build-out provision requiring the telephone companies receiving a statewide franchise to deploy video service facilities in some portion of the state by a certain date. Because these video facilities often carry broadband signals as well, these state laws may quicken the pace of broadband facilities investment by the telephone industry.⁷⁵

A. Selected State Broadband Programs

California: Governor Arnold Schwarzenegger established the California Broadband Initiative on October 26, 2006, to clear the government red tape for building broadband networks, ensure all government agencies are using the best technologies to serve the people, and create a broadband task force that lets experts from government and business work together to identify and eliminate obstacles to making broadband Internet access ubiquitous in the state. The executive order, among other things, streamlined the process of using rights-of-way and established a pricing policy for private companies paying for “rights-of-way” access to state roads, and directed state agencies to enable voice over Internet Protocol (VoIP) technologies for business and government use, and include broadband conduit in their infrastructure planning.⁷⁶

The California Broadband Task Force issued its report on January 17, 2008, containing perhaps the most comprehensive set of recommendations of any state to date.⁷⁷ The report noted that unlike other infrastructure, such as roads, electricity, and water, California’s investment in broadband should not be limited to physical infrastructure, but instead should include policies to increase adoption of broadband technologies. The task force noted that increasing both access to and use of broadband would build economic capital, strengthen public safety resources, improve living standards, expand educational and health care opportunities, and raise the levels of civic engagement and governmental transparency. The task force proposed that 75% of California homes should have access to 50 Mbps service by 2015. While acknowledging the positive impact that deregulation has had on private sector incentives to invest, the report also noted that there were significant gaps in the availability of broadband (unserved

⁷⁴ It should also be noted, however, that the telephone company issuing such a commitment commonly contains the disclaimer that its commitment to invest in the state does not change its overall level of investment that it has provided to investment analysts. Others have questioned whether or not passage of these bills will, in fact, lead to more investment. See, for example, “State Video Franchise Issue a Murky One,” http://telephonyonline.com/mag/telecom_state_video_franchise/.

⁷⁵ The Phoenix Center has written several studies describing the link between statewide franchise reform and broadband deployment. See, for example, “The Impact of Video Service Regulation on the Construction of Broadband Networks to Low-Income Households,” <http://www.phoenix-center.org/>.

⁷⁶ See <http://www.calink.ca.gov/>.

⁷⁷ See <http://www.calink.ca.gov/taskforcereport/>.

areas) and that the government had a role to play in funding broadband in these areas (so as not to compete with the private sector).

The report suggests a variety of funding proposals: a bond program and two different broadband grant programs. It also encourages tax credits and expanded use of rights-of-way and increased resources toward broadband research and development.

In addition to these new initiatives, California has an Emerging Technology Fund, whose mission is to minimize the digital divide by accelerating the deployment and adoption of broadband and other advanced communication services to underserved communities and populations.⁷⁸ The California Emerging Technology Fund is a nonprofit corporation established pursuant to California Public Utilities Commission requirements set by the telecommunications industry mergers of SBC-AT&T and Verizon-MCI. The merged telecommunication companies will contribute a total of \$60 million over 5 years to advance broadband. The CETC plans to leverage the initial seed \$60 million by at least fourfold to achieve impact of about \$250 million through partnerships and co-investments with private sector, government and foundations.

Georgia: Governor Sonny Perdue has committed to ensure the availability of broadband connections in every Georgia community. He has created two programs, Wireless Communities Georgia and Broadband Rural Initiative to Develop Georgia's Economy (BRIDGE), to meet that goal. BRIDGE will provide grants for publicly owned infrastructure based on the number of rural counties receiving new or enhanced high-speed broadband services. BRIDGE will grant \$200,000 for single-county projects and \$400,000 for projects impacting two counties. Regional projects serving three or more counties will not have an award maximum.⁷⁹

Idaho: In the past few years, Idaho has been one of the leaders in reforming its state government policies to encourage broadband deployment. In 2001, Idaho passed a 3% tax credit for broadband investment.⁸⁰ Thereafter, Syringa Networks, a consortium of rural independent telephone companies, built a fiber-optic network to provide middle-mile broadband capability throughout southern and eastern Idaho. Then in 2006, Idaho created a \$5 million broadband development matching fund for the deployment of last-mile broadband service. The state awarded \$4.9 million in matching funds to four broadband providers (Verizon, Qwest, SpeedyQuick, and First Step Internet) to provide the equivalent of DSL capability to about 50,000 residents in 79 projects. Combined with the state-funded grants and the dollar-for-dollar cash match from the companies, the \$9.8 million investment is enabling companies to provide affordable broadband service to rural communities by reducing up-front costs to the point that rural extensions are economically viable.⁸¹

Illinois: Illinois is in the midst of developing its broadband plan. In 2004, two professors authored a study for the Illinois Office of Rural Affairs, *Illinois Online: Recommendations for Universal Broadband Access*.⁸² The report made several recommendations, including creating a statewide "e-champion" that would

⁷⁸ See <http://dev.cetfund.org/Default.aspx>.

⁷⁹ See <http://www.onegeorgia.org/bridge-web/>.

⁸⁰ See <http://labor.idaho.gov/news/PressReleases/tabid/294/ctl/PressRelease/mid/1047/ItemID/1604/Default.aspx>.

⁸¹ See <http://labor.idaho.gov/news/PressReleases/tabid/294/ctl/PressRelease/mid/1047/ItemID/1770/Default.aspx>.

⁸² See <http://www.standingupforillinois.org/pdf/IllinoisOnline.pdf>.

administer a broadband infrastructure grant program and streamline access to rights-of-way. In 2005, Governor Rod Blagojevich issued an executive order creating the Illinois Broadband Deployment Council under the leadership of Lieutenant Governor Pat Quinn.

Kentucky: Kentucky's broadband initiative was announced in 2004 as part of then Governor Ernie Fletcher's Prescription for Innovation. The program was intended to establish a comprehensive broadband deployment and adoption plan that would leverage state, federal and private investment to blanket Kentucky with high-speed Internet access by the end of 2007. A key part of the strategy was the creation of ConnectKentucky, a nonprofit organization funded with a mix of state, federal, and corporate dollars. ConnectKentucky was able to gather detailed information from the broadband providers in the state to conduct an in-depth mapping of broadband facilities in the state. ConnectKentucky also created "e-community" teams in several communities to expand the knowledge and awareness of broadband capabilities. ConnectKentucky claims that its efforts have dramatically improved the deployment and adoption of broadband services in Kentucky. ConnectKentucky has now formed an umbrella organization, Connected Nation, which is proposing similar mapping and broadband awareness campaigns in other states.

In addition, the Kentucky Infrastructure Authority (KIA) authorizing legislation was amended in 2006 to allow it to engage in broadband deployment projects, focusing on "unserved areas." The KIA is authorized to issue revenue bonds financed through the collection of a tax of no more than 2% of the gross amount of each water service or sewer service purchase. The KIA then makes funds available through loans and or grants to governmental agencies within the state to be used for infrastructure development including broadband deployment.⁸³

Maine: Governor John Baldacci announced one of the earliest and most ambitious broadband initiatives in his 2005 State of the State address. He set a goal of ensuring that 95–98% of Maine communities would have broadband access by 2010. The governor created a Broadband Access Infrastructure Board in May 2005 to focus on how to expand the availability of broadband services throughout the state to private homes, businesses, public and private educational institutions, research centers, and other entities. The initiative identified three tiers of broadband consumers—home, business, and enterprise—and three major levels of infrastructure: the connectivity of "big pipes" or "backbone" into the state; interregional connectivity from the backbone to the various towns and cities; and finally, intraregional connectivity that bridges those nodes to the individual home or business premises.

In its draft report issued in November 2005, the Broadband Access Infrastructure Board recommended several actions, including:⁸⁴

1. Providing incentives and funding for broadband infrastructure, noting that the USDA/RUS low-interest loan programs are available but little used in Maine; increasing the awareness of these programs and using state funds to help meet the USDA/RUS 20% match requirements; creating a new low-interest loan program of its own for broadband investment; and using a mix of tax credits and direct state funding, possibly funded through a bond issuance.
2. Allowing broadband providers to access state towers, facilities, and rights-of-way.

⁸³ See <http://kia.ky.gov/broadband/>.

⁸⁴ See http://www.maine.gov/mpuc/broadband/activities/BAIB_DraftReport110905.pdf.

3. Bifurcating the Maine Universal Service Fund (MUSF) into two parts: one section to provide high-cost support for rural incumbent telecommunications companies, and the other to provide funding for cellular tower construction, direct broadband facility construction, and debt service on broadband development bonds.
4. Increasing awareness and demand for broadband services through public service announcements, telecommuting programs, enhanced government services available online (perhaps at a discounted rate), and other methods.
5. Providing state grant funding for broadband technology demonstration projects in unserved or underserved areas; developing an RFP process to enable all providers and technologies to participate; creating a Citizens' Advisory Board that, with assistance from the PUC and the Broadband Development Authority, would develop a list of projects that would be eligible for funding, either in whole or to fill gaps.
6. Creating a Broadband Development Authority that would have rulemaking authority and access to a professional staff. It would be independent of competitive providers of broadband services and would monitor broadband deployment in Maine, as well as maintain and publicize information on broadband availability, demand, and funding mechanisms.

In 2006, Maine created the ConnectME Authority to expand broadband and cellular infrastructure throughout Maine. The statute authorizes the ConnectME to assess every communications service provider an annual fee not to exceed 0.25% of revenue received or collected for all communications services provided in the state by the provider. Maine will use up to \$500,000 annually for at least two years to accelerate private investment in communication services including wireless, broadband, cellular, and satellite infrastructure especially in underserved areas.⁸⁵ The ConnectME Authority awarded its first seven grants to expand broadband and mobile communications services to unserved and underserved areas in Maine on October 31, 2007. A total of more than \$787,000 has been awarded to the recipients, expanding services to an estimated 14,400 residents. Successful projects are to be completed within one year of receiving the grant funding. Created under the Connect ME legislation, the Authority contains five members representing the public and private sphere.⁸⁶

Separately, the Maine PUC recently announced an agreement with Verizon to make high-speed Internet access available to almost 35,000 Mainers who now lack DSL broadband service. The stipulated agreement identifies specific locations where new DSL will become available, increasing to 70% the proportion of Verizon Maine landline customers who will have the option of high-speed access to the Internet. Under the agreement Verizon will complete that build-out, using all-new equipment, within six months.⁸⁷

Maryland: In July 2006, Maryland established the Rural Broadband Coordination Board⁸⁸ and Rural Broadband Assistance Fund. The board is charged with assisting in the deployment of middle mile broadband communication infrastructure in Maryland's rural and underserved areas and cooperating with public, private and nonprofit entities to establish broadband communication services. The Rural

⁸⁵ See <http://www.maine.gov/connectme/documents/CMA2006NOR.pdf> and <http://www.maine.gov/connectme/ConnectMERule101-ProvAdopted120606.htm>.

⁸⁶ See <http://www.maine.gov/connectme/>.

⁸⁷ See http://www.maine.gov/mpuc/staying_informed/news/index.html.

⁸⁸ See <http://www.msa.md.gov/msa/mdmanual/26excom/html/31rural.html> and <http://www.mdbc.us/>.

Broadband Assistance Fund in the Department of Business and Economic Development consists of money appropriated in the state budget, federal money allocated or granted to the fund, and money from other sources accepted for the benefit of the fund. The fund may be used only for planning, construction, and maintenance of broadband communication services in rural areas. The legislation authorizes \$4 million per year in funding for fiscal years 2008 and 2009.

The legislation also requires the Department of Transportation to allow the use of any state right-of-way for the installation of broadband communication infrastructure provided by nonprofit telecommunications services providers in rural and underserved areas of the state without imposition of any charge for the use of the right-of-way.⁸⁹

Michigan: The Michigan Broadband Development Authority (MBDA), an independent state government agency, was created to help Michigan attract more private sector investment in high-speed Internet infrastructure, and to increase demand for and utilization of broadband services. The MBDA was initially capitalized by the state's housing authority through a \$50 million bond sale. The MBDA was authorized to issue investment grade, taxable and tax-exempt bonds, the proceeds of which could be used to provide financing assistance.

