A Framework for a National Broadband Policy

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Washington, DC
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This report is written from the perspective of an informed observer at the 2007 Aspen Institute Roundtable on Spectrum Policy (AIRS) and the Twenty-Second Annual Conference on Communications Policy. Unless attributed to a particular person, none of the comments or ideas contained in this report should be taken as embodying the views or carrying the endorsement of any specific participant at the Roundtable or Conference.

Foreword

The importance of broadband access to functioning modern society is obvious at this point. From government to business to medicine, broadband promises to offer new services in voice, video, and data while driving down costs and reaching more people. Today, urban and rural communities, young and older users, affluent and disadvantaged consumers all have much to gain from affordable access to the nation's expanded electronic nervous system.

Although the medium offers promise, its realization is another matter. Evidence suggests that the United States is dropping behind in broadband access and transmission speeds in comparison with other nations. This can result in loss of actual or potential economic activity, educational opportunities, social services, and personal enjoyment.

Recognizing this problem as early as the 2004 campaign, President George W. Bush emphasized the need for "universal, affordable access for broadband technology by the year 2007." He went on to suggest that "we ought to make sure as soon as possible thereafter, consumers have got plenty of choices when it comes to [their] broadband carrier."[1] Unfortunately, as 2007 comes to a close, millions of Americans remain unconnected, choices are few, and there is no clear plan for fixing the problem within the patchwork of federal, state, and local broadband policy.

To address this issue, the Aspen Institute Communications and Society Program convened two conferences in 2007: its annual Aspen Institute Roundtable on Spectrum Policy (AIRS) in the spring of 2007, addressing wireless broadband issues, and the Twenty-Second Annual Conference on Communications Policy in the summer of 2007. A variety of impressive leaders from the media, telecommunications, and information technology industries; government; and academia met at the Aspen/Wye River House in Queenstown, Maryland, and at the Aspen Meadows in Aspen, Colorado, for a series of roundtable discussions with the goal of outlining a new national broadband policy. Condensing this complex set of conversations into a coherent narrative,

Professor Philip Weiser of the University of Colorado at Boulder sets out in the following report a series of specific and concrete policy recommendations for expanding access, affordability, and adoption of broadband in the United States.

Ensuring meaningful Internet access for all Americans requires a complete overhaul of the universal service programs that have provided telecommunications to rural residents and other underserved groups for decades. Establishing definitions of "sufficient" broadband for different groups of consumers is a first step, the report observes, and regulators will then need to make sure providers meet those goals efficiently. This topic highlighted the importance of state and federal cooperation to any successful national policy.

The group next turned to the goal of keeping broadband access affordable by encouraging competition in the broadband market. The central question here regards wireless broadband: Is it a viable third means of access next to cable and digital subscriber lines (DSL)? Participants raised several concerns, from limited capacity for carrying data to potential interference with other spectrum users, but also expressed optimism that new technologies in this area could indeed perform a key role in preserving competition among carriers.

Finally, after access is available and affordable, what can be done to convince disinterested consumers that broadband is worth their money and effort? Education must play a large role, with technological literacy programs increasing users' comfort and allaying their fears about online safety. Roles exist for both the government and the private sector in promoting new applications to further increase broadband's appeal.

Although no group of communications experts and leaders as diverse as the participants in the Roundtable and Conference could agree on every point of a new U.S. national policy, rapporteur Phil Weiser has taken the many areas of general or near consensus and created a perceptive and coherent report. Nevertheless, readers should not assume that attendees at the Roundtable and Conference agree with all of the statements made within the report.

Acknowledgments

We want to take this opportunity to thank our sponsors for making possible these conferences: AT&T, Cablevision Systems, Cisco Systems, Comcast Corporation, Cox Enterprises, Credit Suisse First Boston, Google, Intel, National Association of Broadcasters, QUALCOMM, Stifel Nicolaus, Time Warner, Verizon Communications, Vonage, and the Walt Disney Company.

We also thank Phil Weiser for this concise and insightful account of the discussions; authors Robert Atkinson, Ellen Goodman, and Drew Clark who crafted papers for the conference, reprinted in the appendix of this report; our participants for the hard work, perceptive comments, and willing cooperation necessary to tackle this contentious issue in a productive way; and Kate Aishton, project manager in the Communications and Society Program, for her efforts planning and carrying out this conference.

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January 2008

A Framework for a National Broadband Policy

Philip J. Weiser

A Framework for a National Broadband Policy

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Introduction

This report pulls together two sets of discussions and an array of background readings to outline a new direction for a U.S. national broadband policy. The Aspen Institute Communications and Society Program convened a top-flight group of academics, policymakers, and industry leaders for two conferences—one on the Wye River in Maryland, May 17-18, 2007, and another in Aspen, Colorado, August 15-18, 2007—to discuss the future of American broadband policy. For ease of exposition, and in a "Talmudic-like" fashion,[2] this report weaves together the two discussions into a single coherent conversation—even though they occurred months apart, in different places, and with different participants (see Appendix).

Throughout both sets of discussions, there was a remarkable degree of consensus on the fundamental point that access to and adoption of broadband connectivity is a national imperative to ensure the greatest opportunities for economic growth, national competitiveness (vis-à-vis other nations), cultural and creative development, and our aspirations for a fully educated and engaged citizenry. The participants agreed on the foundational point that broadband connectivity allows every American to participate effectively in today's information society, using widely available information and communications technologies that enable them to be more effective producers and consumers of information. The more difficult issues, the participants observed, include how to:

1) Identify and advance strategies for promoting the widespread availability of broadband connectivity (access);
2) Ensure that broadband is as affordable as possible; and
3) Promote the wide adoption and use of broadband for an array of applications.

Thus, after providing a background discussion regarding the strategic importance of broadband, this report discusses each of these issues—access, affordability, and adoption.

The Strategic Importance of Broadband

The conference in Aspen began with a talk from the European Union's Commissioner for Information Society and Media, Viviane Reding, who explained that championing broadband was the central communications policy goal of most European countries. In particular, Reding emphasized that the critical determinants of broadband adoption in Europe were a commitment to competition between alternative platforms, including access to the existing copper infrastructure, and an educated population with an appetite for using a variety of broadband-based applications.

The European comparison raises the question of whether the much-discussed Organization for Economic Cooperation and Development (OECD) rankings on broadband highlight a public policy concern. For Robert Atkinson, president of the Information Technology and Innovation Foundation, any imperfection in these rankings cannot disguise America's relative slide (from 4th in the world to 15th).[3] Moreover, unlike products that do not serve as a platform for economic growth, the relative adoption of broadband Internet access matters because it facilitates enormous economic opportunities that rise with the number of users.[4] Consequently, as Federal Communications Commission (FCC) Commissioner Jonathan Adelstein put it, the normal rule that the development of "a technology should be left solely to the marketplace does not apply in the case of broadband, which promises an array of social and economic benefits, ranging from distance learning to telemedicine to public safety to democracy."

Participants expressed widespread support for the basic proposition that broadband usage is crucial to our nation's well-being and requires an affirmative agenda involving the governmental, nonprofit, and private sectors. The United States' political and policy leadership, the participants noted, has largely failed to appreciate the strategic importance of this technology and thus has missed opportunities to promote its development and catalyze efforts in the nonprofit and private sectors. Lara Warner, director of research for Credit Suisse, captured this con-

cern by concluding that "to call the nation's leadership on broadband policy 'lackluster' is a gross understatement."

Developing the case for vigorous leadership in the area, Cisco's director of technology and communications policy Jeff Campbell explained that "[i]n a world where technology and knowledge are the key competitive advantages, broadband infrastructure is going to be increasingly important to a healthy economy."[5] Picking up this line of argument, a *Washington Post* article noted that the availability of fast and cheap broadband access in Japan has already enabled "high-definition teleconferencing, for telemedicine—which allows urban doctors to diagnose diseases from a distance—and for advanced telecommuting to help Japan meet its goal of doubling the number of people who work from home by 2010."[6] In short, a true appreciation for the importance of broadband policy recognizes how it will greatly influence economic and cultural development (including spurring economic growth and innovation), real estate development (i.e., where people can live), energy policy (i.e., the ability to avoid commuting), and the availability and quality of health care.

"In a world where technology and knowledge are the key competitive advantages, broadband infrastructure is going to be increasingly important to a healthy economy."

Jeff Campbell

Unlike traditional telecommunications technologies—the landline telephone network, cable TV systems, satellite TV systems, and others—broadband is a multipurpose platform that cannot be defined by any single application. On this point, Andrew McLaughlin, chief policy counsel of Google, said that "it is pointless to talk about how people are using broadband because they are using it for everything." Speaking more broadly, McLaughlin suggested that broadband is driving the "democratization of culture, politics, and business," leading to "the death of couch potato culture and the beginning of a creation culture." He then noted several examples of how broadband Internet access had facilitated online communities, such as deviantArt (where people post art and others can comment on it), citizen journalism (such as photographs of

the Virginia Tech tragedy on Flickr and reporting summaries via Wikipedia[8]), and new business models (such as prosper.com's support for person-to-person lending).

Statistics on how individuals are using broadband Internet access provide considerable support for the "user as creator" perspective. According to a recent Pew study, 57 percent of U.S. teenagers created something and posted it online.[9] More generally, 42 percent of all home broadband subscribers have posted something online. In many cases, individuals are creating forms of content that combine different information in creative ways—often called "mashups." McLaughlin noted a few of the more interesting ones, including Fastfoodmaps.com, Healthmap.org, and websites that report performance data on K–12 schools. Following up on McLaughlin's presentation, Charles Firestone, executive director of the Aspen Institute Communications and Society Program, asked, "How are these sites sustaining themselves?" The answer, according to McLaughlin, is that some are able to run advertising on their sites (using Google's AdSense technology, for example), and others just do it for love.

In a notable development, broadband has enabled all kinds of communities to develop online. For example, McLaughlin reported that Google had underestimated the community aspect of broadband video in developing its Google Videos service. YouTube, on the other hand, realized that it was all about community, and built several features to enable sharing and commenting. Sounding a similar theme, Susan Crawford, law professor at the Cardozo School and board member of the Internet Corporation for Assigned Names and Numbers (ICANN), emphasized that "the Internet is more than just a supply chain or distribution vehicle; it is group-forming."

The ability of online communities and businesses to develop highlighted an important feature of broadband technology: its benefits to society far exceed the benefits recouped by the providers who build broadband networks. William Webb, senior technologist at OfCom (a telecommunications regulator in the UK), noted that the existence of social benefits above private benefits means that the market is likely to under-produce this good and thus creates a rationale for government to step in and support the building of basic infrastructure. This issue is a concern not only at the national level but at the state and local levels as well, where governors and mayors are increasingly concerned about the levels of broadband deployment and adoption in their communities.

For example, FCC Commissioner Deborah Tate cited an alarming report from the mayor of Jackson, Mississippi that only 20 percent of the city's citizens have adopted broadband connections and only 35 percent of small businesses are connected to broadband.

Notably, on the state and local level, some governors and mayors have sought to grasp the mantle of leadership on broadband policy.[10] One such exemplary leader, Graham Richard, mayor of Fort Wayne, Indiana, recounted a series of efforts he spearheaded to drive the deployment and adoption of broadband in his community. Richard explained that, in a "world is flat" environment, businesses generally focus on where they can find smart, qualified employees and broadband connections. He noted that Thomas Friedman, author of *The World is Flat*, told a gathering of state and local officials that a fundamental part of an economic development agenda must be an effort to ensure the deployment of broadband connectivity.

What is Broadband?

The discussion of the opportunities made possible by broadband access raises a more fundamental question: What level of connectivity constitutes "broadband"? The participants began that discussion from a common premise—that the FCC must revise its antiquated definition of "200 kilobits per second [kbps] in at least one direction." Andrew McLaughlin of Google, who called 200 kbps "anemic," suggested that at least 1 mbps in at least one direction (and a substantial amount in the other) was a more reasonable definition. Dale Hatfield, adjunct professor in the Interdisciplinary Telecommunications Program at the University of Colorado at Boulder, added that one cannot merely focus on the relevant "speed" provided; metrics related to latency, for example, also are important because low latency is required for many applications.

Because of the limited bit rates currently available in the United States, in particular with regard to "upstream traffic," McLaughlin suggested that Google was less able to deploy some new applications in the United States than it would be deploying elsewhere, such as in South Korea and Japan. In a challenge to the claim that the United States is behind, Dean Brenner, vice president for government affairs at QUALCOMM, noted that the rollout of third-generation (3G) wireless broadband services is further along here than in Europe or Asia.

James Gattuso, research fellow in regulatory policy at the Heritage Foundation, countered McLaughlin's view by suggesting that the U.S. has developed an effective broadband infrastructure. Yochai Benkler, a law professor at Yale University, responded that the United States is far off the mark with the ability of users to be creators—including by hosting their own servers—inhibited by the current broadband infrastructure and the limitations network providers impose on its use. Phil Weiser, law professor and executive director of the Silicon Flatirons Program at the University of Colorado, added that there is a ray of hope in Verizon's FiOS initiative, which may loosen those restrictions and invite more user-based development in an effort to win customers away from cable.

Broadband is driving the "democratization of culture, politics, and business."

Andrew McLaughlin

The question of "How much broadband is enough?" triggered a debate about the current uses of broadband. In particular, there is an active debate as to what level of Internet traffic is consumed by peer-to-peer file sharing—in particular, BitTorrent (a popular means of downloading video programming via the Internet). Several participants cited the conventional wisdom that as much as 60 percent of Internet traffic may be composed of uses of BitTorrent. McLaughlin suggested that in Korea, however, the biggest bandwidth hogs are multiuser games. In U.S. university networks, by contrast, many administrators report very high levels of BitTorrent traffic.

Joe Waz, vice president for external affairs and public policy councel for Comcast, raised the important question as to what level of connectivity is "good enough" broadband and constituted a defensible level of investment for a socially beneficial use of the technology. To that end, William Webb of Ofcom reported that most U.K. users seem content with 2–4 mbps. Similarly, the *New York Times* reported that as to the high speed connections common in Japan (an average of 61 mbps), "Industry analysts and some companies question whether the push to install fiber is worth the effort, given the high cost of installation, affordable alternatives and lack of services that take advantage of the fast connections."[11]

Disagreeing with the "good enough" broadband position, Google's Andrew McLaughlin outlined a version of the "build it and they will come" argument. In particular, he maintained that for whatever level of bandwidth can be provided, valuable applications will be developed and deployed. In defense of this position, *Business Week* reported that Verizon's strategy of investing in fiber optic technology appeared to be paying dividends, concluding that Verizon was showing signs of success in the broadband market by "following the same aggressive capital spending plan that it used in the wireless market, where it has seen strong financial returns."[12] Sidestepping this question, the participants agreed that our society has not reached a point where the levels of bandwidth meet the available demand because many citizens have no available broadband, regard it as unaffordable (at least compared to the options abroad), or have chosen not to adopt it for any number of reasons. The remainder of this report discusses these three issues—access, affordability and adoption.

Addressing the Lack of Ubiquitous Broadband Access

Building on a working group report, roundtable participants embraced a vision of promoting broadband access by "bringing up the top" (i.e., providing higher speeds to those who already have access) and "bringing up the bottom" (i.e., extending access to broadband to areas that do not have it). The participants thus set out an aspirational vision on the former point—deferring the question of what policy response, if any, might be warranted to meet it—and they reached substantial agreement on a plan for addressing the need, as Comcast's Joe Waz put it, "to bring broadband where it isn't."

With respect to the aspirational vision, participants agreed that two distinct types of broadband users should be regarded differently. For users in metropolitan areas, some participants suggested, as a reasonable aspirational goal, that speeds of 50 mbps should be widely available and affordable within five years. On the policy front, the participants did not agree on any particular response other than the generally sound policies of reducing barriers and bottlenecks (i.e., facilitating competition) and promoting investment (e.g., through extending the investment tax credit).

The second class of users consists of those living in lower-density areas—suburbs and exurbs—who generally have access to broadband

infrastructure. Current levels of access should continue to increase, with a goal of reaching speeds of 10 mbps over five years and 25 mbps over 10 years. Participants did not necessarily call for any particular strategies to ensure this goal, but agreed that the market should be given time to evolve before considering any additional public policy responses.

Conversely, some participants supported an immediate policy response for areas where citizens currently lack any broadband connection. Those citizens, by and large, live in low-density rural areas. In terms of goals, the participants concluded that all such citizens should have access to broadband with speeds of at least 1 mbps in one direction within five years and 10 mbps within 10 years. To meet the near-term goal, participants called for the establishment of a targeted and efficient subsidy program.

Broadband technology: its benefits to society far exceed the benefits recouped by the providers who build broadband networks.

