

Anchor Institutions Help Secure Broadband's Promise

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1. Executive Summary

Broadband Internet access is basic infrastructure and contributes significantly to economic growth. To realize its benefits, first, broadband must be available, which requires infrastructure investment, and then broadband must be adopted and used effectively. The fact that broadband is so important and widely used as an input to economic activity and in our social lives is what makes it basic infrastructure. Broadband's status as basic infrastructure implies an enduring public interest in ensuring ubiquitous, affordable access to all citizens and businesses. That means that when economic conditions leave some communities or segments of our population unserved or underserved by broadband, public policy has an obligation to address these digital divides. Addressing those digital divides may require public investment.

Anchor institutions – our schools, libraries, hospitals, and cultural institutions – play a special role in maintaining the healthy fabric of society and our communities. Consequently, ensuring access to broadband by anchor institutions is critically important for enabling anchor institutions to achieve their mission goals and will help realize the

¹ I would like to acknowledge the support of the Schools, Health & Libraries Broadband Coalition (SHLB) and the Benton Foundation in preparing this essay.

benefits of broadband for our economy and society and for meeting the public obligation to provide universal access to broadband. Ensuring access to appropriate broadband for anchor institutions ought to be a primary goal of broadband policies, and sound programs for public investment in broadband ought to include funds for ensuring adequate investment in broadband for anchor institutions.

2. Introduction

In this essay, I explain why broadband Internet access is appropriately viewed as basic infrastructure and review the emerging evidence of how providing broadband access contributes to economic growth. I then focus on why broadband is important for anchor institutions – our schools, libraries, hospitals, and cultural institutions -- and the role that anchor institutions may play in realizing our goals for expanding broadband access and use. In light of their special and unique role, it is reasonable to conclude that anchor institutions ought to have a priority position in broadband promotion policies and with respect to any funding that may be available to promote broadband.

3. Broadband and Economic Growth

Broadband Internet access is now generally recognized as essential basic infrastructure for society and the economy.² Although it only became widely available

² For example: President Obama has reaffirmed this position. Speaking for his administration, Susan Crawford commented in a speech on May 14, 2009 that "Broadband is the new essential infrastructure." (see <http://www.broadcastingcable.com/article/232506-President-Obama-Focused-On-Broadband.php>). Similar positions have been adopted in Europe, where the European Commission has concluded that "widespread and affordable broadband access is essential to realize the potential of the Information Society" (see http://ec.europa.eu/information_society/eeurope/2005/all_about/broadband/index_en.htm); in Australia, where a government report concludes that "ubiquitous, multi-megabit broadband will underpin Australia's future economic and social prosperity" (see

and adopted in the United States since 2000,³ broadband is critical for unleashing the power of the Internet as a global communications and computing platform. Citizens across the economy use the Internet at work, at school, and at play. In our professional lives – whether in for-profit or non-profit businesses, government or social institutions – we rely on the broadband Internet to connect with customers, suppliers, and distributed operations, and to host data and computing applications and services, including electronic commerce. In our social lives, we use the Internet to communicate with family, friends, and colleagues via email, on-line chat, blogs, and photo/video sharing; we use the Internet for social networking, for researching our hobbies, healthcare options, investments, politics, and general interests, for accessing news and media content, and for myriad services from making travel arrangements to on-line banking.⁴

Increasingly, the broadband Internet is being used in education and skills development,⁵ contributing to the enhancement of our labor force; in job search;⁶ and

http://www.dcita.gov.au/communications_for_consumers/internet/broadband_blueprint/broadband_blueprint_html_version/chapter_one_broadband_as_critical_infrastructure); in Japan, where the Japanese have joined with regional partners to "enable all people in Asia to gain access to broadband platforms" by 2010 (see <http://www.dosite.jp/asia-broadband/en/pdf/abp005.pdf>); and other countries.