In 2005, Governor Jennifer Granholm of Michigan released her Rural Broadband Initiative (RBI), a program to target MBDA funding to expand high-speed Internet access to rural and underserved areas. Under the RBI, qualifying broadband providers in eligible regions could qualify to receive 4% loans (a 50% reduction of the standard 8% MBDA interest rate) with interest-only draw periods of up to 24 months.

Since inception, the MBDA has reviewed more than \$100 million in loan applications and approved approximately \$30 million worth of loans. By its sunset date, the agency will have impacted more than 2.4 million people in 900,000 households, affecting over 400 cities, towns, and villages in 63 of Michigan's 83 counties. The cable and telephone industries, however, objected to the program, maintaining that the MBDA was funding small competitors where broadband service already existed. The MBDA was not renewed in 2007.⁹⁰

Minnesota: Get Broadband is a public-private partnership program administered by the Minnesota-based Blandin Foundation that aims to increase the availability of broadband-based technologies in rural communities.⁹¹ The Blandin Broadband Initiative began in 2003 with a review of the level of broadband utilization and deployment in Minnesota's rural communities. The initiative identified the need to increase broadband use as a top priority. In response, the foundation launched the Get Broadband community grant program, which supports locally-led education and outreach efforts aimed at bringing the benefits of broadband to rural households and businesses. Communities are eligible for funding of up to \$25,000 if the community matches the amount of the grant funding. By January 2006, 20

⁸⁹ See <http://somed.com/news/headlines/2007/6045.shtml>.

⁹⁰ See http://www.techpolicybank.org/AM/Template.cfm?Section=Policy_Models&template=/customSource/ProgramExample.cfm&programID=44.

⁹¹ See <http://www.blandinfoundation.org/bsite/index.htm>.

communities were participating in the program. Get Broadband has received \$250,000 from the state government.⁹²

New York: On December 6, 2007, Governor Eliot Spitzer announced the formation of the New York State Council for Universal Broadband. The council will develop a comprehensive statewide strategy to ensure access to affordable high-speed Internet service for every citizen of New York. The council issued a request for proposal to distribute \$5 million in competitive grants for research, design, and implementation of Internet services for disadvantaged and rural areas of the state.⁹³

The strategic goals of the council include:

- Supporting the “I Live New York” initiative to attract and retain young professionals by ensuring every New Yorker has access to high-speed, affordable broadband;
- Fostering economic development and building stronger public/private partnerships;
- Creating jobs through innovative community-based digital literacy and technology training programs, including household technology adoption and support; and
- Accelerating the use of state e-Government services offered through the Internet for residents, businesses, and visitors.

North Carolina: In August 2000, the North Carolina General Assembly created the Rural Internet Access Authority, which was replaced in 2003 by the e-NC Authority. Recently, North Carolina extended the work of e-NC for five years from January 1, 2007, through December 31, 2011. The e-NC originally focused only on rural areas of the state, but now works on developing Internet connectivity in all economically distressed areas. The e-NC originally sought to ensure that 100% of the state had broadband Internet access within three years.⁹⁴

The e-NC is a state authority but it is housed in a nonprofit organization, the North Carolina Rural Economic Development Center. The e-NC is a hybrid organization that benefits from funding and collaborating with private entities, nonprofits, national, state and local governments, telecommunications companies, small Internet service providers, universities, think tanks, and others.

Since inception, e-NC has issued grants, advocated policies, and conducted research on broadband issues. It awarded \$30 million in connectivity grants primarily to counties and to specific government institutions such as libraries, consortia, and private enterprise. All work with e-NC is a unified effort to improve North Carolina’s connectivity. E-NC has received funding from the North Carolina state government, various foundations, and corporations.

Ohio: Ohio has begun to implement Governor Ted Strickland’s Broadband Ohio strategy. This plan will establishing the Ohio NextGen Network, increasing connectivity among local and state government agencies and extending middle-mile broadband access to rural areas. In July 2007, the governor signed an executive order establishing the Ohio Broadband Council and the Broadband Ohio Network. The order directs the council to coordinate efforts to extend access to the Broadband Ohio Network to every county in Ohio. The order also allows public and private entities to tap into the Broadband Ohio

⁹² See <http://www.house.leg.state.mn.us/hrd/bs/84/hf1197.html>.

⁹³ See <http://www.oft.state.ny.us/oft/UniversalBroadband/overview.htm>.

⁹⁴ See <http://www.e-nc.org>.

Network—all with a goal of expanding access to high-speed Internet service to all 88 counties, including parts of the state that presently do not have such service. In addition, the council is charged with coordinating all state-funded broadband initiatives, pursuing additional federal investments in broadband, promoting public and private broadband initiatives, and addressing the digital divide in Ohio’s rural and urban areas.⁹⁵

South Carolina: The South Carolina Legislature passed a bill in February 2003 deregulating broadband service in the state. The new law now exempts the incumbent telephone company from having to share its high-speed network with competitors. As a result of the legislation, BellSouth has promised to spend \$10 million to expand its broadband network statewide.

Vermont: In his inaugural address in January 2007, Governor Jim Douglas proposed that Vermont become an “e-state” by 2010, and he announced that his goal is to ensure universal access to broadband Internet and cellular phone service. To accomplish this, he announced his intent to create a Vermont Telecommunications Authority, which would have financial backing from the state in the form of moral obligation bonds and be charged with pulling together a public-private partnership.

The Vermont Telecommunications Authority was created by the Vermont Legislature in the spring of 2007 and recently hired an executive director.⁹⁶ Its explicit goals are to ensure Vermonters have:⁹⁷

- Affordable broadband access to every Vermont household by 2010, capable of delivering speeds of at least 1.5 megabytes per second, and increasing speeds in the future
- Cellular service in every community and along main routes by 2010
- Mobile broadband, Wi-Fi or equivalent in every community by 2010

The initial focus will be on delivering broadband services to currently underserved rural areas and to deploy wireless services throughout these areas.⁹⁸ The authority will serve as a bridge between public sector efforts and private sector investments, intended to share in—but not eliminate—the financial risk of these projects, provide a longer-term investment horizon, and support projects that can become self-sustaining over time. The state can provide the authority with its moral obligation of up to \$40 million in bonds to back projects in the first year of construction and possibly more if needed and sustainable.⁹⁹ The initial target is to leverage more than \$200 million in private sector investment with the state’s backing. Repayment of borrowing for the projects will be based on revenues generated from leasing access to the infrastructure, such as fiber-optic networks and space on towers, or the revenues from services provided over the network. The value of the assets controlled or created by the authority will also help to secure the value of any bonds.¹⁰⁰

⁹⁵ See <http://governor.ohio.gov/News/July2007/News72707/tabid/335/Default.aspx>.

⁹⁶ See <http://www.telecomvt.org/>.

⁹⁷ See http://dii.vermont.gov/newsletters/may_2007/vermont_telecommunications_authority.

⁹⁸ See http://governor.vermont.gov/priorities/e-state_Initiative_VTA_Briefing_2007.pdf.

⁹⁹ Moral obligations bonds do not pledge the full faith and credit of the state. Nevertheless, they are a serious obligation.

¹⁰⁰ See <http://web.valley.net/files/vtbroadband/EStateBriefing.pdf>.

Right-of-way reform is also a key component of the Vermont Way Forward strategy. The authority will work to reduce the amount of time and review required for lower-impact wireless facilities in wireless permitting processes at the state and local level.

Vermont has also used its regulatory authority to expand broadband coverage. The Public Service Board in 2006 allowed Verizon to set rates in excess of its costs in exchange for a commitment to expand broadband availability from 56% of its Vermont lines in 2005 to 65% of its Vermont lines by 2007, 75% by 2008, 77% by 2009, and 80% by 2010. The commitment requires Verizon to expand an unregulated service, broadband Internet access, in areas that it did not find sufficient market motivation to serve prior to the commitment.¹⁰¹

In addition, the state's Broadband Grant Program, which provides grants in increments of up to \$50,000, has granted \$550,000 over the past three years. The program favors projects that will bring last-mile connectivity to unserved areas of Vermont. Grants are issued to towns where the private market is unlikely to provide broadband services.

Virginia: In 2005, Virginia became the first state to use tobacco settlement funds to build open-access broadband network. The Southside Regional Broadband Initiative (previously called the Regional Backbone/Roots of Progress) is using \$12 million in state funds to build a 700-mile fiber-optic network connecting five cities, 20 counties and 56 industrial parks in southern Virginia. The purpose of this investment is to ignite commerce and economic growth in the region by allowing communities to more effectively compete for new jobs, attract technology-based industry and retain skilled labor. In addition, in June 2007, the Mid-Atlantic Broadband Cooperative (MBC), in conjunction with the Virginia Tobacco Commission (VTC), awarded five projects to private sector broadband providers to test various approaches for enabling broadband expansion in rural markets. The VTC provided \$1 million in 50% matching capital funds to encourage private sector telecommunications companies to invest in infrastructure to serve the last mile. As a result of this program, over 7,000 households and businesses will have access to advanced high-speed Internet services provided by private sector telecom companies.¹⁰²

B. Selected Municipal Broadband Networks

There are many examples of local governments that are engaged in building their own municipal fiber-optic networks.¹⁰³ The Fiber to the Home Council (FTTH Council) reports that, of the 652 FTTH communities that have built FTTH, 42 were built by local governments.¹⁰⁴

In early 2007, the FTTH Council commissioned a study by Strategic Networks Group (SNG), which conducted an in-depth survey of three fiber-to-the-home communities to determine the impact of each community's fiber network. The three municipal network included in the survey were Bristol, Virginia; Jackson, Tennessee; and Reedsburg, Wisconsin. The findings provided significant evidence to support

¹⁰¹ Vermont Department of Public Service, "Access for All: Meeting Vermont's Broadband and Wireless Goals," February 2007, <http://publicservice.vermont.gov/Broadband/Act172FinalReport.pdf>.

¹⁰² See http://mbc-va.com/news_2007_06_21_vtc.php.

¹⁰³ An excellent explanation of the issues concerning municipal fiber projects written by Jim Baller of the Baller-Herbst Law Group is available at http://www.baller.com/pdfs/BHLG_White_Paper_Tenn_3-4-06.pdf.

¹⁰⁴ See <http://www.ftthcouncil.org>.

investments in FTTH. Businesses reported total increases in sales of \$3.4 million, total decreases in costs of \$4.0 million, and an average increase in employment of 11.9% because of FTTH over a 12-month period. The majority of sales, cost, and employment impacts occur after two to three years of fiber use. The most common perceived benefits are making operations easier, increasing efficiency, and saving time. Organizations are increasingly incorporating high-speed capabilities into their daily operations, such as large document transfer, real-time communications with customers and suppliers, online transactions, and research. The highest benefits of fiber are operational:

- 60% cite cost saving as important
- 50% have adopted new processes
- 46% see marketing benefits¹⁰⁵

Below are just a few examples of these municipal fiber projects:

Bristol, Virginia: The municipal utility, Bristol Virginia Utilities (BVU), first deployed a fiber-optic network in 1999 to commercial and public sector entities (such as schools and libraries) to help fuel the town's economic development and provision of services to its citizens. The town decided to invest in an advanced all fiber-optic network, even though it would have been less expensive to deploy a traditional hybrid fiber coaxial (HFC) network. The enhanced capacity turned out to be well worth the additional expense. BVU began offering the "triple-play" package over the new FTTH network in July 2003, and by the middle of 2004, it had a penetration rate exceeding 40%. BVU is working hard to build out quickly enough to meet growing demand.

Bristol, Tennessee: Impressed by the positive impact that BVU's network has had on its community, its cross-border sister city, Bristol, Tennessee, followed suit with its own FTTH deployment in 2006. At the request of other nearby communities, BVU is extending its network to other counties in southwest Virginia.