A fundamental issue is what portion of the low-density rural areas is not served by broadband. A minority view is that there are no such areas, given that satellite broadband access is available throughout the country. FCC wireless bureau chief Fred Campbell noted that satellite broadband technology could be viewed as a viable competitor. As Campbell explained, WildBlue (a satellite broadband provider) offers nearly ubiquitous broadband access at 1.5 mbps (downstream) for $50 per month. Wal-Mart, moreover, recently decided to market satellite broadband (from Hughes Communications) in 800 of its stores.[13] Suggesting that satellite broadband is really a second-tier service, Dale Hatfield of the University of Colorado at Boulder noted that latency issues with satellite connections are serious, explaining that certain real-time applications—including Voice over Internet Protocol (VoIP)—might not operate effectively via satellite connections. Others added that satellite is considerably more expensive than existing cable modem and DSL offerings and that it also is not as reliable. The participants agreed that a sound approach would be to use the level of broadband access available in more densely populated areas as a benchmark and then evaluate—in a technology-neutral fashion—whether such access exists in

low-density areas, whether it is provided via satellite broadband, hybrid satellite-terrestial wireless access, or some other medium.

In attempting to quantify the percentage of Americans without access to broadband technology on a par with the DSL or cable modem connections available to most Americans, participants looked for relevant guideposts. One such guidepost is the statistic from Kagan research (cited by Comcast's Joe Waz) indicating that cable's high-speed Internet service is available to 94.4 percent of U.S. housing units. Other participants suggested that this statistic seemed high, noting reports whose findings range from pegging the percentage of the U.S. population without broadband access at 10 percent;[14] to others that suggest that "21% of Americans—the nearly 60 million people who live in rural areas—are often underserved."[15] Several participants pointed out that the current definition of broadband—200 kbps in one direction—undoubtedly yields a greater number of Americans with access to "broadband" than would an evaluation based on a definition of 1 mbps in one direction. In any event, given the limited reliability of the FCC's current measurement program (which may not include many wireless providers and which focuses on availability based on ZIP codes), it is difficult to determine with confidence the percentage of Americans who lack access to broadband.[16]

Regardless of the scope of the problem, the underlying concern remains—for a significant number of Americans, broadband offerings either do not exist or are woefully inadequate. These Americans cannot participate fully in today's information society because they lack access to emerging broadband-intensive applications such as telecommuting, distance learning opportunities, and telemedicine. In a painful irony, Americans living in remote areas without access to broadband often are the ones who can benefit most from such opportunities because job opportunities in technology professions, top-flight educators, and medical specialists often are hard to reach from remote areas.

Toward a New Universal Service Policy for Broadband

Participants agreed that a sensible universal service policy for the information age would begin with the premise that the availability of affordable broadband access for all Americans should be a critical goal. The current universal service fund fails to advance this goal except to

the degree that subsidized access to schools and libraries provides some level of guaranteed access. Several participants recommended that the fund principles be reformed to emphasize broadband connectivity and to redistribute funds from existing programs and/or general tax revenue including funds used to support the current Rural Utilities Service (RUS) loan program designed to spur broadband deployment. Link Hoewing, assistant vice president for Verizon, suggested that support for broadband be provided only from general revenue rather than through a reformed system of universal service support, on the ground that the current model is deeply flawed.

Several weeks after the Aspen conference, the FCC's Federal-State Joint Board on Universal Service echoed the participants' recommendation to spur ubiquitous broadband access. In particular, the Board added broadband to the list of services to be supported (although it did not suggest any prioritization for its deployment).[17] In so doing, the Board also suggested that a universal service fund strategy should be guided by four basic principles:

1) Cost control,

2) Accountability,

3) State participation, and

4) Infrastructure build-out in unserved areas.

Significantly, the participants also called for a broadband strategy animated by these four principles.

Cost Control and Infrastructure Build-out

To ensure that the new universal service initiative would be committed to controlling costs and focused on spurring build-out to unserved areas, the participants set forth three strategies to structure the new program. First, it is important to define broadband at a realistic and not overly ambitious level for the level of build-out that should be required. To that end, the commitment to delivering at least 1 mbps downstream, with a substantial upstream capacity (say, 256 kbps), struck the participants as a reasonable approach. In support of the 1 mbps level, Preston Padden, executive vice president for Walt Disney Company, noted that this level of connectivity was necessary to support

video downloading services such as the one his company offered (at least for standard definition programming). Moreover, as noted above, low-latency service is required to support real-time applications. Finally, the participants realized that the 1 mbps service level would need to be defined in a realistic manner—it need not necessarily be an average level of capacity, but it also should not be based on any kind of "up to" claim in which the upper bound may be a fantastical limit that is rarely, if ever, reached.[18]

For a significant number of Americans, broadband offerings either do not exist or are woefully inadequate.

A second cost-limiting principle would be to recognize that some areas are sufficiently remote to make satellite the only practical option. For such areas, providing access to more effective broadband connections—with low latency and higher speeds—at local resource centers (e.g., schools, libraries) remains important. Indeed, in evaluating the impact of the 1 mbps level, Jeff Brueggeman, vice president for regulatory policy at AT&T, emphasized that it is important both to ensure that local resource centers such as schools, libraries, and hospitals have superior access options and to recognize the relative inefficiency of extending those connections to areas with lower economies of density.

A third cost-limiting factor is to provide support only for front-end infrastructure costs. Under this approach, for example, providers would be eligible—under a competitive bid scenario—for support to cover their capital costs on a one-time basis. After all, the principal obstacle to delivering broadband to unserved areas is the high capital costs involved in building out a new system. To be sure, a company might also need some subsidies for ongoing operational costs, but it should appropriately build such costs into its bid for the level of subsidy it feels is necessary to provide a prescribed level of service.

Reflecting all of the above points, the participants concluded that ensuring broadband access to all Americans probably would not require a massive investment strategy—at least compared to the current universal service program. Using very rough estimates, the participants assumed for this exercise that as many as 10 million households (approximately 15 percent of all U.S. households) lack access to broad-

band that could be provided on the basis of a one-time subsidy of $2,000 (based roughly on construction cost projections for WiMAX systems).[19] Because that subsidy in all likelihood would be paid over a period of time (such as the time frame for which the provider committed to offer service), the participants arrived at a very rough estimate of a $20 billion investment that could be annualized at $2 billion per year over 10 years. By contrast, the current universal service fund operates at a level of $7 billion per year.

State Participation and Accountability

The implementation of a new program to spur broadband deployment in unserved areas should involve states in an oversight and management role. Simply stated, it is not realistic for the FCC to develop and implement a program that would evaluate the state of broadband deployment, administer a competitive bidding program to ensure provision of service to unserved areas, and ensure that firms are providing the level of service contracted for. Each of these efforts will take considerable focus and attention, and although each can be managed more effectively with the benefit of federal guidance, these administrative functions are best handled at the state level.

The first element of a universal service strategy for broadband is to develop a clear understanding of where broadband connections are not available. In the often-cited case of ConnectKentucky, the nonprofit organization that spearheaded an effort to bring ubiquitous broadband to that state, a "broadband mapping" effort was an essential first step in its broadband initiative. In that case, the mapping effort went hand-in-hand with logistical support, broadband evangelizing, and efforts to tap available funding sources. As reported in *The Economist:*

> [ConnectKentucky reports that by the end of 2007] 98% of residents will have access to inexpensive broadband services. This is primarily because of ConnectKentucky's effort to map broadband demand in communities that didn't have access, [ConnectKentucky reported], which indicated that enough people in Kentucky farm country would sign up if providers entered the market. At the same time, the organization also talked up high-speed

> Internet services to skeptical residents, creating demand where it was slack.[20]

The payoff of this effort has been considerable, *The Economist* noted: "Once isolated Kentuckians can now consult with doctors in faraway cities or telecommute."[21] Notably, as Link Hoewing of Verizon highlighted, the ConnectKentucky effort spurred the build-out and adoption of broadband without any need for government subsidies—highlighting that the mapping project, along with a healthy dose of broadband evangelizing, could itself drive broadband forward.

A successful mapping effort may require a structure like the Kentucky model whereby a nongovernmental entity either contracts with the government or manages the effort on its behalf. The reason for this structure is the sensitivity that private firms have about providing proprietary information to a governmental entity that might have to release such information when presented with an open records request. To avoid this situation, a nongovernmental organization can collect the relevant information, enter into nondisclosure agreements with cooperating companies, and relay to the governmental agency only the critical information it needs—namely, which portions of the state are unserved by broadband.

To ensure that the mapping effort is consistent across the United States and a federal program could disperse funds fairly, the FCC should develop a uniform standardized format with well-specified speed tiers for all states to use. Cisco's Jeff Campbell noted that California developed an extensive effort along these lines, assembling a database that focused on the availability of broadband at the street-address level as well as available speed tiers and service availability (without regard to the number of rivals). Whatever the contours of the standardized federal framework, states could manage the program and welcome citizen input to improve the quality and reliability of the data.[22]

Discussing a framework for a competitive bidding program, the participants agreed on a remarkable number of details about how such an initiative should operate. The first premise is that the program should focus on ensuring build-out of new infrastructure and eschew any focus on particular technologies or carriers. Second, this infrastructure, as noted above, would be subsidized through a single capital grant (which should be paid out over a period of time) rather than ongoing subsidies (i.e., funds should not be awarded beyond the up-front grant amount

necessary to induce entry). Third, the use of a competitive bidding model (sometimes referred to as a "reverse auction") would enable any willing bidder—public, nonprofit, or private—to obtain a grant in exchange for meeting certain specified criteria. Fourth, the fund to provide these grants would not operate as part of the traditional universal service fund system; instead, the participants generally suggested, this fund should be established under a new model, with funds redirected from the legacy universal service fund or supported by general tax revenues. Finally, the participants emphasized, such a model would need to be implemented carefully with a monitoring system in place to ensure compliance with relevant terms for quality, availability, and price/performance of the broadband service delivered.

The participants recognized that the foregoing broad principles would need to be developed by the FCC to ensure that the program would operate effectively. In highlighting these principles, the participants recognized the difficulties that would arise in implementing them in practice, although they regarded these issues as challenges that could be managed effectively. Consider, for example, the often vexing issue of defining "service areas" for the purposes of determining subsidies. Don Stockdale, deputy bureau chief of the Wireline Competition Bureau, remarked that this issue will strongly influence—as in the spectrum auction context—which firms would be willing to bid and setting a reserve price (i.e., a price above which government would not be willing to subsidize broadband build-out) presents a difficult judgment call. Reflecting some of the learning that has emerged from the spectrum auction context, Tom Hazlett, professor of law and economics at George Mason University School of Law, noted that it is important, if at all possible, to define geographic areas in a neutral fashion (e.g., based on political boundaries) and to allow combinatorial bidding (i.e., the opportunity for firms to bid on a combination of service areas at once). More broadly, the rules for the competitive bidding process must be guided by sound economic principles and must not be subject to gerrymandering efforts designed to give advantages to particular firms.

With regard to enforcing the commitment to offer the supported service, the participants recognized that a credible and effective enforcement strategy was essential to make the program a success. To enable any monitoring program to succeed, state agencies would need to develop a mechanism to provide an ongoing feedback loop that offers

regular information about the availability of the contracted service and the grant winner's compliance with relevant service requirements. Those requirements, the participants concluded, should include not only providing a particular level of service (i.e., 1 mbps) but also offering it at a price that is reasonably comparable to that charged in more densely populated areas. To ensure that such requirements are met, the capital subsidy payments must be spread out somewhat over a period of years and the state must take a lien on the underlying infrastructure. Notably, this approach would give the state two important tools—the ability to withhold future capital payments and/or the ability to take possession of the infrastructure—that it could use to address noncompliance with the requirements of the grant program.

The implementation of a new program to spur broadband deployment in unserved areas should involve states in an oversight and management role.

As to the future direction of the marketplace, the participants recognized that the ambitions of this program should be constrained to reasonably achievable goals. Over time, the participants believed, technological changes would create new possibilities, suggesting that a 10-year timeframe is appropriate to enable a later review of the program's structure. To the extent that new technologies facilitate broadband service delivery in remote areas during that time period, other firms (i.e., those that did not initially seek grants) could enter and compete with the grant winner. Similarly, to the extent that technological changes do not create new possibilities, it might be the case that a new program would need to be chartered at the end of the 10-year period (for example, if the infrastructure installed during the first decade of the program was no longer effective and needed to be replaced). In any event, that judgment should be made well into the life of the program.

In the "path not taken" category, one participant, Eli Noam, director of the Columbia Institute for Tele-Information and professor of economics and finance at the Columbia Business School of Columbia University, suggested a very different model for spurring broadband deployment in remote areas. In particular, Noam advocated that a state-chartered corporation, possibly endowed with a license to use

wireless spectrum, be created to deliver broadband access to remote areas. In Noam's view, the practical likelihood that the service would be a monopoly lends itself to relying on the government to provide the service. As for the model recommended by the participants, the great weight of opinion supported the view that leaving the door open to competition between alternative providers would yield better results as it had in other geographic markets and that, *a priori*, there was little reason to focus on government service provision as opposed to government-regulated service provision.[23]

Finally, in terms of other important strategies, roundtable participants noted that governments could adopt a series of measures that would promote broadband deployment without providing subsidies. Several participants, including AT&T's Brueggeman, emphasized that the mapping process itself—coupled with outreach and empowerment efforts—might identify unserved areas that providers would be able to serve (with some encouragement) without the need for any subsidy. Other participants emphasized that backhaul connections (those from the last mile to Internet access points) often are very expensive and that even backbone connections (those from an access point to a major Internet hub) may be expensive as well and thus constitute impediments to providing service in remote areas. To address these issues, government can use its power as an anchor tenant (i.e., a purchaser of bandwidth) to spur the deployment of infrastructure that can also be used by private providers. Third, government can provide logistical support (such as advice on technical expertise and best practices) to support upstart efforts to use wireless spectrum to offer broadband service in rural areas.[24] Finally, the federal government can and should (as discussed below and in the briefing paper by Ellen Goodman, see Appendix) use its regulatory authority over the wireless spectrum to ensure that a maximum amount of spectrum is available, both in terms of flexible licenses and unlicensed spectrum, for wireless broadband services in rural areas.

Affordability

In a briefing paper (see Appendix), Robert Atkinson set forth two basic visions of how broadband technology will develop. The first vision, which Atkinson calls the "engineer's" vision, holds that both the

cost and the capacity of fiber optics argue for constructing only a single network to deliver broadband connectivity—a network that might best be owned by government or, at a minimum, regulated by government. That view also holds that wireless networks will not provide effective competition to fiber optic networks. The second vision, which Atkinson calls the "economist's" perspective, holds that the market will yield opportunities for competition and should be permitted to work. Atkinson also notes that this view highlights the pitfalls of government ownership or government regulation of the one or two wired broadband pipes. Thus, in Atkinson's view, the fundamental question about whether competition could be counted on to deliver affordable broadband access revolves around whether the engineer's perspective or the economist's perspective is the right one.

Whereas there was general consensus among the participants about the value of following sound competition policy principles to promote entry, the suggestion that government should invest in particular technologies as part of a strategic bet (e.g., on fiber to the home) met with some skepticism. Notably, John Kneuer, assistant secretary of commerce and National Telecommunications and Information Administration (NTIA) administrator, resisted this argument, suggesting that broadband could not and should not be defined singularly. There are many different flavors of broadband, Kneuer said, including those offered via mobile wireless services (including Evolution Data Optimized [EVDO] and High-Speed Downlink Packet Access [HSDPA]), fixed wireless, and satellite broadband. Moreover, Kneuer concluded, given the uncertainty about the benefits of different technologies in different contexts, the government should be cautious about investing in a particular technology. Adding to this point, Ofcom's William Webb noted that "if the government invests in the most expensive network possible, it is probably overdoing it." Also counseling against aggressive government involvement, Disney's Preston Padden summed up:

> This is not all that complicated. The first fork in the road—does government fund broadband like street lights or leave it private sector?—was passed a long time ago. We are well down the road of private parties. In terms of government subsidies, the first principle is that we don't do any harm.

