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Broadband Deployment and the Digital Divide
A Primer

by Wayne A. Leighton

Executive Summary

In the New Deal of the 1930s the Rural Electrification Administration used federal subsidies to extend electricity to rural and isolated communities across the country. By subsidizing the significant capital investment needed to run wires and build infrastructure, REA support brought electricity to households that might otherwise have waited many years for such service.

Today, similar arguments are being made for subsidizing new technologies, such as broadband Internet service. Some people are promoting the equivalent of an "REA for broadband" to ensure that rural and low-income communities gain access to high-speed communications connections. However, the REA analogy is not only misplaced, it is harmful. The wires over which broadband service can be transmitted are already in place—owned by telephone, cable, and even electricity providers. Upgrades are needed to provide broadband, but not the massive investment that is required to run a new line to every customer's home. And wireless transmission from both satellite and land-based systems has just begun. Whereas electricity has traditionally been provided by a single distributor, broadband Internet service has many potential distributors that use a variety of technologies.

Tax credits or subsidies to promote broadband deployment would distort competition between those technologies, enriching incumbents and thwarting the technologies of tomorrow. For an industry in which the technologies of today were unheard of just a few years ago, nothing could threaten progress more. And for those consumers who are waiting for prices to fall or service to extend to their communities, new technologies and competition will offer the best solution.

Lost in this debate, moreover, is the fact that access to the information superhighway does not require broadband. While broadband is superior, it is not necessary for access.

The first question, then, is whether low-income, rural, and other households are gaining access to the Internet at all. The second question is whether those households—and for that matter, all Americans—are gaining broadband Internet access. To both questions, the answers are decidedly positive. In light of this, broadband tax credits or subsidies appear to be an unwise, unnecessary, and expensive approach to what is quickly becoming a nonproblem.

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Introduction

Proposals in Congress

One of the hottest debates on Capitol Hill is on the availability of advanced, high-speed Internet service, or what is frequently called "broadband." Within the first month of the 107th Congress, three bills had been introduced to promote broadband deployment through tax credits. In the previous Congress 18 bills were put forth to promote broadband deployment.[1] These proposals may be grouped into three fairly distinct categories: (1) tax credits and subsidies, (2) regulation, for example, requiring cable providers to open their networks to competing Internet service providers (ISPs), and (3) deregulation, for example, eliminating resale and unbundling requirements for the incumbent local exchange carriers (ILECs).

Whereas all three approaches are designed to promote broadband Internet access, they would do so in different ways. That results from the fact that two distinct types of service are needed to gain access to the Internet. First, a transport provider is needed to provide the physical connection through which electronic transmissions flow. Telephone companies, cable companies, and wireless providers offer such service. Second, an ISP is needed to supply a link to the consumer from the transport provider's physical connection to the Internet. America Online and Earthlink are two examples of ISPs. Whereas regulatory and deregulatory actions affect both transport providers and ISPs, the broadband tax credits considered by Congress focus specifically on transport providers. Congress and the press have focused most of their attention on tax credits, which would affect transport providers. For this reason, and because transport providers are probably the most critical link in broadband deployment, the focus of this report is on the firms and technologies that provide the physical connection to the Internet.

What Exactly Is Broadband?

In the Federal Communications Commission's 1999 report on broadband service, known as the First Report,[2] the agency defined "broadband" as services "having the capability of supporting, in both the provider-to-customer (downstream) and the customer-to-provider (upstream) directions, a speed (in technical terms, 'bandwidth') in excess of 200 kilobits per second (Kbps) in the last mile."[3] In the FCC's Second Report,[4] released in August 2000, the agency declined altogether to use the term "broadband" because of "its now common and imprecise usage."[5] The agency instead used the term "high-speed" to describe services that transmit data in excess of 200 Kbps in one direction and "advanced services" to indicate services that transmit data at these speeds in both directions.[6]

The FCC's avoidance of the term "broadband" shows clearly how difficult it is to define this rapidly changing technology. The agency recognizes this when it states: "Our definition of advanced telecommunication capability will evolve over time. Future reports will reconsider it in light of changing conditions in both demand and supply."[7] That which is considered "broadband" or "advanced service" today may be unacceptably slow—the technology of the information have-nots—in the near future.

Because the term "broadband" is often used to describe both high-speed and advanced services—indeed, the General Accounting Office uses the term to describe both types of service[8]—I will use the term to describe both types of service herein as well, with the recognition that the more precise definitions given earlier are necessary for more technical discussions. The key point is that these services represent a second generation of Internet access and data transmission speed.

As will be discussed later, the first generation of Internet access was—and still is—supplied by unmodified telephone lines providing narrowband "dial-up" service. Access to these services has increased dramatically over the last few years at the same time that broadband has emerged on the market. But as broadband service remains only a small part of the total market for Internet access, some observers worry that it will reach an unacceptably small number of fortunate citizens.

This concern is remarkably familiar: it was expressed in the earliest stages of dial-up service, too. Indeed, compared to the national average, some demographic groups have lower penetration rates for Internet access. This difference in penetration rates has produced what some label as a “digital divide” in U.S. society.

What Exactly Is the Digital Divide?

The term “digital divide” refers, in its most simple form, to the division between information “haves” and have-nots. To be among the “haves,” one must have Internet access, a computer or other tool to communicate on the Internet, and a basic knowledge of how to use it. The Department of Commerce, which has issued four reports on Internet access, has most recently posited the problem as follows:

> The tremendous growth in household computer and Internet use has occurred across all demographic groups, including income and education levels, races, locations, and household types. Nevertheless, some Americans are still connecting at far lower rates than others, creating a “digital divide” (i.e., a difference in rates of access to computers and the Internet) among different demographic groups.[9]

But before policymakers do anything about the digital divide—indeed, before they even *decide* if they should do anything at all about it—they must answer some important questions. First, what is the difference in the penetration rates between demographic groups? Is it dramatic? Is this difference increasing or decreasing over time?

Second, what factors—public policies, technological advances, and so on—would tend to raise penetration rates over time?

Third, what specific effect would public policies such as tax credits have on Internet access in general and broadband Internet access in particular? What benefits would they bring, and at what cost? Might other solutions produce more benefits?

This study addresses those questions. It recognizes a difference in the penetration rates across groups while noting the incredible growth of access for *all* groups. This growth is found to reduce drastically the lag between the haves and have-nots in acquiring the tools needed to participate in the new economy. For now, the issue appears to be connectivity, not speed. Of course, as consumers’ needs change and they begin to demand faster speeds and richer content, the market will change with them. Indeed, it is doing so already. The latest advances give even more reason to believe that an increasing number of Americans—including low-income and rural Americans—will have cheaper access to better services in the near future.

Still, as the Internet becomes ubiquitous, it may be accompanied by ever more tax breaks, subsidies, and other regulatory proposals. And some legislation may be necessary, so that the rules of the new economy, like those of the old economy, are well-defined. But broadband tax credits are likely to produce significantly greater costs than benefits. These costs include a real burden on taxpayers and, perhaps much more notably, an even heavier burden on the competitive process in which both existing and upstart firms attempt to provide new and better broadband services to a growing pool of customers. It is this competitive process that offers the most promise of serving those customers who heretofore were too remote to receive such service or could not afford its high price.

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The Role of the Government: Current Federal Policies

The Telecom Act of 1996

In section 706 of the Telecommunications Act of 1996, Congress directed the

FCC and state regulators to encourage deployment of advanced telecommunications services to all Americans "by utilizing, in a manner consistent with the public interest, convenience, and necessity, price cap regulation, regulatory forbearance, measures that promote competition in the local telecommunications market, or other regulating methods that remove barriers to infrastructure investment."[10] Congress also required the FCC to conduct regular studies of the availability of advanced telecommunications services and, if necessary, to take actions to accelerate deployment.[11] In the event the FCC does not find that "advanced telecommunications capability is being deployed to all Americans in a reasonable and timely fashion," Congress directs that the agency "shall take immediate action to accelerate deployment of such capability by removing barriers to infrastructure investment and by promoting competition in the telecommunications market."[12]

In response to its mandate to study the availability of advanced services, the FCC issued its First Report in February 1999. The agency noted that, although its conclusions were based on limited data, the overall deployment of advanced telecommunications services was reasonable and timely, especially given the early stages of their development.[13] A year and a half later, in August 2000, the FCC issued its Second Report. That report involved considerably more research, including an official data collection program and inquiry, field hearings, case studies, and reports from industry, academics, and other experts.[14]

The FCC noted that, although its conclusions were based on limited data, the overall deployment of advanced telecommunications services was reasonable and timely.

The FCC's Second Report evaluated whether the development of advanced services was "reasonable and timely" by examining three things: (1) subscription levels and their increase since the First Report, (2) the level of investment in the telecommunications infrastructure for advanced services and estimates of future investment, and (3) the choice of providers and technologies that offer advanced services to consumers.[15] After evaluating these criteria, the agency concluded:

> The deployment of advanced telecommunications capability to all Americans is reasonable and timely at this time. Providers are rapidly building the infrastructure for two major types of advanced services—DSL services and cable-based services. Large-scale entry by other providers deploying fixed wireless and satellite technologies is also likely. Great amounts of capital, even by the standards of the communications industry, have poured into the infrastructure for advanced services. Demand, measured by the rates of subscription to high-speed services, is increasing rapidly and shows no sign of losing momentum.[16]

The FCC's Second Report thus concludes that intervention on its part is not warranted at this time. Nonetheless, the agency makes it clear that action may be needed in the future to speed deployment to groups that do not receive access to advanced services.[17]

At the same time, the FCC is deeply involved in providing a number of universal service subsidies that relate, directly or indirectly, to advanced telecommunications services. The Telecommunications Act of 1996 both expands the definition of universal service and codifies subsidies that had not theretofore been mandated by Congress.[18] Section 254 of the act establishes the following guidelines for universal service policies: Consumers in all regions of the country should have access to advanced telecommunications services and information services. Consumers in rural and high-cost areas should have access to telecommunications and information services, including advanced services, at rates reasonably comparable to rates charged in urban areas. Health care providers in rural areas should have access to advanced services at rates reasonably comparable to urban rates. And elementary schools, secondary schools, and libraries should have subsidized rates for these services.[19]

As a result of this mandate, the FCC continues to monitor the deployment of advanced services, while advancing subsidy programs for rural and high-cost areas, schools, libraries, and health care providers. The rural and high-cost program is designed to help cover the costs of all telecommunications services in those areas—most of which are for voice telephony service and thus involve little support for deployment of broadband or other advanced services. In contrast, support for schools, libraries, and health care providers is directly linked to advanced services such as broadband, one of the telecommunications services most needed by these institutions.

The FCC's Schools and Libraries Program: The E-Rate

Section 254(h)(1)(B) of the Telecommunications Act of 1996 stipulates that schools and libraries shall receive specified telecommunications services "at rates less than the amounts charged for similar services to other parties." In implementing this requirement, the FCC claims it intended "to provide schools and libraries with the maximum flexibility to purchase from telecommunications carriers whatever package of commercially available services they believe will meet their telecommunications needs most effectively and efficiently."[20] The FCC established the Schools and Libraries Division to administer its discount program, also known as the E-rate (or education-rate) program. Internet access figures prominently in these services.[21] Schools and libraries receive a discount of 20 to 90 percent, depending on economic need.[22]

The E-rate program is financed by universal service obligations (i.e., taxes) that the 1996 act imposes on all interstate telecommunications carriers.[23] Carriers providing discounted service to eligible schools and libraries reduce their obligation accordingly, or may receive reimbursement.[24] The FCC has capped the E-rate program at $2.25 billion annually, and current requests for funding exceed the $2.25 billion annual maximum.[25] In its first three years of operation, the program disbursed $5.8 billion.[26]

Although federal tax revenues do not finance the E-rate program, it also is not free. In fact, this program is financed by a particularly inefficient tax on telecommunications consumers.[27] Nonetheless, it remains a large source of funding for promoting advanced services to schools and libraries.

The FCC's Rural Health Care Program

Section 254(h)(1)(A) of the Telecommunications Act requires that public and nonprofit health care providers receive telecommunications services that are "necessary for the provision of health care" at rates "reasonably comparable to rates charged for similar services in urban areas" in that state. The FCC established the Rural Health Care Division to administer the program. As health care providers in rural areas increasingly use advanced services such as broadband to transmit medical data and images—a practice known as "telemedicine"—this program ties directly to the deployment of advanced services in rural areas.

The same tax on interstate telecommunications providers that funds the E-rate also funds the Rural Health Care Program, which shares the inefficiencies and tax burden of the E-rate. However, this program for rural health care providers is much smaller, having distributed slightly more than $7 million from July 1999 to June 2000.[28]

Other Federal Programs That Promote Advanced Services

A recently published CRS Report for Congress lists 16 federal programs that promote telecommunications development and the use of advanced technology.[29] Most of those programs focus specifically on rural communities or low-income communities, or both, though some have a broader focus on using technology to improve schools, libraries, or health care facilities. The CRS report projects FY 2001 support for these programs at just under $1.2 billion for direct funding and an additional $620 million in loans and loan guarantees.[30]

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Bush Administration Proposals to Promote Advanced Services

With the Bush administration's new budget, some of the federal assistance programs mentioned in the CRS report are likely to change. For example, the administration proposes a $3 billion Enhancing Education through Technology Fund that would combine the E-rate with eight technology programs managed by the Department of Education. What has not changed is the consistent theme of generous federal spending on advanced technology for schools, libraries, and other community institutions (see Table 1).