Jackson, Tennessee: Jackson has the largest in-service FTTH network in the United States. The Jackson Energy Authority (JEA) heard from business and consumer leaders that private sector telecommunications and cable entities were not acting quickly enough to offer advanced services and that this was causing Jackson to lose business opportunities to other communities. As a result, the JEA, a hybrid municipal and public utility, resolved that it would build its own FTTH network to spur the local economy and ensure consumers would have access to advanced data and video services. It began construction in 2004 and built a network that is open to competitive providers of telecommunications and data services. Customers can receive service from two competitive local exchange carriers up to four VoIP telephone lines and Internet access service at speeds ranging from 512 kbps to 10 Mbps (with the potential for 40 Mbps). From JEA, they can receive 270 all-digital channels of cable television. The JEA now has over 11,500 customers and now passes over 30,000 homes and businesses.

Reedsburg, Wisconsin: Reedsburg is a small town with a population of about 8,000. Several years ago, Reedsburg Utility Commission (a municipal utility for over 100 years) determined that deployment of a FTTH network—the first in Wisconsin—offering voice, high-speed Internet access, and video services would be, in the words of Superintendent Dave Mikonowicz, "an excellent investment in our community's economic development and quality of life." The utility initiated construction of a state-of-the-art FTTH network in 2002, began acquiring its first customers in 2003, and had acquired over 1,000

¹⁰⁵ See <http://www.reedsburgutility.com/News/Results%20Fiber%20Survey%20Summary%20-%20Reedsburg.pdf>.

customers by late 2004 (about a 25% penetration rate). Today, construction is largely complete, and the subscriber base continues to grow—approaching 2,000 customers.

Utah: One of the most unique municipal FTTH deployments in the country is the Utah Telecommunications Open Infrastructure Agency (UTOPIA), a consortium of 14 Utah cities that have banded together to create an all-fiber network that will serve about 170,000 homes and businesses when completed. The fiber-optic cable can provide data rates that 100 Mbps, but the actual speed received by the consumer will be determined by the consumer's choice of service plans made available by ISPs using the network. The network is operated on a wholesale basis, allowing multiple retail providers to sell voice, Internet access, and video services.¹⁰⁶

UTOPIA is a nonprofit government agency funded through municipal bonds issued by participating communities. The agency is intended to be self-sustaining, which they predict will be possible if 30% of eligible homes subscribe to at least one service. When consumers use the network, a portion of each fare is returned to the municipality, which is then used to pay operational costs and retire revenue bonds. In other words, only those who use the service pay for it. If fewer households sign up, the 11 cities are on the hook, and they will have to honor UTOPIA's bond commitments with money from sales taxes that the participating communities' referendums authorize them to collect. According to Roger Black, chief operating officer of UTOPIA, the take rate is ahead of projections.

VII. Other Countries Have Taken a Much More Aggressive Approach to Stimulating Broadband Deployment Than the United States

A. International Telecommunications Union

The International Telecommunications Union (ITU) has been exploring the full set of issues surrounding the deployment of next-generation broadband networks (NGN). The ITU has launched a website and held a variety of workshops and forums around the world. In general, the work focuses on the balancing act faced by regulators: the need to foster robust competitive markets with the need to avoid stifling regulation that could deter investment in NGN facilities. The emphasis of much of the discussion is on the importance of creating mechanisms for collaboration among regulators, policymakers and industry, such as consultative committees, hearings, seminars, forums, and use of technology experts. The goal of such collaboration is to ensure that the regulatory framework does not become so restrictive that it thwarts investment in NGN and, at the same time, it does not act too late to encourage competition.¹⁰⁷

B. European Union

1. Unbundling Policy in the European Union

The EU formally began a process to liberalize its telecommunications sector in the late 1990s. In January 1995, the European Commission (EC) published "Green Paper on the Liberalization of Telecommunications Infrastructure and Cable Television Networks," which advocated a policy of

¹⁰⁶ See <http://www.utopianet.org/what/faq.html>.

¹⁰⁷ See <http://www.itu.int/osg/spu/ngn/index.phtml>.

opening telecom networks to competition.¹⁰⁸ The EU required its member countries to unbundle their telecom networks by December 31, 2000. While the initial policy was focused on voice telephony, the policy was amended to address Internet access by 2003. The European parliament and council defined narrowly what was to be unbundled to the providers' "essential facilities" and authorized the national regulators to enforce the regulation.

The EC threatened to take strict enforcement measures against countries that delayed implementing its unbundling directive. In 2002, the EC opened infringement proceedings against Ireland, Germany, France, the Netherlands, Greece, and Portugal for failing to implement unbundling. The EC regulators focused particularly on opening the "subloop", the junction boxes between individual houses and the telcos' central offices. Access to these subloops was seen as critically important to the competitive provision of video services via broadband.¹⁰⁹

The EU's unbundling policies appear to have been highly successful in promoting broadband subscribership, reducing prices and encouraging competition. According to the OECD, broadband prices in countries without unbundling policies exceed prices in countries with unbundling policies:

In 2006, Mexico, New Zealand, Switzerland, and the United States were the four countries with either limited or no unbundling rules in place. Prices per Mbit/s were significantly higher in the least expensive of these four countries than other *leading* broadband economies with unbundling rules.¹¹⁰

The market for shared lines and unbundled local loops increased in 2003–2004 by 110%.¹¹¹ The European Competitive Telecommunications Association (ECTA) asserts that these unbundling policies have allowed Europe to catch up to and surpass the United States and Japan.¹¹² One recent report alleges that the EC's unbundling policies are allowing the European countries to take the idea invented in America and leap-frog the United States by achieving the equivalent of a broadband universal service goal. According to Professor Amil Shejter at Penn State:

The European Union launched its own innovative industrial scheme, which included enforcing local loop unbundling (LLU), a policy which helped it almost catch-up (on average), and in some locales, even plunge ahead of the United States in broadband penetration levels, after starting out far behind.... Europeans may be on the way to taking a more innovative and effective approach to what was once considered a badge of pride of the U.S. telecommunications policy, universal service, by considering the adoption of a universal broadband goal, thus once more adopting an American concept and perfecting it to serve up-to-date policy goals.¹¹³

¹⁰⁸ See http://europa.eu/documents/comm/green_papers/index_en.htm.

¹⁰⁹ See <http://news.zdnet.co.uk/communications/0,1000000085,2107102,00.htm>.

¹¹⁰ See OECD, *Monitoring of Broadband Development in the Context of the OECD, Recommendation of the Council on Broadband Development*, May 3, 2007, ¶ 29 [hereinafter *OECD Monitoring of Broadband Development*].

¹¹¹ The Tenth Report on European Electronic Communications Regulation and Markets can be accessed at <http://europa.eu/scadplus/leg/en/lvb/l24217e.htm>.

¹¹² See <http://www.websiteoptimization.com/bw/0709/>.

¹¹³ See Amit M. Schejter, "From All My Teachers I Have Grown Wise, and from My Students More Than Anyone Else: What Lessons Can the U.S. Learn from Broadband Policies in Europe?" Prepared for presentation at TPRC, the 35th Research Conference on Communication, Information, and Internet Policy, George Mason University School of Law, Arlington, Virginia, September 28–30, 2007, <http://web.si.umich.edu/tprc/papers/2007/673/schejter%20Universal%20service%20TPRC.pdf>. It should be noted that some academics dispute the notion that unbundling leads to greater broadband penetration and investment. A good review of the anti-unbundling research, as well as a substantive critique of unbundling, is provided by Crandall and Sidak. The paper works theorizes that the growth of broadband penetration and investment in other countries is

As Shejter suggests, the European Commission is now considering taking the next step—addressing the growing divide in broadband penetration among EU member states. In its latest report on broadband growth in the EU, the EC highlighted the large difference between the country with the highest broadband penetration, Denmark (37.2%), and the member state with the lowest broadband use, Bulgaria (5.7%). According to the EC, the main reason for the broadband divide is the lack of significant alternative infrastructures in some member states or the need for a more consistent and speedy application of existing regulatory remedies.

2. Universal Service and Broadband in the European Union

Compared with the United States, the European Union was relatively slow to address the concept of universal service, but it is now on the verge of surpassing the U.S. universal service was not a central element of E.U. policy historically—European policies were designed to guarantee continuity of service and not universality of supply, while protecting the telephone company against legal action for damages incurred for failing to provide service.

In 2002, however, the EC issued a new directive on universal service that expands the concept to include the ability to receive and make local, national and international telephone calls, facsimile communications, and data communications sufficient to permit “functional Internet access.”¹¹⁴ It is now considering even further enhancement of the concept to include both broadband access and access to content (net neutrality).

In its 2006 Review of the Regulatory Framework, the EC noted that a “broadband gap” is emerging in Europe along geographical lines.¹¹⁵ The working document, following the review and previewing the imminent green paper, stops short of establishing broadband as a universal service. It does, however, create the conditions for a debate about a new definition for universal service that distinguishes universal access from universal content (perhaps addressing both the concepts of universal service and net neutrality). The EU is expected to publish a new green paper on universal service, which will include a roadmap for a new definition in 2008. This effort is also part of a broader initiative, termed “i2010,” a grand multiyear master plan that aims to serve Europe’s goal of international leadership on broadband.

In *Bridging the Broadband Gap*, the EC issued an official communication endorsing a six-point action plan to address the growing digital divide among European countries on March 20, 2006. The action plan called for the following steps:

caused by a variety of other factors, including the lack of cable infrastructure, the availability of computers, income and population density, rather than unbundling. They conclude as follows:

The economic literature suggests that there is no statistically significant relationship between unbundling policies and broadband penetration after controlling for other factors that explain the variation in broadband penetration across countries. The literature also appears to undermine the stepping-stone (or ladder-of-investment) hypothesis, which posits that mandatory unbundling encourages entrants to invest in their own infrastructure after establishing a customer base through non-facilities-based entry.

See Robert W. Crandall and J. Gregory Sidak, “Is Mandatory Unbundling the Key to Increasing Broadband Penetration in Mexico? A Survey of International Evidence,” http://papers.ssrn.com/sol3/papers.cfm?abstract_id=996065.

¹¹⁴ Article 4(2).

¹¹⁵ COM(2006) 129 final, Brussels, 20.3.2006.

- i. Regulatory reform to enhance open access and facilitate competitive entry in rural areas.
- ii. Develop expanded loans and grant programs, as part of public-private partnerships, consistent with competition rules and technological neutrality.
- iii. The Commission will provide further guidance on state-aid rules for broadband projects.
- iv. Bring together the industry and rural constituencies to examine how to use the Structural Fund and Rural Development Funds to invest in knowledge when the market fails to support it at affordable cost and at an adequate service level.
- v. Exchange best practices to stimulate demand aggregation at the local and community level.
- vi. Promote online public services and e-government services.

The document concludes as follows:

This Communication invites all levels of government in the European Union to be more active in using the available instruments and technologies. Member States are invited to update their existing National Broadband Strategies to provide additional guidance to all stakeholders. Their documents may well define targets in terms of coverage as well as take-up, on the basis of an active partnership with regional authorities, and exploiting synergies between alternative sources of funding (national, Structural Funds, Rural Development Fund). National broadband strategies should also set clear targets for the connectivity of schools, public administrations and health centres.¹¹⁶

C. Examples of Broadband Programs in Selected Countries

Several countries have taken proactive approaches to broadband deployment. The following discussion summarizes the developments in a few of these countries that may be most informative to U.S. policymakers.

1. Canada

In October of 2000, the federal government of Canada set a nationwide goal of ensuring that broadband networks and services should be available to homes and businesses in every Canadian community by 2005. The government recognized that many rural communities, especially Inuit and First Nations communities, would not be served by market forces alone. Canada took the view that all of its citizens should be able to access sophisticated, value-added services nationwide. As a result of this early attention to broadband, Canada developed an early lead on the United States and the rest of the world in broadband connectivity and has maintained much of the advantage in the following years.

Canada has used three programs to fund its broadband investment:

- Broadband for Rural and Northern Development Pilot Program (BRAND)
- Canada Strategic Infrastructure Fund (CSIF)
- National Satellite Initiative (NSI)

The Province of Alberta also has developed its own broadband program:

- Alberta SuperNet

¹¹⁶ Available at <http://www.ftthcouncil.org/documents/406841.pdf>.