For those who reject the "engineer's vision," the issue becomes how to assess the state of the marketplace from an economic perspective. Some participants vigorously defended the U.S. model of platform competition, highlighting the consumer benefits that have arisen as a result of head-to-head competition between cable companies and telephone providers. By contrast, Yale University law professor Yochai Benkler criticized policymakers for an excessive focus on the need to incentivize investment and abandonment of intra-modal competition as a core principle. In particular, Benkler suggested, U.S. policy went awry when it focused on competition between rival platforms (namely, cable and telephone providers) and abandoned the commitment to promote "intra-modal" competition using legacy facilities (including the so-called "line sharing" requirement).[25]

Consistent with Benkler's point as well as the perspective offered by Viviane Reding, Commissioner for Information Society and Media for the European Commission, at the outset of the August Aspen conference, a recent study emphasized that European countries—and Japan, for that matter[26]—that adopted effective line-sharing regimes enjoy markedly greater levels of competition and more affordable broadband access than their counterparts who failed to do so.[27] Notably, unlike the U.S. policy not to require leased access to new fiber deployment (which spurs new investment), the now-abandoned U.S. line-sharing policy only required leased access to infrastructure that was already built and paid for.[28] Consequently, this policy fits—in the words of regulatory economist Alfred Kahn—the "archetypal case for mandatory sharing," as "the sharing of [the already constructed copper infrastructure] would therefore not seem to involve any discouragement of future risk-taking investment."[29]

Wireless Broadband and the Search for the Third Broadband Pipe

The commitment to promote competition between rival platforms raises the question of whether wireless platforms will compete with the established wireline incumbents who employ DSL, cable, and fiber. On that point and the broader question of whether a third broadband pipe will emerge, Blair Levin, managing director of Stifel Nicolaus, said that it "was unclear whether any entrant will be able to have an impact" on the broadband marketplace. To that end, Levin suggested that

Clearwire—the leading entrant boosting a strategy around the development of WiMAX technology—was valued on the basis of its spectrum and takeout value and that Sprint's WiMAX strategy contributed no value to the company.[30] As for new entrants spurred on by the upcoming 700 MHz auction, Levin was skeptical that they could be significant. He noted that municipal wireless initiatives and other businesses built on the use of unlicensed spectrum are likely to provide services that are complementary to incumbent broadband platforms, rather than a significant competitive alternative to them.[31] Finally, Levin suggested that incumbent 3G and fourth-generation (4G) services are unlikely to compete against incumbent broadband services and that satellite and broadband over powerline options will be limited in terms of their market impact.

One point that emerged from Levin's skeptical presentation was that it is unclear what, if anything, policymakers can do to promote competition against the two principal broadband platforms (telephone and cable). Levin did emphasize, and other participants agreed, that competition between two pipes is significant, and that countries with both upgraded cable and telephone infrastructure are far better off—in terms of enjoying the benefits of competition—than those with a broadband monopoly. In the case of the United Kingdom, where cable providers have not made significant broadband rollouts, the regulatory authority mandated that British Telecom (BT) separate its wholesale and retail arms, requiring BT to treat retail suppliers the way they treat their own suppliers. In the UK, Ofcom's William Webb reported that 99.6 percent of all homes have access to broadband at 2 mbps, and a few homes get 4 mbps. Webb acknowledged that the wholesale/retail split does leave BT with a limited incentive to build out fiber, but he suggested that it is unclear whether people are truly interested in speeds beyond what is currently available.

The participants generally did not quarrel with Levin's suggestion that wireless broadband would not be a full-fledged competitor to incumbent wired options. Jon Peha noted that all high-profile efforts to provide wireless broadband have gone bankrupt or have given up. Peha did note that changing access to spectrum could change the economics of wireless broadband offerings, but he was uncertain whether wireless platforms could develop speed offerings that are reasonably comparable to their wired counterparts. If a wireless provider wanted to offer

comparable speeds, Intel senior fellow Kevin Kahn noted, it probably would require installation of more transmitters, thereby pushing the price up. Nonetheless, it is still possible that wireless broadband options could discipline the prices of their wired counterparts—even if they do not match their speeds or capacity—by providing a "good enough" alternative.[32]

Because we don't really know which models of innovation via wireless platforms will succeed, the best bet is to "let a thousand flowers bloom."

Janice Obuchowski

Even recognizing the limitations of wireless as a rival to wired broadband options, several participants took up the "good enough" alternative argument and explained how wireless platforms could still constrain the behavior and pricing of wired broadband alternatives. As University of Pennsylvania Wharton School of Business professor Kevin Werbach put it, wireless connections are the most effective vehicle for facilitating disruptive innovation in the broadband arena. Although Werbach acknowledged that wireless may not emerge as a third broadband pipe over the next three to five years, it remains potentially very powerful over the long term. Bolstering this argument, one study conducted by industry veterans suggests that WiMAX, "if deployed and marketed correctly, is a truly disruptive technology that could unseat the telco-cable duopoly and provide consumer choice in broadband services."[33] In short, one powerful promise of WiMAX is to offer a solution that provides both mobility and home broadband access.

Possible Directions in Spectrum Policy

Benkler suggested that one strategy to facilitate effective wireless broadband would be a model whereby wireless services could be managed by end users. He recommended, for example, that the last mile could be a wireless infrastructure—akin to a driveway to roadway—in which devices would create a "municipal broadband cloud" that no one could manipulate or claim because it would not be "built out" by a single entity. Jon Peha suggested that this architecture would be difficult to develop because it would depend on a critical mass of users and an

agreed-upon system for security. If an infrastructure is based on the assumption of cooperation among all users, there should be margin for error in the event cooperation is not forthcoming. One solution to this dilemma, Peha added, is that one vendor could build all of the relevant products; another is that a condition of operating in a particular band is to provide proof of cooperation.

Janice Obuchowski, president of Freedom Technologies, suggested that unlicensed wireless operators would have to comply with a specified etiquette requirement "or you have law of the jungle." Others noted that wireless Internet service providers (WISPs) that have relied on unlicensed spectrum have been furious with Motorola. As one participant put it, the Motorola Canopy system uses interference as a competitive tool. Consequently, many participants concluded that even though spectrum etiquettes are not necessarily democratic (e.g., if imposed by the FCC), they may be necessary.[34]

The possibility that wireless broadband will emerge as an important competitive constraint on wired connections left participants with different perspectives on the right policy strategy. Ofcom's William Webb cautioned that distorting spectrum policy to promote wireless broadband would be a mistake; rather he suggested allowing a free and open market to dictate the possible uses of spectrum would be preferable. Google's Andrew McLaughlin countered that he regarded the upcoming 700 MHz auction as an opportunity to facilitate the emergence of a nationwide wireless entrant with an open platform. Obuchowski suggested that because we don't really know which models of innovation via wireless platforms will succeed, the best bet is to "let a thousand flowers bloom."

Ensuring More Efficient Use of the Wireless Spectrum

To frame the discussion of how spectrum could be used more efficiently, University of Colorado professor Dale Hatfield emphasized that "interference between different uses of spectrum is in the receiver." Given that premise, Hatfield suggested, regulators can focus on the quality of transmitting and receiving equipment. Even if regulators focus on transmitters, he noted, they must begin with a conception of a model receiver and protect stations from interference with those receivers in mind.

To protect users of spectrum from interference, Hatfield explained, regulators can adopt restrictions that operate either *ex ante* (before the fact) or *ex post* (after the fact). However regulators set the rules, parties can engage in bargaining over their specific entitlements after the fact. In general, however, the parties will need to rely on some system of measurement to ensure that they can agree on a level of protection against interference. The FCC can set the level of protection, but it must be careful in doing so lest it create an opportunity for spectrum licensees to use their property rights strategically and potentially harmfully (in the manner of "patent trolls").[35]

Ellen Goodman, professor of law at Rutgers University-Camden, suggested that regulation of spectrum should rest on a concept of nuisance rather than trespass. Under nuisance law, Goodman explained, the question is whether the use of a resource is unreasonable as it impacts neighboring users. This system, however, puts pressure *ex post* on the adjudication system. In Goodman's view (as she explains in a briefing paper, see Appendix), the best solution is for the FCC to develop a new institutional system to deal with such challenges.

Tom Hazlett, professor at George Mason University, suggested that the use of property rights in spectrum could be guided by the law and economics literature of property rights. That literature, he noted, provides three distinct models:

1) Governance rules to regulate use via a license;

2) Governance rules to regulate use via equipment regulation; or

3) Exclusionary rules that enforce a boundary.

In endorsing the third model, Hazlett suggested that cellular providers had operated very effectively in settling disputes and managing interference. In response to that point, Phil Weiser, professor of law at the University of Colorado, explained that one should not ignore that the relevant carriers are in a better position to cooperate than many other spectrum users, because they are repeat players (thereby creating an important incentive for cooperation) and operate using low power (thereby enabling them to manage interference more effectively than other systems).

Michael Calabrese, director of the New America Foundation's spectrum policy program, suggested that the most important frontier in

spectrum regulation is that technology can replace regulation. As Calabrese put it, "No matter how optimistic you are about reform, there is going to be a tremendous amount of white space, and new technologies—such as software-defined radio—can allow opportunistic use of white spaces." With regard to the development of new technologies, Wharton professor Kevin Werbach underscored a lesson from the success of Wi-Fi where users of spectrum have been able to work out disputes through experimentation and trial-and-error learning. NTIA Administrator John Kneuer noted that the federal government is indeed trying to promote such experimentation and is committed to the concept of dedicating a swath of spectrum as a test bed.

The most important frontier in spectrum regulation is that technology can replace regulation.

Michael Calabrese

Intel's Kevin Kahn emphasized that the relevant calculus must weigh the relevant risk/benefits as they arise in different contexts. He noted, for example, that the questions are different when protecting TV sets than when protecting radar from interference. Unfortunately, he noted, some parties suggest that the only appropriate stance is 100 percent protection from interference. In trying to protect spectrum licensees from interference (whether or not at 100 percent assurance), Kahn suggested that software-defined radios are not a cure-all.

There was considerable agreement that spectrum regulation can better facilitate greater efficiency and experimentation. Insofar as the current framework emphasizes front-end rules, new entrants are often at a disadvantage. Dean Brenner of QUALCOMM noted that, after a lengthy 18-month proceeding that governed the use of spectrum for a new service, his company was able to receive some additional flexibility. However, Hazlett emphasized that, for many entrants, restrictions on licenses function as an entry barrier and limit the development of disruptive innovations. As a general rule, therefore, he advocated "a pro-entrant policy that will lead incumbents to do more pro-entrant things."

Finally, with regard to the suggestion that the government could free up additional spectrum, John Kneuer suggested that the major challenge is the federal appropriations process because Congress will not

allow agencies to retain additional funds that might be collected in exchange for giving up spectrum, meaning that agencies will never have incentives to do so. In the Commercial Spectrum Enhancement Act, however, Congress did allow identification of efficiency gains through moving or buying equipment, meaning that the NTIA can move ahead to facilitate win-win bargains in terms of enabling agencies to give up spectrum and receive direct benefits in return. With regard to the use of government spectrum, some participants noted that a formal process for audits of government spectrum holdings would provide a greater level of transparency. In a related approach, some suggested that fees should be placed on agencies using wireless spectrum, thereby ensuring that they recognize the cost (and value) of the spectrum they may currently take for granted.

Conclusion on Competition Policy and Affordability

In general, the participants agreed that government ownership or regulation of broadband infrastructure would be unwise. Even with the U.S. policy on network unbundling (emphasizing the "Unbundled Network Element Platform" and ending line sharing) and the relatively slow progress on spectrum policy reform, there is a powerful case that U.S. consumers are generally often able to gain access to broadband connections at reasonable rates. As Verizon's Link Hoewing pointed out, for example, consumers in Verizon's service territory can purchase speeds of up to 768 Kbps for only $14.99 per month (with a two-year commitment) and can purchase this plan on a "same price-for-life" plan.[36] (Verizon also offers a 3 mbps plan under the same terms for $27.99 a month.[37])

The participants recognized that the price of computers may be an affordability challenge that the marketplace is less able to solve. Some countered, however, that the $100 laptop initiative (led by MIT's Nicholas Negroponte and others) indicated that computers are becoming increasingly affordable. In any event, all of the participants embraced the goal that programs should be developed—ideally through private-public partnerships—to make low-cost computers (or broadband equipment) readily available to lower-income families.

One notable private-public partnership whose model bears mention is the non-for-profit venture One Economy. The mission of One

Economy is to use "technology to support the needs and potential of low-income individuals" by "developing Web-based online content" and "providing low-income people with technology infrastructure and capacity."[38] To that end, One Economy has used innovative strategies both to facilitate broadband adoption and to enable low-income households to benefit from the power of broadband to facilitate economic opportunity, enable educational enhancement, and empower civic participation. On the content front, for example, One Economy has developed a website—thebeehive.org—that provides users with valuable information, including advice on starting businesses and the ability to "go online, not wait in line" for vital services. On the infrastructure front, One Economy has developed strategies for using tax credit subsidies for low-income housing to facilitate broadband build-out and adoption.[39]

The challenge… is to investigate strategies for convincing Americans who have yet to become Internet users to do so.

In line with the view that the marketplace is producing reasonably affordable broadband connections, the consensus of the participants (in line with a working group recommendation) was that policymakers should wait to see how competition develops and pricing patterns evolve over the next several years. Moreover, the participants agreed that solid social science research is needed over the next several years to investigate the real barriers to universal broadband adoption. The participants concluded that universal broadband adoption is important as a goal and that price should not be a barrier to adoption. After all, the applications and functionalities enabled by broadband will continue to blossom—ranging from health care home monitoring to sharing photos with grandparents to distance education—and such opportunities will benefit both individuals and society at large (because of the network effects that will make all broadband applications more valuable and effective as more people can use them). For now, however, the participants suggested that the best government policy would be to avoid adding regulations that would drive up the price of broadband—such as allowing taxation of DSL or cable modem connections—and to closely monitor how the market develops.

In short, the participants concluded that it was too soon to determine whether individuals are not adopting broadband out of affordability concerns or for other reasons. Consequently, the participants chose not to call for any new program at present but recommended a reevaluation in 2011 as to whether the lack of affordable broadband connections—at least for certain socioeconomic groups—accounted for the decision not to adopt broadband. If the gap in broadband use between the top income decile and the bottom decile has not fallen to half by then, the participants suggested, Congress should seriously consider a "Lifeline"-like program to subsidize broadband access for low-income Americans (i.e., the same group that is now eligible for Lifeline).[40] More immediately, however, there are several non-affordability-based reasons to explain why U.S. citizens have yet to adopt broadband connections. As noted in the following section, the most effective near-term policy focus is to address those issues.

Adoption

The final question the participants wrestled with was whether government could take important steps to spur adoption of broadband connectivity. The general consensus was that many Americans have yet to adopt broadband technology for reasons other than access or affordability. As Brian R. Mefford, chief executive officer of Connected Nation, noted in testimony to the U.S. House of Representatives Subcommittee on Telecommunications and the Internet, access is only part of the problem; "[t]he remainder of the challenge relate[s] to the actual *use* of broadband-related technology."[41]

As James Gattuso of the Heritage Foundation highlighted, a focus on people who have yet to adopt broadband is a "glass half-empty" perspective. In fact, on many accounts, broadband may be the fastest growing technology in U.S. history. To take the "glass half-full" perspective, consider that 47 percent of U.S. households had adopted broadband connections as of February 2007, and broadband adoption topped 50 percent later in 2007—only nine years after its introduction. By contrast, John Horrigan, in a report from the Pew Internet and American Life Project, noted that "it took 10 years for the compact disc player to reach 50% of consumers, 15 years for cell phones, and 18 years for color TV."[42] Nonetheless, as Ron Binz, the chairman of Colorado

Public Utilities Commission, highlighted, if broadband is viewed not merely as a consumer electronics device but as a communications platform with considerable network externalities, policymakers should not be satisfied until the U.S. reaches much higher levels of penetration.

We have to appeal to our citizens' hopes for valuable applications and address their fears about harmful ones.

The challenge for policymakers who are concerned about the relative lack of broadband adoption is to investigate strategies for convincing Americans who have yet to become Internet users to do so. At present, as Pew reports, "non-users don't yet see the benefits of home high-speed access;" to make the case to them, "policymakers might consider more aggressive and targeted outreach efforts that educate hard-to-reach populations about the benefits of online connectivity."[43] Alexandra Wilson, vice president for public policy for Cox Enterprises, suggested that this effort is not primarily the job of the government but should be addressed by commercial providers—who have a powerful economic incentive to promote broadband adoption. To that end, Lee Schroeder, vice president for regulatory and government affairs for Cablevision, explained that the challenge of explaining the value proposition of broadband is one her company takes seriously, recognizing that some populations (such as immigrant communities) do not immediately grasp the utility of adopting broadband and need training to see how broadband can get them information that is relevant to them. Drew Clark, senior fellow and project manager for telecommunications and media at the Center for Public Integrity, echoed Schroeder's remarks, adding that the right combination of appealing applications and technology literacy is likely to spur users to adopt broadband (see Clark's briefing paper in Appendix).

The participants focused on a three-part plan to promote broadband adoption:

1) Develop and implement effective technology literacy programs for all ages and demographics;
2) Encourage federal, state, and local governments to develop and implement more broadband-based applications; and

3) Continue research and data collection regarding which strategies are effective, as well as implement a series of measures to spur broadband use.