Another Federal Role? The Benefits and Costs of Tax Credits

Many observers are concerned about the potential negative consequences if broadband service fails to reach rural and low-income communities. The FCC's First Report observed that a lack of broadband infrastructure "could limit the potential of these communities to attract and retain businesses and jobs . . . [and] could restrict community access to education, healthcare, and recreational services."[31] But the agency stopped short of recommending any action, noting, "At this early stage, deployment may be proceeding quickly enough to be considered 'reasonable and timely' even if we have not yet reached the ultimate goal that all Americans have meaningful access to advanced telecommunication services."[32]

Congressional sponsors of broadband tax credits share the FCC's concerns about a potential lack of infrastructure while not sharing its optimism regarding the pace of deployment. Hence, tax credits and other subsidies receive considerable attention in Congress. Supporters of these programs make claims that are well represented by the following quote:

> The services available at higher speeds will truly revolutionize and improve our daily lives. Children can download educational video in real time. Adults can train for new jobs from their homes. Complex medical images such as MRIs and x-rays that today take several minutes to download can be transmitted in seconds. Telecommuting, business teleconferencing, and personal communication will all rise to new levels.[33]

Such language helps illustrate the fact that broadband tax credits for rural and low-income areas may have two quite different sets of beneficiaries—first, institutions such as small businesses, schools, libraries, and health care providers and, second, individual households. While tax credits to promote broadband service could affect one or both of these groups, it is important to remember that they are not the same.

Consider first the case of small businesses, schools, libraries, and health care providers in low-income and rural areas. Tax credits or other subsidies aimed at bringing broadband to these communities may be noble, but they are not necessary. Numerous programs already exist to promote broadband services to these communities, including the aforementioned universal service programs and the E-rate administered by the FCC, rural telephone subsidies and loan programs administered by the Rural Utilities Service, and technology programs administered by the National Telecommunications and Information Administration.

With so many federal programs already in place to promote advanced telecommunications to these groups, a broadband tax credit is neither innovative nor necessary. In addition to these federal programs, various state and local programs help provide advanced telecommunications services to schools, libraries, and health care providers. To the extent that these programs are more closely tailored to the individual needs of their local communities, they may better provide for those institutions that will benefit most from broadband and other advanced services.

Table 1
Federal Programs to Promote Telecommunications Development and Internet Access, FY 2001

Program	Agency	Estimated FY 2001 Funding ($ millions)
Technology Opportunities Program	National Telecommunications Information Administration, Department of Commerce	45.12
Rural Telephone Loans and Loan Guarantees	Rural Utilities Service, Department of Agriculture	
Hardship loans		50
Cost-of-money loans		300
Federal Financing Bank treasury loans		120
Rural Telephone Bank Loans	Rural Utilities Service, Department of Agriculture	175
Distance Learning and Telemedicine Loans and Grants	Rural Utilities Service, Department of Agriculture	
Grants		20
Loans		200
Community Technology Centers Program	Office of Vocational and Adult Education, Department of Education	10
Technology Literacy Challenge Fund Grants	Office of Elementary and Secondary Education, Department of Education	450
Technology Innovation Challenge Grants	Office of Assistant Secretary for Educational Research and Improvement, Department of Education	78.233
Star Schools	Office of Assistant Secretary for Educational Research and Improvement, Department of Education	50.55
Telecommunications Demonstration Project for Mathematics (FY 2000)	Office of Assistant Secretary for Educational Research and Improvement, Department of Education	8.5
Regional Technical Support and Professional Development Consortia (FY 2000)	Office of Assistant Secretary for Educational Research and Improvement, Department of Education	10
Special Education—Technology and Media Services for Individuals with Disabilities	Office of Special Education and Rehabilitative Services, Department of Education	34.523
Rural Telemedicine Grants	Health Resources and Services Administration, Dept. of Health and Human Services	5
Medical Library Assistance	National Library of Medicine, National Institutes of Health, Dept. of Health and Human Services	50.371
State Library Program	Office of Library Services, Institute of Museum and Library Services, National Foundation on the Arts and Humanities	151.78
Native American Library Services	Office of Library Services, Institute of Museum and Library Services, National Foundation on the Arts and Humanities	2.616
Denali Commission Program	Denali Commission [infrastructure grants for distressed Alaskan communities]	49

Source: Lennard G. Kruger, "Broadband Internet Access and the Digital Divide: Federal Assistance Programs," CRS Report for Congress, Congressional Research Service, Updated January 26, 2001, Table 2.

Unfortunately, many legislators confuse the value of access with the value of broadband.

Finally, it is worth noting that private foundations also play a prominent role in improving access to advanced telecommunications services such as broadband. For example, Bill and Melinda Gates established the Gates Library Foundation in 1997 to provide the computers, training, and technical support needed to bring the Internet to public libraries. Just as Andrew Carnegie helped to establish so many public libraries a century ago, today Bill and Melinda Gates are making these institutions more relevant and effective. The Gates Foundation established this program with a $200 million commitment, and Microsoft has made a commitment of an additional $200 million in software.[34]

This combination of federal, state and local, and private foundation support—and perhaps most important, the support from the private companies that actually provide broadband service—has had a profound effect. A recent report from the U.S. National Commission on Libraries and Information Science observed that, for public libraries as a whole, access to the Internet has increased from 83 percent to more than 95 percent in just the last two years. Rural areas are not far behind the national average; they demonstrated an even greater increase in their public libraries' Internet access, which rose from 78.4 percent to 93.3 percent in the same period.[35] The goal of providing community access to the Internet through public libraries is being met, even in rural America.

A tax credit to bring broadband to the second group, individual households, is a very different story. If small businesses, schools, libraries, and health care providers form a critical infrastructure in their communities, and if broadband service is necessary for their effectiveness, then it makes sense to be concerned about their rate of access to this technology. Whether it makes sense for government to further subsidize this access is another matter, though, since such support already exists and is, in fact, increasing. But for individual households, it is less clear what is needed. Most legislators—and most everyone else, for that matter—fail to make the distinction between the two categories under discussion.

Unfortunately, many legislators also confuse the value of access with the value of broadband. Consider the description of one Senate proposal to promote broadband infrastructure in rural areas: "This is a cost-effective measure that will assure that the Internet is a local call away, because too many families and businesses have to dial long-distance to connect to the Internet."[36] Such claims confuse the issue. When families and businesses have to make a long-distance call to connect to the Internet, the problem isn't a lack of broadband; it's a lack of any local ISP. This is particularly true in rural areas. Such areas need local access even more than they need broadband, however desirable high-speed service may be.

Ultimately, broadband is better. But it is also more expensive. Universal access to the Internet is the first—and most important—step. Broadband access to the Internet will follow, as it is already beginning to. Yet to the dismay of observers across the political spectrum, broadband has not surpassed slower, narrowband Internet service.[37] Perhaps consumers do not feel the need for online speed. Perhaps they do not yet desire the information-rich content that comes with broadband. To be sure, as more people do business, conduct research, consume entertainment, and simply interact with high-speed services, the demand for broadband will spread to an increasing number of consumers. The providers of broadband service realize this and, as a result, are making tremendous investments to profit from the expected future demand.

In short, a significant amount of government support exists to bring broadband to small businesses, schools, libraries, and health care providers, especially those in rural and low-income areas. A significant amount of private investment also exists to bring broadband to those institutions and to individual households. What would an additional government program contribute beyond those efforts, and to what extent might the costs outweigh the benefits?

The Costs of a Broadband Tax Credit

The Cost to Taxpayers

The Congressional Budget Office, as of this writing, has not scored the broadband tax credit bills currently before Congress, nor did it estimate the costs of the bills offered in 2000.[38] However, two of the bills currently under consideration—S. 88, sponsored by Sen. John D. Rockefeller IV (D-W.Va.) and H.R. 267, sponsored by Rep. Philip S. English (R-Pa.)—are essentially the same as a broadband tax credit bill that the Joint Committee on Taxation has estimated would cost more than $1.4 billion over 10 years.[39] All of these costs would be incurred in the first 5 years of the program.

While $1.4 billion may seem small compared to the trillions of dollars of federal spending expected over the next 10 years, it is a considerable sum. It will be raised by cutting some other program, by raising taxes, or by denying already-promised cuts to individual taxpayers. Perhaps more significant, however, other costs will be imposed on the providers and the consumers of broadband Internet access. These costs raise the probability that tax credits and similar subsidies will be counterproductive—that despite their proponents' best intentions, they will hinder rather than help advance access to broadband services. A few of these other costs are outlined here.

Politicizing a Dynamic Industry

Of the tools at the disposal of Congress to promote broadband service—tax credits and other subsidies, regulation, and deregulation—tax credits and subsidies are unique. More than regulatory or deregulatory policy changes, tax credits meet the needs of politicians. The burden of such tax credits is spread across all taxpayers. In contrast, the benefits are focused on a few companies that will be clearly identified, that will tout the jobs created by their new investment (allowing politicians to be seen as job creators), and that will have greater incentive to be politically active in the future (allowing politicians to count on future campaign contributions). In contrast, few legislators are remembered or rewarded for "heroically" removing the regulatory burdens that stifle economic growth. Even if the long-term interests of consumers require deregulation rather than subsidization, the short-term interests of legislators may lie elsewhere.

That public policies such as tax credits affect special-interest groups goes without saying; one need only look at the lobbying forces arrayed in favor of such programs. Where are the voices clamoring for restraint, in the interest of taxpayers? To the extent they exist, they have no presence among Washington lobbyists.

More than regulatory or deregulatory policy changes, tax credits meet the needs of politicians.

Creating a Never-Ending Subsidy

Although the deployment of broadband to virtually all Americans is likely to take a fraction of the time it took to deploy electricity, there is one aspect that the two may have in common. Increasingly, it appears that Congress will attempt to establish what essentially would be a never-ending subsidy program for broadband, much as it has for electrical service.

The story of electricity subsidies in America is a classic tale of a government program that will not die, even after its original objectives have been met. In 1936 Congress created the REA to promote electrical service in rural areas. Today electricity service is ubiquitous, even in rural America,[40] but the need for the REA is seldom questioned. In fact, the agency is bigger than ever, having become the Rural Utilities Service, which now has the mission of promoting the development of electricity, water, and telecommunications service in rural America.[41]

It is reasonable to expect that the proposed tax credits for broadband development will, like the REA, become a permanent federal subsidy. Indeed, some legislators have expressed their desire to establish an "REA for telecom."[42] But the REA is the wrong model to follow. Providing electricity to rural areas was extremely expensive. There was only one way to get electricity to these or any other areas—by running wires to each home. But because there are different ways of delivering broadband to rural areas, with the most costly elements of the infrastructure already in place, the REA experience has little relevance. Indeed, subsidization may lead to a situation wherein we have a single provider, which is forever dependent on government support. The REA model runs the risk of creating another never-ending subsidy.

Unbalancing a Competitive Industry

Proponents of tax credits and other government subsidies often advocate these programs as a "technology neutral" approach to promoting private investment. This means that no technology or provider would be favored over any other. And the truth is that broadband tax credit proposals before Congress generally have been written to make their tax credits available to any provider of broadband infrastructure, regardless of technology.

However, although industry analysts refer to these proposals as technology neutral, those same analysts provide an outline of potential corporate winners and losers under such a policy.[43] This is what good investment analysts do—they provide outlines of how a proposed policy would improve or diminish the business models of various players in an industry. Investors respond accordingly. Yet when analysts and investors decide that one technology or set of providers will do well as a result of a proposed government policy—especially compared with other technologies—the claim of technology neutrality loses its credibility.

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Under the current proposals, the big winners are expected to be providers of network equipment, especially computer chips that allow broadband to be supplied over standard telephone lines and cable systems.[44] This indicates that the existing dominant suppliers of broadband services (e.g., telephone and cable systems) will benefit from the proposed rules. That is, if investment analysts predict that the companies that supply equipment to DSL (digital subscriber line) and cable modem providers will benefit, that is because the providers themselves are expected to benefit.

Such a result is not neutral. While broadband services offered by telephone and cable operators will continue to reach more people, they will be challenged over time by new technologies. And what attracts new competitors is the ability to make a profit by offering lower prices or better service to the existing providers' current customers, or by serving customers whom those providers have yet to serve. Government programs that benefit existing providers ultimately reduce incentives to develop advances in service. This is especially true for customers who may be expensive for the existing providers to serve, such as rural customers who desire broadband service from their local telephone or cable company.

Thwarting Potential Competitors

The fact that a tax credit for broadband is not technology neutral is not simply an academic problem; it has real consequences for Internet users, especially those in rural areas. Not only may some firms gain a competitive advantage from the tax credit, as discussed earlier, but that advantage creates a disincentive for new technologies, since existing providers can use their tax credit to finance construction, despite the fact that they employ older technology.