Broadband for Rural and Northern Development Pilot Program (BRAND)

In January 2001, the Minister of Industry established a National Broadband Task Force (NBTF) with the mandate to advise the government on how best to achieve the objective of universal broadband access. In its June 2001 report, *The New National Dream: Networking the Nation for Broadband Access*,¹¹⁷ the task force recognized that of its 5,426 communities, 4,206 communities (approximately 77%) had no access broadband, and most of these were located in northern, rural, and remote Canada. It thus proposed a policy framework and an action plan for extending broadband networks and services to First Nation, Inuit, rural and northern communities that were unlikely to be served by market forces without some form of government assistance. The task force recommended that an action plan should be implemented under the leadership of the private sector, through community-based initiatives involving businesses, residents, public institutions and other stakeholders. It recommended that the total cost of this plan should be shared between the public and private sectors.

In response to the task force's recommendations, the federal government created the Broadband for Rural and Northern Development Pilot Program, which was launched in September 2002. This pilot program aimed to extend broadband to unserved communities by 2005. The results of this pilot program provided a basis for considering what additional measures might be required. The program received three-year funding of \$105 million with a matching capital cost structure (the funding was later extended to 2007). The program provided funding to communities first to prepare business plans that detail the need for broadband services, and second to help them build the broadband infrastructure. In both cases, the program provided up to 50% of the eligible costs.

Under the first phase, \$4.2 million in funding was awarded to 2,285 communities to assist with the development of their business plans. In the second phase, \$80.3 million was invested to build broadband facilities in 63 projects covering 900 communities in most of the Canadian provinces. (Because of comparable provincial and Canada Strategic Infrastructure Fund (CSIF) programs, there were no Broadband Pilot Program projects in New Brunswick and only one Broadband Pilot Program project in Alberta.) The number of communities receiving funding was over twice the original expectation of 400 communities. Many projects ended up including communities outside the "project area," largely because outlying communities wanted to become part of the project once they learned that their neighbor was applying. Also, some vendors found that they had to run their facilities through a nonapplying community in order to reach the applying community. As a result, the program reduced the number of communities yet to be served by broadband by half, from approximately 4,000 to roughly 2,000.¹¹⁸

Some examples:

- *Northern Saskatchewan:* In 2004, federal-provincial funding of \$2 million was awarded to support a two-year, \$8.9 million project to install high-speed Internet in 35 northern Saskatchewan communities. The \$2 million consisted of \$1.6 million from Western Economic Diversification Canada (WD) and \$400,000 from the province of Saskatchewan.
- *Newfoundland and Labrador:* Funding of about \$500,000 was announced in March 2006 for the Kittiwake Economic Development Corporation representing an estimated 18 communities. The

¹¹⁷ See <http://broadband.ic.gc.ca/pub/program/NBTF/broadband.pdf>.

¹¹⁸ Industry Canada, Audit and Evaluation Branch, "Formative Evaluation of the Broadband for Rural and Northern Development Pilot," July 2006, available at <http://www.ic.gc.ca/epic/site/ic1.nsf/en/home>.

funds were available because of cost savings realized from some of the 58 previous Broadband Pilot Program project recipients. For instance, in some cases recipients were able to secure additional funding partners, thereby reducing the amount of funding required from the pilot program.

In a survey after implementation of the project, the communities that received funding noted that the pilot program helped them identify their broadband needs and engage in greater collaboration within and among communities, with the result that demand for broadband exceeded the amount expected by many vendors and ISPs. On the other hand, half of the survey respondents found the program to be ineffective and inefficient—largely because of the difficulty of finding matching funds, the lack of sufficient cash flow to undertake project-related activities while the environmental assessment was being conducted, lack of technical expertise, and the additional administrative and reporting burdens of the program.

Canada Strategic Infrastructure Fund

In his September 30, 2002, Speech from the Throne, Prime Minister Jean Chrétien committed to a 10-year involvement in public infrastructure, including funding for broadband initiatives. Canada has followed through on that commitment, most recently when the Government of Canada's 2006 federal budget committed \$16.5 billion over the next four years for provincial, territorial, and municipal infrastructure, including an additional \$2 billion for the Canada Strategic Infrastructure Fund, which has funded a variety of broadband projects in provinces and territories in Canada. Some examples:

- *Newfoundland and Labrador:* On September 15, 2005, the Government of Canada and the Government of Newfoundland and Labrador announced that they would each contribute up to \$5 million towards a broadband initiative, along with Persona Communications, which will contribute \$19.9 million through their agreement with the province. This funding will provide broadband access to 68 schools and 103 communities, located in the rural and remote regions of Newfoundland and Labrador.
- *New Brunswick:* In July, 2006, the Canadian government announced that the New Brunswick Broadband Initiative had been completed six months ahead of schedule. The project involved a collaboration between the Government of Canada, the Government of New Brunswick, and Aliant Inc., a private sector broadband provider. The program was initially launched in November 2003. The project extended availability of broadband services in rural New Brunswick to 90% of residences, 95% of business lines, and 100 % of health care centers and business parks. This initiative also brought the 15 First Nations communities 100% broadband coverage. The Government of Canada provided up to \$16.5 million for this infrastructure project, with the Government of New Brunswick investing \$12.5 million and Aliant \$15.6 million. All interconnections between Aliant and third parties used open standard protocols, and the network complies with the Government of Canada's open access policy, which promotes a competitive market for broadband. Broadband services with a minimum standard level of 1.5 Mbps download speed and 640 Kbps upload speed is provided over the new infrastructure.¹¹⁹
- *Nova Scotia:* In October, 2007, the Province of Nova Scotia announced that its Broadband for Rural Nova Scotia project to bring high-speed broadband services to rural Nova Scotians would receive funding from the federal government of Canada. The project, which was initially

¹¹⁹ See http://www.infrastructure.gc.ca/ip-pi/csis-fcis/news-nouvelles/2006/20060629fredericton_e.shtml.

announced in January, will receive 50% of eligible public sector costs from the federal government. The announcement follows the province's successful pilot project in Cumberland County earlier in 2007.

National Satellite Initiative

In October, 2003, the Canada announced the launch of the \$155 million National Satellite Initiative, a joint project between Infrastructure Canada, Industry Canada, and the Canadian Space Agency (CSA). The satellite project was launched to provide high-speed broadband Internet access services via satellite to communities located in the Far and Mid North, and in isolated or remote areas of Canada. The project targeted approximately 400 communities, most of them Aboriginal.¹²⁰ Some examples:

- *Northwest Territories:* In November 2005, Canada signed agreements to provide satellite broadband services to 31 Northwest Territory communities. The satellite network will connect communities to each other and to the Internet backbone. The proposal calls for each building within a community to connect to a satellite dish using the broadband wireless system. The Government of Canada is contributing just over \$12 million in support of the network, including \$7 million from the Canada Strategic Infrastructure Fund. Two private sector companies—Fallon Communications GP Ltd. and SSI Micro Ltd.—will contribute an additional \$7.4 million.
- *Québec:* On August, 24, 2007, Canada's New Government announced an additional contribution of up to \$20.65 million, or 75% of the \$27.5 million cost, for two satellite transponders, the earth station, and local access network upgrades. The remaining 25% (\$6.88 million) will come from the Northern Ontario Heritage Fund (\$1.8 million), the Government of Québec's Villages branchés program (\$2.2 million) and Telesat Canada (\$2.88 million).

Alberta SuperNet

A discussion of Canadian broadband initiatives would be incomplete without including the SuperNet fiber project in the province of Alberta.¹²¹ Alberta SuperNet is one of the largest private IP networks in the world, connecting over 429 communities in both urban and rural Alberta with over 10,000 kilometers of trenched fiber optics and 3,000 kilometers of high-speed wireless. It connects 1,300 health care facilities, 2,300 schools, 311 libraries, and 200+ small urban municipalities.

The Government of Alberta invested \$193 million in the construction of the local extended area links with Axia. In addition, Bell Canada spent over \$102 million to build the backbone network and "meet me" facilities in 27 larger markets. Alberta SuperNet was designed to use existing infrastructure, wherever feasible, but also included additional construction. Fiber-optic cable amounts to approximately 84% of the network. Fixed wireless point-to-point links covers the remaining 16%.

The SuperNet is an open network, available to all independent ISPs at standardized rates. These service providers can then offer high-speed network services to businesses and residences in and around the extended area communities. Alberta SuperNet is designed to be self-sustaining. Revenue generated by SuperNet customers—including government offices, schools, health facilities, libraries, and municipal

¹²⁰ "Government of Canada Launches National Satellite Initiative to Provide Broadband Access to Northern and Remote Communities." press release issued by Industry Canada, October 5, 2003.

¹²¹ See <http://www.albertasupernet.ca/>.

government offices, as well as ISPs and application service providers (ASPs)—will be applied to the operation and maintenance of the network.

Prior to the SuperNet, there were only seven service providers operating outside Alberta's two largest metropolitan centers. There are now 81 service providers who have contracts with Axia to connect to the SuperNet. There are approximately 500 service connections and 223 communities that have retail access to high-speed connectivity. Currently, 80% of Alberta residents have access to high-speed Internet options. Once service providers have a presence in all SuperNet communities, 95% of Alberta residents will have access to high-speed Internet options. The project was completed in 2005, approximately one year later than originally planned.

2. The United Kingdom

Broadband deployment and subscribership in the U.K. has surged in the past four years, largely due to both regulatory and funding initiatives undertaken by the British government. British Telecom committed to making DSL service available to 99.4% of households by the end of 2005, but in fact exceeded that goal and achieved coverage of 99.7% of households, a level higher than France, Germany, the United States, or Japan.¹²² Over half the U.K. already subscribes to broadband, and over 60% of homes can choose from at least four service companies. The average speed of these connections has tripled over the past year and a half and is now 4.6 Mbps.¹²³ According to Competitiveness Minister Stephen Timms, "When I became e-commerce minister five years ago, the U.K. was neck and neck with Croatia on broadband availability and use...we fixed that problem and put Britain in a leading position."¹²⁴

The U.K.'s resurgent broadband capability can be traced to three government efforts:

- Broadband planning and public/private sector cooperation;
- The UK Broadband Fund and other financing mechanisms to stimulate broadband deployment; and
- Unbundling and the functional separation of BT.

Broadband Planning and Public/Private sector Cooperation

In February 2001, the British government published a white paper, "Opportunity for All in a World of Change," which set a new target for the U.K. to have the most extensive and competitive broadband market in the G7 by 2005.¹²⁵ In addition, the British government created the Broadband Stakeholders Group, a public-private advisory committee. The BSG, founded in 2001, consists of private sector firms, as well as government departments and others. The BSG has written several reports analyzing the broadband industry and providing thoughtful advice to the government on the future direction of the

¹²² See <http://www.vnunet.com/computing/analysis/2200365/uk-match-world-broadband-elite>.

¹²³ See <http://business.guardian.co.uk/story/0,,2177574,00.html>.

¹²⁴ Address of British E-Commerce Minister Stephen Timms to the Broadband Stakeholders Group concerning next-generation access, September 18, 2007.

¹²⁵ See <http://whitepapers.techrepublic.com.com/whitepaper.aspx?docid=138748>. The U.K. also published "UK Online: The Broadband Future," to accompany the white paper.

broadband industry. In April 2007, the BSG published a report that calls for a mix of investment incentives and competition policies to enable a market-led transition to next generation broadband.¹²⁶

The UK Broadband Fund

The 2001 white paper called for the creation of the UK Broadband Fund (the Fund). The Department of Trade and Industry (DTI) created the Fund in late 2001 and administered it through March 2004, a total of 30 months. Its purpose was to help develop innovative broadband-related schemes to meet local requirements and to ensure that as many people and businesses as possible across the U.K. were provided with access to affordable broadband services, especially in rural areas.¹²⁷

Money from the Fund was disseminated to the 12 Regional Development Agencies/Devolved Administrations (RDA/DA) of the U.K.; each has used the Fund in different ways and focused on different strategies according to local priorities. The Fund was responsible for the origination of over 130 projects. During the Fund's lifetime, the coverage of the nation by a terrestrial broadband solution increased from 63% in November 2001 to 90% in June 2004.