³ Household broadband access in the United States rose from close to 4% in 2000 to 68% by the end of 2010 (see, Figure 1 in NTIA (2011), *Digital Nation: Expanding Internet Usage*, National Telecommunications and Information Administration (NTIA), Washington, DC, February 2011, available at: http://www.ntia.doc.gov/files/ntia/publications/ntia_internet_use_report_february_2011.pdf)

⁴ As of May 2011, 78% of American adults were using the Internet. Of those, 92% are using email, 83% access information on healthcare, 78% do pre-purchase product research, 76% look at news on-line, 71% buy products on-line, 65% make travel reservations, 61% bank on-line, 61% engage in political research, and so on (see, "What Internet Users Do Online," Pew Internet & American Life Project, May 2011, available at: http://www.pewinternet.org/Static-Pages/Trend-Data/~media/Infographics/TrendData/May2011/Online_Activities_-_all_May2011.xls).

⁵ There is a large labor economics literature discussing the positive wage impacts for Internet users and the benefits/complementarities with skills development. See, for example, DiMaggio, P. and B. Bonikowski (2008) "Make Money Surfing the Web? The Impact of Internet Use on the Earnings of U.S. Workers," *American Sociological Review*, 73(2), 227-50; or Chun, H. (2003)

through e-Government,⁷ in enabling better communication between citizens and local, state, and federal government.

Broadband Internet access is necessary to fully participate in modern civil society and remain competitive in today's global information economy. Indeed, a Poll released in March 2010 found strong international support for the view that Internet access should be a basic fundamental right.⁸

It is precisely because broadband is used as an input in completing so many tasks in society and professional life that it has become recognized as basic infrastructure. While its effects are widespread, measuring the social and economic impacts proves challenging. This difficulty is common to measuring the effects of other components of our Information and Communications Technology (ICT) infrastructures. Indeed, in the 1980s, Robert Solow, a Nobel laureate economist, commented, “we can see the computer

"Information Technology and the Demand for Educated Workers: Disentangling the Impacts of Adoption Versus Use," *The Review of Economics and Statistics*, 85(1), 1-8.

⁶ Beard *et al.* (2010) examined the Internet's significant positive impacts on job search and unemployment (see, Beard, T. R., G. Ford, and R. Saba, "Internet Use and Job Search," Phoenix Center Policy Paper No. 39, Washington, DC, September 2010, available at: <http://www.phoenix-center.org/pcpp/PCPP39Final.pdf>).

⁷ In addition to contributing to the efficiency of government by reducing the costs and expanding the reach for government-provided information and services, there is evidence that eGovernment contributes to improving citizen trust in government (see, Tolbert, C. and K. Mossberger (2006) "The Effects of E-Government on Trust and Confidence in Government," *Public Administration Review*, 66(3), 354-69). OECD data indicates a significant increase in e-Government access by citizens from 2005 to 2010 (see "Uptake of e-government services," OECD, available at: <http://www.oecd-ilibrary.org/docserver/download/fulltext/4211011ec055.pdf?expires=1328129134&id=id&accname=guest&checksum=FC9B112EF356D13258E6CBD77CF4576F>).

⁸ According to the broadbandC: "Four in five adults (79%) regard internet access as their fundamental right, according to a new global poll conducted across 26 countries for broadbandC World Service." (See "Internet access is a 'fundamental right'," broadbandC News, 8 March 2010, available at: <http://news.broadbandc.co.uk/2/hi/technology/8548190.stm>). Finland became the first nation to make broadband Internet access a legal right in July 2010 (see, "First nation makes broadband access a legal right," CNNTech News, 1 July 2010, available at: http://articles.cnn.com/2010-07-01/tech/finland.broadband_1_broadband-access-internet-access-universal-service?_s=PM:TECH).

age everywhere but in the productivity statistics."⁹ There are many reasons for the measurement difficulties, including the fact that while ICT's represent a significant share of fixed business investment, it still represents only a relatively small share of the total capital stock, and the ICT-producing sectors, a relatively small share of total GDP. Moreover, measuring the output of the service sectors which have been most impacted by ICTs, is notoriously difficult. Measuring ICT inputs is difficult because the pace of technological advance complicates efforts to accurately measure quality-adjusted prices and quantities.