Right now, telephone and cable providers are offering broadband in select markets, and satellite television and other providers are in the process of launching their own broadband services. As the existing telephone and cable operators improve their systems to offer broadband beyond the largest markets, they must compare their expected revenues in the more rural markets with the expected costs. Tax credits and subsidies, by definition, help to lower those costs.

Ironically, however, lowering the cost of serving a particular area may not be in the best interests of the customers who live there. One provider may be able to immediately take advantage of the tax credit, thus thwarting potential competitors who see too few remaining customers to justify entering the market. For example, consider how tax credits may make it possible for an existing cable or telephone provider to extend its broadband services to those living in midsized towns or in less-populated areas just beyond the larger cities. While this would be a great benefit to previously unserved customers, those in smaller towns remain unserved and, ironically, are more likely to stay that way. The reason is that residents of small and midsized towns and remote households are a viable market for new providers—especially the wireless carriers that have built their business plans around those markets—but federal programs that finance their competitors makes it less profitable for them to enter the market.

Such a loss of competitors, though subtle and seldom seen, can be more harmful than first appears. No one knows what technologies will best provide broadband; that is, no one knows how supply will be shaped over time. All that is known is that tax credits have an effect on who supplies what. If this effect means some of the most efficient technologies—for example, wireless services in rural areas—are not offered, customers incur real costs that may persist indefinitely.

The Sum of All Errors (in economics at least)

An economic fallacy is committed whenever government promotes the benefits of a particular program without counting fully the associated costs. Some of these costs—such as the loss to consumers of new technologies and new providers that never materialize—cannot be seen at all. They represent benefits that do not exist, and cannot exist, because they have been prevented by policy.

This lesson was first put forth by French economist Frederic Bastiat more than 150 years ago.[45] It was aptly summarized a century later by economist Henry Hazlitt as follows: "In studying the effects of any given economic proposal we must trace not merely the immediate results but the results in the long run, not merely the primary consequences, but the secondary consequences, and not merely the effects on some special group but the effects on everyone."[46] This important lesson should not be forgotten as policymakers debate broadband tax credit policy.

The Role of the Market: Current Providers

Before evaluating the wisdom of government support for broadband service, policymakers must first understand the broadband market. And in order to understand the broadband market, they must have a clear picture of the providers and technologies that make this service available today as well as those that may provide it in the near future. They also must know a little about the customers who buy this service, those who would like to have it but are for some reason unserved, and those who may be customers in the future. In other words, policymakers must understand both the supply and the demand sides of the market.

Current Technologies for Basic Internet and Broadband Service

Dial-Up Connection: The most common means of accessing the Internet is through a dial-up connection that uses a standard telephone line and a 56K or slower modem.[47] This "narrowband" service is slower but also less expensive than broadband service. It can be had for little or no cost by using an existing telephone connection and a local ISP such as AOL (America Online), MSN (Microsoft Network), or Earthlink.[48] As of August 2000, about 90 percent of Americans on the Internet used 56K or slower modems, making narrowband service by far the most popular way to access the Internet.[49]

Increasingly, Internet users are turning to higher-speed broadband services that transmit data at much faster rates. The most common technologies currently used to deliver broadband are DSL, which transmits via a standard

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telephone line, and cable modem, which transmits via a cable television connection.

DSL: This technology converts standard "twisted copper pair" telephone lines into high-speed digital lines. The most popular DSL technology is asymmetric digital subscriber line (ADSL), which offers up to 8 megabits per second (Mbps) for downstream transmission and 1 Mbps for upstream transmission.[50] While the average downstream speed will be between 1.5 mpbs and 8 mpbs, this still is many times the speed offered by a 56K modem.

DSL technologies have several useful characteristics, including (1) "always-on" service, meaning there is no need to dial up, (2) simultaneous access to both the Internet and the voice or fax capabilities of the telephone line, and (3) a dedicated line between the customer and the central office, that is, a line that is not shared with other users. The most notable disadvantage is that the service can extend only approximately three miles from a telephone company's switching office.[51] While 80 percent of local telephone customers reside within this range, it nonetheless excludes some customers, especially those in more remote areas.[52]

Access to the Internet is growing so quickly that it is almost impossible to portray accurately the level of access at any point in time, and most observations are likely to be outdated by the time they are reported.

Cable Modem: This technology modifies the existing, one-way cable transmission lines of a cable network to provide a two-way connection to the Internet at very high speeds. While performance varies across cable systems, the industry claims that downloading at 1 to 3 Mbps is realistic, and speeds of up to 27 Mbps are possible. For uploading data to the Internet, the industry claims speeds of 500 Kbps to 2.5 Mbps are realistic, with 10 Mbps possible.[53] The advantages of this technology are similar to but not the same as the advantages of DSL. Cable modems offer (1) "always-on" service, thus no need to dial up, and (2) simultaneous access to both the Internet and cable television.

As opposed to DSL services, cable modems use networks that group nearby houses together and then link them to an Internet connection. This shared connection can result in slower speeds when many users transmit simultaneously[54] and raises security concerns with some users.[55] On the other hand, this technology is not limited to a three-mile range from switching facilities, as DSL technology is, which as a result gives cable modems a further "reach."[56]

Significantly, both DSL services and cable modems offer a key development of interest to lawmakers, regulators, and others who follow the state of competition in the local telephone and cable television markets. A cable modem gives an average home an extra two-way connection, a potentially useful first step for cable providers interested in providing telephone service. For their part, local telephone companies are increasingly likely to compete with cable, especially as some DSL technologies permit applications such as interactive multimedia and video on demand.

Current Customers of Basic Internet and Broadband Service

In order to know who has access to the Internet, the following questions must be answered: How many people own computers or other devices needed to access the Internet?[57] How many people have access to narrowband (dial-up) services or broadband services? Commerce, the FCC, and numerous private organizations recently have attempted to answer those questions.

One note of caution, however: Access to the Internet is growing so quickly that it is almost impossible to portray accurately the level of access at any point in time, and most observations are likely to be outdated by the time they are reported. For this reason, the data reported here most likely understate the current rate of access to the Internet in general and broadband in particular.

The Department of Commerce has issued four reports on access to the Internet and technology. The latest, *Falling through the Net: Toward Digital Inclusion,* released in October 2000, estimates that 116.5 million Americans were online at some location as of August 2000. About 43.6 million households (41.5 percent of the U.S. total) were online, and an estimated 53.5 million households (51.0 percent of the U.S. total) had computers as of August 2000.[58]

Other sources provide more recent estimates that include data through December 2000. Each uses a slightly different methodology and thus presents numbers that do not compare directly with those of the Commerce study, yet all show a large and rising popuflation of Internet users. A forecast by eTForecasts estimates that 135 million Americans had Internet access in the United States in 2000.[59] ACNielsen estimates that 168 million Americans had access to the Internet from their homes as of April 2001.[60] The Pew Internet and American Life Project estimates that at the end of last year 104 million American adults, or 56 percent of those 18 or older, had Internet access. The project estimates that that 73 percent of those aged 12–17 had Internet access.[61]

In the broadband market, the number of subscribers almost quadrupled during the 12 months from December 31, 1999, to December 31, 2000. There were an estimated 2 million broadband subscribers at the beginning of the year[62] and almost 8 million 12 months later. Kinetic Strategies, an analytical service that focuses on the cable industry and publishes CableDataCom, estimates that about 7.8 million households received this service at the end of 2000. Cable modems were used by about 5.5 million of those customers while DSL served most of the remaining 2.3 million.[63] A prominent DSL data source argues the DSL providers had more than 2.4 million subscribers by year's end.[64]

Clearly, these figures are rough estimates, as there is no simple way to measure Internet access. And this difficulty will only increase. For example, more and more people are using personal digital assistants (PDAs) with Internet capabilities, such as Palm Pilot's Palm VII and its numerous competitors. Those users may have home computers with Internet access, or they may rely solely on their PDAs for access. Equally hard to measure is the number of people who have access to the Internet at work and use it as a substitute for household access. Many companies provide employees with high-speed Internet access that is superior to DSL or cable. Such benefits may be sufficient incentive for some employees to forgo Internet access at home, though that does not make those individuals technology have-nots.

Despite the wide range of estimates, the data consistently show a large and growing population with Internet access—whether broadband or narrowband. Commerce's estimate of 116.5 million Americans online represents an increase of 37 percent in the 20-month period from December 1998 to August 2000.[65] Telecom Reports estimated that the number of Americans online increased more than 50 percent during the 12 months ending December 31, 2000.[66] ACNielsen estimated that during the last part of 2000 almost 5 million new subscribers were added every month.[67]

Perhaps most significant, as growth in Internet access has continued, it has spread beyond the wealthy and techno-savvy to more and more demographic groups. Counting households, not individuals, the Pew Internet Project observes that "16 million newcomers gained Internet access in the last half of 2000 as women, minorities, and families with modest incomes continue to surge online."[68]

Still, concerns remain. The Department of Commerce, for example, expresses concern that some groups, especially those in central-city households,[69] have access rates that falls below those of other groups. As discussed earlier, this is the essence of the "digital divide." Yet Commerce is almost schizophrenic as it applauds the gains in access for all groups—including the least advantaged—while pointing out the gaps in access that remain between demographic groups. At the same time that it recognizes that "large gains occurred at every income category, at all education levels, among all racial groups, in both rural and urban America, and in every family type,"[70] the study is careful to add that "divides still exist between those with different levels of income and education, different

As growth in Internet access has continued, it has spread beyond the wealthy and techno-savvy to more and more demographic groups.

The real story is in the rapid increase in service to all, which drives the decrease in the digital divide.

racial and ethnic groups, old and young, single and dual-parent families, and those with and without disabilities."[71]

While this underlying concern may reflect good intentions, it lacks perspective. The exceptional growth in access for all consumers, including the least advantaged, has made the "digital divide" both smaller and less relevant. This point is best illustrated by the following observation from Commerce's data: rural and central-city households that have comparatively low rates of Internet access have higher access rates today than their wealthy urban counterparts had less than two years ago. This point can hardly be overstated. In 1998 an estimated 27.5 percent of urban households had Internet access, more than rural or inner-city households.[72] In 2000, less than two years later, 38.9 percent of rural households and 37.7 percent of central-city households had Internet access. Of course, urban households continued to increase their access as well, which stood at 42.3 percent in 2000.[73] But the strong growth for all groups persists. The access rates for less-fortunate rural and central-city households almost certainly will surpass in a few months the rates of their wealthier urban counterparts today.[74]

Similarly, computer ownership rates for rural and central-city households in 2000 exceeded the computer ownership rates for urban households in 1998. And in 1998 computer ownership rates for rural and central-city households exceeded the rate for urban households in 1997, just one year earlier.[75] By this measure, the lag for less-fortunate households may be a matter of months.

Indeed, this trend suggests the swiftness with which new technologies such as broadband will reach every American who wants them. The Commerce study reached a similar conclusion: "If computer ownership provides any pattern, we may soon see some stabilization and perhaps even narrowing of the Internet divide."[76] Technologies are being adopted by an increasing number of consumers and are on track to eventually become ubiquitous.[77]

As the Commerce study recognizes, there are two effects of this far-reaching growth: (1) a fast increase in the rate of access for each demographic group and (2) a steady decrease in the relative gap between the groups. This distance between demographic groups is the digital divide, and, as both the FCC and the Department of Commerce reports indicate, it is decreasing. But the real story is in the first effect, the rapid increase in service to all, which drives the decrease in the digital divide. It is a story that has played itself out time and again as a new technology becomes increasingly affordable, working its way from novelty item for the rich to necessity for the masses.

Industry Growth and the S-Curve

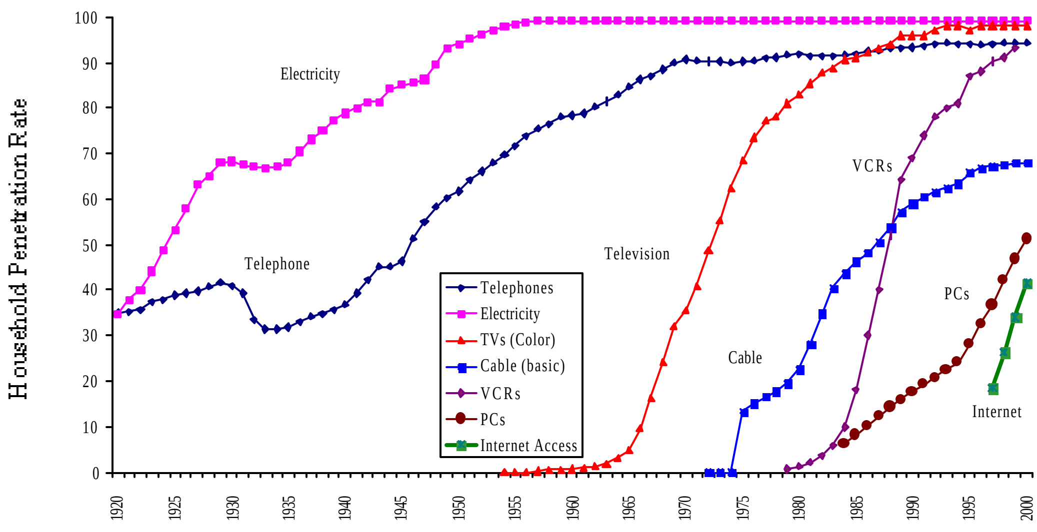
The rise in use of a new technology—as seen in computer ownership, access to the Internet, and many other phenomena—tends to follow an established pattern. This pattern is well described by the standard S-curve, which is depicted in Figure 1.