The Fund appears to have been successful in prodding British Telecom (BT) to increase its investment in ADSL deployment. In April 2004, BT announced a planned upgrade program to roll out broadband to a further 1,200 exchanges, serving 99.6% of all U.K. households by summer 2005. The Hyder review concluded as follows:

We have no doubt that [the Fund] had an important part to play in the decisions taken by BT in relation to the ADSL enablement of exchanges. Thus even if the BT activity had an adverse effect on some Funded projects, for example the cancellation of two of Yorkshire Forward's projects, it could be said that the result of increased broadband availability was achieved. Whether this is accepted or not it is a fact that, where it was recorded by RDA/DAs, 1,606,021 residents and 76,901 SMEs [small and medium enterprises] who did not have the choice of wireless, cable or ADSL services before the Fund, have so now.

A note about the proposed government purchase of broadband services: While it appears the Fund may have succeeded in stimulating greater broadband coverage, another initiative was not so fortunate. In November 2002, the prime minister announced that the U.K. would spend £1 billion to purchase broadband connectivity for use by the government agencies from the private sector. Money would be provided to the regional aggregation bodies to spend on telecommunications and broadband services. The idea was that the private sector, in order to meet the demand from the government, would be obliged to build broadband facilities that could also be used to serve the needs of schools, hospitals, and health care centers. The policy was introduced as a keystone in the government's strategy to bridge the U.K.'s digital divide.

¹²⁶ See <http://www.broadbanduk.org/content/view/236/7/>.

¹²⁷ The majority of this description of the Fund was reported in "Review of the U.K. Broadband Fund," written by the Hyder Consulting Ltd. for Department of Trade & Industry, January 7, 2005, available at <http://www.berr.gov.uk/files/file13440.pdf>.

Some observers, however, raised questions about whether the program would promote monopolization of these rural markets. They claimed that, in the long run, rural consumers would be best suited by competitive forces that would ultimately stimulate greater broadband investment.¹²⁸

When the project was initially launched in 2003, Stephen Timms, then e-commerce minister, said the regional aggregation bodies would help slash £200 million off the government's broadband bill over three years. But after one year of operation, savings had reached just £3.5 million. As a result the government cut central funding, closed the central body set up to oversee the program, and devolved aggregation policy to the localized Regional Development Agencies.

Local Loop Unbundling

For several years, competitive operators complained that the U.K.'s dominant fixed-line telco—BT—had stifled competition, failed to develop new services fast enough, and given preferential treatment to its own businesses. Oftel (now Ofcom) launched an investigation into these alleged anticompetitive actions in which it considered breaking the company in two—creating a wholesale entity and a separate retail firm. Rather than mandate this approach, Oftel struck a deal with BT comprising 230 “legally binding undertakings,” including provisions that require BT to promise never again to “restrict competition” or “discriminate” against its competitors.

A key part of the deal was the creation of an access services division within BT, now called Openreach. This separate division, which provides access to the local loop and is overseen by an independent body, allows “all communications providers to gain real equality of access to critical BT infrastructure on fair and equal terms.”¹²⁹

However, this “functional separation” of BT was not enough to encourage competitive entry. When local loop unbundling (LLU) was first implemented, it was prohibitively expensive, mainly because Ofcom allowed BT to set the pricing models. U.K. prices were significantly higher than those in other European nations. As a result, at the beginning of 2004, only 11,000 loops were in service by competitors out of the 25 million served by BT.

In 2004 and 2005, Ofcom reduced the cost of access to the unbundled loop by about 70%, thereby bringing U.K. LLU pricing in line with that of continental Europe. The price cuts stimulated unprecedented demand. In Q2 2006, U.K. broadband lines surpassed that of France, making the U.K. the number one broadband market in Europe. As of the end of September 2007, the U.K. had 3.195 million unbundled local loops.

Focusing on Fiber

Having achieved some degree of success in enhancing the availability of DSL service, the U.K. is now beginning to focus on fiber. BT Chairman Sir Christopher Bland told the *Financial Times* the firm is looking at the possibility of beefing up its fiber-optic cable by extending it as far as the street curb. He claimed that such a rollout could push download speeds to 40-50 Mbps compared to the current top

¹²⁸ See <http://www.broadband4britain.co.uk/>. The founder of this organization, Barrie Desmond, is quoted in the website as saying, “Broadband Britain—more like broadbanned in Britain!”

¹²⁹ See http://www.theregister.co.uk/2006/01/11/bt_openreach/.

speed of 8 Mbps offered by most U.K. firms.¹³⁰ BT Retail Chief Ian Livingstone added that he sees an urgent need for faster infrastructure, saying “BT remains very interested in further expanding the speed of access for customers, whether that be through faster copper, fiber to the home, [or] fiber to the cabinet [neighborhood node].”

The U.K. has some catching up to do. The latest OECD records the number of fiber to the home connections in the U.K. at zero, compared to 46,000 in the Slovak Republic, 900,000 in the United States, and almost 8 million in Japan. BT is upgrading its core network and is beginning to deploy fiber to new housing developments (greenfield sites), with plans to reach eventually perhaps three million homes. And, unlike in some other countries, BT will provide fiber access from the outset on a wholesale basis to other service providers.

U.K. authorities are considering two scenarios to install fiber. According to one estimate, laying fiber between BT’s central offices and the neighborhood “cabinets” would cost an estimated £7–10 billion. Putting fiber-optic cables all the way to the U.K.’s homes would cost a further estimated £15 billion.¹³¹

To jump-start the nation’s fiber push, Competitiveness Minister Stephen Timms recently called for a roadmap to push forward the U.K.’s move to superfast broadband. He also announced a high-level summit on the need for public sector intervention in broadband deployment. Telecom executives met with the government and the regulator, Ofcom, in late November 2007 to develop a plan to deploy next-generation networks. Ofcom is attempting to find the balance between the need for investment and competition. Ofcom appears to be dedicated to preserving competitive market forces, however. “We could trade competition for faster investment,” said Ofcom’s director of policy development Dougal Scott. “But the evidence is that in the longer term competition delivers wider coverage, lower prices and higher take-up than that kind of monopoly provision.”¹³²

3. France

In 2001, France had one of the weakest markets for broadband Internet access in the developed world, with less than a quarter of the penetration of the United States. Today, it has sailed past the United States to become one of the world’s most connected nations. The policy most often cited for France’s broadband turnaround is its strong local loop unbundling policy, enforced by the French regulatory body ARCEP (formerly ART).

Local Loop Unbundling

France has set some of the lowest rates for unbundled local loops in the world and as a result has one of the most competitive markets for broadband services. France now leads Europe in the use of VoIP calls. Much of this growth is due to Free, an Internet-based provider that originally offered its service at no charge. Free, a subsidiary of Iliad, launched DSL broadband service in October 2002 and acquired a half-million users in its first three years. The competition from Free spurred France Telecom (FT) to substantially increase its investment in broadband. Free originally purchased entire service from France Telecom on a wholesale basis, but then learned to place its own equipment in France Telecom’s central offices and leased unbundled loops from the incumbent. By adding its own electronics to FT’s loops,

¹³⁰ See http://www.theregister.co.uk/2007/07/19/bt_faster_broadband/.

¹³¹ See <http://business.guardian.co.uk/story/0,,2177574,00.html>.

¹³² See <http://www.vnunet.com/computing/analysis/2200365/uk-match-world-broadband-elite>.

Free has been able to provide a 24 Mbps service using ADSL+2 technology. Its service includes free domestic phone calls, free digital television, and radio stations. Free generates revenues from extra TV channels and paid calls to mobile phones or international calls.

Fiber Investment

France Telecom has argued that the use of unbundled loops would deter investment in separate facilities. Ironically, it appears that FT's DSL rivals are now strong enough that they have begun weaning themselves off France Telecom's network by building their own. Iliad and Neuf Cegetal, another broadband entrant, announced past year that they would each start rolling out their own fiber links to subscriber homes in France.¹³³

France Telecom (FT) also is developing its own fiber deployment plans. It tested FTTH in the summer of 2006 in six districts in Paris and six cities in the Haute-de-Seine region. The experiment delivered optical fiber service into thousands of trial households, delivering high-definition TV, unlimited telephony, and very high-speed Internet services.

It is interesting to note that FT favors fiber to the home over fiber to the curb (or the cabinet), in part because the cabinets in France tend to be farther away from the home, and the long copper loops from the cabinet to the home do not permit the kind of high-speed service that consumers are demanding.

Government Funding

Other activity worthy of note in France is the greater role played by local authorities in the development of broadband infrastructure. Government has encouraged these bodies to build out their own local access loops by offering reduced-rate loans. In 2006, the mayor of Paris announced his goal of deploying fiber throughout "all of Paris."¹³⁴

4. Japan

Japan's Prime Minister Yoshiro Mori gave a keynote speech in 2000 in which he announced Japan's e-Japan Initiative to promote Internet and broadband development. It included the ambitious goals of addressing infrastructure, human resources, e-commerce, e-government, and network security. Perhaps in response to neighboring South Korea's National Infrastructure Initiative (NII), Japan focused on expediting the development of the world's most advanced telecommunications networks, using private and/or public sector resources. The e-Japan Initiative in 2001 became focused on the goal of deploying high-speed broadband services of 30–100 Mbps to the home over a five-year period.¹³⁵

Unbundling

Japan adopted one of the earliest unbundling regimes. According to Ovum Research in July 2002, Japan "was the only country where full and fair local loop unbundling has successfully driven DSL, broadband

¹³³ Jennifer L. Schenker, "Vive la High-Speed Internet!" *BusinessWeek*, July 2007, http://www.businessweek.com/print/globalbiz/content/jul2007/gb20070718_387052.htm.

¹³⁴ Paris Plans FTTH Network," *Light Reading*, January 9, 2006, http://www.lightreading.com/document.asp?doc_id=86547.

¹³⁵ See http://www.kantei.go.jp/foreign/it/network/0122full_e.html.

takeup.”¹³⁶ At the beginning of the decade, Japan trailed South Korea badly, due in part to the resistance of Nippon Telephone and Telegraph (NTT) to cannibalize its own business and to open access. The response of the Ministry of Public Management, Home Affairs, Posts, and Telecommunications (MPHPT) was to mandate unbundling based on long-run incremental costs (LRIC) in 2000 following the split of NTT into NTT East and NTT West, and to announce the National Broadband Initiative in 2001. By the first quarter of 2003, Japan had just pulled ahead of the United States and South Korea in the number of DSL lines (over 7 million) and was one of the fastest-growing markets.

Initially, Japan had the world’s lowest network charges for shared lines. The low rates led to a rapid growth in subscribers—DSL subscribers jumped from 760,000 in May 2000 to 7.9 million in May 2003. In recent years, however, Japan’s growth in DSL has leveled off as the focus has shifted to deployment of fiber.

Fiber

Japan’s National Broadband Initiative aimed to have 10 million households connected to fiber by 2005.¹³⁷ Although it fell slightly short of this goal, Japan led the OECD in fiber connections directly to the home with 7.9 million fiber-to-the-home subscribers in December 2006. Fiber subscribers alone in Japan now outnumber *total* broadband subscribers in 23 of the 30 OECD countries.¹³⁸ In November 2005, NTT expanded its FTTH network via a new wiring system with an aim to reach a target FTTH subscriber base of 30 million by 2010.

The following table shows the stabilization of DSL service as the nation has shifted its focus to fiber:

GROWING BROADBAND MARKET IN JAPAN¹³⁹					
(subscribers in millions)					
	2002	2003	2004	2005	3q 2006
DSL	2	7	11	13	14.4
FTTH	0	0.5	1.5	3.75	7.2
CABLE	1.2	2.2	3	3.2	3.5

While Japan has provided tax incentives and low-interest loans to promote broadband rollout, these appear to be less significant (because of low tax and interest rates) than direct government subsidies. For instance, in rural areas, the Japanese government has promoted partnerships between the municipalities and private sector firms. One-third of the cost of deploying fiber to the curb/home is subsidized, and the municipal network is made available on a wholesale basis.¹⁴⁰

¹³⁶ “Competition in the Local Loop: Unbundling or Unbungling?” (Ovum Report), Ovum Research, July 2003, http://www.trp.hku.hk/tif/papers/2003/jul/briefing_030708.pdf.

¹³⁷ Ibid.