Finally, and perhaps most important, ICT is a general purpose technology¹⁰ that is used in productive activities by businesses, government and social institutions in diverse ways to produce many different types of intermediate and final goods and services. ICT's transform "production functions" (how we make things) and contribute to enhancing the quality of other "factor inputs" (the stuff we use in making things) such as labor and non-ICT capital. ICTs and the broadband Internet change the ways workers work, firms are organized, and markets function. New practices like just-in-time manufacturing, supply-chain management, and electronic commerce expand the geographic reach and flexibility of businesses, enabling new options for outsourcing, and wholly new ways for delivering products and services (e.g., distance training for employees, collaboration groupware, or streaming movies over the Internet). The benefits of transformative technologies like the broadband Internet may take significant time to diffuse through industry and institutional

⁹ New York Times, May 20th, 1987, p. A1.

¹⁰ See Bresnahan, T. and M. Trajtenberg (1995) "General purpose technologies: Engines of growth," *Journal of Econometrics*, vol. 65, p. 83-108.

value chains and require the development of complementary inputs like an ICT-skilled labor force and new organizational practices to be fully realized.

In spite of the measurement difficulties, a growing body of empirical evidence attests to the significant contribution of broadband to economic growth, productivity improvements, and job creation. For example, a recent OECD study found that countries with higher broadband penetration experienced significantly higher GDP growth rates, a result that has been echoed by a number of other recent studies.¹¹ Earlier Lehr *et al.* (2005) looked at zip-code level data on broadband deployment in the U.S. during the period from 1999 through 2002 and found evidence that zip codes that had broadband as of 1999 experienced faster job growth (1 to 1.4%) from 1998 to 2002, had higher rental rates in 2000 (by 6%), experienced faster growth in business establishments (0.5 to 1.2%), and a favorable shift in the mix of business toward higher-value-added ICT-intensive sectors (0.3 to 0.6%).¹² Crandall *et al.* (2007) looked at state-level data to estimate that a

¹¹ The OECD study looked at a panel of OECD countries and found that 1% higher broadband penetration resulted in 0.109% faster GDP growth (see OECD (2011) "Economic Impact of Internet/Broadband Technologies," DSTI/ICCP/IE(2011)1/REV1, Working Party on the Information Economy, Directorate for Science, Technology and Industry, OECD, Paris, 30 May 2011); Quiang *et al.* (2009) used data for 120 countries from 1980-2006 and found that a one percent increase in broadband penetration added 0.121% to the GDP growth of medium to high income countries (see "Economic Impacts of Broadband" published in "Extending Reach and Increasing Impact," *2009 Information and Telecommunications for Development*, World Bank); and Katz and Avila (2010) analyzed data for 24 Latin American and Caribbean countries from 2004-2008 and found that a 1% increase in broadband penetration resulted in a 0.0178% increase in GDP (see Katz, R. and J. Avila (2010) "Estimating Broadband Demand and Its Economic Impact in Latin America," *Proceedings of the 4th ACORN-REDECOM Conference*, Brasillia, May 14-15, 2010).

¹² See Lehr, William, Carlos Osorio, Sharon Gillett, and Marvin A. Sirbu (2005) "Measuring Broadband's Economic Impact," paper prepared for Telecommunications Policy Research Conference, Arlington, VA, September 2005.

1% increase in broadband penetration could be expected to add 0.2-0.3% higher job growth, or an additional 300k jobs nationally.¹³

In addition to the top-down empirical studies cited above, a number of researchers have estimated employment and productivity multipliers associated with broadband investments. For example, Crandall & Singer (2010)¹⁴ conclude that cumulative broadband investments of \$182.5B (averaging \$30.4B per year) in the United States over the period from 2010-2015 will result in an average of 509,546 jobs being sustained and a cumulative increment to GDP of \$542.1B. Atkinson et al. (2009),¹⁵ seeking to estimate the impact of broadband investment in the United States, concluded that a \$10B investment in broadband had the potential to create 498,000 jobs.