At first, the number of users is low, both in aggregate and as a percentage of the total population. From this low base, the number of users then grows quickly, as shown in the lower part of the S-curve. Later, the total number of users continues to grow, but less rapidly, as shown in the points beyond the middle of the S-curve. Finally, as the total number of users approaches the entire market for the technology, the growth rate virtually stops. In more colloquial terms, the technology is unknown at first and adopted only by the rich, the technically expert, and the curious. As it becomes familiar to more people, easier to use, and, perhaps most important of all, easier to afford, the technology is adopted by more and more people. Finally, only a few new customers come forward, as most people who want the technology have it.

This explanation, and the S-curve that describes it, corresponds to the experience of many technologies that have been used for

Figure 1
The Standard Technology S-Curves

Figure 2
S-Curves for Various Technologies



Sources: Data on telephone and electricity industry, 1920–1970, from U.S. Department of Commerce, *Historical Statistics of the United States: Colonial Times to 1970, Part 2* (Washington: Government Printing Office, 1975), p. 783. Cable data from ACNielsen Co. as reported by the National Cable Television Association, www.ncta.com. Data on VCRs, personal computers, and television from Consumer Electronics Association, E-Brain, http://www.ebrain.org. Internet data from U.S. Department of Commerce, http://www.ntia.doc.gov/ntiahome/fttn00/chartscontents.html.

The latest technologies, including computer use and access to the Internet, are being adopted at a faster rate than the technologies of only a generation or two ago.

years, as well as some that are new. Some of the most important "new" technologies of the 20th century are depicted in Figure 2. Electricity and telephone service advanced considerably more slowly than did more recent technologies such as cable television, personal computers, and the Internet.[78]

Electricity and telephony faced the necessity of building large networks, the enormous capital costs of those networks, and extensive government regulation and subsidization. Computers and the Internet are much more recent technologies and thus have not advanced as far along their respective S-curves. That is, they have not been adopted to the same degree as older technologies such as television and telephones.

A quick glance at Figure 2 illustrates an important phenomenon: the S-curves of more recent technologies are steeper than those of older technologies. That is, the rate of adoption of newer technologies—VCRs, cable television, computers, Internet access—is notably faster than it was for older technologies. Several factors may explain this experience, including, among others, (1) a wealthier population with greater disposable per capita income, (2) more efficient marketing and distribution channels, (3) lower fixed capital costs per customer, and (4) a less-burdensome regulatory environment than was experienced by older technologies.

In short, the latest technologies, including computer use and access to the Internet, are being adopted at a faster rate than the technologies of only a generation or two ago. This has important implications for policymakers concerned about technology "haves" and have-nots. For a technology that requires a generation or two to reach the vast majority of a population, a considerable lag may exist from the time the most fortunate acquire it to when the less fortunate do so. For a faster-disseminating technology, this time lag may be only a few years, or even months. As noted earlier, this lag can be remarkably brief.

The relevant questions for policymakers, then, are, Where are various demographic groups in their adoption of this new technology, and what will help them acquire it more rapidly? The Commerce study argues that the wealthiest households—those with incomes greater than $75,000 per year and at least a college degree—already "have reached the flattening stage of the S-curve."[79] Other demographic groups lag behind, however briefly. It is worth understanding this lag and what shortens it.

A recent study by the General Accounting Office underscores how price influences Internet access. The study was initiated specifically to address concerns about a possible digital divide and thus examined demographic characteristics of Internet users as well as details on ISPs and the availability of broadband.[80] As a technology that has been generally available to household consumers for only a short time, broadband has a much lower penetration rate than does narrowband service. In short, broadband is much lower on its S-curve than narrowband, as might be expected with a newer technology. And according to the GAO, income is one of the most significant characteristics driving adoption of broadband service: "We found no differences in marital status, household size, race, Hispanic origin, education, or employment, between narrowband and broadband subscribers. However, we did find a statistically significant difference with respect to income."[81] Furthermore, the GAO survey revealed that about 80 percent of those with dial-up, or narrowband, service would not be willing to pay more than $10 extra per month to upgrade to broadband.[82] The GAO's summary provides a useful perspective on the issue:

> Some of these findings suggest the existence of a "digital divide" at this time. However, it is often the case that individuals with greater education and income are the first to adopt new technologies, and individuals in rural areas are the last to be reached by the deployment of new telecommunications infrastructure.

> Since the Internet is still in a relatively early stage of commercial deployment, these socioeconomic and geographic differences in Internet usage are not surprising and may not be long lasting. The challenge for policymakers over the long run will be to determine whether any *continuing* disparities in the availability and use of the Internet among different groups of Americans threaten to deepen the socioeconomic divisions within our society.[83]

It should come as no surprise that income plays a critical role in the adoption of broadband or even narrowband, as it has for so many other technologies. This is related to the high prices associated with the latest technology, as the GAO report acknowledges. Those with high incomes are less deterred by high prices and more able to try the latest thing. As prices fall somewhat, a few more people subscribe; as prices fall further, even more people follow. Consider the example of another technology, one that is nearly commonplace today: A decade and a half ago mobile phones were scarcely used, with about 100,000 subscribers. Last year subscribership reached 100 million. Over the same period of time (1984–99), the average price for a mobile phone went from $2,000 to less than a tenth of that, about $180.[84] And, of course, this does not measure the quality of service, which has improved dramatically. Looking only at the price paid for the service, as price fell to a tenth its original level, subscribership rose by a factor of one thousand.

At the same time, it is worth noting that price is not the only factor involved. The Commerce study reports that, as of August 2000, there were 8.7 million households with computers but no Internet access, and the most common reason given for not having access was that it was not wanted.[85] This despite the real advantages of connectivity. As Brooking Institution economist Robert Crandall observes:

> It is also possible, even likely, that households on the wrong side of the digital divide would improve their educational, cultural, and professional status if they owned a PC and connected to the Internet. But such improvements are internal to these households and do not call for extraordinary market incentives for them to be connected. Households can choose for themselves.[86]

This is particularly true given that those people choosing not to use the Internet simply may be the tail end of a transition. The Department of Commerce study notes that the two groups with the lowest Internet use rate are children below that age of 8 years and nonworking adults above the age of 50.[87] The Pew Internet and American Life Project provides more detail, estimating that 87 percent of Americans 65 years of age or older do not have Internet access. Of those not online, most see little benefit in the Internet and consider it a dangerous thing.[88] In short, this is a generational divide. For another generation or so, no one should expect the market for Internet access to approach the nearly 100 percent penetration rate that is seen with electricity, or even the quite high rate for telephones. Not all people or all households will want the technology, especially in this early stage. Over time, of course, most will have an interest, and they will access the Internet as doing so becomes increasingly affordable.

For that reason, the experience with mobile telephones is instructive: The best way to shorten the lag in adoption for most people is to lower the price. As noted earlier, government subsidization may lower the price for some technologies, but with potentially negative effects, including the risk of eliminating new competitors. Competition between the existing providers, and that from new providers, may do much more to lower price, increase quality of service, and ultimately reach more households. The next section describes some of the potential new providers.

A decade and a half ago mobile phones were scarcely used. Last year subscribership reached 100 million.

Satellite service may be the most anticipated new technology coming to the broadband market and one that is likely to help attract many new subscribers.

The Role of the Market: Future Providers

New Technologies for Broadband

About 90 percent of all households with Internet access use narrowband (dial-up) connections, and 10 percent have broadband connections, according to August 2000 data.[89] DSL and cable modems provide most of those connections, serving more than four of five broadband subscribers.[90] Nonetheless, many telecommunications industry observers, analysts, and providers expect multiple firms—and multiple technologies—to provide broadband in the future. In fact, the future is here. Some of the new technologies listed below are available today. Others are just around the corner. Most present an opportunity that was notably absent from the early experience with electricity and telephone service—the ability to reach rural households more easily. And the added competition means there is a greater chance the price of service will fall more quickly than if broadband were left to fewer providers.

Satellites

Satellite service may be the most anticipated new technology coming to the broadband market and one that is likely to help attract many new subscribers. The largest distributors of two-way broadband Internet service are affiliated with DirecTV and EchoStar, the market leaders in satellite television.[91] Both offer service that allows receipt of satellite television and Internet signals from a single dish.

DirecTV, the largest satellite television provider in the country, has recognized for some time that broadband Internet access can complement satellite television. In fact, DirecTV has offered several versions of broadband satellite service, but until now the satellite transmission could be used only for downloading data. Because uploading to the Internet was accomplished through a standard narrowband telephone connection, the service was less efficient and less marketable than it would be with two-way broadband service via satellite.

DirecTV's broadband Internet service, DirecPC, announced that for 2001 its latest version will provide two-way satellite transmission of data at speeds up to 400 Kbps for downloading and 128 to 256 Kbps for uploading.[92] Like its DSL and cable modem competitors, satellite Internet offers an "always-on" (no dial-up) capability. The service also allows for simultaneous use of the satellite television and broadband Internet capabilities.

DirecPC will partner with Pegasus, a satellite television distributor with a strong rural presence, as well as ISPs EarthLink and Juno. The firm's business model also includes the acquisition of Telocity Inc., a leading provider of Internet access via DSL connections. Such partnerships will help give DirecPC what the *New York Times* calls "a legitimate high-speed Internet option."[93] With the 9 million satellite television customers of DirecTV and the Internet experience of some of its new partners, DirecPC is well positioned to compete aggressively in the broadband market.

EchoStar's DISH Network is the second-largest satellite television provider and the first to provide two-way broadband access to the Internet via satellite. The firm's new service, StarBand, operates much like the DirecPC system, with a single dish providing both satellite television and Internet access. It also advertises itself as the first broadband satellite service available and currently is offered anywhere in the continental United States, with service to Alaska, Hawaii, and Puerto Rico expected in the next year.[94]

StarBand offers downloading at speeds up to 500 Kbps and uploading at speeds up to 150 Kbps, similar to speeds with DirecPC.[95] At $69.99 per month, plus installation and equipment, StarBand is more expensive than many cable and DSL services. Still, it is reasonable to expect that StarBand's price will fall as DirecPC extends operations and cable and DSL operators expand their services.

Indeed, two-way satellite broadband is an infant industry. A StarBand press release announces that "in just over one year, StarBand has gone from a business plan to over 25,000 subscribers."[96] But the real news is the system's reach, since its new subscribers include "customers throughout all 48 states in the continental U.S.—from the Havasupai Indian tribe surfing at the bottom of the Grand Canyon to an investment banker in a New York City Park Avenue penthouse."[97] More significant yet is the firm's plan to reach rural America. In March of this year, StarBand announced it had formed a strategic partnership with the National Rural Telecommunications Cooperative. StarBand and the NRTC claim this partnership "will make it possible and easy for the Cooperative's more than 20 million consumers to join the high-speed Internet revolution."[98] The expectations are big but not unreasonable. As Bob Phillips, NRTC's chief executive officer, puts it, this broadband service "will help close the 'circle of connectivity' for rural America."[99]

Even in the satellite broadband market, DirecTV and EchoStar are expected to be challenged by other competitors. Chief among them is Teledesic, a new venture that will use a global network of satellites to provide Internet access virtually anywhere on the planet. While service is not expected to be available until 2005, the Teledesic satellites, once launched, will offer transmission speeds well in excess of those currently available, downloading at up to 64 Mbps and uploading at up to 2 Mbps.[100]

The Teledesic business model is unique and, to some extent, unproven. It uses more than 200 low-earth-orbit (LEO) satellites that circle the earth constantly at less than 1,000 miles up rather than geosynchronous-earth-orbit (GEO) satellites that remain at a fixed point 22,000 miles above the equator.[101] Both EchoStar and DirecTV transmit via high-altitude GEO satellites, which are more expensive but, because they stay in place and cover a fixed geographical area, need not work in tandem with multiple moving satellites. The Teledesic model also requires additional infrastructure on the ground, as its satellites transmit not to individual customers' dishes but to commercial receivers that forward the signal to the customer. The method used to forward the signals will vary by location and is obviously an important variable in the potential success of the Teledesic project.

Furthermore, transmitting through a global network of LEO satellites worries some observers, given the well-known failure of a previous LEO satellite business, Iridium. However, that company's business model was built on providing worldwide voice communications and required cumbersome, heavy hand-held units.[102] In contrast, the Teledesic business model is built on providing worldwide Internet access. Perhaps as important, the Teledesic venture benefits from the combined experience of investors such as Bill Gates, Craig McCaw, Motorola Corporation, and Boeing Corporation.