¹³⁸ See http://www.oecd.org/document/7/0,3343,en_2649_34223_38446855_1_1_1_1,00.html.

¹³⁹ Ebihara slide presentation to ITIF, http://www.itif.org/files/Ebihara_Japanese_Broadband.pdf.

¹⁴⁰ Ibid.

According to one account, Japan's focus on fiber is typical of the nation's focus on the long-term future rather than short-term profits:

The heavy spending on fiber networks, analysts say, is typical in Japan, where big companies disregard short-term profit and plow billions into projects in the belief that something good will necessarily follow.... But even without Japan's tax incentives, NTT and some other Japanese companies say that selling fiber lines makes sense because their older copper networks need to be replaced anyway, and because they have to develop services to offset the decline in revenue from traditional phone lines.

And while acknowledging that initial investments are expensive, NTT and KDDI, the second-largest phone company, expect to recoup some of their money by selling additional products, like Internet phone and television services, that are delivered over fiber lines. They also expect electronics companies to produce an array of products that rely on fiber networks, including high-definition videoconferencing equipment and medical devices that can instantly relay X-rays between hospitals.¹⁴¹

U-Japan

In 2006, Japan declared that it had met the broadband goals of e-Japan and announced that it is now turning to the next phase of its strategy, called u-Japan. The "u" in u-Japan represents not only *ubiquitous*, but also *universal, user-oriented, and unique*.¹⁴²

The development of infrastructure in the past mainly centered on wired connections, ranging from narrowband to broadband such as DSL, cable networks, and fiber optics. However, under the u-Japan policy, a seamless ubiquitous network environment will be created in which people can receive services without being conscious of the networks (wired or wireless). The goal is to integrate network availability into all aspects of everyday life at the grassroots level.

5. Other Nations

Ireland: Ireland remains at 14th for European broadband penetration at 15.5%. Ireland has had the third highest proportional growth rate in the EU with 6.7 new broadband lines being installed per 100 people from January to July 2007. Only Luxembourg at 7.1 and Denmark at 7.7 installed more fixed broadband lines per person in the same period.

With significant government investment and initiatives, Ireland hoped to achieve 100% broadband coverage by 2007. As of August 2005, the government had invested over 7.4 million Euros in 265 communities covering over 165,000 of the population in its Group Broadband Scheme. Also, the government has approved 81 projects.¹⁴³

¹⁴¹ Ken Belson, "Unlike U.S., Japanese Push Fiber over Profit," *New York Times*, October 3, 2007, <http://www.nytimes.com/2007/10/03/business/worldbusiness/03broadband.html?pagewanted=1&ei=5070&en=3ef8f71cec43b376&ex=1192075200>.

¹⁴² See http://www.soumu.go.jp/menu_02/ict/u-japan_en/new_outline01.html.

¹⁴³ Ovum Report.

Sweden: Sweden was one of the first countries in Europe to establish a broadband strategy and to consider developing broadband infrastructure with public funding.¹⁴⁴ Sweden has focused on promoting municipal broadband fiber facilities that are available at wholesale prices to new entrants. A major driver for broadband uptake in Sweden is the public sector—schools, universities, and other public services. By the end of 2004, only 10 municipalities out of 283 did not have infrastructure in place to support broadband services, and some have developed open access fiber networks. For example, in Västerås, an open access fiber network has been developed, and any operator can use it. In addition, the high number of apartments has made it relatively easy to install fiber, pushing forward the rollout of higher speed services. Landlords have made high-speed broadband services a key differentiator in the residential property rental market.

After Sweden liberalized its telecommunications industry in 1993, the city of Stockholm created a municipally owned company called Stokab in 1994 to provide dark-fiber infrastructure capacity to end users and operators. Stockholm hoped that creating Stokab would lead to the rapid introduction of advanced telecommunications services to its businesses and citizens—and it appears to have succeeded. Stokab has laid some 500,000 km of fiber throughout Stockholm, benefiting from the city's water, sewer, and electricity ducts and tunnels and a relationship with city officials. Stokab leases its dark fiber to banks, insurance companies, retailers, media companies, universities, urban networks, property owners, computer and IT companies, telecom operators, Internet operators, cable TV companies, mobile telephony operators, and network capacity operators.

Stokab claims that Stockholm has a higher degree of fiber penetration than any other city in the world. Not surprisingly, Sweden is constructing other municipal networks based on the Stokab model, and these networks are creating more competition in local markets and lowering prices. Customers in Sweden receive access to a future-proofed fiber-optic broadband platform, greater service choice, and competitive prices—in attractive combination, all of which can be traced to Sweden's pioneering broadband policies.

Italy: The Italian government had already set aside €300 million so that all of Southern Italy would have broadband access. Unlike the U.K., there is no cable in Italy, but the unbundled lines used by Fastweb demonstrates a much greater deployment of LLU than in the U.K. Italy also demonstrates the most successful use of fixed-wireless access for triple play outside Asia. Reasonable prices in the areas of local LLU and wholesale DSL mean uptake has been relatively successful, with aggressive deployment from Fastweb and Wind.¹⁴⁵

South Korea: South Korea's strong central government provided the push to become a leading global force in the broadband space. The South Korean government invested significant amounts of money into national backbone infrastructure to stimulate competition. It also provided major tax-breaks for broadband operators. But government and service providers failed to fully appreciate the business case for broadband. In 2003, several South Korean telcos suffered substantial losses, and the financially distressed cable operator Thrunet was acquired by Hanaro in 2005 as a direct result of promoting excessively cheap broadband.¹⁴⁶

¹⁴⁴ *Governmental Investments in Broadband Communications—Three Case Studies: France, Ireland, Sweden* (Cullen International, September 2002).

¹⁴⁵ Ovum Report.

¹⁴⁶ Ovum Report.

Australia: Using broadband as a key election platform, Prime Minister Kevin Rudd has promised to spend almost \$5 billion to build an open-access national high-speed broadband fiber network for Australia.

Developing Countries: A recent report from Ovum, a consulting firm, found that broadband growth rates were highest among developing countries that had a favorable regulatory regime.¹⁴⁷ “To make broadband penetration grow you need competition, reduction in prices and improved service offerings,” said Jonathan Coham, an Ovum analyst. “Regulation tends to be the best way of achieving those things.” Nine out of the world’s top 10 fastest-growing broadband markets during 2006 that Ovum identified are in developing economies where broadband penetration is typically in the low single-digits (which makes it easier to hit the high-growth numbers).

One article summarized the report’s conclusions as follows:

Ireland is the only developed economy to make Ovum’s top 10 (but the country still only had 13% broadband penetration by the end of 2006). “Ireland has historically been lagging behind other Western European countries, due to poor regulatory involvement, which has allowed uncompetitive pricing at a wholesale and LLU level,” notes Coham.

Greece is the world’s fastest-growing broadband market, clocking up a 168% increase in the number of broadband subscribers between the end of 2005 and the end of 2006. Next down the pecking order of highest growth come the Philippines, Indonesia, India and Ukraine, each achieving broadband subscriber growth well in excess of 100%. Ireland, Thailand, Vietnam, Russia and Turkey make up the remaining 10, with growth rates ranging from 85% (Ireland) to 69% (Turkey).

“In the less developed markets, regulators have traditionally had a very close link with the incumbent,” says Coham, “but what we’re seeing now is more involvement by the regulators, whether through setting the levels of wholesale pricing or forcing incumbents to unbundle their local loops. Regulators in these countries are beginning to recognize there are wider [economic] benefits to be had with higher broadband penetration.”

A more proactive broadband strategy by OTE, the Greek incumbent, has been central to the country’s broadband surge observes Ovum. After initially hindering broadband take-up in order to prolong the revenue-generating life of its dial-up and ISDN services, OTE has been forced to crank up DSL investment as alternative operators, spurred by better regulation, have begun to roll out broadband services. But there is still a long broadband road ahead for Greece. At the end of 2006, only three out of 100 Greek households had a broadband connection.

More effective regulation is not only the only reason for the higher broadband growth rates. Low broadband cost in relation to disposable income has also played its part, most notably in Greece, Turkey, Ireland and Russia, says the Ovum report.

Coham expects the broadband markets in Thailand, Indonesia, Vietnam and the Philippines will receive a fillip once rules on foreign investment are relaxed. “Foreign investors are only allowed to

¹⁴⁷ “Ovum Unveils Top 10 Fastest-Growing Broadband Markets,” Ovum press release, September 28, 2007, <http://www.ovum.com/go/content/c,377,72271>.

invest up to 49% in firms in these countries, but I expect this will change [to meet WTO requirements] over the next five years, which will encourage higher investment.”

Of the top 10 fastest-growing broadband markets, only Russia and Turkey prohibit LLU. Such a regulatory position will be unsustainable, says Coham. “Not allowing LLU is not a smart move in the long term,” he says. “Market forces will push for broadband service innovation, which will require LLU.”¹⁴⁸

VIII. The Broadband Experiences of Other Countries and U.S. States and Municipalities Demonstrate Several Broadband Success Factors

The information above reveals a number of important lessons for U.S. policymakers. The following discussion summarizes the successful steps taken by these governments to improve their broadband status:

- 1. Leadership and Goals: The executives of almost every successful government initiative began by announcing a broadband plan and setting specific broadband goals.** South Korea, Japan, and Canada each announced their initiatives to promote broadband at the beginning of this decade. In fact, Japan has now launched the second generation of its broadband plan (replacing e-Japan with u-Japan). Recognizing that they were about to be left behind, France and the U.K. announced their own broadband strategies in 2002–2004. Perhaps recognizing the void at the federal level, many U.S. governors have put together their own broadband plans in the past two to four years. While the details of these plans often differ, the common “success factor” is that they each put together a broadband plan with support from the highest levels of the government.
- 2. Public Funding: Almost every successful government program has included significant government funding.** Other governments have recognized that broadband is not a communications issue; it is an infrastructure issue that generates public benefits to economic growth, health care, education, and so forth. These governments recognize that broadband should not be left for the market because the profit maximizing incentives of private industry do not reflect the overall public welfare. Canada, Japan, South Korea, the U.K., and Sweden are among the nations that have invested large amounts of public funds to build broadband services. State government funding has been provided or proposed by California, Georgia, Idaho, Kentucky, Maine, Michigan, Vermont, Virginia, and others.
- 3. Open Broadband Networks: One of the most popular models has been to require that big broadband network providers provide service on a wholesale basis to multiple retailers.** Most municipal broadband networks, such as UTOPIA and the Alberta SuperNet, operate on a wholesale basis and allow competitors to resell the network to consumers. Sweden has followed this model in encouraging their municipalities to construct fiber networks. Similarly, British Telecom now provides wholesale access to its network through a subsidiary called OpenReach. This model allows the network owner to concentrate on building and running the network on a

¹⁴⁸ See http://www.telecommagazine.com/newsglobe/article.asp?HH_ID=AR_3528.

neutral basis to multiple competing providers of retail service that market their services to the general public.

4. **Public-Private Partnerships: Another consistently successful theme is government-private sector cooperation in building broadband networks.** Very few, if any, state governments express interest in building a government-owned broadband network. The plans of almost every state governor involve providing funding or incentives for the private sector to expand their broadband networks. California, Kentucky, Maryland, Minnesota, North Carolina, and Virginia are among the states that have adopted programs to stimulate greater private sector investment by establishing a government-industry task force, nonprofit entity, or other organization. Several countries have also operated in a similar fashion, including Japan, the U.K., and Canada.
5. **Unbundling: The policy of unbundling local copper networks has been used successfully to stimulate broadband, although the application of unbundling to fiber facilities is still under consideration.** France and the U.K. have had great success in unbundling the local loop as a means to jump-start their broadband adoption, allowing them to jump to the top of the G7 in broadband adoption in just a few years. The European Union has taken an active role in enforcing unbundling regimes on some countries that were initially reluctant. European countries are now debating whether the unbundling regime should be applied to fiber facilities as well. Japan does require NTT to unbundle its fiber facilities.
6. **Fiber: Except for Japan and South Korea, which are well ahead of the rest of the world in deploying fiber, municipalities are taking the lead on fiber deployment.** The EC, the U.K., and France have yet to announce a fiber deployment plan, although it is under active consideration. In the meantime, several European cities (including Paris and Vienna) are jumping on the fiber bandwagon. Sweden has had a municipal fiber deployment strategy from the beginning. Many U.S. cities have built or are building fiber networks, often funding the build-out by selling municipal bonds. Several studies document the economic benefits to those cities that have deployed their own fiber networks.
7. **States Focus on Low-Speed Broadband: Most of the state government initiatives have focused on expanding low-speed broadband services to unserved areas, not big broadband.** Almost every state has some amount of rural and high-cost areas that have not been served by the private sector. The states' governors express understandable concern that rural Americans should not be left behind and should have access to basic broadband connectivity. Unfortunately, the majority of state programs do not address the need to promote big broadband capability that will be necessary in the next few years. While these state initiatives are certainly well-intentioned, the question is whether the low-speed services used to fill the gaps today will become the dial-up of the future. Most states' programs are largely designed to expand the reach of DSL and cellular broadband access more widely available. There remains a need for the federal government to address the need for big broadband.