While this evidence is encouraging, the real benefits of expanding broadband use are yet to be realized. The National Broadband Plan identifies a number of key opportunities for investing in U.S. sustainable competitiveness and long-term growth.¹⁶ The broadband Internet provides the communications fabric for tying together distributed computing and sensor resources that are increasingly being deployed to add ICT intelligence or "smarts" to everything from power and transportation grids (so called, smart grids) to consumer

¹³ See Crandall, Robert, William Lehr, and Robert Litan (2007), "The Effects of Broadband Deployment on Output and Employment: A Cross-sectional Analysis of U.S. Data," *Issues in Economic Policy*, The Brookings Institution, Number 6, July 2007 (available at: <http://www.brookings.edu/views/papers/crandall/200706litan.htm>).

¹⁴ See Crandall, R. and H. Singer (2010) "The Economic Impact of Broadband Investment," *Broadband for America*, Washington, DC, available at: http://www.broadbandforamerica.com/sites/default/themes/broadband/images/mail/broadbandforamerica_crandall_singer_final.docx).

¹⁵ See Atkinson, R., Castro, D. & Ezell, S.J. (2009), "The digital road to recovery: a stimulus plan to create jobs, boost productivity and revitalize America," The Information Technology and Innovation Foundation (ITIF), Washington, DC.

¹⁶ See FCC (2010), *National Broadband Plan: Connecting America*, Federal Communications Commission, Washington DC, March 16, 2010 (available at: <http://www.broadband.gov/download-plan/>).

appliances. We are in the early stages of transitioning to the "Internet of Things" with 24/7 interactions of sensors and embedded processors.¹⁷ The ICT smarts that make it possible to undertake just-in-time production¹⁸ and market-of-one customization¹⁹ is also critical to enabling more green and energy efficient resource management. It can help integrate renewable (but more irregular) sources of power like solar and wind into our electricity grids,²⁰ help smooth the flow of traffic on "smart" highways,²¹ and revamp the way we monitor patients and deliver healthcare through the introduction of new "smart" healthcare.²² A recent study estimates a global impact of \$4.5 trillion by 2020 from expanding access to the world of connected devices.²³

Broadband is essential infrastructure for securing United State's leadership and sustainable competitiveness in the future of smart-technology-enabled markets. For broadband to deliver these benefits today and in the future, it first has to be available, then adopted, and, finally, used appropriately with the right skills and complementary

¹⁷ For example, see <http://www.internet-of-things-research.eu/>, or "Internet of Things – An Action Plan for Europe," Commission of the European Communities, 18 June 2009, COM(2009) 278, available at: http://ec.europa.eu/information_society/policy/rfid/documents/commiot2009.pdf.

¹⁸ Rai *et al.* (2006) show how Internet-powered supply chain management that facilitates just-in-time production contributes to sustainable firm-level performance gains (see, Rai, A., R. Patnayakuni and N. Seth (2006) "Firm Performance Impacts of Digitally Enabled Supply Chain Integration Capabilities," *MIS Quarterly*, 30(2), 225-46).

¹⁹ Dewan *et al.* (1999) show how use of Internet-enabled customization can allow firms to earn higher revenues (see Dewan, R., B. Jing and A. Seidmann (1999) "One-to-One Marketing on the Internet," *Proceedings of the 20th international conference on Information Systems*. Charlotte, North Carolina, United States: Association for Information Systems, 93-102).

²⁰ See http://pesd.stanford.edu/research/low_carbon_electricity

²¹ See <http://dsc.discovery.com/technology/wide-angle/smart-highway.html>.