To advance all three initiatives, the participants recommended that the FCC assemble an advisory board to coordinate efforts at the federal, state, and local levels.

With regard to the importance of technology literacy, Joe Waz of Comcast cited a recent MacArthur Foundation report, "Confronting the Challenges of Participatory Culture: Media Education for the 21st Century," which sets forth a powerful case for an emphasis on technology literacy.[44] The 2006 report contends that the U.S. education system has not yet incorporated the collaborative and community aspects of broadband technology because "schools are currently still training autonomous problemsolvers, whereas as students enter the workplace, they are increasingly being asked to work in teams, drawing on different sets of expertise, and collaborating to solve problems."[45] The report's central theme shifts the focus of the conversation about the digital divide from questions of technological access to the importance of participation and the development of cultural competencies and social skills that young people need in the new media landscape.

Waz also noted a Benton Foundation report, "Universal Access in the Information Economy: Tracking Policy Innovations Abroad," commenting that an effective and successful broadband strategy must be "holistic" including effective responses addressing adoption as well as affordability and access concerns.[46] To address this point, participants recommended that government do more to promote the use of broadband applications by teachers and that accreditation organizations take teachers' use of broadband tools into account in evaluating curricula and teacher performance.

In short, the commitment to transform education will require a significant culture change in K–12 education that cannot be taken for granted. To spur this change, schools must require and reward competency by teachers in broadband literacy by offering free broadband to teachers in their homes and other incentives for teachers using broadband-intensive applications. Related to the opportunity to spur greater usage of broadband in education is the long-promised (and still developing) application of distance education. Through interactive online

education, students will be able to take advantage of courses at home for remedial purposes and, in specialty areas where human teaching resources are not locally available, for enrichment purposes as well.

The participants recognized that education on broadband usage also should extend to young adults (and adults of all ages, for that matter) through other community-based initiatives.[47] The participants recommended a program, led by the private or nonprofit sectors under the auspices of the aforementioned FCC advisory board, to educate all Americans about the benefits of broadband, as well as how to control the perceived and actual risks. In so doing, the federal government can encourage and support efforts such as One Economy's beehive.org website, which promotes opportunities via the Internet (such as starting a business) and safe Internet usage, including how to take precautions to avoid viruses and identity theft.

Giving tax breaks to promote commuting while denying similar treatment to telecommuting expenses undermines the incentives to support broadband use in the home.

Joe Waz

A key element of technology literacy is to develop the technology tools needed to protect families online and educate users about these tools. To that end, Stephen Balkam, chief executive officer of the Family Online Safety Institute, emphasized that "parents fear what kids see and are more afraid about Web 2.0"—meaning that we have to appeal to our citizens' hopes for valuable applications and address their fears about harmful ones. To address this concern, the participants recommended that broadband providers explore offering free or low-cost server-side filtering and empower parents and other community leaders to use technology tools and set rules for use of broadband content. Moreover, from a policy perspective, as Adam Thierer of the Progress and Freedom Foundation noted in endorsing bills introduced by Senator Ted Stevens and Representative Melissa Bean, the federal government should support broad-based educational initiatives as "the cornerstone of any serious effort to deal with the issue of protecting children from either objectionable content or online cyber-dangers."[48]

Several participants agreed that governments can play an important role as a leader, adopter, and evangelizer of broadband-intensive appli-

cations. To that end, Werbach emphasized that Mayor Richard's leadership in Fort Wayne consisted not only of his efforts to spur deployment of broadband but also his efforts to develop and implement new applications such as distance learning. On the whole, the participants gave government at all levels poor marks in terms of facilitating and adopting broadband-based applications addressing areas ranging from education to health care. To address this shortcoming, the participants called for government at all levels to put more information as well as social and governmental services online in a way that helps citizens access them through broadband connections and provide creative incentives (including savings on government fees) for people who use these services online.

Broadband is not merely an infrastructure challenge but a transforming technology that can facilitate radically new innovations.

The final recommended strategy was to develop a national clearinghouse for the collection, evaluation, and dissemination of best practices in utilization of broadband technology from all sources, as well as implementing a series of measures to spur greater uses of broadband. (From the standpoint of the participants, this effort could be, but need not be, based in the federal government.) The participants suggested some of the likely best practices that, when disseminated, should be implemented across the United States. For example, the participants noted that there was a real need for what Joe Waz of Comcast called "tax parity": Giving tax breaks to promote commuting (parking spaces and transit passes) while denying similar treatment to telecommuting expenses undermines the incentives for employers to support broadband use in the home. After all, working from home (telecommuting or telework) can give rise to considerable efficiency benefits (broadening the workforce) and act as an effective energy conservation strategy. Finally, the participants believed that there were real opportunities—in the public and private sectors—for increased use of group buying programs that would enable businesses and government to get cheaper access to broadband and broadband-intensive applications.

No discussion of the Internet could be complete without commenting on the powerful role of unintended and unforeseeable conse-

quences. On the applications front, it is worth noting that some of the best aspects of Internet adoption relate to benefits from innovations that have yet to reach the market. As Intel's Kevin Kahn reported, the Internet has already facilitated an array of applications that no one could have predicted. With regard to applications that are likely to develop, Kahn reported, "I am skeptical that we can predict what the next big breakthroughs are going to be."

Taking the point about the Internet's development one step further, Blair Levin of Stifel Nicolaus emphasized the uncertainty regarding how broadband policy might operate effectively. Looking back at the rise of broadband, Levin noted that one could argue that the principal driver was the program access rules in the 1992 Cable Act. These rules, he suggested, ensured that cable's competitors could gain access to programming owned by cable companies, thereby helping to spur competition from satellite, which in turn gave cable the incentive to upgrade its capacity to remain competitive with satellite. This investment in an upgraded infrastructure, Levin noted, led cable to begin offering broadband services, which then prodded the telephone companies to offer their own DSL technology, which encouraged cable to increase its speeds, which has now led to expanded investment in fiber by both competitors. Thus, as we think about the future of broadband policy, thinking outside the traditional policy contours is a valuable exercise. This suggests, for example, the value of a strong policy focus on how broadband can help address concerns about the environment, our reliance on foreign energy sources, or the shortcomings in our health care system.

Both Kahn's and Levin's perspectives comport with the line of argument offered in the Benton Foundation report that explains why, with respect to broadband, policymakers need to shift their thinking "from 'connectivity' to an 'arena of innovation.'" In other words, broadband is not merely an infrastructure challenge but a transforming technology that can facilitate radically new innovations. By appreciating this dynamic of broadband, we can focus on the "bottom-up innovations on the Internet," thereby "expand[ing] the mental space within which policy options are framed."[49]

Conclusion

The tendency to regard broadband policy as a subset of traditional telecommunications policy has left this critically important issue unaddressed to any meaningful degree by federal policymakers. There are several important strategies related to promoting access to broadband, ensuring its affordability through sound competition policy, and spurring its adoption that can make a more important contribution to broadband growth. Such strategies depend, however, on making the case that broadband matters to the lives of ordinary Americans. In that respect, policymakers and industry players need to do a far better job of explaining the transformative potential and powerful opportunities created by broadband.

As this report discusses, several promising policy strategies exist, but all of them depend on a political commitment to make broadband policy a priority. This commitment must involve a broad array of stakeholders, including those addressing matters as diverse as education policy, health care policy, and public safety. In short, broadband policy cannot simply reflect the needs of the traditional participants in "telecommunications policy." Thus, as a new administration takes office, the participants urge serious consideration of FCC Commissioner Jonathan Adelstein's call for a broadband summit to bring together relevant stakeholders, focus national attention on the opportunities created by ubiquitous broadband adoption, and spur the development of a comprehensive policy framework in this area.

APPENDIX

Broadband Affordability[50]

Robert Atkinson

Achieving the goal of universal high-speed broadband adoption will require, among other things, that most families can afford broadband. Competition is said to be a key aspect of affordability. Is encouraging competition sufficient to keep prices low enough and quality of service high enough to encourage widespread adoption? If so, what policies can best encourage competition in the broadband sector? This discussion paper lays out a framework for thinking about these questions.

Is Broadband Affordable?

Before discussing the role of competition in keeping prices low, it is worth first assessing broadband pricing in the United States. In terms of price per megabit per second (mbps), broadband prices have fallen in the United States over the past decade. For example, Verizon customers can purchase 768 kilobits per second (kbps) DSL service for just $14.99 a month—40 percent cheaper than 56 kbps dial-up service was 10 years ago.

Compared to other Organization for Economic Co-operation and Development (OECD) nations, the United States performs better on pricing than on broadband take-up. The Information Technology and Innovation Foundation (ITIF) has calculated that the U.S. ranks seventh in price for broadband (measured as the monthly rate per advertised mbps of the fastest service generally available), compared to 12th on take–up (see Table 1).[51] Japan, Korea, and Sweden top the list, in large part because of extensive very fast fiber deployments. For example, some Japanese residents subscribe to 100 mbps service for less than $40 per month.

Table 1: Price of the Fastest Generally Available Broadband Services

Nation	$/Month for 1 Mbps (PPP)	Nation	$/Month for 1 Mbps (PPP)
Japan	0.27	Belgium	6.69
Korea	0.45	New Zealand	9.20
Sweden	0.63	Portugal	10.99
France	1.64	United Kingdom	11.02
Australia	2.39	Spain	12.46
Finland	2.77	Poland	13.00
United States	3.33	Ireland	13.82
Italy	3.36	Luxembourg	18.48
Norway	4.04	Switzerland	21.71
Netherlands	4.31	Czech Republic	24.10
Denmark	4.92	Greece	33.19
Iceland	4.99	Hungary	44.24
Germany	5.20	Slovak Republic	50.15
Austria	5.99	Mexico	60.01
Canada	6.50	Turkey	115.76

Source: The Information Technology and Innovation Foundation

Competition Über Alles?

What is the role of competition in driving broadband price performance? In the past decade the Washington Telecom Consensus (WTC) has focused first and foremost on competition as the driver of all things good in the telecommunications space. To be sure, competition has much to commend it. It provides consumers with choice. It spurs companies to improve service quality, including customer service. It helps keep prices down. Based on the experience of other industries—including banking, airlines, and trucking—where regulation was reduced or eliminated and competition enabled, the benefits of competition clearly can be profound.

Applied to the goal of achieving a universal and affordable broadband network, the WTC's focus is clear: spur more competition by encouraging alternative "pipes" (e.g., opening more spectrum for

broadband data transmission; establishing rules to enable broadband over power lines [BPL], fostering municipally-owned networks); or by requiring incumbent providers to open their networks for competitors to ride on.

Is telecommunications—in particular broadband—like banking, airlines and trucking, or is it more like municipal water, electricity, and gas service? In other words, is broadband more like a natural monopoly or a service provided in highly competitive markets? This question has been at the center of debates over telecommunications for many years and should be at the center of the broadband debate.

Engineers versus Economists

One's view of this question depends in part on whether one brings an engineer's or an economist's perspective to it.

Here's what an engineer will say: It's really expensive to build a standard broadband network to homes, and even more expensive to build a high performance one with large data capacity (e.g., fiber optic) just as it was to build a telephone network 100 years ago. Why not just build one network, since these IP networks are just transmitting bits on applications that reside outside the network? This, after all, is why most homes have just one electricity line, one water pipe, one gas pipe, and one sewage line. Building a duplicative "pipe" for any of these services would cost an enormous amount of money.[52] In this sense, as the Institute of Electrical and Electronics Engineers states, fiber networks are a natural monopoly and therefore only one should be built.[53]

In the engineers' view, network costs involve fixed costs that must be paid to serve a neighborhood and marginal costs that vary depending on the number of customers. Advertising would be a fixed cost; customer service would be a marginal one. Most of the central office expenses and wiring to the neighborhood would be a fixed cost, with wiring going directly to the customer's premises from the street a marginal cost. Because most of the total costs are fixed, building multiple networks to serve the same neighborhood increases overall costs and therefore increases prices. In the engineer's ideal world, there would be one very high speed "pipe" to the home.

Engineers have one other belief: You can never get enough. In other words, more computer processing capacity, more storage, and more

data speed are always good investments. They cite the history of computing and telecommunications, which at least to date has always immediately used more processing, storage, and speed. As a result, they argue, why not future-proof networks by building very fast pipes?

Here's what an economist will say: Competition brings important consumer benefits by forcing companies to cut costs, improve service, and reduce "excessive" profits. Without competition, companies get lazy, limit their innovation, provide poor service, and reap monopoly profits. In this view, robust broadband competition reduces excessive profits and forces companies to cut both marginal and fixed costs through innovation and the drive to gain greater efficiencies. According to this logic, more competitors are better because they will make the competitive environment even more intense, driving more efficiency, experimentation, and innovation.[54]

Of course, even the most ardent advocate of competition probably will admit that competition can be excessive if it leads to a market structure in which the average establishment and firm size are below optimal levels. For example, if the most efficient automobile factory produces at least 100,000 cars per year (below this level, the plant gains fewer economies of scale), a fragmented and competitive market composed of firms producing 50,000 cars per year would be inefficient.[55] Excessive competition also can reduce profits to a level that makes adequate capital investments difficult for the industry.

With regard to speed and fiber, economists are circumspect about whether we know what's best. They often argue that consumers may not need all the speed a fiber network will provide (either because technology such as compression will obviate the need or because consumers aren't interested in applications that need high speeds). Moreover, they are skeptical of government's ability to pick the best technology (e.g., fiber); they argue that by doing so, government precludes development of other, potentially superior (in performance and/or price), technologies.[56]

So who's right: the engineers or the economists? Both? Neither? I would argue that both sides bring important perspectives to the issue, and that ignoring either perspective will lead us to the wrong policy conclusions.

First, engineers are right in noting that some elements of broadband infrastructure have natural monopoly aspects, as do water, gas, and sewer

pipes. For example, during the height of the electricity deregulation movement in the 1990s, few advocates proposed deregulating the local electricity network because it was rightly regarded as a natural monopoly. Society as a whole (largely through ratepayers) clearly will bear the costs of "too many" broadband networks. If providers are forced to amortize the fixed costs of their networks over significantly fewer customers, prices will increase (even if profits are squeezed and efficiencies are maximized). The only way this would not be the case is if a new entrant was not successful in gaining any customers. In this case, all the costs would be borne by the entrant's bondholders and stockholders. However, if they gain customers, then the incumbents by definition have fewer customers and therefore less revenue to amortize the costs of their networks.

Yet, economists are also right in noting that there are significant problems with monopolies or duopolies, and that competition can spur innovation as well as increased efficiency and consumer welfare. After all, we just have to remember the bad old days of the "Ma Bell" monopoly (and the Carterphone problems).

The issue, then, becomes how to attain a balance between the efficiency of fewer networks and the competitive benefits of more networks. Before considering this issue, we must realize that the current state of competition is due largely to historical telephony and cable television (CATV) monopolies that enabled providers to build their networks to a large share of households (CATV passes upwards of 90 percent of homes) and a satellite system that had a national footprint. The evolution of technology just happened to allow all three networks to transmit relatively easily IP-switched data on their networks. A few high-income areas also have a second cable system from cable overbuilders such as RCN. As a result, many—though certainly not all—American homes have a choice of at least three broadband providers (CATV, telephone-provided DSL, and satellite).

Although a one-pipe solution may have ultimately resulted in lower total network costs (e.g., especially if that one provider, cable or telephone company, laid fiber to most households) than the three-provider solution than we have today, it's not clear how that solution would have come about. Clearly, the Federal Communications Commission (FCC) or state public utility commissions (PUCs) would not have been in a position to anoint one winner, while shutting the other technologies/companies out of the market.

So what should the role of public policy be with respect to competition? Before getting to that, there are at least two issues to consider. First, is existing competition adequate? Unfortunately, the current reality of the broadband market is that in most local markets there are only two principal competitors—telephone and cable broadband. Indeed, for the foreseeable future, the "last mile" of broadband services is for most consumers at best a duopoly, and sometimes offers just one provider. To be sure, the FCC reports that 75 percent of zip codes have three or more broadband providers. However, the inclusion of satellite broadband services in this measure misrepresents the actual competitiveness of the market, as satellite is generally not a viable substitute for DSL or cable modem service because of higher prices, slower speeds, and high latency. Consequently, the reality is that most Americans have a choice between only two (or fewer) providers of broadband service.[57]

Second, in assessing the competitive state of broadband today, we must realize that not every home has to be served by every provider in an area for that household to realize the benefits of competition. For example, there are homes located in the Washington, D.C., metropolitan area that cannot get DSL service but can get cable modem service. Yet because the incumbent cable companies have to price their offerings on the basis of competition in the entire metropolitan area, households without access to DSL still benefit from competition. This is important in considering proposals that require cable or telephone companies to build-out in their service areas. These proposals often are justified on the basis of providing competition and lower prices to households that would not get service (or would not get it as soon) without a mandate. But if there is competition in the overall local market (indeed this seems to be the case as pricing plans often are statewide or multi-state), then individual households enjoying less competition will still benefit. However, this is less true if incumbents are able to offer discounts to households with choice. In that case, households with fewer or no choices will reap fewer benefits from competition.