Fixed Terrestrial Wireless

In addition to DSL, cable modem, and satellite service, another type of broadband provider may soon be available. Wireless terrestrial services, also known by the oxymoron "wireless cable," use technology similar to cellular telephone technology, transmitting signals short distances—20 to 30 miles—from land-based towers. The technology is limited by this transmission distance and by a line-of-sight requirement, meaning the customer's receiver must not be blocked from the transmission tower by terrain, buildings, or other obstacles. Terrestrial wireless operators can overcome these limitations to some extent by building multiple transmitters in a given area, much like a cellular telephone network. Indeed, the ability to cover an area with a handful of towers—rather than installing thousands of miles of wire—is a competitive advantage of this technology.

One potential wireless terrestrial broadband competitor, Broadwave USA, has a business model that includes providing both broadband and video.[103] This is a familiar

Even in the satellite broadband market, DirecTV and EchoStar are expected to be challenged by other competitors.

Some analysts predict that worldwide Internet customers will number just below 1.2 billion by 2005, of which 700 million will be wireless users.

approach to both the major satellite television and cable providers—combining high-speed Internet access, video, and as many other related telecommunications services as possible in an effort to provide a one-stop shop for consumers. In addition, two of the largest fixed wireless providers, WorldCom and Sprint, paid more than $1 billion in 1999 to purchase wireless operations in select cities, part of their effort to build a broadband wireless local loop. The Sprint and Worldcom business plans focus on residential and small business customers located outside the areas served by DSL technology.[104] Although the technology is not universally available, operators with wireless or broadcast interests have implemented it in a number of cities, including Allentown, Pennsylvania; Colorado Springs; Dallas; Denver; Detroit; Fairbanks, Alaska; Jackson, Mississippi; Mobile, Alabama; New York; Phoenix; Portland, Oregon; and Rochester, New York.[105]

Because wireless terrestrial applications are relatively new, they have problems that are less common in more established technologies. For example, satellite providers argue that the NorthPoint technology used by BroadWave USA interferes with their signals, and regulatory and legislative hurdles have plagued development of the company's technology.[106] Recently, however, the FCC affirmed the technology as technically feasible.[107] Although a detailed list of policy recommendations follows, it is worth noting here that consumers will benefit most if this issue is addressed as a technical, rather than a political, issue.

In addition, wireless terrestrial may suffer from the high cost associated with most new technologies. Reports list initial prices for terrestrial wireless services at $40 to $80 per month, generally above those of satellite, cable, and DSL providers. Although this may be a competitive obstacle, engineers are hard at work trying to lower costs dramatically and are optimistic that they can do so.[108]

Mobile Wireless

Although mobile telephone service is not new, using it to provide Internet service is. Some mobile providers have started offering Internet access, and their advertisements tout such benefits as the ability to check e-mail while away from home. At present, Internet access via mobile phones is limited to narrowband service, though providers are attempting to incorporate technology that will allow for broadband service.[109] Such service will require additional spectrum, which the FCC is expected to put up for auction.[110] As mobile wireless services make the transition to broadband, the demand for mobile access to the Internet is expected to increase dramatically. This may help give rise to one more powerful competitor in the broadband market.

Wireless mobile providers harbor a real potential to bring wireless Internet services to more Americans. Although there are more than 100 million mobile telephone subscribers in the United States,[111] only about 2 million people subscribe to wireless Internet services.[112] Moreover, fixed and wireless Internet providers may be particularly important to less-developed countries that lack the needed wire-line infrastructure. In these countries, wireless solutions may have a competitive edge, serving as the primary, if not the only, means for Internet access. In fact, some analysts predict that worldwide Internet customers will number just below 1.2 billion by 2005, of which 700 million will be wireless users.[113] Does this affect U.S. customers? It might. Serving several hundred million wireless broadband customers in other countries may very well help providers discover ways to provide service more cheaply in this country.

Digital Broadcast Television

Television broadcasters are in the process of moving from analog to digital transmissions.[114] In 1997 the FCC provided a second channel for each existing full-service broadcaster to use for its transition from analog to digital. These channels are to be used on a temporary basis and must be relinquished at the end of the scheduled transition period, currently December 31, 2006.[115]

The amount of spectrum allocated to each broadcast signal for analog transmission (6 megahertz) produces extra capacity when more-efficient digital transmission technology is used.[116] As a result, less spectrum is needed for each television signal. This means existing signals may be broadcast at the same time that adjacent channels can be used to provide additional signals or other services, including Internet access.[117] The FCC recognizes the potential value of this spectrum to broadcasters. The agency's chief engineer, in testimony before Congress on this issue, noted the many advantages—and virtual lack of disadvantages—that would accompany this reallocation of spectrum:

> In making the transition to DTV, we must not do anything that would jeopardize he continuation of free, over-the-air television for the American public. Fortunately, technological developments—including better digital compression and modulation techniques—have given us the luxury of having our cake and eating it too. With digital technology, we can continue to have traditional broadcast services as well as exciting new broadcaster-provided services.[118]

Clearly, broadcasters have the spectrum necessary to provide data transmission and may become part of the competitive picture in the market for broadband Internet access. With a strong presence across the country and clear name recognition, they could be serious potential competitors. For now, however, it is unclear whether the broadcasters will enter this market.

Broadcasters have the spectrum necessary to provide data transmission and may become part of the competitive picture in the market for broadband Internet access.

Electricity Providers

It is easy to consider electricity providers potential competitors in the broadband market. Their power lines are everywhere. Although it is not now technically impossible for them to provide two-way transmission of broadband signals, this would present an engineering challenge. It may be possible to overcome the technical obstacles through an emerging approach known as powerline communications, which uses voltage supply lines to transmit voice and data at high speeds. Such transmissions would coexist with electricity transmissions, making power lines dual-use.

A leader in this technology, Ambient Corporation, recently signed an agreement with Bechtel Corporation, a world leader in engineering and project management.[119] Ambient's development efforts have included tests with a major electricity provider, Consolidated Edison of New York,[120] and Japan's largest manufacturer of electric wire and cable, Sumitomo Electric Industries.[121] The firm announced in January of 2001 the results of a test of its technology in Hong Kong, providing the first successful application of its powerline telecommunications technology in a residential building.[122]

Another leader in this technology is Switzerland-based Ascom Powerline AG, which currently has projects with 16 electricity companies in 11 European countries to test distribution of voice, video, and data.[123] Like its competitor in this technology, Ascom Powerline believes its service will allow electricity distributors to compete in the provision of voice telephony, high- speed Internet, and other information-related services. Moreover, the technology capitalizes on the existing infrastructure, thus minimizing setup costs, which in turn makes it easy for customers to switch from current providers. Ascom Powerline advertises that, upon installation of a simple "house controller," every power supply socket in the home will become a potential communications interface.[124] Such linkage becomes even more significant as firms such as Microsoft, Cisco, and others invest in "smart technologies" for the home—tools that will connect appliances, communications devices, computers, and more.[125]

Nonetheless, no commercial operation currently provides residential broadband service via power lines. As a report in *The*

In short, the efforts of DSL, cable modem, fixed wireless, and satellite service providers make it extremely likely that adoption of broadband service will follow a steep trajectory.

Economist noted last fall, the technology really seems to work, but the delivery of broadband by electricity providers nonetheless may fail. The reason: slow regulatory approval in Europe and a plethora of technologies in the United States that are capable competitors, including cable, satellite, terrestrial wireless, and more.[126] In short, if this technology fails to reach the U.S. consumer, the most likely reason will be that other technologies have already done so.

Market Forecasts

A number of market analysts have attempted to forecast the future demand for DSL, cable modem, fixed wireless, and satellite services. Forecasts by such firms as Merrill Lynch, Bear Stearns, Morgan Stanley, McKinsey & Co., and others were shared with the FCC, which incorporated the data into its Second Report.[127] The agency then calculated an average forecast for each technology on the basis of the forecasts provided.

According to the agency's report, the number of households subscribing to DSL service is expected to grow from about 2 million in late 2000 to 13 million in 2004.[128] For cable modem service, the number is expected to increase from more than 3 million at the end of 2000 to more than 15 million by the end of 2004.[129] Fixed wireless service is forecast to rise from virtually no market share in 2000 to between 3 million and 4.4 million residential subscribers in 2004.[130] For satellite service, the estimates vary. Because it had only a negligible number of subscribers in 2000, the forecast is as low as 1.2 million or as high as 4.6 million households by 2004.[131]

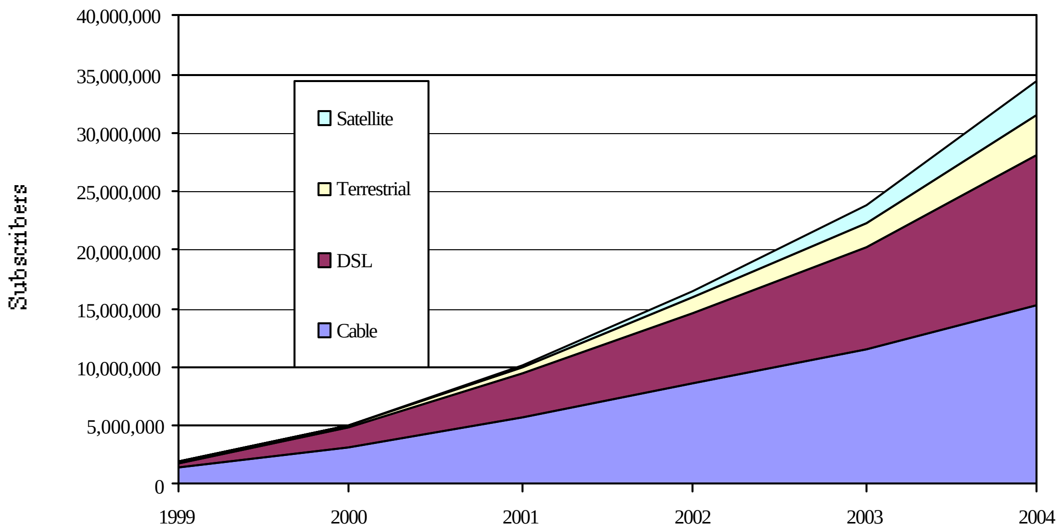
Much of what will drive this growth is investment by broadband providers. This investment will increase the number of competitors, which in turn should put downward pressure on prices. The FCC's Second Report notes that "since 1996, industry investment in infrastructure to support high-speed services has increased dramatically, and analysts forecast that this trend will continue."[132] ILECs have invested more than $20 billion annually since 1996, cable companies have invested more than $10 billion per year, and wireless and competitive local exchange carriers (CLECs) have seen their annual investments rise to more than $10 billion.[133]

These investments will affect consumers across the country. The NRTC and StarBand will deliver broadband by satellite to rural America. As for wire-line service to rural America, the National Telephone Cooperative Association, which represents more than 500 small and rural local exchange carriers, expects that 79 percent of its customers will have access to DSL service by the end of 2001.[134]

In short, the efforts of DSL, cable modem, fixed wireless, and satellite service providers make it extremely likely that adoption of broadband service—like the adoption of narrowband Internet service and many other new technologies—will follow a steep trajectory. Figure 3 provides an estimate of this growth, using the projections from the FCC's Second Report. The image should be familiar: It's the fast-growth stage of the standard S-curve. What's more, this estimate may be too conservative, since it does not include broadband service that may be offered by mobile wireless, broadcast television, or electricity providers.

Even if the mobile wireless, broadcast television, and electricity providers decline to invest in the broadband industry, the number and variety of potential providers in this market is impressive. As shown in Figure 4, the current providers of broadband offer a number of options—DSL, cable modem, satellite, and fixed wireless. What is particularly notable is that this is more competition than exists in the voice telephony, broadcast video, or almost any other telecommunications market. Not to mention the competition among providers of the same technology, such as the rivalry between Hughes' DirecPC service and EchoStar's StarBand service. Finally, there are the constantly emerging new technologies and providers—mobile telephone companies and maybe even electricity companies. The possibilities are more extensive than in virtually any other telecommunications market.

Figure 3
The Estimated Market for Broadband Services, 1999–2004



Source: Federal Communications Commission, *In the Matter of Inquiry Concerning Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Sec. 706 of the Telecommunications Act of 1996: Second Report,* CC Docket No. 98-146, FCC 00-290 (2000), Appendix D.

Figure 4
Current Broadband Competitors and Their Technologies

This is not to say that all technologies will be available to everyone. And that is precisely why it is advantageous to have multiple technologies.

Of course, this is not to say that all technologies will be available to everyone. And that is precisely why it is advantageous to have multiple technologies, and perhaps even multiple providers of any given technology. Some rural areas will be too far from a telephone switching facility to receive DSL but easily accessible by satellite. Some urban residents will find satellite or fixed wireless receivers blocked by obstructions—building codes that restrict their use or actual buildings that block transmissions—at the same time that DSL and cable providers rush to be the first in the neighborhood.