IX. A Blueprint for Big Broadband Connectivity

A. The Need for a Big Broadband Plan

Over the past several years, U.S. policymakers have relied on deregulating the telecommunications industry and underfunded broadband programs as the primary tools to promote broadband deployment and adoption. The evidence above demonstrates that this laissez-faire approach is insufficient. The U.S. broadband ranking among other nations has fallen sharply since the beginning of this decade. At the same time, there is considerable evidence that American consumers will be demanding greater broadband capacity in the very near future (especially with the advent of high-definition video over the Internet).

It is increasingly clear that America needs a national broadband plan to promote big broadband connectivity. Many, if not all, of the nations ahead of us in broadband connectivity adopted broadband plans several years ago.¹⁴⁹ Many states have taken aggressive steps to promote broadband technologies as well, but their focus has been primarily on low-speed broadband—not the kind of big broadband that will be necessary for the future.¹⁵⁰ The United States needs to learn from these experiences and develop a set of policies that propel our Internet capabilities into the 21st century.

The United States can no longer let market forces alone determine the optimum level of broadband deployment. As Gartner and Rob Atkinson have explained,¹⁵¹ the private sector is primarily motivated by short-term profits and cannot take into account the positive externalities of widely available broadband networks. The private sector cannot be faulted for being cautious; the dot-com bust at the beginning of this decade left a battleground littered with bankrupt companies. But something bigger is at stake than the profit and loss statements of the telecommunications industry. Broadband services are no longer an exciting option, an enhancement of our existing telecommunications system. Broadband services have become an essential component of our national infrastructure. Widely deployed broadband pipes available at affordable prices and open to any lawful content are increasingly essential to our full participation in 21st-century economy.

America thus needs to focus on big broadband—very high-capacity networks that are capable of delivering a minimum of 100 megabits of transmission speed to every home, business, and public institution. This goal is both realistic and necessary. Japan has already deployed high-capacity fiber networks to the home advertising speeds of almost 100 Mbps. France and South Korea are making 45 mbps capabilities available to their citizens today. At present, the United States lags behind these countries; to catch up, we will need to do more than build by 2010 the same quality of networks that our competitors are deploying today. If America is to restore its leadership position in broadband capabilities, we must leap-frog the competition. We must design our broadband policy in order to “skate where the puck is going to be.”

¹⁴⁹ A summary of the steps taken by other countries to promote broadband is contained in section VII.

¹⁵⁰ A summary of the steps taken by selected states to promote broadband is contained in section VI.

¹⁵¹ See section IV.

Building big broadband networks is not just a matter of international competition; it is also economically efficient. Because of the limited dollars available, it is more economically efficient to invest these resources into networks with unlimited potential (such as fiber-optic cable) than to invest in the deployment of a multitude of interim technologies whose bandwidth could be overwhelmed by Internet traffic in a few years. American policy should thus focus on future-proof networks—networks employing technologies that are scalable and adaptable to future growth in demand. Several existing technologies are limited by physics and geography and will be obsolete in three to five years. Our resources will be better spent on technologies that have a long shelf life.

Some states are admirably developing programs to fill the gaps in small broadband deployment and availability. Certain municipalities are building fiber networks on a case-by-case basis, but many more municipalities have been bogged down on wireless networks that will not satisfy consumers' hunger for much greater capacity. No agency of government in the United States is addressing the need for big broadband. Only the federal government must fill the void with a comprehensive policy to promote big broadband.

What should the U.S. big broadband policy be? The following presents suggested principles and an action plan.

B. Principles for Enhancing U.S. Big Broadband Connectivity

- 1. Universal:** All communities, institutions, residences, businesses, nonprofits, educational and health care institutions, and individuals should have equitable and affordable access to big broadband services and to the widest possible range of content and service providers.
- 2. Deployment and Subscription:** Our big broadband policies should focus on both deployment and subscription. We must enhance the investment in building the network and also efforts to ensure that big broadband service is affordable so that all consumers are able to subscribe.
- 3. Public and Private Sectors:** Both the public and private sector can and must play significant roles in the nation's broadband deployment. Local governments have shown that they can build broadband networks even where the private sector will not. State governments have demonstrated that they are in the best position to know where resources may be most needed and efficiently used. State and local governments can promote economic development, education, health services, public safety—goals that may not be reflected in corporate boardrooms. At the same time, building broadband networks can be expensive and beyond the financial resources of many governments acting alone. Thus, our policies should also include measures to encourage the private sector to build broadband networks with supervision, guidance, and funding from the public sector.
- 4. Federal–State Cooperation:** Federal, state, and local governments should work together, across traditional jurisdictional lines if necessary, to achieve the shared goals. The United States is a large country, with many different geographic, income, economic, and density zones. There is no one-size-fits-all solution. Different broadband

technologies may be required for different regions. Any federal government program must be designed with flexibility to allow state and local governments to target federal dollars to the best location.

5. **Big Broadband:** U.S. broadband policy should focus on the future. Cable modem, DSL, and wireless technologies are unlikely to meet our future needs. The United States needs to set its sights toward the 100 Mbps speeds that are commonplace in Japan and increasingly the focus of European countries.

C. An Eight-Step Action Plan to Promote Big Broadband Connectivity

1. Leadership, Vision, and Goals

To achieve results, U.S. leaders must set forth a vision of the future. As described above, foreign and state governments addressed the need for broadband with major addresses to their electorate. Their plans included specific goals as well as processes and timelines to meet those goals. U.S. policymakers should do the same. Simply making the announcement in a public manner can motivate the industry and other government leaders to follow suit. These goals must be realistic and achievable, but they must also be aggressive if we are to catch up to and surpass our international competitors. A reasonable starting point is to seek to provide every home, business, and public institution with a minimum of a 100 Mbps connection by the year 2012.

2. Organization

Once the goals are set, achieving them will require hard work from a dedicated set of professionals who understand the needs of consumers and the industry. Almost every country and state that has initiated a broadband plan has created a new organization focused on implementation. The United States should do the same. One suggestion is to create a Broadband Council of government officials, co-chaired by the secretary of commerce and the chairman of the FCC, which would also include a variety of senior officials from federal, state, and local government agencies. The Broadband Council would implement the big broadband policies and programs. For instance, the council would award of funding from the Universal Broadband Fund (described below) and set the rules of openness.

In addition, the Broadband Council would receive input from a Broadband Advisory Committee consisting of a variety of public, nonprofit, and consumer representatives. The Broadband Advisory Committee would receive and analyze information from the general public and provide advice and recommendations to the council. The committee would have its own professional staff and would conduct research on broadband solutions and technologies. For instance, one important component of information would be detailed mapping of the availability of broadband facilities. The FCC's reporting methods also need to be upgraded to provide more granular information that can help locate the areas where broadband does not exist.

3. Tax Incentives

There is some concern that the current investment climate does not provide sufficient rewards for providers to make significant investments in broadband networks. Verizon, the provider that has invested most heavily in fiber to the home through its FiOS project, still faces skepticism from some Wall

Street analysts.¹⁵² While Verizon's rollout of its fiber to the home network is commendable, the company's plans call for the network to pass only one-half of the homes in its service area, most of them high-income residential areas on the east and west coasts. It will be difficult to convince Verizon and other local companies to increase their investment without some additional investment incentives to attract capital.

In 1986, Congress passed legislation providing tax incentives for the accelerated deployment of next-generation communications infrastructure. Consequently, the country's long distance networks were rapidly upgraded. Providing similar incentives for the deployment of next-generation broadband networks would have a similar affect today—allowing us to close the gap with global competitors.

The following summarizes some of the tax incentive programs that have been discussed:¹⁵³

- a. *Expensing of broadband equipment*: Accelerating the depreciation of broadband equipment could dramatically stimulate investment in broadband infrastructure by removing the disincentive of an unrealistically long depreciation cycle. According to ITI, telecom service providers are the largest capital investors in the world; thus depreciation changes should significantly increase capital expenditures in broadband infrastructure.¹⁵⁴
- b. *Tax break for fiber investment*: A broadband tax credit would also stimulate investment in broadband infrastructure by reducing the cost of deployment. Such a tax credit could be focused on "middle mile" or backbone pipes that are not built with UBF funds (see below). According to one estimate cited by ITI, a one-year credit would generate \$2–4 billion in broadband investment, and a five-year credit would generate \$10–20 billion in broadband investment.¹⁵⁵
- c. *Internet tax moratorium*: The Internet prospers today as the result of unshackled innovation and technological growth unfettered by government taxation or regulation. Although policies up to this point have temporarily put a hold on government interference, passing a permanent ban on Internet taxation would send a signal that the Internet is open for further growth and development. The ban on Internet taxes, which was recently extended for seven years, should be made permanent.¹⁵⁶

¹⁵² Based on early adoption statistics that are slightly higher than expected, Verizon has recently upgraded its estimate of market penetration from 30% to 35–40% by 2010. See <http://newscenter.verizon.com/press-releases/verizon/2006/verizon-provides-new.html>.

¹⁵³ The 109th Congress passed H.R. 6111, the Tax Relief and Health Care Act of 2006, that included a retroactive extension of the R&D tax credit from January 1, 2006, through December 31, 2007. Also included is language to strengthen the credit with a new credit formula called the Alternative Simplified Credit effective January 1, 2007, through December 31, 2007.

¹⁵⁴ IT-CSPP, "10-Point Plan to Bring Broadband to More Americans, Information Technology Industry Council and the Computer Systems Policy Project," http://www.cspp.org/documents/ITI-CSPP_10-Point_BBND_Plan.pdf.

¹⁵⁵ Ibid.

¹⁵⁶ K.C. Jones, "President Bush Signs Internet Tax Freedom Act," *InformationWeek*, November 1, 2007, <http://www.informationweek.com/news/showArticle.ihtml?articleID=202801131>.

- d. *New home tax credits*: Local governments should be encouraged to adopt building codes requiring the deployment and installation of next-generation broadband facilities in new home developments. New communities are constantly being developed, and houses built and renovated. These events provide an opportunity for local governments to accelerate the deployment of next-generation broadband networks by adopting new development and building requirements that ensure these homeowners can connect at 21st-century access speeds.¹⁵⁷

4. A New Universal Broadband Fund

To be truly effective, our national broadband policy must incorporate a program to provide direct funding from the government to fund local big broadband connections. As noted above, such funding has been proven to be successful in Canada, the U.K., and Japan, as well as almost every state that has adopted a broadband policy. Just as rural electrification, rural telephone service, and the national highway system in the early 20th century required U.S. government subsidies, the federal government should consider providing subsidies to promote the nationwide deployment of big broadband capability.

The funding should be considered a necessary investment in our future—an investment that will pay for itself over time in several ways. First, the costs of operating these networks once they are constructed will be much smaller than the costs of operating the existing copper and coaxial networks, so there will be considerable cost savings to the network owner.¹⁵⁸ Furthermore, fiber networks are easily scalable upwards, meaning that the one-time investment in fiber facilities will last well into the future. In other words, there will be less of a need for other government subsidies in the future to support older copper networks. Finally, and perhaps most important, several studies demonstrate that an advanced infrastructure generates more jobs, greater business investment, and higher tax revenues.¹⁵⁹ Thus, the economic benefits of an advanced infrastructure will prove that the investment today will bring about enormous long-term benefits.