There are essentially four different policy approaches to competition:

Keep the Same Number of Pipes. Given that a large share of households have effective competition among two and a half providers, is this the right amount? We have to think about that question both in the short run and longer run. For many households, the fact that cable and DSL providers are competing intensely compensates for the fact that the

broadband market is largely a duopoly. Indeed, with less than half of all households currently subscribing to broadband, cable and telephone companies are vigorously seeking to attract new customers. They are rolling out new technologies (e.g., Verizon's Fiber Optic Service, Comcast's recent announcement of high-speed Data Over Cable Service Interface Specifications 3.0 channel bonding technology) and introducing new, low-price offers.

But what happens when the vast majority of households have adopted broadband? And what if some customers are still reluctant, in the face of significant costs and hassles associated with switching broadband providers, to move from an established incumbent to a new entrant?[58] In this case, providers may be able to exercise market power.

More Pipes. The standard answer for most telecommunications policy mavens and policymakers (especially economists) to the conundrum of limited competition is to promote more competition by getting more pipes to the home. This approach can take several forms. One is government-provided or subsidized third (or fourth or fifth) networks. For example, one of the rationales used by promoters of municipal networks (either wireless or wired), is that a publicly subsidized (whether publicly or privately owned) additional network will boost competition, driving down prices and making it easier for community residents to afford broadband. It's not clear that this will be the case, however. Leaving aside the question of whether publicly run (or influenced) networks can operate efficiently, an additional public network will mean fewer subscribers for incumbents, leaving them with the requirement to raise prices or have less capital with which to upgrade to next-generation networks.

The impact on investment is particularly important. Economist Joseph Schumpeter talked about the advantage of innovation in creating temporary monopoly profits, which in turn let companies invest sizeable amounts of capital in more technological innovation. If competition is so fierce in broadband—as it is in the voice long distance business now—the effect will surely be to reduce the large amount of capital needed to deploy next-generation high-speed networks.[59]

What about wireless or broadband over power lines (BPL)? Even if there are costs as well as benefits from more pipes, this doesn't mean that public policy should oppose the development of third pipes. For exam-

ple, in the forthcoming auction of 700 MHz spectrum, it's likely that much of that spectrum will be used for IP data transmission. The appropriate role of public policy is to free up such inefficiently used spectrum, but let the marketplace (with the exception of first responder uses) decide on its use. It is equally wrong for the FCC to prevent such spectrum from being used for broadband services as it is for the FCC to mandate its use for broadband. Likewise, the role of policy toward BPL should be to remove unnecessary regulatory obstacles to deployment. But it should not be to tilt the playing field to promote a particular technology.

This approach is also true for the universal service fund (USF). Currently, in the name of promoting competition, the USF invests over $1 billion a year in competitive, duplicative voice providers in high-cost areas. Yet, we should question whether this $1 billion would be better spent creating and subsidizing a parallel network or building out incumbents' networks to more places or using the funds for broadband. If broadband becomes explicitly eligible for USF payments, policymakers will have to address the issue of how many providers to fund in an area. (Of course, if policymakers decide that mobility is a distinctly valuable service in itself that deserves subsidy, then that is a different matter, and subsidies to both wireless and wireline phone service in the same area could make sense.)

This brings up one point related to wireless. Given that many places in the United States cannot get either DSL or cable modem service, developing a "first" pipe is important. In this situation, fixed wireless may be the most cost-effective technology. Thus, public policies, particularly with respect to spectrum, should promote this approach.

In other words, the right policy for more pipes appears to be: "Enable, but don't promote." If there is spectrum that can be freed up, the market should be able to decide how best to use it. If policymakers provide tax incentives for broadband (either to spur deployment to high-cost areas or deployment of next-generation high-speed networks), these should be available to all providers, and not, as some have argued, available only the providers of additional new pipes.

Regulated Open Pipes. Many of those who want competition but are pessimistic about more pipes emerging (either through market forces alone or with aggressive public promotion) look to spur competition through unbundling. Indeed, the European Union (EU) has pushed

this as the core of its broadband strategy, requiring member nations to craft regulations unbundling the incumbent copper loops.

This strategy has achieved some success. For example, the OECD reports that the company with the best "triple play" in the world—France's Free Telecom—rides on the incumbent, France Telecom's, DSL pipes. Likewise, Yahoo! Japan's fast and cheap DLS broadband service rides on incumbent NTT's wires. In these cases, the competitors lease some parts of the incumbent's network, usually the copper line, and install their own switches and other equipment.

There are various models of open pipes. In most nations, competitors get access to the incumbent's copper loop at regulated prices and terms. However, at least one nation—the United Kingdom—has moved to a virtual separation model, where the incumbent (BT) has been "separated" into a retail and wholesale division. The wholesale division manages the "pipes" and the retail division that sells broadband and other services competes with many other companies.

Many who have promoted this model, particularly in the 1990s in the United States, saw mandatory unbundling as a transitional state until competitive local exchange carriers (CLECs) built their own networks. That did not happen, however—in large part because it makes little economic sense for homes to have multiple DSL lines, for example (businesses in crowded downtowns are another matter). The costs of such a model would be prohibitive; as a result, unbundling or open pipes are not a transitional model. If open pipes are implemented, they probably will *not* be a transitory approach.

What are the benefits and costs? On the plus side, it is a relatively quick way to get competition. This is one reason many nations have chosen open pipes. These countries primarily were nations where intermodal competition was limited. Indeed, according to a Herfindahl-Hirschman Index (HHI) of cable and DSL, the United States and Canada have the lowest scores (0.50)—considerably lower than France (0.90) and Germany (0.94).[60]

The advantages of this kind of intra-modal competition include potentially lower prices caused in part by reduced costs from sharing one line relative to intermodal competition. In addition, it can enable other benefits of competition, including greater consumer choice.

One problem with this model is that it reduces incentives to expand the pipe. If the incumbent has to resell the pipe, where is the incentive to invest a large amount of capital in a better pipe (e.g., fiber)? Indeed, there is a risk that Europe could be in a "DSL-cul-de-sac," with robust competition on copper lines but little investment in next-generation lines. (Because of shorter loops in Europe, this strategy can generate more than adequate speeds, at least for the foreseeable future. For example, Free Telecom offers speeds of approximately 20 mbps.)

In addition, the unbundling model (at least the continental European model) requires regulators to be much more interventionist, including setting prices. If they price access to the network too low, however, they limit investment. If they set the price too high, they limit competition.

In some ways, Japan has appeared to square the circle of getting the benefits of competition with the incentives to deploy big fast pipes. More than 70 percent of the households served by NTT East now can subscribe to 100 mbps (advertised speed) fiber optic service. Yet NTT must resell these lines to competitors.[61] Why did they deploy, given this regime? The answer seems to be twofold: They received generous financial incentives from the government to deploy fiber, and they are 40 percent government owned and therefore can afford to make investments that financial markets, especially more competitive markets in the United States, might not fully support.

Another nation that has been able to combine the engineer's view with the economist's is Sweden where some municipalities (e.g., Stockholm) control the right to lay the underground wires. In fact, in Stockholm, a publicly chartered corporation is the only entity with the right to lay wires, and has deployed a fiber network to most buildings in the city. It leases dark fiber to whatever company—incumbent local exchange carrier (ILEC) or CLEC—wants it. For example, one large CLEC, B2, uses this fiber, installing routers and modems on either end, to provide up to 100 mbps broadband to Stockholm residents and businesses. The advantage of this model is that it limits infrastructure costs—private-sector fiber and cable deployment was largely non-existent—while it spurs competition. This model is different from many of the muni-fiber projects in the United States (such as that in Lafayette, Louisiana), which are overbuilder projects, spending money to build a third pipe and provide their own applications over a closed network. In contrast, the Stockholm model

involves just one pipe over an open network.

Regulated Duopoly Pipes. The final option would be to simply assume that there will be limited competition (a duopoly at best) and that some form of regulation is needed. Regulation has the advantage of limiting abuses of market power. However, it can also, as noted previously, reduce incentives for investment. Moreover, at least for the foreseeable future, there appears to be considerable competition between cable and DSL. In addition, there can be significant institutional challenges in managing rate regulation or allowing new entry once a monopoly is embraced. A "softer" alternative to regulation, but one that would still be premised on a mature duopoly market, would be to use more existing antitrust and consumer protection rules aggressively to limit abuses.

Conclusion

Competition is not an end in itself but a means by which the economic system produces the benefits citizens desire (e.g., efficiency, productivity, innovation, reasonable prices, and quality goods and services). There sometimes are tradeoffs, however, between competition and these goals, and the tradeoffs are higher in industries that display natural monopoly (or, in the U.S. case, natural duopoly) characteristics. Therefore, policymakers need to balance the desire for more competition to enhance consumer welfare with respect to broadband with the need for the most efficient industry structure. To the extent that policymakers desire to enable the emergence of more competition, they should achieve it by removing barriers rather than through proactive support of new competitors.

Spectrum Sharing and Spectrum Efficiency

Ellen P. Goodman

One of the principal objectives of spectrum management is efficient use of the spectrum resource.[62] This briefing paper discusses Federal Communications Commission (FCC) efforts to maximize the utility of the spectrum by mandating or enabling more intensive use, especially through spectrum-sharing arrangements. These techniques raise objections from users, potential users, and other interested parties concerning technical viability, efficiency, and equity. Such objections often lead to protracted battles that delay spectrum decisions and, ultimately, lead to compromised decision making. The current effort to introduce unlicensed devices into broadcast television "white spaces" is one example. This case study illustrates a central limitation of the current approach: the lack of back-end safeguards to resolve unforeseeable, or intentionally risked, conflict among spectrum users.

Obstacles to Spectrum Efficiency

If we consider spectrum use to be efficient when it maximizes the utility of the spectrum resource, spectrum use is inefficient under several common conditions.

First, the spectrum is *idle*, resulting in *technical inefficiency*. Spectrum may be idle for one of two reasons:

The rightsholder (usually the licensee) may not be operating fully or at all because of technical or financial difficulties in building out, because of market changes that reduce demand for the spectrum-based service, or because the rightsholder is a governmental entity that has no immediate need for the spectrum. The Personal Communications Service (PCS) spectrum long left idle by the Nextwave bankruptcy and the spectrum tied up in the failed mobile satellite service (MSS) allocation are examples.

Spectrum may be idle even if the rightsholder is exercising its transmission rights to the fullest because the FCC has not exhaustively dis-

tributed rights to the spectrum. In other words, even where rights holders are operating at maximum capacity, there is still room for other operators on a noninterfering basis. The FCC may make an error at the outset in allocating spectrum, leading to a suboptimal allocation. Alternatively, suboptimal allocations may arise after the fact as technologies develop that would permit more intensive spectrum use by the incumbent, by new entrants, or both. The advent of digital broadcast technologies makes the existing (pre-digital transition) broadcast television allocation suboptimal in this sense because the broadcasters can operate on much less spectrum.

It is not always apparent whether there is technical inefficiency in spectrum use or, if there is, whose fault it is. In some cases, spectrum rightsholders are not deploying technologies that would maximize the communicative capacity of the spectrum. In other cases, independent receiver manufacturers, rather than rightsholders, are deploying suboptimal technologies.

Even where, as a technical matter, spectrum cannot be used more intensively, spectrum use may still be inefficient if it is used for *economically inefficient* applications. Spectrum auctions were introduced in large part to ensure that licenses went to the parties that valued the spectrum most. Yet spectrum allocations, which precede the auctions, remain administrative decisions that may or may not ensure economic efficiency. Sometimes—such as when public safety is involved—the FCC may choose not to prioritize economic efficiency. Other times, the agency may simply guess wrong about what spectrum uses the market demands and what licensing decisions will support those uses (e.g., license area or service rules). In addition, legacy spectrum uses, such as broadcasting or certain satellite allocations, may have outlived their economic efficiency.

Second, determining whether technically inefficient use of the spectrum also is economically inefficient depends on the costs of technical upgrades and the opportunity costs of the current use.

Responses to Spectrum Inefficiency

Recognizing these potential drags on efficient use of the spectrum, the FCC has deployed several strategies.

Secondary Markets. One approach is the secondary markets initiative. Where there are economic inefficiencies, often leading to idle (or potentially idle) spectrum, more intensive exploitation of spectrum will be possible as long as rightsholders can transfer their rights. The FCC has tried to support a market in spectrum rights by writing service rules that are relatively flexible, to permit a wide range of uses within a band, and by permitting licensees in many spectrum bands to lease their spectrum.[63] It is not entirely clear why the market for spectrum remains fairly undeveloped. Although operators within a service, such as Commercial Mobile Radio Service (CMRS), routinely license spectrum, there is not a great deal of spectrum leasing between services or between licensed and unlicensed users.

Possible explanations may be that (a) what parties want are "ownership" rights, not leases, and transfers of ownership interests are not permitted without FCC approval; (b) spectrum is not a commodity and is difficult to trade, especially without a brokerage system/exchange that makes it easy to identify the permissible uses and technical characteristics of a particular segment of spectrum; and (c) even flexible service rules place considerable constraints on the use of a particular band, making the market relatively small for any particular segment of spectrum rights.

Spectrum Allocations. The biggest shifts in spectrum use have been effected not through the market but through additional FCC grants to existing rightsholders or new rightsholders to exploit the spectrum. These grants may take the form of reallocating idle or otherwise inefficiently used spectrum to a new set of rightsholders, giving existing rightsholders expanded rights to exploit spectrum, or allowing new rightsholders to share spectrum on a secondary (noninterfering) basis or on a co-primary basis with incumbents.

In many *spectrum reallocations*—such as the 1990s reallocation of spectrum from microwave to PCS use—the FCC orders incumbent users to vacate spectrum that can be used more efficiently for a new service. In the PCS case, as in the more recent case of the Sprint-Nextel displacement of public safety and fixed wireless users from the 2 GHz band, the new rightsholder must pay the relocation costs of the incumbent, and the FCC finds new spectrum for dislocated licensees. Disputes in these proceedings typically involve the schedule for relocation and the amount of compensation due to the incumbents.

In other reallocation situations, the controversy is not between the new and old users but among potential users over how the new band should be structured. This was the case in the reallocation of the 3650 MHz band for fixed and mobile wireless services. After initially contemplating auctioning the spectrum for licensed use, the FCC changed course in 2002 and sought comment on unlicensed use of the band. Wireless Internet service providers (WISPs) backed unlicensed use, whereas commercial wireless carriers opposed it. In March 2005, the FCC compromised by creating what seemed like an oxymoron: nonexclusive licensed use. Users must acquire a license, but the license does not confer exclusive usage rights or interference protection. Licensees are required only to "make every effort" to avoid interfering with others. To facilitate sharing, the FCC required that devices operating in the band use a "contention-based protocol" such as "listen before talk."

Soon after the FCC's designation of the 3650 MHz band as a commons, wireless manufacturers and others filed petitions for reconsideration that, among other things, sought clarification of licensee rights and obligations. In the two years since, interested parties—including WISPS—have petitioned the FCC to move to exclusive licensing at least in urban areas. Use of the band remains uncertain.

Another way in which the FCC attempts to increase the utility of spectrum is by *granting additional rights* to incumbent users. This was the case, for example, in the MSS 2 GHz spectrum. Satellite users were unable to make effective use of their allocated spectrum because there was insufficient market demand for a satellite communications service that had huge upfront capital costs. The FCC had the choice of taking the licenses away from satellite operators or granting the operators additional rights to use the spectrum for terrestrial mobile communications as an ancillary service to satellite operations. The FCC granted the incumbents the right to use the spectrum for an "ancillary terrestrial component" while still requiring build out for the originally licensed satellite use.

These grants of additional spectrum usage rights to incumbents raise two sets of questions. The first set concerns whether it is fair or equitable to give the incumbent a "windfall" benefit. These concerns often are couched in terms of competitive harm to other players that did not similarly benefit from regulatory largesse. Windfall opponents typically argue that incumbents should pay for any new grant of rights as a

matter of distributional fairness. The second set of questions concerns efficiency and whether the initial allocation, or assignment to the incumbents, was efficient. Where the incumbent's business model has failed or the initial allocation otherwise leaves spectrum idle, there is a good argument that the spectrum should be reallocated in full or, where possible, that additional spectrum usage rights should be auctioned to the user that values them most.