Success Stories across the Country

As the above list of providers, their technologies, and expected market shares indicates, the vast majority of Americans will soon have access to broadband. This is a natural consequence of new technology becoming increasingly inexpensive to produce and distribute. Nonetheless, there may be a small group of people who want access to this technology but remain without it for financial reasons. In direct response to this need, private companies have formed partnerships to bring broadband services to those least likely to have them. These firms, in the business of making a profit from providing broadband, often provide free or heavily discounted services to government agencies, disadvantaged communities, or other groups. Some people may view this as responsible corporate citizenship; others may see it as an attempt to gain publicity in the community or favor with regulators. No matter. Unless government officials reward a provider's philanthropic efforts by thwarting its competitors or otherwise tilting the playing field, the end result will be a greater number of users, many of whom may have been among the slowest to adopt the technology.

Ultimately, providers of broadband are anxious to make their technology ubiquitous, and government regulators are eager to help them. Because many projects have been developed that include some sort of public-private partnership, or that include extending broadband services to disadvantaged communities, FCC and state regulators have developed a database to help public agencies and private providers share the lessons of successful partnerships.[135] This database shows incumbent providers that are upgrading and extending their networks as well as new providers that are anxious to reach customers the incumbents may have been slow to reach.

- The Blackfoot Telecommunications Group, a partnership of telephone cooperatives and other carriers serving mostly rural communities in Montana, will deliver DSL service over existing telephone lines.
- In northwestern Minnesota, Sjoberg's Inc., a local cable company, provides broadband via cable modem to several small towns, as well as their schools.
- Shield Networks, a small wireless terrestrial provider in Austin, Texas, delivers broadband service to downtown business customers as well as residential customers in the economically challenged East Austin area.[136]

These examples are few, yet the ways in which broadband providers are extending their services are endless. Providers of all stripes—DSL, cable modem, satellite and land-based wireless, and more—know the demand for their service will grow as more people go online and eventually demand the speed and richness of broadband. They are investing accordingly.

Policy Questions: What Is —and What Is Not— to Be Done?

As the FCC and Department of Commerce reports acknowledge, it would be premature to declare that a problem exists in broadband deployment to certain groups. Unfortunately, lack of a clear problem doesn't stop some advocates from coming up with a "solution." Still, there are a few things wise policymakers should do—and many they should not do—to unfetter the development of broadband and ultimately improve consumers' access to this technology.

What Policymakers Should Not Do

Do Not Provide Tax Credits. About a dozen and a half proposals to promote broadband deployment were presented before the 106th Congress,[137] and three proposals are currently before the 107th Congress. Each of the current bills would provide tax credits for five years to companies that invest in broadband equipment in rural and low-income areas. S. 150, sponsored by Sen. John F. Kerry (D-Mass.), would provide a 10 percent tax credit for "current generation" broadband investment. H.R. 267, sponsored by Rep. Philip S. English (R-Pa.), and S. 88, sponsored by Sen. John D. Rockefeller (D-W.Va.), would offer the same tax credit for "current generation" broadband service as well as a 20 percent tax credit for "next generation" broadband service.[138] Illustrating the popularity of this proposal, Sen. Rockefeller's bill currently has 52 cosponsors in the Senate.[139] In addition, as of this writing, other broadband proposals have been promoted but not introduced in Congress. These include a combined broadband tax credit, loan guarantee, and bond program proposed by Sen. Hillary Rodham Clinton (D-N.Y.) and a tax credit and subsidy program proposed by Rep. Barbara Cubin (R-Wyo.).

The potential costs of tax credits, discussed earlier, should be reason enough to avoid this risky policy. Tax credits are also ineffective, at least compared with the consumer benefits that accompany promising new technologies such as fixed wireless and satellite services. These technologies hold some of the most promise for reaching rural and isolated households, yet they are less likely to be developed with tax credits, which are *more* likely to favor existing technologies.

Do Not Increase the E-Rate or Other Subsidies. With more than $2 billion going annually toward deploying advanced services in schools and libraries (E-rate) and about 20 federal subsidy and loan programs contributing roughly another $2 billion per year for advanced telecommunications elsewhere, mostly in rural areas (Table 1), it is hard to argue that another program is needed. And, as do tax credits, such programs tend to favor existing technologies, creating disincentives for new technologies. This is not in the long-run interest of low-income and rural households, which stand to gain more from the development of new technologies and the increase in competition they bring to the market.

Do Not Increase Open-Access Requirements on Internet Transport Providers. Under FCC rules, the portion of incumbent local telephone carriers' lines used to provide broadband service must be made available to CLECs.[140] The two largest cable firms face similar regulation: AOL Time Warner must grant open access as part of its merger approval,[141] and AT&T (which purchased the large cable company Tele-Communications, Inc.) is in court to determine if it must do the same.[142] Such rules are designed to make multiple ISPs available from a single transport provider (the telephone or cable provider), but they come at a cost. The telephone and cable companies, which account for almost 90 percent of the broadband market,[143] extend broadband service to more and more households precisely because it is profitable to do so. The profits come from the combination of transport and ISP services offered. Open-access requirements lower the revenues and thus the profits telephone and cable providers may expect. This may not affect more populated areas, where enough customers are present so that it remains profitable to operate under such restrictions. But in the marginal areas—especially the most rural areas—the lack of this additional revenue may be sufficient to make broadband unprofitable. Whereas those customers could have had only one ISP using broadband by their telephone company—and perhaps one more via their cable company—they now will have no ISP with broadband capability whatsoever, because they will have no broadband via these landline connections.

The potential costs of tax credits should be reason enough to avoid this risky policy. Tax credits are also ineffective.

The must-carry rule is particularly onerous for satellite television providers.

What Policymakers Should Do

Eliminate, or at Least Reduce, Open-Access Requirements for Collocation. These requirements force ILECs to allow CLECs to locate physical assets at the incumbent's facilities. The FCC claims its efforts are focused on "promoting facilities-based competition in the last mile, middle mile, and last 100 feet—the portion of the network in which the greatest barriers to truly competitive markets remain."[144] As the agency recognizes, these efforts ultimately affect the market for broadband service via telephone lines (DSL). But collocation requirements merely help new entrants to compete by using the facilities—and wires—of existing providers. While this should encourage an incumbent local carrier not to ignore any opportunity to provide broadband —since doing so would risk entry by a CLEC—it presupposes that existing providers are in the habit of turning down profitable opportunities to supply broadband. That is unlikely. A greater probability exists that FCC regulators will fail to set a market price for the use of the incumbent's facility.[145] If the incumbent anticipates incurring uncompensated costs due to the forced leasing of part of its facility, this will create a disincentive for incumbents to make the improvements necessary to provide broadband, since doing so may attract the competitors who impose such costs.

Of course, local telephone providers still may make these upgrades, if doing so is profitable. The collocation requirements would simply be an additional cost of business, much like a tax. But an increase in costs, like an increase in taxes, means the marginal business opportunity in deploying broadband no longer will be pursued. And these marginal opportunities will most likely be in the most rural and isolated areas.

Eliminate, or at Least Reduce, Resale, Unbundling, and Line Sharing. These requirements force ILECs to offer wholesale prices for local exchange services to CLECs (which the CLECs in turn resell to their retail customers) and to offer their services separately (unbundled) rather than as a package. They allow CLECs to use the incumbents' physical infrastructure. In its August 2000 report, the FCC argues that such requirements are an effective means to promote further the deployment of broadband services.[146] But, as with collocation requirements, these are forced exchanges, which means the FCC ultimately must determine the price for each service. And, as with collocation, incumbent providers have a notable disincentive in those cases in which they expect to be burdened with uncompensated costs. Again, this disincentive will tend to have the most effect on investment decisions in the marginal markets, especially in rural and isolated areas.

Eliminate, or at Least Restrict, Must-Carry Rules. Under these rules, a cable company or satellite television provider must carry the local broadcast television stations of any market in which it operates.[147] Given limited channel space, some local broadcast stations are carried by cable or satellite providers to the exclusion of other programming. Because must-carry rules prioritize cable companies' use of channels—rather than allow providers to do so on the basis of consumer demand—these rules lower the returns to cable providers and thus also lower their incentive to invest in their systems.[148] Moreover, the benefits to some broadcast stations have been minimal and arguably are outweighed by the effects on displaced cable channels: more home shopping channels are carried, to the exclusion of other programs such as C-Span.[149] Civic knowledge cedes to shopping, in other words.

The must-carry rule is particularly onerous for satellite television providers. The two largest providers, DirecTV and EchoStar, expect this rule to limit their deployment of nationwide broadcast television service. While these firms are capable of transmitting their signals almost anywhere in the continental United States,[150] they do not have the capacity to carry the nearly 1,600 local stations in the country. By law, satellite TV providers must carry the local television stations of all markets they serve by January 1, 2002.[151] In effect, the new must-carry rules make satellite television expensive if not impossible to provide in rural America. Will such a rule affect satellite carriers' Internet service? Most likely, yes. Satellite providers such as EchoStar and DirecTV believe combining hundreds of television stations with high-speed Internet access provides an attractive product. This is especially true as the equipment is built to allow all services to transmit via one dish, as EchoStar's Starband service offers. Moreover, as individual providers start to offer voice telephony, video, Internet, and more—an effect known as convergence—it becomes more likely that must-carry rules will expand, too. As economist Tom Hazlett of the American Enterprise Institute observes, "A policy forcing broadcast signals onto Internet servers . . . is the logical extension of must-carry."[152] The disincentive for future investment by Internet providers could be significant.

Deregulate Spectrum: Recent industry estimates show consumer demand for wireless spectrum will surpass the existing supply in the next three to four years, with twice as much needed by 2010.[153] Educational and religious institutions, the Department of Defense and other federal users, and industry providers such as broadcasters and wireless voice and Internet providers all make demands on the existing supply of spectrum. In some cases, such as with national defense, the dedicated applications are not likely to be subject to any sort of flexible use standard for many years.[154] This makes flexible use for other license holders all the more important.

At present, the vast majority of spectrum licenses are assigned for specific purposes: fewer than 6 percent of spectrum frequencies are zoned for flexible use.[155] Although Sprint and Worldcom provide wireless Internet services via spectrum originally designated for wireless video (multipoint, multichannel distribution service, or MMDS), this hardly counts as flexibility. Rather, the FCC had to approve the new use, a rare act in and of itself. With true flexibility, mobile telephone providers, broadcasters, and all other holders of spectrum licenses could use their spectrum to provide Internet access or any other service consumers desired.[156] Indeed, license holders should be free to trade their spectrum in an open market, effectively allocating licenses to their highest-valued use.[157] Such an idea is not radical, nor is it new. It was suggested to the FCC more than 40 years ago by Nobel-prize winning economist Ronald Coase.[158]

Eliminate Telephone Taxes. Numerous federal, state, and local taxes or surcharges appear on the typical consumer's telephone bill. While most of those taxes are imposed by state and local authorities,[159] the federal government's 3 percent telecommunications excise tax nonetheless is a huge revenue generator: A 1999 report by the Joint Committee on Taxation estimates that only taxes on alcohol (distilled spirits, wine, and beer combined) and taxes on cigarettes would generate more revenue in the coming years.[160] The federal telecommunications excise tax revenue is about $6 billion annually, according to the committee report, and other sources estimate state and local telecommunications taxes generate an additional $12 billion.[161] Like taxes on alcohol, cigarettes, or gasoline, the federal telecommunications excise tax is regressive. But unlike gasoline taxes—which partly help fund highway projects—federal phone taxes go into general Treasury funds.[162] And unlike alcohol or cigarette consumption, no one is proposing curbs on the consumption of telecommunications services. Finally, like most bad public policies, the federal telecommunications excise tax continues long after it has outlived the reason it was established in the first place: this tax was imposed to help finance the Spanish-American War.

In summary, rather than promote a tax credit that is likely to have adverse results, policymakers should focus on removing the regulatory impediments that make it difficult to deploy broadband in the first place. Promoting broadband deployment by means of tax policy and simultaneously inhibiting it by means of regulatory policy is a rather curious approach.

License holders should be free to trade their spectrum in an open market, effectively allocating licenses to their highest-valued use.

Conclusion

At a press conference earlier this year, FCC chairman Michael Powell rejected the notion of a digital divide in this country, suggesting instead that we have a "Mercedes divide" and adding, "I would like to have one, but I can't afford one."[163] This prompted a harsh rebuttal from Consumers Union, which argued that the issue has nothing to do with having a Mercedes but instead "is about affordable connectivity to the information infrastructure."[164] But if connectivity (i.e., access) is the central issue, then all that is needed is a computer, a modem, and a telephone line. With a 56K modem and standard telephone connection, you have a simple but effective means of driving on the information superhighway. In other words, you have a Chevy. Or you may opt instead for a broadband connection. In this case, you have a Mercedes. But both will put you on the information superhighway.

Of course, there still are people who want to be on the information superhighway but have yet to get there, frequently because of the cost. However, the market is responding to those needs with lower costs and higher quality every year. The Chevy keeps getting better and faster. Indeed, tomorrow's Chevy may outperform today's Mercedes. The experience with Internet access makes this analogy particularly appropriate: when many earlier technologies were being adopted, the less fortunate lagged behind the more fortunate by a generation or more, with access to the Internet, the less fortunate lag behind the more fortunate by a matter of months or, at most, a few years. As goes today's narrowband access to the Internet, so broadband will go.