Where should this new fund be housed? Perhaps neither of the existing programs are appropriate:

The existing federal Universal Service Fund is not a suitable vehicle for providing broadband funding. The existing \$7 billion USF is extraordinarily complex. It consists of four separate programs, each with its own rules. The high-cost fund, which is the largest component of the USF, provides funding for ongoing (recurring and capital) costs of operating narrowband networks (i.e., for voice telephony) and may only secondarily be used for broadband services. In contrast, the costs of deploying broadband consists primarily of one-time costs of deployment, and the costs of maintaining a broadband network are lower than maintaining a narrowband network. As a result, folding a broadband subsidy program into the existing federal USF is not ideal, as the two programs are not compatible.

¹⁵⁷ OneEconomy, a nonprofit organization, has championed the need for tax credits to promote broadband connectivity in new housing developments for low-income persons. It claims to have changed the tax policies in 42 states. See <http://www.one-economy.com>.

¹⁵⁸ As discussed below, FiOS will save Verizon \$4.9 billion through 2010 in reduced operating expenses from not having to maintain the old copper network.

¹⁵⁹ Using a method that considers the correlation between penetration (or “density”) of an advanced communications technology and GDP per capita, California’s One Gigabit or Bust initiative estimated that pervasive broadband speeds could yield a \$376 billion increase in the incremental gross state product (GSP) and two million additional jobs. See “A \$376-Billion Opportunity for California,” <http://www.cenic.org/GB/gartner/376Billion.htm>.

The Rural Utilities Service Broadband Loan and Grant Program does not provide the best model for meeting the nation's broadband needs. The RUS program, while specifically designed for broadband deployment, provides the majority of its assistance through loans to those entities that can demonstrate the financial strength to repay the loan. While it is understandable that the federal government would want some assurances that the loan will be repaid, the net effect is that most loans are awarded to entities that already have significant financial resources. Very few if any loans can be awarded to the highest-cost areas that need broadband the most. Furthermore, both the loan and grant programs provide funding for low-speed broadband, not the high-speed big broadband that America needs. Finally, the RUS program operates without oversight and involvement of many parties, such as consumer organizations, nonprofit organizations, and state and local governments, that should have an integral role in determining the success of the nation's broadband program. Finally, unlike the existing USF and RUS programs, there is a strong argument that any federal dollars distributed to broadband providers should have a matching component, which is not a feature of either the USF or the RUS program.

For these reasons, the United States should consider creating a brand-new fund using a public-private partnership focused only on broadband deployment. For purposes of discussion, the proposed fund is called the Universal Broadband Fund (UBF). The UBF would be funded by the federal government, either through general appropriations or from selling broadband bonds.

Funds would be distributed from the UBF to the states based on a variety of factors as long as the states contributed an equal amount of support (i.e., a match). The states would award the combined federal and state funding to private or public sector entities to cover up to two-thirds of the deployment costs on a community-by-community basis. The recipient of any funding must agree to comply with the open network principles (discussed further below).

How much funding should be provided? One way to estimate the amount of funding needed is to use Verizon's costs of deploying its FiOS FTTH network as a guide. Verizon has told investment analysts that it costs \$817 per home passed and estimates that it will pass 18 million homes with its FiOS service by 2010. Because there are approximately 115 million households, there will be approximately 97 million homes remaining. The costs of "wiring" the remaining homes is probably higher than Verizon's current costs because Verizon is probably choosing to wire homes that are lower cost than average (though the increased cost of serving these areas may decline over time, just as the provider's costs of deploying FiOS networks have declined over time). Assuming that it will cost approximately \$1,000 to pass each home, and that there will be approximately 97 million homes remaining, the total amount of funding necessary to provide fiber connectivity to each home in the United States would come to approximately \$97 billion.¹⁶⁰

The federal government need not provide the entire amount of funding. The United States should consider adopting the type of matching grant program used by several provinces in Canada, whereby the federal government, the state/province, and the network builder/owner each contribute one-third of the funding for each broadband construction project. The federal government could, for instance,

¹⁶⁰ Furthermore, AT&T is constructing a fiber to the node network for an additional 18 million homes, and presumably it will be somewhat less expensive to run fiber from the node to these homes. See *Bernstein Research Report*, November 5, 2007; Kende slides for analysis, delivered at Columbia U. Broadband Conference;

<http://www4.gsb.columbia.edu/citi/events/eventsarchive/stateoftelecom2/>;

http://money.cnn.com/magazines/fortune/fortune_archive/2007/03/05/8401289/.

contribute \$8 billion per year for four years (a total of \$32 billion) to fund one-third the costs of building a big broadband network capable of providing a minimum of 100 Mbps service.

While there are a variety of methods of distributing these funds, one proposal is as follows:

- a. The program would be distributed by the Department of Commerce, under guidelines provided by the Broadband Council.
- b. Available funds would be apportioned to each state based on a formula developed by the Broadband Council. The formula would include an evaluation of the costs of deploying local broadband connections in that state, the population, household income, and other considerations.
- c. The funding for each state would not be released until the state makes available an equivalent amount of funding on a dollar-for-dollar basis (i.e., matching program).
- d. Each state would determine which entity will build the local big broadband network on a market-by-market basis in each local community. The network builder could be a commercial for-profit entity, a nonprofit entity, or a state or local government agency. The guidelines for distributing the funds should mandate that the state require the network builder to provide at least one-third of the funding for each project.
- e. The network builder will own the local network, but will be required, as a condition of receiving the federal/state funds, to ensure that the network is open to all lawful content and applications and that its prices are affordable. In addition, government policymakers will determine whether or not the network owner should be required to make a certain amount of capacity available on a wholesale basis to competitive retail service providers.

5. Openness

A big broadband Internet connection is only useful if you can use it. A superfast connection that can only connect to the websites chosen by the ISP, or a connection that does not provide access to the distance learning, telemedicine, or the next creative application would not serve the consumer or the nation's economic or national security goals. At present, however, there is no legal requirement to provide consumers with access to the Internet services they desire, and there is no rule preventing operators of broadband networks from blocking or preferring Internet applications they choose. Some network operators have considered imposing extra charges for carrying the traffic of certain entities, or providing "enhanced" carriage for entities that can afford to pay. The result of these practices, if implemented, could lead to enhanced Internet access for entertainment but not for education.

The United States should adopt a simple provision ensuring that consumers can reach the services of their choice and that network owners cannot impede or degrade any lawful service or application. The provision should be enforceable through a streamlined complaint process that ensures rapid decisions that Internet-based services require. Penalties should be imposed for particularly egregious or anticompetitive conduct.¹⁶¹ The requirement should ensure that consumers obtain access to the

¹⁶¹ The language agreed to by AT&T in its merger agreement with BellSouth provides a useful model for this provision:

AT&T/BellSouth also commits that it will maintain a neutral network and neutral routing in its wireline broadband Internet access service. This commitment shall be satisfied by AT&T/BellSouth's agreement not to provide or sell to Internet content or application providers, including those affiliated with AT&T/BellSouth, any service that privileges, degrades or

services and applications they desire, and that new entrants and entrepreneurs should be able to “innovate without permission.”

In addition, the United States should undertake an inquiry to determine whether owners and operators of broadband networks should make their facilities available for interconnection and resale by competitors on an unbundled basis. The European experience demonstrates that unbundling and interconnection creates a competitive dynamic that provides lower prices for consumers and can enhance broadband deployment and penetration. On the other hand, network owners allege that network sharing inhibits their incentive to invest. If these private network operators receive two-thirds of the funding they need to cover deployment costs, however, that would appear to address the investment incentive. Competitors often offer innovative services by adding their own electronics to the network that benefit consumers. At the same time, network owners must be assured that they are not subsidizing their competitors by being required to offer below-cost rates.

6. State and Municipal Broadband and Rights-of-Way

States and municipalities have demonstrated a keen interest in promoting broadband deployment. Unfortunately, at least 14 states that have passed laws either prohibit or limit municipalities from deploying communications services. These laws take various forms. For example:

- Minnesota requires municipalities to obtain a 65% supermajority vote before building a broadband network.
- Texas prohibits municipalities and municipal electric utilities from providing certificated telecommunications services either directly or indirectly through public-private partnerships.
- Nevada flatly prohibits municipalities and counties of certain sizes from providing telecommunications services.

Several municipalities have demonstrated that they can build sophisticated big broadband networks to serve their consumers. Furthermore, several reports document the economic benefits of broadband capability. Sweden and other countries in Europe are also deploying fiber. Given the shortage of available broadband capacity in the United States, it seems unwise for states to thwart the efforts of municipalities to deploy greater broadband.

Senators McCain and Lautenberg have introduced legislation in the Senate (S. 1853), and in the House of Representatives Boucher and Upton (H.R. 3281) have sponsored a bill to expressly permit municipalities to offer broadband service. The Senate bill has been approved by the Senate Commerce Committee and is awaiting action on the Senate floor. These bills will remove the legal uncertainties surrounding municipal broadband plans and will also make it clear that the private sector cannot use the state political process to block cities that want to build their own networks.

7. Enhancing Consumer Education Concerning the Benefits and Availability of Broadband Services

To take advantage of broadband has to offer, consumers need to have better information concerning the availability of services, the technical requirements for accessing these services (computer skills, etc.) and the benefits that broadband connectivity can provide to their lives. Many consumers are unaware of the e-government services, online instruction, telehealth, and other applications that could benefit them. Some state governments, including Kentucky, North Carolina, and others, have already taken steps to address this need. The federal government should support these efforts through funding, mapping of broadband facilities, and enhancing the information of available federal e-government services.

8. Broadband Technology Research

As demonstrated in Section V, the United States must increase the resources it devotes to basic research on broadband technology. The movement toward competition, while positive in general, has the unfortunate result that the private sector is sacrificing long-term R&D in the interests of short-term profits. The federal government must make up the shortfall of basic research if we are to safeguard our long-term future.

To its credit, Congress has begun to address the shortfall in American telecommunications research. On August 9, 2007, President Bush signed into law H.R. 2272, the America COMPETES Act (America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science Act). The legislation was designed to enhance the research competitiveness of the United States based on recommendations contained in the National Academies 2005 Report, "Rising Above the Gathering Storm." Not included in the new law, though, was the recommendation to enact a stronger research and development tax credit.

In addition, Congress should enact S. 1493, the Advanced Information and Communications Technology Research Act. The bill would establish a telecommunications program within the National Science Foundation to focus research on the development of affordable advanced communications services. It would authorize \$40 million in fiscal year 2008, increasing in \$5 million increments to reach \$60 million in FY 2012. The bill would also establish a Federal Advanced Information and Communications Technology Board within NSF to advise the program on appropriate research topics. Finally, the bill would accelerate efforts initiated almost four years ago to promote spectrum sharing technologies. It would require the National Telecommunications and Information Administration (NTIA) and the FCC to initiate a pilot program within a year that would make a small portion of spectrum available for shared use between federal and nonfederal government users.

X. Conclusion

The United States faces a challenge unlike any other in its history. Our nation's economic and social future depends on answering the growing demand for very high-speed broadband connectivity, a capability this paper calls "big broadband." Unlike previous international challenges, the race to deploy big broadband does not involve a space program or a military-industrial complex consumers may read about but seldom see. The race to deploy big broadband is local. Big broadband connectivity affects the Internet experience of each and every home and business in America. The evidence is clear: America's broadband resources are lacking. Failure to take on the challenge could lead to a decline in our global competitiveness and an inability to educate our students and provide needed telemedicine services. Our country's lackluster broadband performance results directly from our failure to adopt a comprehensive national broadband policy, with specific goals and significant public funding.

This paper proposes a solution that draws on the successful efforts of our own state and local governments and those of other countries—the creation of a new Universal Broadband Fund to subsidize open, big broadband networks to every home and business by 2012. An investment of \$8 billion per year will pay enormous dividends in cheaper network management and overall economic, educational, and social growth. We urge policymakers to adopt this plan as soon as possible to restore our nation's leadership position in high-technology and to prepare for the 21st century.

About the Author

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