The other way the FCC typically shifts spectrum uses is by ordering *spectrum sharing* between an incumbent service and one or more newly authorized services. The FCC is particularly likely to consider spectrum-sharing arrangements when it is has not exhaustively allocated spectrum, leaving some portion of a band idle, or when an incumbent rightsholder is leaving a portion of its assigned spectrum idle. Spectrum-sharing arrangements can be characterized as "overlays" or "underlays."

An *overlay right* is the right to use idle spectrum that was not previously assigned. The FCC has characterized this unassigned spectrum as a "white space." Like other spectrum, white space spectrum can be defined along the dimensions of frequency/power/time/geography. It is spectrum that incumbent licensees operating on the same or adjacent frequencies, in the same or neighboring places, have not been authorized to use.

The issue of whether spectrum is "white" is contested. White spaces emerge as technology matures. At first, the technological state of the art does not permit more intensive use of the spectrum without harmful interference. Then, as technology advances, the spectrum becomes usable. Parties debate the state of the available technology and therefore the extent to which the space is white—or really gray.

Where the FCC determines there is white space, an overlay license gives new entrants the right to use the white space spectrum as long as they create no new interference to incumbents. The FCC has granted overlay licenses, for example, in the paging band when it converted from site-based to geographic-area licensing. If incumbents themselves want expanded rights, they have to obtain the overlay licenses. Overlay licenses can be licensed by rule or made available for unlicensed use.

Overlay rights are not novel. Indeed, the FCC has long made efforts to introduce new services into licensed bands without using the terms

"white spaces" and "overlays." A relatively recent example was the insertion of a new terrestrial wireless service in the 12 GHz Direct Broadcast Satellite (DBS) band. The DBS service was authorized in the mid-1990s and given priority over incumbent terrestrial fixed wireless operators, effectively rendering the fixed service secondary. In 1998, a company called Northpoint Technology proposed to introduce terrestrial wireless operations (called Multichannel Video Distribution and Data Service [MVDDS]) into the band by transmitting in a northerly direction (DBS satellites are in the southern sky). In this sense, it was proposing to use white spaces. After much controversy and study, the FCC authorized the service in 2002 on the grounds that whatever interference would be caused was not severe and could be easily mitigated by the parties.[64]

An *underlay* right typically is the right to operate at low power, on a non-interfering basis, under the noise floor of existing licensed uses. Underlay users, such as the ultrawideband operators at 3–11 GHz, operate on spectrum that was idle not because it was not unassigned but because incumbent users were not using it.

White Spaces Overlay/Underlay

A principal controversy in spectrum sharing concerns interference. The premise of underlay and overlay rights is that the new entrant does not interfere with the existing user. If there were harmful interference, the spectrum allocated for the new service would not be a white space, nor would the new entrant be operating under the noise floor. The interference debate was at the core of the Northpoint dispute. It also has been central to the ongoing "white spaces proceeding" concerning the introduction of new wireless service into the broadcast television band.

In 2002, the FCC floated the idea of permitting the operation of low-power unlicensed devices on vacant channels in the TV band below 800 MHz—and perhaps even on the channels used for television below the noise level. Thus, the proposal combined the overlay and underlay concepts to blanket the band with devices operating opportunistically. The technology community—particularly Intel—favored the proposal, as did public interest advocates of unlicensed use such as the New America Foundation. Television incumbents opposed the idea, arguing that although the channels were vacant, they were not unused because they

served as buffers between high-power television channels. To the extent that there were white spaces, the incumbents and others (including QUALCOMM, which is a licensee in the neighborhood) argued, this available spectrum should be allocated for licensed uses.

In October 2006, the FCC decided to permit fixed "lowish" power (higher than Part 15 allows) TV-band devices in the spectrum provided that they employ spectrum sensing and dynamic frequency selection to determine when the channels are unused. Still unsettled are whether such devices will operate on a licensed, unlicensed, or hybrid basis; just what technology and uses will be authorized; and whether low-power, unlicensed devices will be permitted as underlays to the TV channels in use.

The opening of the TV band presents as challenging a sharing scenario as any the FCC has ever considered. The newly introduced technical architecture for TV band devices will be wholly unlike the incumbent broadcast architecture, as will the power requirements and the industry structure. Even under the best circumstances, creating spectrum sharing in this band would be difficult. As broadcasters themselves introduce mobile services and make more use of distributed transmission methods (i.e., a cellular-like architecture), the situation will become more complex.

Perhaps the greatest obstacle to spectrum sharing in this band is the pressure on the FCC to determine upfront that authorized uses will not create interference to existing services. Such services include low-power as well as full-power broadcasting, wireless microphones, land mobile services, and cable transmission services. Particularly if the new entrants are unlicensed, a faulty prediction could result in interference that, though illegal, is difficult to shut down.

Back-End Dispute Resolution

Uncertainty about harmful interference is debilitating in spectrum policy because there are very few remedies if interference does occur. The FCC guarantees licensees the right to be free from "harmful interference." The term "harmful interference" is only vaguely defined. Moreover, when harmful interference occurs, the FCC usually instructs the parties to "work it out" or opens lengthy proceedings to reformulate the spectrum allocations. Given this back-end uncertainty and inflexibility, the FCC is very conservative in its spectrum allocations, to avoid

harmful interference. This conservatism is evident both in the substantive decisions the FCC makes and in the time it takes to reach those decisions.

Interference disputes, like many kinds of resource disputes, are a by-product of intensive use of the resource. Where efficiency goals demand more intensive use of the spectrum, meeting these goals will entail more interference. Therefore, we must consider what mechanisms the FCC might adopt to resolve interference disputes when they occur at the back end, instead of how it can prevent them from occurring at the front end.

A review of the record in the white spaces and other proceedings suggests three principal impediments to interference dispute resolution:

- *Responsibility.* Existing spectrum users fear that interferors will be hard to identify and will not be made to remedy the interference problem when it arises.
- *Rights.* When interference occurs, it is often not clear whose fault it is: even though incumbents are entitled to be free from harmful interference, they are also under some duty to avoid interference through reasonable filtering and other methods.
- *Enforcement.* There are no established methods for rapid and clear decisionmaking to enforce rights against interference.

There has not been nearly enough discussion at the FCC about how these problems could be addressed. Here are a few ideas:

The *responsibility* problem has at least two components: identifying the interfering party and making that party "pay" for the interference. Identification is most likely to be a problem where there are many mobile transmitters. It might be addressed, in part, with a requirement that signals be tagged—much as automobiles are—to increase accountability for interference. Traditionally, the relief available to victims of interference is injunctive. That is, the FCC orders the interfering party to cease its interfering activities. This remedy often is impractical, especially where thousands of unlicensed devices are in play. Therefore, incumbents rightly fear that the FCC will be unwilling to resolve the interference problem at all and thus increase their resistance to sharing.

Worth considering is whether the use of a damages remedy, instead of an injunction, for interference would give incumbents greater comfort

that they will be made whole in the event of harmful interference, while assuring new entrants that they will not be shut down. Where unlicensed devices are involved, it might be desirable for an unlicensed proponent, or proponent coalition, to take responsibility upfront for interference that may ensue, perhaps posting a bond to compensate for the costs of interference. Alternatively, even where injunctive relief is used, the FCC might consider upfront Plan B modes of operation in the event that interference occurs and build this safeguard into the authorization.

The *rights* problem might be addressed upfront in the rulemaking. The FCC should make clear that the right against harmful interference is not an absolute right and that all operators need to be making reasonable investments in the robustness of their systems.

The *enforcement* problem probably is the most important to address. The FCC now handles interference disputes either informally by mediating between the parties in private meetings or through protracted proceedings in which it adjusts spectrum usage rules or allocations. What does not exist is an efficient and transparent dispute resolution procedure. There has been little apparent need for such a procedure because the FCC attempts to cut off disputes before they happen through conservative allocations and service rules. A system of administrative hearings at which rights to cause, or be free from, interference were adjudicated and an appropriate remedy fashioned would provide front-end security to spectrum users. Over time, a case law would develop to clarify what counts as harmful interference and where damages are an appropriate remedy.

What Drives Broadband Adoption?

Drew Clark

What do broadband users want? The ability to connect online through some form of access, obviously. Service that doesn't cost a fortune, clearly. Fundamentally and personally, however, what do broadband users want by going online? Why do 47 percent of adult Americans subscribe to broadband?[65] Conversely, why do a little more than half not subscribe? Why do subscribers keep paying their monthly bills? In considering a framework for a national broadband policy, what can we learn from considering broadband adoption trends, both quantitatively and qualitatively?

In this paper, two specific questions about broadband adoption are addressed. Both are framed in the context of also considering the availability of broadband access and the affordability of available choices; those topics are explored in other papers. For this paper, consider:

- What other factors, such as equipment subsidies and consumer education, are necessary for encouraging adoption?
- What applications—such as telemedicine, e-government, or online education—are likely to increase demand for high-speed broadband access?

Both questions are viewed from the lens of the individual broadband user to determine why individuals subscribe, or fail to subscribe, to broadband. In the first section, some of the quantitative and qualitative research about broadband adoption are surveyed. In the second section, I offer my own set of questions and personal answers about the combination of applications, education, experience, and other motivations that lead an individual to subscribe. The next section offers tentative conclusions about the broadband applications on the "supply side." And, the fourth and final section, offers tentative conclusions about some aspects of directed "education" and "subsidies" that could potentially stimulate demand.

What Do Researchers Say about Who Subscribes to Broadband?

Research on broadband adoption shows that Americans are adopting broadband. Put aside, for the moment, the debate about whether the United States is adopting broadband as fast as other developed nations—or developing nations. The Pew Internet and American Life Project's annual and semiannual surveys about broadband adoption show a consistent pattern of increase. Figure 1, from the June 2007 *Home Broadband Adoption* report, by John Horrigan, Associate Director for Research, and Aaron Smith, Research Specialist,[66] shows the breakdown of broadband adoption across various demographic categories.

Trends in Broadband Adoption Across Population Subgroups

	% with broadband at home (2005)	% with broadband at home (2006)	% with broadband at home (2007)
All adult Americans	30%	42%	47%
Gender			
Male	31	45	50
Female	27	38	44
Age			
18-29	38	55	63
30-49	36	50	59
50-64	27	38	40
65+	8	13	15
Race/Ethnicity			
White (not Hispanic)	31	42	48
Black (not Hispanic)	14	31	40
Education			
Less than high school	10	17	21
High school grad	20	31	34
Some college	35	47	58
College +	47	62	70
Income			
Under $30K	15	21	30
$30K-50K	27	43	46
$50K-$75K	35	48	58
Over $75K	57	68	76
Community Type			
Urban	31	44	52
Suburban	33	46	49
Rural	18	25	31

Figure 1: Trends in Broadband Adoption Across Population Subgroups

Pew's 2005 report argued that broadband adoption at home in the U.S. was "growing but slowing." The 2005 report created the following model of broadband adoption:

- People do more things online the longer they've been online.
- Dial-up users are more likely to want broadband the longer they've been online.
- Not everyone wants broadband—and the people who do not want broadband typically have less online experience and are processing fewer bits.
- High-speed users switch to broadband to process more bits, less so because of price.[68]

Under this model, the decision to get broadband depends on the "intensity of Internet use," which in turn is a function of time online and connection speed.[69] Considering this model, Horrigan concluded in 2005 that although "years of online experience" may have driven broadband adoption in 2002, early in the growth phase, that was no longer the case in 2005.

> On the one hand, this is not too surprising—early adopters, the "low hanging fruit," have been picked. But it is important to recognize that there could be very different migratory patterns toward broadband. Internet use, rather than tapering off in recent years, could have continued its late '90's-early 00's upward climb. Broadband prices could have been on the decline or network speeds might have improved substantially. That or other forces might have meant more switching from dial-up to high-speed and more adoption "de novo" of high-speed by new users.

Somewhat unexpectedly, the Pew 2006 report found home broadband adoption growing 40 percent from March 2005 to March 2006—twice the growth rate of the preceding year.[70] Horrigan writes, "A significant part of the increase is tied to Internet newcomers who have bypassed dial-up connections and gone straight to high-speed connections. This is a striking change from the previous pattern of broadband adoption."[71] Among the factors, many of them new for that year,

Horrigan identified:

- There was strong growth in broadband adoption by African Americans and by people with low levels of education.
- Digital subscriber line (DSL) market share increased, driven by aggressive price-cutting by DSL providers.
- About 48 million Internet users were posting online content, the majority of whom are home broadband users.
- Awareness about Voice over Internet Protocol (VoIP) increased 86 percent between February 2004 and December 2005.[72]

Jump forward one more year, to the June 2007 report, and the adoption growth rate is down again. Figure 2 is Pew's chart of year-to-year growth grates in home broadband adoption.[73]

Federal Communications Commission (FCC) and Pew data from 2003 to 2007 show similar trends year-to-year growth grates in home broadband adoption.[74] The number of "high-speed lines" (200 kbps in either direction) grew 32 percent, from 32.5 million on June 30, 2004,

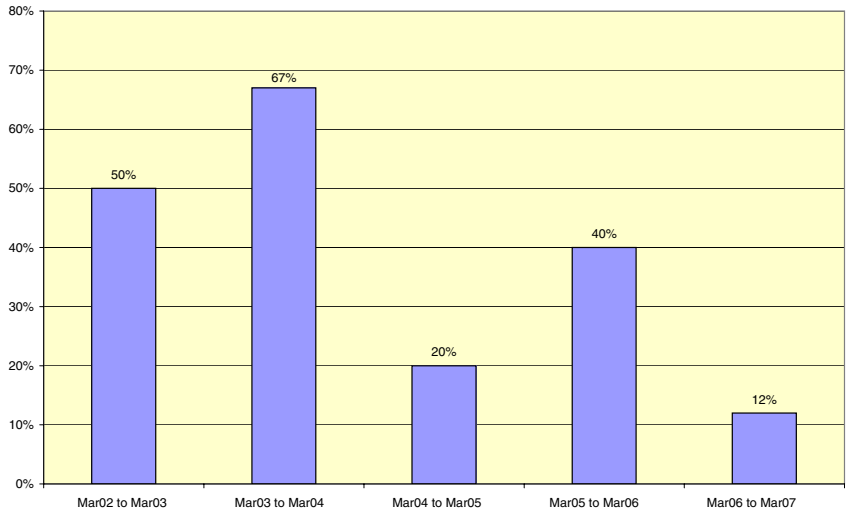

Figure 2: Year-to-year growth rates in home broadband adoption

to 42.9 million on June 30, 2005.[75] The number of such lines grew 52 percent, to 64.6 million, by June 30, 2006.[76]

Of those 64.6 million lines (the most recent total from the FCC), 50.3 million served primarily residential end users. Of those residential broadband connections, the FCC reported that 55.2 percent of subscriptions were cable modem connections, 40.1 percent were asymmetric DSL connections, 0.2 percent were symmetric DSL or traditional wireline connections, 0.9 percent were fiber connections, and 3.7 percent were other types of technologies, including satellite, terrestrial fixed or mobile wireless (licensed or unlicensed), and electric power lines.[77] The FCC says that broadband is available via DSL to 79 percent of local telephone company subscribers and via cable modem to 93 percent of cable television subscribers.[78]

It is increasingly clear that there are two major groups of people who have not yet subscribed to broadband: dial-up users and non-Internet users. Dial-up users may be "happy dial-up users" because they get what they want out of their slower Internet experience. Alternatively, they may be frustrated dial-up users because of price or, more likely, availability constraints on broadband.

Non-Internet users have rejected the Internet experience, for whatever reason. Occasionally, as is evident in the spike of broadband adoption from March 2005 to March 2006, they can be lured directly to broadband subscriber status. Many, however, simply wish to avoid aspects of the Internet, such as pornography and the threat of various forms of identity theft.

Pew also has survey results on some of the reasons that individuals choose to take broadband, based on three separate surveys—January 2002, February 2004, and December 2005 (Table 1).[79]

Table 1: Reasons for choosing high-speed Internet connection at home

	Dec 05	Feb 04	Jan 02
Faster access/Greater speed	57	5	50
To perform job-related tasks	10	10	5
Previous connection was too slow/frustrating	6	36	3
Frees up phone line/Don't need extra phone line	4	7	n/a
To find educational materials	4	3	*
To download files faster	4	22	6
Price fell to more affordable level/Finally could afford it	3	3	n/a
Convenient	2	3	n/a
For entertainment, such as music or movies	2	3	1
Wanted an "always on" connection	2	7	n/a
Responded to a promotion/special offer from a service provider	1	3	n/a
Other	14	6	41
Don't know/Refused	4	2	1

Note: Respondents answered the question: What is the MAIN reason you decided to get a high-speed Internet connection at home? Based on Internet users with broadband at home [N=1,014]. Totals exceed 100 percent because of multiple responses.