For policymakers interested in getting more Americans on the information superhighway—especially with broadband connections—the most productive efforts will be to remove the regulatory roadblocks that keep new providers and new technologies out of the market. This means eliminating or limiting such requirements as open access by transport providers, collocation, resale and unbundling, and must-carry. It also means eliminating antiquated restrictions on spectrum usage and the century-old telephone tax.

For policymakers interested in getting more Americans on the information superhighway, the most productive efforts will be to remove the regulatory roadblocks that keep new providers and new technologies out of the market.

Federal tax credits or subsidies won't get Americans on the information superhighway any sooner, but they will help finance a few Mercedes. Tax credits and subsidies will also hinder the development of new technologies—including those not yet dreamed of—that may provide unimaginable benefits. Policymakers shouldn't overlook these consequences. To do so would be to fall victim to economic fallacy once again.

Notes

1. Lennard G. Kruger and Angele A. Gilroy, "Broadband Internet Access: Background and Issues," CRS Issue Brief 10045, Congressional Research Service, Updated February 1, 2001, pp. 13–15. Not all of these bills included a tax credit, but all included a focus on broadband deployment.

2. Federal Communications Commission, *In the Matter of Inquiry Concerning Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Sec. 706 of the Telecommunications Act of 1996,* CC Docket No. 98-146, FCC 99-005 (1999). Cited hereinafter as First Report.

3. Ibid., ¶ 20.

4. FCC, *In the Matter of Inquiry Concerning Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Sec. 706 of the Telecommunications Act of 1996: Second Report,* CC Docket No. 98-146, FCC 00-290 (2000). Cited hereinafter as Second Report.

5. Ibid., ¶ 10.

6. Ibid.

7. Ibid., ¶ 14.

8. U.S. General Accounting Office, "Characteristics and Choices of Internet Users, Report to the Ranking Minority Member, Subcommittee on Telecommunications, Committee on Energy and Commerce, House of Representatives," February 2001. See, in particular, n. 5.

9. U. S. Department of Commerce, *Falling through the Net: Toward Digital Inclusion,* October 2000, p. 2, http://www.esa.doc.gov.

10. Telecommunications Act of 1996, P.L. 104-104, § 706(a).

11. Ibid., § 706(b).

12. Ibid.

13. First Report, ¶¶ 6–7.

14. Second Report., ¶¶ 5–6.

15. Ibid., ¶¶ 6, 203.

16. Ibid., ¶ 204.

17 Ibid., ¶ 205.

18. Subsidies to promote universal service (i.e., "affordable" telephone service to everyone who wants it) have been promoted by the FCC since at least the 1970s. For an excellent history of these subsidies and their anti-competitive effects, see Milton Mueller, *Universal Service: Interconnection, Competition, and Monopoly in the Making of American Telecommunications,* MIT Press/AEI Series on Telecommunications Deregulation (Cambridge, Mass.: MIT Press, 1997).

19. Telecommunications Act of 1996, § 254(b).

20. FCC, *In the Matter of Federal-State Joint Board on Universal Service,* CC Docket No. 96-45, FCC 97-157, May 8, 1997, ¶ 431.

21. Ibid., ¶¶ 436–49.

22. Ibid., ¶¶ 492–98.

23. Ibid., § 254(d).

24. Ibid., § 254(h)(1)(B).

25. Universal Service Administrative Company, Schools and Libraries Division, "SLD Provides Updated Demand Estimate for Year 4 to the FCC," March 2, 2001, http://www.sl.universalservice.org.

26. Angele A. Gilroy, "Telecommunications Discounts for Schools and Libraries: The 'E-Rate' Program and Controversies," CRS Report for Congress, IB98040, Congressional Research Service, January 12, 2001.

27. See Jerry Hausman, "Taxation by Telecommunications Regulation: The Economics of the E-Rate," in *AEI Studies in Telecommunications Deregulation* (Washington: American Enterprise Institute, 1998). Professor Hausman estimates that the type of tax used to pay for the E-rate—a tax on interstate long-distance calls—imposes a cost of at least $2.36 billion *in addition* to the $2.5 billion raised for the program. The total cost of the program, therefore, is approximately double the $2.5 billion program "limit."

28. Universal Service Administrative Company, Rural Health Care Division, "Funding Commitments," March 19, 2001, http://www.rhc.universalservice.org.

29. Lennard G. Kruger, "Broadband Internet Access and the Digital Divide: Federal Assistance Programs," CRS Report for Congress, Congressional Research Service, Updated January 26, 2001, Table 2.

30. Ibid. One of the 17 programs is not listed here because its focus is on modernizing public (i.e., noncommercial) broadcast stations; it has no specific focus on rural areas, low-income areas, or schools, libraries, or health care providers.

31. First Report, ¶ 3.

32. Ibid.

33. Office of U.S. Sen. John Kerry, "Connecting Our Communities to the New Economy," Press release, February 7, 2001, http://www.kerry.senate.gov.

34. Bill and Melinda Gates Foundation, "The Origin of the Gateses' Support for Public Libraries," http://www.gatesfoundation.org/learning/libraries/libraryprogram/about.htm.

35. John Carlo Bertot and Charles R. McClure, "Public Libraries and the Internet: Summary Findings and Data Tables," National Commission on Libraries and Information Science, September 7, 2000, http://www.nclis.gov/statsurv/2000plo.pdf.

36. Office of Sen. Hillary Rodham Clinton, "New Jobs for New York: Creating Opportunities and Revitalizing Our Upstate Economy," March 1, 2001, http://clinton.senate.gov/Brochureopening.html.

37. See, for example, George Gilder and Bret Swanson, "The Broadband Economy Needs a Hero," *Wall Street Journal,* February 23, 2001, p. A14; and Jamal Le Blanc, "Toward Digital Inclusion: Why Not Broadband?" Digital Divide Network, http://www. digitaldividenetwork.org/content/stories/index. cfm?key=10.

38. Current legislative proposals with Congressional Budget Office scores are available at http://www.cbo.gov, which updates this information periodically. The Joint Committee on Taxation offers estimates on the costs of various tax bills at http://www.house.gov/tax.

39. Joint Committee on Taxation, S. 1352: Community Renewal and New Markets Act of 2000, JCX-106-00, October 5, 2000, http:// www.house.gov/ jct/x-106-00.pdf.

40. More than 98 percent of Americans have had access to electricity since the mid-1950s. U.S.

Department of Commerce, *Historical Statistics of the United States: Colonial Times to 1970* (Washington: Government Printing Office, 1975), p. 827.

41. The Rural Utilities Service describes itself as follows: "The Rural Utilities Service is a Rural Development Agency of the United States Department of Agriculture. We help Rural America finance electric, telecommunications, and water and waste water projects, and make loans and grants for rural distance learning and telemedicine projects. We are also a policy and planning rural advocacy agency." See http://www.usda.gov/rus.

42. See, for example, Ed Henry, "Dorgan Fears Digital Divide for America's Rural Areas," *Roll Call,* March 20, 2000, www.rollcall.com/pages/pb/00/03/pb20b.html.

43. Jim Lucier, John Barton, and Craig M. Hettenbach, "Broadband Tax Credit Looks Like a Good Bet for DSL and Network Equipment Manufacturers," *Washington World,* Prudential Securities, January 17, 2001.

44. Ibid.

45. Frederic Bastiat, "What Is Seen and What Is Not Seen," in *Selected Essays on Political Economy,* ed. George B. de Huszar, trans. Seymour Cain (Irvington, N.Y.: Foundation for Economic Education, 1964), pp. 1–24.

46. Henry Hazlitt, *Economics in One Lesson* (New York: Crown Publishers, 1946, 1979), p. 103.

47. The term 56K refers to 56,000 bits per second (bps), though this is somewhat misleading. Most 56K modems transmit data at speeds below 56,000 or even 50,000 bps. The 56K modem was preceded by the much slower 28.8K modem, which is still in use today. Both of these modems transmit with analog, rather than digital, signals.

48. Internet service providers offer a variety of service packages, with the simplest offerings available for free and other packages starting at about $20 per month. If dial-up service is not available from a local exchange, a long-distance call must be made, which significantly increases the cost of Internet access.

49. Commerce, *Falling,* pp. 23–24.

50. Asymmetric digital subscriber line is part of a larger group of DSL technologies, known collectively as XDSL, and falls in the middle of this group in terms of transmission speed. See http://www.adsl.com/faq.html.

51. GAO, "Technological and Regulatory Factors Affecting Consumer Choice of Internet Providers," Report to the Subcommittee on Antitrust, Business Rights and Competition of the Senate Committee on the Judiciary, GAO-01-93, October 2000, p. 17. Cited hereafter as GAO, "Factors."

52. See "Tutorial," DSL Forum, http://www.adsl.com/general_tutorial.html.

53. See "Cable Modem FAQ," Cable Datacom News, http://www.cabledatacomnews.com.

54. GAO, "Factors," p. 17.

55. Kruger and Gilroy, p. 3.

56. GAO, "Factors."

57. Computers are by far the most common tool used to display transmissions to and from the Internet. Thus, lack of access to a computer often indicates lack of access to the Internet. However, some new tools such as personal digital assistants and Internet-accessible cell phones also provide Internet access and are becoming more common.

58. Commerce, *Falling,* Executive Summary.

59. "Internet Users Will Surpass 1 Billion in 2005," Press release, eTForecasts, February 6, 2001, www.etforecasts.com/pr/pr201.htm.

60. "Average Web Usage," *Weekly Web Usage Data,* ACNielsen, Week ending April 15, 2001, http://209.249.142.27/nnpm/owa/NRpublicreports.usageweekly.

61. "More Online, Doing More," Pew Internet and American Life Project, February 18, 2001, http://www.pewinternet.org/reports/toc. asp?Report=30.

62. The FCC estimates 1.8 million subscribers at the start of the year, while Kinetic Strategies estimates about 2 million. See Second Report, ¶ 67, and Kinetic Strategies Inc., "Cable Continues to Dominate DSL in Residential Broadband Market," March 1, 2001, http://www.kineticstrategies.com/ksi_release_3-1-01.html.

63. Ibid.

64. xDSL.com, "North American DSL Market Nears 3 Million Lines at Year End 2000," http://www.xdsl.com/content/tcarticles/wp021301.asp.

65. Commerce, *Falling,* Executive Summary.

66. Telecommunications Reports, "Free ISPs Fade from the Scene as High-Speed DSL Installations Finally Draw Promised Subscribership," *TR's Online Census,* January 30, 2001, http://www.tr.com/newsletters/rec/TROC_PR.HTM.

67. NetRatings, Inc., "Internet Penetration Reaches 60 Percent in the U.S., According to Nielsen/NetRatings," Press release, February 28, 2001.

68. "More Online, Doing More."

69. Commerce, *Falling,* p. 6

70. Ibid., p. 1.

71. Ibid., Executive Summary.

72. Ibid., Figure A-8.

73. Ibid.

74. It also is worth noting that urban and suburban areas are not necessarily the most served. The greatest penetration is in rural areas in the Northeast (at 49.9 percent in August 2000), followed by urban areas in the West (at 47.2 percent). See Commerce, *Falling,* pp. 6–7.

75. Ibid., p. 1 and Figures I1, A1, A2.

76. Ibid., p. 16.

77. As the Commerce Department study recognizes, growth rates are often expressed in percentage terms, which can be confused with data on the percentage of a population that has Internet service. For example, if technology "haves" enjoy 50 percent penetration in Internet access while the have-nots are at 10 percent, then a 10 percentage point gain for each group would represent a 20 percent gain for the privileged group (from 50 to 60 percent) and a 100 percent gain for the have-nots (from 10 to 20 percent).

78. Both telephone and electricity services have maintained relatively stable penetration rates for more than two decades. Most everyone who wants a telephone does in fact have one, as even customers in high-cost areas have affordable telephone service due to universal service subsidies. Indeed, the FCC notes that these subsidies, which preceded the Telecommunications Act of 1996, served to "increase subscribership levels nationwide by ensuring residents in rural and high-cost areas were not prevented from receiving phone service because of prohibitively high telephone rates." See FCC, *In the Matter of Federal-State Joint Board on Universal Service,* CC Docket No. 96-45, FCC 98-068, April 10, 1998, ¶ 7.

79. Commerce, *Falling,* p. 6.

80. GAO, "Characteristics and Choices of Internet Users," p. 4.

81. Ibid., p. 23.

82. Ibid., Appendix II, Question 15.

83. Ibid., p. 7.

84. Cellular Telecommunications Industry Association, "U.S. Wireless Industry Continues to Experience Record-Setting Growth," Press release, October 18, 2000, http://www.wow-com.com/news/press/body.cfm?record_id=904; and Consumer Electronics Association, http://www.eBrain. org.