The leading response to the survey: "Faster access/Greater speed" in January 2002 and December 2005 and "Previous connection was too slow/frustrating" in February 2004. The latter response may be effectively identical to the former. Indeed, at the spring 2007 meeting of the Aspen Institute Roundtable on Spectrum Policy, Andrew McLaughlin of Google gave a great definition of broadband: when a user isn't constantly frustrated with the Internet experience.

If the goal is to get more people to subscribe to broadband, exclusive of considerations of availability and price, then happy dial-up users and non-Internet users are key groups to be targeted.

What Do Individuals Say about Why They Subscribe to Broadband?

Understanding the demographics of broadband subscription begins to put some substance behind our key inquiry: How can individuals be motivated to subscribe to broadband?

The following model may be useful for thinking about this question:

1. Think of yourself: When did you subscribe to broadband in your home, and what led you to subscribe?
2. Think of other Americans, particularly the "happy dial-up users" and the "Internet rejecters." How would a pitch to subscribe to broadband be targeted at them?
3. Think about individuals facing the prospect of adopting broadband in other parts of the world, such as China.[80] It may be more exciting to consider a "fresher" market than the United States, with its more mature stage of broadband adoption.

Some questions to ask include:

- How long did you use the Internet before subscribing to broadband at home?
- How frequently did you experience the broadband Internet (i.e., at university, in the workplace) before subscribing at home?
- What companies were offering service to your home, what type of service were they offering, and at what price?
- What applications tipped the balance in favor of your subscribing to broadband at home?
- Were any other factors involved in your decision to subscribe to broadband at home?

Here are my own answers:

- I used a primitive form of Internet access, via an America Online dial-up connection, through a creaky Apple MacIntosh in February 1995. I first saw the high-speed Internet at Columbia University in August 1995. I finally subscribed to broadband on March 14, 2004—making nine years of Internet use before subscribing to broadband.

- I used broadband constantly at school, and then at work, in the years since 1995. My extensive use of broadband and work probably was a major factor in delaying my personal broadband adoption.
- I did not inquire about broadband availability in the homes and apartments I moved into in 1996 and 1997. When I moved to a home in 1999, I did make an inquiry about DSL broadband availability (it was available), but I did not subscribe. When I decided to subscribe, I tried DSL, but the service did not work; I then subscribed to cable modem service. (I believe the price of DSL was $40, when included with traditional phone service; the price of cable modem service was $40, when included with basic cable television.)
- Saving money by subscribing to Voice over Internet Protocol (VoIP) service was the primary deciding factor in my decision to subscribe to broadband. I cancelled local telephone service and Internet service.[81] A second motivating factor was the ability to get basic cable television programming—that is, assembling an ad-hoc "bundle."
- A final factor motivating adoption was simple embarrassment: How could I be a decent technology journalist and not subscribe to broadband at home?

My responses offer one personal window on broadband adoption. I have asked the same questions of friends, neighbors, colleagues, and sources. I'd like to see and participate in ways to publish more of these responses. This kind of qualitative, even anecdote-driven, research also is instrumental in helping us better understand broadband deployment. Indeed, when I interviewed John Horrigan about this subject, I asked the same questions of him. He told me that he made the transition from dial-up to broadband in 2003 and that one of the factors influencing the decision was that his employer agreed to pay for a home broadband subscription. Cisco Systems is another company that pays the home broadband subscription costs as an employee benefit.

Broadband Applications on the "Supply Side"

Although speed frequently is identified as the reason for broadband subscription, my personal experience suggests that usually some particular application (or combination of applications) causes an individual to reach the tipping point. In my case, it was VoIP. Almost immediately thereafter, I installed a WiFi router, enabling broadband access anywhere in the house. That technology, in turn, facilitates a host of additional applications, any one of which could be the tipping point for others to subscribe to broadband.

Other heavily used high-bandwidth broadband applications in the Clark home include the following:

- Google Earth (Three-year-olds and seven-year-olds love it!)
- Educational videos and games
- Blogging
- Smugmug photo-sharing
- Video and audio streaming, including Internet radio
- Google Calendar for sharing schedules
- "Presence," in the form of G-mail/instant message integration, etc.
- Online classes.

An application such as VoIP can prove successful in motivating a broadband purchase because it takes broadband off the desktop/laptop and into another device—such as a telephone—that is frequently used. I have been disappointed that equipment manufacturers and webcasters have not taken better advantage of opportunities to embed Internet radio applications into dedicated, IP-centric devices. Of course, the TV-PC convergence remains, after all these years, very much a work in progress. When I was watching an important cablecast that began to experience technical difficulties, I fired up my laptop and watched the webcast version of the program. Viewing on the larger TV screen was not possible, however.

In addition to IP-centric capabilities taking over telephones, radios, and televisions, such capabilities integrated into refrigerators, free-standing Webcams (whether for security or other purposes), or other household devices may reach those "happy dial-up users" and even some Internet rejecters. It is better to think about such applications in

specific rather than general terms. In other words, diabetes patients or prospective diabetes patients may be motivated to subscribe to broadband to participate in a specific experimental trial but not to take advantage of "telemedicine" in general. The ability to enroll in a specific class may motivate a broadband purchase. The ability to do a job from home and avoid a commute is likely to be another key motivator in nudging broadband subscriptions upward.

Educating and Subsidizing for Broadband Demand

What forms of subsidization and education are necessary to stimulate demand for broadband? In the case of subsidization, consider various potential subsidizers: governments, employers, access providers, educators, and advertisers.

Subsidization of Internet services by the government or a business partner interested in advertising is central to many municipal wireless build-outs, including services to be offered by Earthlink in Philadelphia. In San Francisco, Google will subsidize a slower, ad-sponsored version of the wireless service. Other nationwide proposals, including that of M2Z Networks, contemplate free nationwide wireless Internet access through a 20 megahertz block of radio frequencies. As discussed above, employers play an important role—possibly a crucial role—in subsidizing their employees' broadband use to facilitate work from home. According to a study by RVA Market Research for the Fiber to the Home Council, 13 percent of home fiber optic users work from home more often—a monthly average of 7.3 more workdays at home instead of the office.[82] In most of these cases, having a fiber-optic connection made their employers' attitude toward telework more favorable.

Nevertheless, most discussions about subsidization deal with the Universal Service Fund's (USF) system of cross-subsidization to broadband services offered by *carriers*, not subsidization of services or goods purchased by a consumer.

Equipment subsidies have received even less discussion. Here the question must be: What device to subsidize? Among the choices are the following:

- WiFi or other wireless-enabled laptops
- WiFi routers
- Wireless access devices (for non-WiFi fixed wireless services, such as a satellite dish in a rural area)
- Other standalone health- or home security-related IP devices.

Ironically, Congress has not chosen to subsidize any IP device at all. Instead, it has chosen to offer a $40 subsidy for a converter box that allows an analog device to receive digital television broadcasts. Aside from television, subsidies for *equipment* seem like a stretch for the government and for employers, for the simple reasons that prices are always dropping and government always seems to have more pressing priorities for its funds. Finally, worth noting is the fact that access providers routinely subsidize equipment (e.g., cable modems and wireless access devices) as part of a package of paid Internet service.

A final point for consideration is what kind of education consumers need to understand their broadband options. "Education" can include basics such as computer and Internet literacy. In most cases, this basic education is a prerequisite for home broadband use. Education also can include broader information about the true availability of broadband services in one's area—as well as information about actual offers of service. The Center for Public Integrity's Well Connected Project is engaged in one aspect of this effort: seeking to publicly display the names of each company that provides broadband within a particular ZIP code.[83] If this effort is successful, it could enable consumers to see a complete list of all companies that offer broadband within their geographic area. The Federal Trade Commission (FTC) also intends to monitor the information that telecommunications and cable companies provide about high-speed Internet service in the service plans they offer to customers.[84]

Endnotes

1. See http://www.whitehouse.gov/infocus/technology/economic_policy200404/chap4.html.

2. The Talmud is the authoritative source on Jewish law. The Talmud includes both a recitation of Jewish law (the Mishnah) and commentaries on the law (the Gemara). Notably, the commentaries are presented as a coherent conversation, even though they include discussions among Rabbis who lived centuries apart from one another and therefore never met.

3. See Organization for Economic Co-operation and Development, *OECD Broadband Statistics to December 2006* (2007), http://www.oecd.org/sti/ict/broadband. Moreover, other such rankings echo the results of the OECD numbers. Consider, for example, a Communications Workers of America report that estimates average speeds around the world, with the U.S. median of 1.9 megabits per second (mbps) trailing other countries (such as Japan [61 mbps], France [19 mbps], and Canada [7 mbps]). See "First-Ever State-By-State Report on Internet Connection Speed Shows U.S. Far Behind Other Industrialized Nations," press release, Communications Workers of America (June 25, 2007), http://www.cwa-union.org/news/page.jsp?itemID=28663094. Similarly, the 2005/06 ITU Digital Opportunity rankings list the United States in 20th place; see *World Information Society Report: Beyond WSIS* (International Telecommunications Union, 2007), p. 36, http://www.itu.int/osg/spu/publications/worldinformationsociety/2007/WISR07_full-free.pdf. For a critical look at the OECD numbers, see Scott Wallsten, "Towards Effective U.S. Broadband Policies," Progress on Point: Periodic Commentaries on the Policy Debate release 14.7, Progress and Freedom Foundation (May 2007), http://www.pff.org/issues-pubs/pops/pop14.7usbroadbandpolicy.pdf.

4. Atkinson developed his argument for a U.S. broadband policy in Robert D. Atkinson, "The Case for a National Broadband Policy," Information Technology and Innovation Foundation, 2007, http://www.itif.org/files/CaseForNationalBroadbandPolicy.pdf. With Andrew S. McKay, Atkinson developed the case for regarding information technology (including broadband) as a driver of economic growth and efficiency; see Robert D. Atkinson and Andrew S. McKay, "Understanding the Economic Benefits of the Information Technology Revolution," Information Technology and Innovation Foundation, 2007, http://www.itif.org/files/digital_prosperity.pdf.

5. Jeff Campbell, "How Fast IS Your Broadband?" posting to Cisco High Tech Policy Blog, June 26, 2007, http://blogs.cisco.com/gov/2007/06/how_fast_is_your_broadband.html.

6. Blaine Harden, "Japan's Warp-Speed Ride to Internet Future," *The Washington Post*, August 29, 2007, http://www.washingtonpost.com/wp-dyn/content/article/2007/08/28/AR2007082801990_pf.html.

7. See Alexander Wolfe, "Web 2.0 Evident in Aftermath of Virginia Tech Shootings," posting to *Information Week* Digital Life Weblog, April 16, 2007, http://www.informationweek.com/blog/main/archives/2007/04/web_20_evident.html.

8. See Noam Cohen, "The Latest on Virginia Tech, from Wikipedia," *New York Times*, April 23, 2007, http://www.nytimes.com/2007/04/23/technology/23link.html.

9. Amanda Lenhart and Mary Madden, Pew Internet & American Life Project, "Teen Content Creators and Consumers," Pew Internet and American Life Project, 2005, p. 1, http://www.pewInternet.org/pdfs/PIP_Teens_Content_Creation.pdf.

10. For some recent reports of state-centered leadership, see Michael Martinez, "Broadband Talk

From Wisconsin to Florida," National Journal's Insider Update: The Telecom Act, August 16, 2007, http://www.njtelecomupdate.com/2007/08/broadband_talk_from_wis_to_fla.html.

11. Ken Belson, "Unlike U.S., Japan Pushes Fiber Over Profit," *New York Times,* October 3, 2007, http://www.nytimes.com/2007/10/03/business/worldbusiness/03broadband.html?ei=5088&en=1137e9bfb40d3406&ex=1349064000&partner=rssnyt&emc=rss&pagewanted=print.

12. Steve Rosenbush, "Verizon's Big TV Bet Pays Off," *BusinessWeek,* October 1, 2007, http://www.businessweek.com/print/technology/content/sep2007/tc20070928_484223.htm.

13. Olga Kharif, "Wal-Mart's Latest Sale: Broadband," *Business Week,* October 8, 2007, http://www.businessweek.com/technology/content/oct2007/tc2007108_060026.htm.

14. Ibid.

15. Robert Mitchell, "ISPs to Rural America: Live with Dial-up," *Computerworld*, August 27, 2007, http://www.computerworld.com/action/article.do?command=printArticleBasic&articleId=299844.

16. See generally "Telecommunications: Broadband Deployment Is Extensive Throughout the United States, But It Is Difficult to Assess the Extent of Deployment Gaps in Rural Areas," U.S. General Accountability Office Report to Congressional Committees, GAO-06-426 (May 2006), http://www.gao.gov/new.items/d06426.pdf.

17. See "Federal-State Joint Board on Universal Service Statement on Long Term, Comprehensive High-Cost Universal Service," Public Notice, FCC 07J-3 (September 6, 2007), http://fjallfoss.fcc.gov/edocs_public/attachmatch/FCC-07J-3A1.doc.

    In "Commissioner Michael J. Copps Applauds Joint Board Statement on Comprehensive USF Reform," press release, Federal Communications Commission, 2007 WL 2580014 (September 6, 2007), http://fjallfoss.fcc.gov/edocs_public/attachmatch/DOC-276474A1.doc, FCC Commissioner Michael Copps commented on this development:

    > The Joint Board's decision is a historic step forward. At long last we are starting down the road of making broadband the central focus of universal service for the 21st century. High-speed, high-value broadband isn't a luxury any more; it's a necessity, and universal service ought to be driving its deployment into every house and business in America.

18. With regard to issues concerning consumer understanding of broadband speeds, see Philip J. Weiser, "The Next Frontier for Network Neutrality," *Administrative Law* Review, Vol. 60, No. 2, 2008, http://ssrn.com/abstract=1080672.

19. Although WiMAX is only in its incipient stages, some WiMAX systems are already in operation in rural areas, demonstrating that it provides a plausible solution. See Carol Wilson, "WiMAX Sweeping Down the Plains," *Telephony Online,* September 26, 2007, http://telephonyonline.com/home/news/wimax_broadband_oklahoma_092607.

20. "Wiring Rural America: A Public-Private Partnership Success," *The Economist*, September 13, 2007, http://www.economist.com/displaystory.cfm?story_id=9803963.

21. Ibid.

22. The Information Technology and Innovation Foundation has proposed a model along these lines. See "Comments of Information Technology and Innovation Foundation Before the Federal Communications Commission," to the *Notice of Inquiry* in Broadband Industry Practices, WC Dkt. No. 07-52 (April 16, 2007), http://fjallfoss.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6519416542.

23. Indeed, in a departure from models used around the world, the United States traditionally has eschewed government service provision and relied instead on regulation. See Paul Starr, *The Creation of the Media* (New York: Basic Books 2004); see also Philip J. Weiser, "The Ghost of Telecommunications Past," 103 *Michigan Law Review* 103 (2005): 1671, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=694085 (explaining how Starr's book shows the unique development of U.S. telecommunications policy).

24. Such support can include encouraging coordination between wireless Internet service providers (ISPs). See Philip J. Weiser and Dale N. Hatfield, "Policing the Spectrum Commons," *Fordham Law Review* 74 (2005): 663, 678, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=704741 (discussing, among other issues, the Broadband Access Network Coordination [BANC] initiative).

25. In what proponents of line sharing regard as insult on top of injury, legacy copper lines in the Verizon territory are now being cut as Verizon migrates to a fiber-based infrastructure—thereby negating the possibility of line sharing (even at the rate for the entire local copper loop). See Deborah Yao, "Verizon Cutoff Worries Some Users, Small Rivals," *USA Today*, July 8, 2007, http://www.usatoday.com/tech/products/services/2007-07-08-verizon_N.htm. The opposite phenomenon—a surprising outcome in the face of the FCC's retreat from line sharing—is that, as AT&T's Andrew Brueggeman reported, AT&T continues to work with Covad (a leading competitive DSL provider) to enable it to use AT&T's lines even when AT&T no longer is required to do so by FCC rules.

26. See Harden, "Japan's Warp-Speed Ride to Internet Future."

27. "ECTA Reports on Broadband," *Light Reading's Cable Industry Insider,* September 6, 2007, http://www.lightreading.com/document.asp?doc_id=133206&site=cdn.

28. The Japanese policy provides generous access to legacy copper facilities and, in theory, provides access to new fiber build-out as well. In practice, however, Japanese regulatory authorities have set the price of access to leased fiber so high as to undermine its attractiveness. See Douglas Galbi, "Ubiquitous Fiber Network in Japan," *Purple Motes* (April 15, 2007), http://purple-motes.net/2007/04/15/ubiquitous-fiber-network-in-japan.

29. Alfred E. Kahn, *Regulatory Politics as Usual* (AEI-Brookings Joint Center, Policy Matters 03-3, March 2003), http:// www.aei.brookings.org/policy/page.php?id=127.

30. Some analysts are more optimistic about the potential success of WiMAX. As one article reported:

> Analysts are bullish on the prospects for Wi-Max. Boston-based Yankee Group is forecasting 28 million subscribers by 2011, while research firm In-Stat says Wi-Max infrastructure equipment and devices will become a $5 billion market within four years, up from $177 million today.
>
> Wi-Max "will enable all sorts of new devices we've never even thought of," says Fred Wright, senior VP for networks and enterprise at Motorola. "Any applications that are

cumbersome today because the cell phone can't provide a fast enough data rate, those will be the sweet spots Wi-Max will be able to address."

Michal Lev-Ram, "The Wide World of Wi-Max," *Business 2.0*, June 26, 2007, http://money.cnn.com/magazines/business2/business2_archive/2007/07/01/100117043/index.htm?postversion=2007062605.

31. Earthlink's recent challenges in its municipal wireless business appear to support this conclusion. See Marguerite Reardon, "Earthlink's Wi-Fi Dreams May Be Fading," CNET News, August 28, 2007, http://www.news.com/2102-7351_3-6204984.html?tag=st.util.print.

32. See Andrew Odlyzko, "The Many Paradoxes of Broadband," *First Monday* 8 (2003), http://www.firstmonday.org/issues/issue8_9/odlyzko/index.html.

33. Carol Wilson, "WiMAX Truly Disruptive if Marketed Well, Study Says," *Telephony Online*, July 23, 2007, http://telephonyonline.com/wimax/technology/wimax_disruptive_study_072307.

34. For a discussion of this issue, see Weiser and Hatfield, "Policing the Spectrum Commons," 688.

35. For a discussion of this concern and policy responses, see Dale Hatfield and Philip J. Weiser, "Property Rights in Spectrum: Taking the Next Step," University of Colorado Law School Legal Studies Research Paper 06-20 (September 30, 2005), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=818624.

36. See http://www22.verizon.com/content/consumerdsl/plans/all+plans/all+plans.htm (last accessed October 13, 2007).

37. Ibid.

38. "What We Do," http://www.one-economy.com/whatwedo/default.asp (last accessed October 14, 2007).

39. For an overview of One Economy, see http://www.one-economy.com/overview/index_files/frame.htm (last accessed October 14, 2007). For a discussion of the strategy for building broadband infrastructure in low-income housing, see One Economy, "Bring IT Home: Campaign Report: 2004–2006" (2006), http://www.one-economy.com/pdf/bih_2006_report-low-res.pdf.

40. Lifeline is a program that "provides qualified consumers with a discount on monthly charges for their primary home phone line, even if it's a cell phone." See http://www.lifeline.gov/lifeline_Consumers.html (last accessed October 14, 2007).

41. Brian R. Mefford, "Broadband Mapping and Data Collection," written testimony for Subcommittee on Telecommunications and the Internet, U.S. House of Representatives, 110th Cong. (May 17, 2007), http://energycommerce.house.gov/cmte_mtgs/110-ti-hrg.051707.Mefford-testimony.pdf.

42. John B. Horrigan, "Why It Will Be Hard to Close the Broadband Divide," Pew Internet and American Life Project (August 1, 2007), http://pewresearch.org/pubs/556/why-it-will-be-hard-to-close-the-broadband-divide.

43. Ibid.

44. See Henry Jenkins et al., "Confronting the Challenges of Participatory Culture: Media Education for the 21st Century," MacArthur Foundation Occational Paper on Digital Media and Learning (2006), http://www.digitallearning.macfound.org/atf/cf/%7b7e45c7e0-a3e0-4b89-ac9c-e807e1b0ae4e%7d/jenkins_white_paper.pdf.

45. Jenkins et al., "Confronting the Challenges of Participatory Culture," MacArthur Foundation (2004), p. 21.

46. See Krishna Jayakar and Harmeet Sawhney, "Universal Access in the Information Economy: Tracking Policy Innovations Abroad," Benton Foundation Universal Service Report (2007), http://www.benton.org/benton_files/Jayakar_Sawhney.doc.

47. As the Benton Foundation sponsored report explained (Jayakar and Sawhney, "Universal Access in the Information Economy," 6.):

> Governments seem to have realized that programs that call for broad-based citizen participation require a strong element of local leadership and control. Canada's BRAND program and the National Satellite Initiative provide resources for local communities with a degree of autonomy. In Korea, government funding has been made available to set up neighborhood computer clusters called PC bangs, around which a youth culture involving game playing, instant messaging and web browsing has evolved. These clusters were the pathway by which many who could not have afforded ICT access have learned critical network skills.

48. Adam Thierer, "Two Sensible, Education-Based Legislative Approaches to Online Child Safety," Progress and Freedom Foundation Progress Snapshot 3.10 (September 2007), http://www.pff.org/issues-pubs/ps/2007/ps3.10safetyeducationbills.html.

49. Jayakar and Sawhney, "Universal Access in the Information Economy," 8, citing Harmeet Sawhney and Seungwhan Lee, "Arenas of Innovation: Understanding New Configurational Potentialities of Communication Technologies," *Media, Culture, and Society* 27 (2005): 391.

50. The author wishes to thank the following individuals for comments on earlier drafts: Dan Correa, Julie Hedland, Jon Peha, and Phil Weiser.

51. We measure take-up on a per-household basis; as a result, the United States ranks 12th instead of 15th on a per-capita basis. Daniel K. Correa, *Assessing Broadband in America: OECD and ITIF Broadband Rankings* (Washington, D.C.: Information Technology and Innovation Foundation, April 2007).

52. A related issue is whether incumbent telephone companies must keep their legacy copper network after a customer switches to fiber. An engineer's view of the issue is that they should not because the maintenance costs can be significant and are passed along to all customers. (See www.usatoday.com/tech/products/services/2007-07-08-verizon_N.htm.)

53. IEEE/Cornell University, "Report from the Workshop: This Decade's (R)evolutionary Telecommunications Paradigm" (February 2003), http://forum.johnson.cornell.edu/afn/publish/WSR/WSR.pdf.

54. See Howard A. Shelanski, *Competition and Regulation in Broadband Communications in Broadband: Should We Regulate High Speed Access?* ed. Robert W. Crandall and James H. Alleman (Washington, D.C.: AEI-Brookings Joint Center, 2002).

55. Most economists would argue that the market would prevent this from happening by enabling more efficient firms to gain market share, putting inefficient producers out of business. The real world does not always approximate the textbook world, however.

56. Andrew Odlyzko notes, "Technological predictions have always been hard, of course, and much of what broadband proponents say has to be treated cautiously." See "The Many Paradoxes of Broadband," *First Monday* 8 (September 2003): 4, http://firstmonday.org/issues/issue8_9/odlyzko/index.html.

57. A 2006 Government Accountability Office (GAO) analysis of broadband in eight states confirmed that the number of broadband providers available to consumers is far below what the FCC's broadband statistics suggest. The GAO found that the median number of providers available to households surveyed was only two, whereas the FCC reported a median of eight providers for the relevant ZIP codes. *Broadband Deployment is Extensive throughout the United States, but It Is Difficult to Assess the Extent of Deployment Gaps in Rural Areas* (Washington, D.C.: GAO, 2006), pp. 17–18.

58. For example, some broadband subscribers use their providers' email services for their email address—e.g., ratkinson200@verizon.com instead of platform-independent email services such as ratkinson200@gmail.com—which makes switching broadband providers more difficult.

59. Verizon's FIOS strategy requires considerable capital. Comcast's recently announced DOCSIS 3.0 investment is expected to cost less but will still cost billions of dollars. Whether such high-speed networks will be rolled out in most places, however, remains to be seen.

60. The Herfindahl-Hirschman Index (HHI) is a measure of firm concentration in an industry, calculated as the sum of the squares of each firm's market share. HHI scores range from 0 to 1, with higher scores indicating an industry dominated by a small number of firms. The HHI for an industry monopolized by a single firm is 1. To gain a better understanding of the importance of platform competition for broadband in OECD countries, we calculated the HHI for each country's mix of broadband technologies. For this measure, we used the OECD's latest data, "Broadband Statistics to December 2006" (www.oecd.org/sti/ict/broadband). The OECD data includes four broadband technologies (DSL, cable, fiber, and other), only two of which—DSL and cable—have significant market share in most countries. For this reason, we have calculated the HHI for DSL and cable alone, and scores fall between 0.5 and 1 (0.5 represents a case in which both platforms have equal market share).

61. According to Takeshi Eberhara of NTT, they must resell their fiber lines to CLECS; see http://www.itif.org/index.php?id=38.

62. Congress has ordered the FCC to "study new uses for radio…and generally encourage the larger and more effective use of the radio in the public interest" and to seek to promote "efficient and intensive use of the radio spectrum"; 47 U.S.C. §§ 303(g); 309(j)(3)(D).

63. Because of statutory constraints in the Communications Act, licensees may not transfer their licenses outright without FCC approval.

64. Northpoint appealed this decision and lost, with the D.C. Circuit deferring to the FCC's allocation and assignment decisions.

65. John B. Horrigan and Aaron Smith, "Home Broadband Adoption 2007," Pew Internet and American Life Project, June 2007, p. 1.

66. Ibid., p 4.

67. John B. Horrigan, "Broadband Adoption at Home in the United States: Growing But Slowing," paper presented to 33rd Annual Telecommunications Policy Research Conference, September 24, 2005.

68. Ibid., p. 16.

69. Ibid.

70. John B. Horrigan, "Home Broadband Adoption 2006: Home broadband adoption is going mainstream and that means user-generated content is coming from all kinds of Internet users," Pew Internet and American Life Project, May 28, 2006.

71. Ibid., p. i.

72. Ibid., pp. i–iii.

73. Horrigan and Smith, "Home Broadband Adoption 2007," p. 2.

74. Horrigan and Smith, "Home Broadband Adoption 2007," p. 2.

75. "High-Speed Services for Internet Access: Status as of June 30, 2005," Industry Analysis and Technology Division, Wireline Competition Bureau, Federal Communications Commission, April 2006.

76. "High-Speed Services for Internet Access: Status as of June 30, 2006," Industry Analysis and Technology Division, Wireline Competition Bureau, Federal Communications Commission, January 2007.

77. Ibid.

78. Ibid.

79. November/December 2005 Daily Tracking Survey, Princeton Survey Research Associates International for Pew Internet and American Life Project; data for November 29–December 31, 2005, p. 16.

80. Deborah Fallows, "China's Online Population Explosion: What It May Mean for the Internet Globally… and for U.S. Users," Pew Internet and American Life Project, July 12, 2007.

81. Drew Clark wrote about this in a column, "The Future is Now," *Congress Daily,* June 7, 2004:

> Last month our household canceled telephone service. We signed up with a cable company in April, taking the cheapest television service and also its high-speed Internet access. Additional channels such as C-SPAN and faster download speeds are nice, but we wouldn't have done it if we didn't save money. We cut off the local Bell company and now pay half as much on our monthly bill—and kept our old number—with a startup company selling voice-over Internet protocol, or VoIP….
>
> My experience with VoIP underscores two messages for policy-makers. First, demand for broadband doesn't come from fancy Web sites but from basic things like local phone service. Second, consumers couldn't care less about whether it comes from a

local Bell company, a long-distance competitor, a cable operator, a cellular carrier or a software company. They vote on quality and price.

82. "Growth of Fiber-to-the-Home Drives Teleworking, Home-Based Businesses," press release, Fiber to the Home Council, July 10, 2007; http://www.ftthcouncil.org/?t=262.

83. Drew Clark, "Center Spearheads Efforts to Disclose Broadband Data: Telco Deployment by ZIP Code at Issue in Legislation," Center for Public Integrity's Well Connected Project, (June 27, 2007), http://www.publicintegrity.org/telecom/report.aspx?aid=886.

84. Drew Clark, "FTC Report on Broadband Resurrects Freedom of Service Information," Center for Public Integrity's Well Connected Project, (July 3, 2007); http://www.publicintegrity.org/telecom/telecomwatch.aspx?eid=2977.

The Aspen Institute Roundtable on Spectrum Policy (AIRS)

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May 17-18, 2007

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Philip J. Weiser

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Philip J. Weiser

The report describes the communications problems facing the safety enterprise community and their potential solutions. The report offers several steps toward a solution, focusing on integrating communications across the safety sector on an Internet-Protocol-based backbone network, which could include existing radio systems and thus make systems more dependable during emergencies and reduce costs by taking advantage of economies of scale. The conference participants stressed that the greatest barriers to these advances were not due to lagging technology but to cultural reluctance in adopting recent advances. Writes Weiser, "the public safety community should migrate away from its traditional reliance on specialized equipment and embrace an integrated broadband infrastructure that will leverage technological innovations routinely being used in commercial sectors and the military." 2006, 55 pages, ISBN Paper: 0-89843-458-0, $15.00

Reforming Telecommunications Regulation

Robert M. Entman

The report of the 19th Annual Aspen Institute Conference on Telecommunications Policy describes how the telecommunications regulatory regime in the United States will need to change as a result of technological advances and competition among broadband digital subscriber line (DSL), cable modems, and other players such as wireless broadband providers. The report proposes major revisions of the Communications Act and FCC regulations and suggests an interim transitional scheme toward ultimate deregulation of basic telecommunications, revising the current method for universal service subsidies, and changing the way regulators look at rural communications. 2005, 47 pages, ISBN Paper: 0-89843-428-9, $15.00

Challenging the Theology of Spectrum: Policy Reformation Ahead

Robert M. Entman

This report examines the theology of spectrum—that is, the assumptions and mythology surrounding its management and use. The report looks at how new technologies affecting spectrum, such as software-defined radio, can challenge the conventional wisdom about how spectrum should be managed. Such innovations allow for access to unused frequency space or time on frequencies that are otherwise licensed to an exclusive user. 2004, 43 pages, ISBN Paper: 0-89843-420-3, $15.00

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Robert M. Entman

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secure the intellectual property rights of content suppliers, and adjust the system of subsidized pricing to bring about competitively neutral pricing. 2004, 92 pages, ISBN Paper: 0-89843-394-0, $12.00

Balancing Policy Options in a Turbulent Telecommunications Market

Robert M. Entman

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Robert M. Entman

In the telecommunications world, what would a fully competitive environment look like? What communications initiatives should policymakers develop-considering the ultimate welfare of the consumer-to implement change in the regulatory climate? This report explores ways to reshape the current regulatory environment into a new competitive space. It addresses competition not only within but across separate platforms of communications such as cable, wireline telephony, wireless, satellite, and broadcast. The report also includes an essay on an innovative approach to wireless regulation, "Opening the Walled Airwave," by Eli Noam. 2002, 64 pages, ISBN Paper: 0-89843-330-4, $12.00

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Robert M. Entman

This report examines a "layered approach" to regulation. By viewing telecommunications in four separate layers-content, application, network, and data link-policy discussions can address concerns in one

layer without negatively affecting useful existing policy in other layers. Also presented are beliefs that the growth of broadband should prompt a new discussion about universal service reform. The report also includes "Thoughts on the Implications of Technological Change for Telecommunications Policy," by Michael L. Katz. 2001, 78 pages, ISBN Paper: 0-89843-309-6, $12.00

Six Degrees of Competition: Correlating Regulation with the Telecommunications Marketplace

Robert M. Entman

This report addresses basic conceptual questions about what the nature of regulation should be in a competitive, broadband future. It also examines how fundamental policy issues such as interconnection, mergers, spectrum allocation, jurisdiction, universal service, and consumer protection should be handled in the interim. The report also includes "Regulation: The Next 1000 Years," by Michael L. Katz. 2000, 65 pages, ISBN Paper: 0-89843-279-0, $12.00

Residential Access to Bandwidth: Exploring New Paradigms

Robert M. Entman

This report explores policy initiatives that would encourage widespread deployment of residential broadband services throughout the United States. It identifies the regulatory system as one of the chief obstacles to achieving ubiquitous broadband deployment and offers a new regulatory model to overcome these barriers. 1999, 35 pages, ISBN Paper: 0-89843-256-1, $12.00

Competition, Innovation, and Investment in Telecommunications

Robert M. Entman

This report considers how public policy can foster investment, competition, and innovative services in local exchange telecommunications. The report also includes "An Essay on Competition, Innovation, and Investment in Telecommunications," by Dale N. Hatfield and David E. Gardner. 1998, 52 pages, ISBN Paper: 0-89843-235-9, $12.00

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The Program's Executive Director is Charles M. Firestone, who has served in that capacity since 1989. He also served as Executive Vice

President of the Aspen Institute for three years. He is a communications attorney and law professor who formerly was director of the UCLA Communications Law Program, first president of the Los Angeles Board of Telecommunications Commissioners, and an appellate attorney for the U.S. Federal Communications Commission.