85. Commerce, *Falling,* pp. 25–26 and Figure I-17.

86. Robert W. Crandall, "Bridging the Divide Naturally," *Brookings Review* 19, no. 1 (Winter 2001): 40.

87. Commerce, *Falling,* pp. 41–45 and Figures II-9, II-11.

88. Amanda Lenhart, "Who's Not Online: 57 Percent of Those without Internet Access Say They Do Not Plan to Log On," Pew Internet and American Life Project, September 21, 2000, http://www.pewinternet.org/reports/toc.asp? Report=21.

89. Commerce, *Falling,* pp. 23–24.

90. Ibid., pp. 23–24 and Figure I-15.

91. Most recipients of satellite television use direct broadcast satellite (DBS) technology. The 8 million subscribers to DirecTV and 4 million subscribers to EchoStar make up the majority of the 13 million customers in the DBS market.

92. DirecPC, "Hughes Network Systems Ships Two-Way DirecPC Systems," Press release, December 21, 2000, http://www.direcpc.com/consumer/scoop/twoway.html.

93. Geraldine Fabrikant and Seth Schiesel, "Satellite v. Cable: A Rivalry beyond TV," *New York Times,* February 19, 2001.

94. Ibid.

95. StarBand Communications, Inc., "What Is StarBand?" www.starband.com.

96. StarBand Communications, "StarBand Passes 25,000 Customer Milestone," Press release, March 12, 2001, www.starband.com/whoweare/pr/031201_b. htm.

97. Ibid.

98. StarBand Communications, "StarBand Partners with National Rural Telecommunications Cooperative," Press release, March 12, 2001, http://www.starband.com/whoweare/pr/031201_a.htm.

99. Ibid.

100. Teledesic, "About Teledesic," http://www.teledesic.com/about/about.htm.

101. EchoStar and DirecTV use GEO satellites. While more expensive to build and launch, one GEO satellite can cover a large geographical "footprint" (e.g., North America) whereas multiple LEO satellites are needed to accomplish the same task.

102. The assets of the bankrupt Iridium project were recently acquired by a group of investors that intends to use the system to provide voice and data communications, with a focus on serving governments as well as industrial customers in remote settings. That the original business model failed is illustrated by the fact that the primary sponsor, Motorola, invested between $5 billion and $6 billion in the project, while the new investors acquired the bankrupt project's assets for $25 million. See Jim Wolf, "Brazilian, Australian, Saudi Investors Own Bulk of Iridium," *Yahoo! Finance,* April 4, 2001, http://biz.yahoo.com/rf/010404/n04450011.html.

103. BroadWave USA uses NorthPoint technology to provide wireless terrestrial service. This technology is designed to share spectrum used by GEO satellites. GEO satellites transmit to home reception dishes pointing south (at least in North America), while the NorthPoint/BroadWave towers transmit to reception dishes pointing north (hence the name). BroadWave USA and NorthPoint technology are not affiliated with NorthPoint DSL. See http://www.northpointtechnology.com.

104. See Second Report, n. 145, citing a speech by Bernie Ebbers of WorldCom; and "High-Speed Net Access Takes New Turn," *San Jose Mercury News,* January 25, 2001, www.worldcom-merger.com/press_room/ ebbers_npc_speech.htm.

105. CableDataCom News, "Wireless Broadband Trials & Deployments," CableDataCom News, Updated February 2, 2001, www.cabledatacomnews.com/wireless/cmic12.html.

106. For example, the Local TV Act of 2000, which provided loan guarantees to promote local television signals in rural areas, required the FCC to engage in further testing of NorthPoint technology to determine whether it would cause interference.

107. "Analysis of Potential MVDDS Interference to DBS in the 12.2-12.7 GHz Band," MITRE Technical Report, produced by the MITRE Corporation, McLean, Va., for the U.S. Federal Communications Commission, April 2001, http://www.fcc.gov/oet/info/mitrereport/mitrereport_4_01.pdf.

108. Joshua L. Kwan, "High-Speed Net Access Takes New Turn," *San Jose Mercury News,* January 25, 2001.

109. Digital broadband wireless service represents what is known as Third Generation, or 3G, technology. First Generation is represented by analog wireless service, and Second Generation is represented by narrowband digital technology.

110. GAO, "Factors," p. 47.

111. Cellular Telecommunications Industry Association.

112. ETForecasts, "Internet Users Will Surpass 1 Billion in 2005," Press release, February 6, 2001, http://www.etforecasts.com/pr/pr201.htm.

113. Ibid.

114. Many people associate digital television with HDTV (high-definition television). Although HDTV uses digital technology to transmit signals of very high resolution (more than 1,000 lines per inch), the FCC does not require such a high standard for digital transmission. Thus, while broadcasters are required to provide digital television, they need not provide—and generally are not providing—HDTV.

115. FCC, *In the Matter of Advanced Television Systems and Their Impact upon the Existing Television Broadcast Service,* Sixth Report and Order, MM Docket No. 87-268, FCC 97-11.

116. With about 400 megahertz (MHz) of spectrum at their disposal, broadcasters control a very large portion of the airwaves. By comparison, cellular and personal communications systems have licenses for less than 100 MHz.

117. Thomas W. Hazlett, "The Wireless Craze, The Unlimited Bandwidth Myth, The Spectrum Auction Faux Pas, and the Punchline to Ronald Coase's 'Big Joke': An Essay on Airwave Allocation Policy," *Harvard Journal of Law and Technology,* forthcoming. In particular, see §§ 3 and 15.

118. Dale N. Hatfield, chief, Office of Engineering and Technology, Federal Communications Commission, Testimony at Oversight Hearing on High-Definition Digital Television and Related Matters before the Subcommittee on Telecommunications, Trade and Consumer Protection of the House Committee on Commerce, 106th Cong., 2d. sess., July 25, 2000, http://com-notes.house.gov/cchear/hearings106nsf/ main.

119. Ambient Corporation, "Ambient Corporation and Bechtel Telecommunications Announce Technical Services Agreement and Letter of Intent," Press release, March 20, 2001, http://

www.ambientcorp.com/Content.asp?PID=37.

120. Ambient Corporation, "Ambient Corporation and Consolidated Edison of New York Announce Successful Initiation of First Phase Joint Testing of Ambient's Powerline Telecommunications Technology," Press release, November 21, 2000, http://www.ambientcorp.com/content. asp?PID=32.

121. Ambient Corporation, "Ambient Corporation Announces Successful Joint Demonstration of Ambient's Powerline, Telecommunications Technology in Japan," Press release, January 11, 2001, http://www.ambientcorp.com/content. asp?PID=33.

122. Ambient Corporation, "Ambient's First Ever Testing in Actual Residences Establishes Achievability of Connectivity with Existing Electrical Wiring," Press release, January 25, 2001, http://www.ambientcorp.com/content.asp?PID=34.

123. Ascom Powerline Communications AG, "Powerline Communications Series of Field Trials," Press release, October 6, 2000, http://www.ascom.com/ apps/WebObjects/ecore.woa/de/showNode/siteNodeID_19589_contentID_96354_languageID_1.html.

124. Ascom Powerline, "Figures and Technical Details," http://www.ascom.com/apps/ WebObjects/ecore.woa/de/showNode/siteNodeID_19619_contentID_-1_languageID_1.html.

125. "Microsoft Has Plans for You," *Jerusalem Post,* March 4, 2001.

126. "Loopy," *The Economist,* September 9, 2000.

127. Second Report, Appendix D.

128. Ibid., ¶ 191, Figure 27, and Appendix D.

129. Ibid., ¶ 189, Figure 26 and Appendix D.

130. Ibid., ¶ 197 and Appendix D.

131. Ibid., ¶ 202 and Appendix D.

132. Ibid., ¶ 185.

133. Ibid., ¶ 185–200 and Figure 23.

134. National Telephone Cooperative Association, "NTCA Members Internet? Broadband Survey Report," November 2000, http://www.ntca.org/press/releases/broadbandstudy.pdf.

135. This database is maintained by the National Regulatory Research Institute, the research arm of the National Association of Regulatory Utility Commissioners. See http://www.nrri.ohio-state.edu/telecom.htm.

136. Ibid.

137. H.R. 1685 (Boucher), H.R. 1686 (Goodlatte), H.R. 2420 (Tauzin), H.R. 2637 (Blumenauer), J.Con.Res. 173 (Markey), J.R. 4122 (Stupak), H.R. 4477 (Towns), H.R. 4728 (English), H.R. 5069 (Minge), S. 877 (Brownback), S. 1043 (McCain), S. 2097 (Burns), S. 2307 (Dorgan), S. 2321 (Rockefeller), S. 2454 (Burns), S. 2698 (Moynihan), S. 2902 (Brownback), and S. 3152 (Roth). For a brief description of these proposals, see Kruger and Gilroy.

138. In these bills, the term "current generation" broadband means service with download speeds of at least 1.5 Mbps and "next generation" broadband means service with download speeds of at least 22 Mbps.

139. See the "Bill Summary" listing for S. 88, Library of Congress, www.loc.gov.

140. GAO, "Factors," pp. 19–20 and Appendix IV.

141. *In the Matter of Applications for Consent to the Transfer of Control of Licenses and Section 214 FCC, Authorizations by Time Warner Inc. and America Online, Inc., Transferors to AOL Time Warner Inc., Transferee,* CS Docket No. 00-30, Memorandum Opinion and Order, January 22, 2001.

142. See the federal district court ruling in *AT&T Corp. v. City of Portland,* 43 F. Supp.2d 1146 (D. Or. 1999), and the federal appeals court ruling, which overturned the lower court's ruling, in *AT&T Corp. v. City of Portland,* 216 F.3d 871 (9th Cir. 2000).

143. Commerce, *Falling,* pp. 23–24.

144. Second Report, ¶ 246.

145. For the problems associated with government price setting in telecommunications markets, see Wayne Leighton, "Prescriptive Regulations and Telecommunications: Old Lessons Not Learned," *Cato Journal* 20, no. 3 (Winter 2001), http://www.cato.org/pubs/journal/cj20n3/cj20n3-4.pdf.

146. Second Report, ¶¶ 253–54.

147. Cable providers are subject to must-carry rules under the Cable Television Consumer Protection and Competition Act, P.L. 102-385, 47 U.S.C. 534, 535, October 5, 1992. Satellite television providers are subject to these rules under the Satellite Home Viewer Improvement Act, P.L. 106-113, 17 U.S.C. 122, November 29, 1999. For more information on this satellite legislation, see Marcia S. Smith, "Satellite Television: Summary of the Provisions of the Satellite Home Viewer Improvement Act and the Launching Our Communities Access to Local Television Act," CRS Report for Congress, RS20425, updated January 22, 2001.

148. Thomas Hazlett, "Digitizing 'Must-Carry' under *Turner Broadcasting v. FCC* (1997)," *Supreme Court Economic Review* 8 (2000): 158–62.

149. Ibid., pp. 169, 173–78. See also the comments of Brian P. Lamb, chairman and chief executive officer of C-SPAN Networks, before the Senate Committee on Commerce, Science, and Transportation, July 8, 1998, http://www.c-span.org/about/mustcarry.asp.

150. Not every household can receive these signals. Because these satellites remain in stationary orbit above the equator, households in the Northern Hemisphere that have an obstructed view to the south may fail to recive DirecTV or EchoStar signals.

151. Satellite Home Viewer Improvement Act, § 1008(a)(3).

152. Hazlett, "Digitizing 'Must-Carry,'" p. 202.

153. "A Turf Fight for the Airwaves," *New York Times*, March 28, 2001, http://www.nytimes.com/2001/03/28/ technology/28SPEC.html?pagewanted=1.

154. FCC, "Spectrum Study of the 2500-2690 MHz Band: The Potential for Accommodating Third Generation Mobile Systems," Final Report, March 30, 2001.

155. Hazlett, "The Wireless Craze," p. 6.

156. A more radical, yet more efficient, solution: The FCC should give a true property right to the winner of its auctions, rather than a right to a spectrum license.

157. Of course, any user should be subject to the noninterference rules currently in place.

158. Ronald Coase, "The Federal Communications Commission," *Journal of Law and Economics* 2 (1959): 1–40.

159. One study estimates that telecommunications providers face more than 300 state and local taxes and fees, more than three times the number faced by businesses in general. While some of those fees are for public services (e.g., 911 emergency service), this does not explain all of the disparity between telecommunications and other types of businesses. See Joseph J. Cordes, Charlene Kalenkoski, and Harry S. Watson, "The Tangled Web of Taxing Talk: Telecommuni-cations" *Progress on Point* 7, no. 12 (September, 2000); and Committee on State Taxation, *50-State Study and Report on Telecommunications Taxation* (Washington: COST, September 1999).

160. U.S. Congress, Joint Committee on Taxation, *Schedule of Present Federal Excise Taxes* , January 1, 1999, Table B.

161. Committee on State Taxation.

162. See comments of Jeff Kupfer, tax counsel, Senate Finance Committee in "Understanding Telecom Taxes: A Symposium," *Progress on Point* 7, no. 8 (May 12, 2000).

163. Quoted in Christopher Stern, "New FCC Chairman Favors a Non-activist Approach," *Washington Post*, February 7, 2001, p. E-1.

164. Quoted in ibid.

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