²² See <http://www.smartconnectedcommunities.org/community/urban-planning/health>.

²³ See Machina Research (2012), "The Connected Life: A USD4.5 trillion global impact in 2020," a joint report prepared by Machina Research and the GSM Association, February 2012 (available at: <http://www.gsma.com/go/download/?file=connectedlifegsmapositionpaper.pdf>).

assets. Although significant progress has been made in the United States toward realizing universal availability of broadband access services, there are still unserved or underserved communities and user groups. As FCC Chairman Genachowski commented in October 2011:

"The goal of deploying broadband networks to every American is vital. So is empowering every American who has access to broadband to adopt it... Right now, 100 million Americans – including the 18 million Americans I mentioned – aren't adopting high-speed Internet at home. That's one-third of our population – a 67 percent adoption rate. Compare that to South Korea and Singapore where adoption rates top 90 percent. The digital divide is more troubling than ever because the costs of digital exclusion are rising."²⁴

While broadband is available in most communities, there are still 14 million Americans (5% of the population) who live in locations without terrestrial broadband.²⁵ There are also significant income, skill-based, and ethnic Digital Divides that need to be addressed. For example, while 93% of Americans with household incomes in excess of

²⁴ See FCC Chairman Genachowski's Remarks on Broadband Adoption, Washington DC, October 12, 2011, available at: http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-310350A1.pdf.

²⁵ See Rosen, Jeffrey (2010), "Universal Service Fund Reform: Expanding Broadband Internet Access in the United States," *Issues in Technology Innovation*, Brookings Institution, Washington DC, April 2010 (available at: http://www.brookings.edu/~media/Files/rc/papers/2011/04_universal_service_fund_rose_n/04_universal_service_fund_rosen.pdf); and NTIA (2011), *Digital Nation: Expanding Internet Usage*, National Telecommunications and Information Administration (NTIA), Washington, DC, February 2011 (available at: http://www.ntia.doc.gov/files/ntia/publications/ntia_internet_use_report_february_2011.pdf).

\$75K have adopted broadband, only 40% of Americans in households with incomes of less than \$20k have broadband; while 84% of Americans with college degrees or higher have broadband, only 30% of Americans with only some high school education have broadband; and while rates for broadband adoption among whites Americans are 68%, adoption rates among blacks (50%) and hispanics (45%) are significantly lower.

Expanding availability to broadband access services addresses only part of the challenge, albeit a necessary first step. In addition to ensuring that broadband is available, it is also important to ensure that end-users possess the skills and requisite complementary assets such as computers and software with which to access, and ultimately, make effective use of the Internet. Moreover, to ensure this is the case, it is important that broadband access be affordable.

Among the third of Americans who could but have not yet adopted broadband at home, three of the most important reasons are (a) the cost of broadband service and/or the cost of a computer to make use of the service; (b) a lack of digital literacy skills; and (c) a perceived lack of relevance to their lifestyle. The latter two issues may be addressed through education and increased experience with using the broadband Internet.

Finally, since most of the investment in broadband infrastructure in the United States is undertaken by for-profit enterprises, it has to be sufficiently economically attractive for broadband providers to be willing to invest in expanding broadband services to communities. This presents a greater challenge to less dense or more remote rural communities, where the costs of deploying services are greater, and to lower income communities where the revenue potential from broadband services is less. From the cost-side, investments are required both in the last-mile facilities that provide the final

connections to households and the second-mile (back-haul) broadband distribution networks that aggregate and connect the last-mile networks to the wide-area networks that provide the connections to the rest of the Internet. From the demand-side, broadband providers need to believe that there is sufficient demand to justify investing in broadband services.

4. Anchor Institutions and Broadband

Ensuring adequate access to broadband for anchor institutions should be a primary goal of broadband policy. Schools, libraries, hospitals, and cultural institutions are appropriately referred to as "anchor institutions" because of their central role in the life and economy of our communities. Collectively, they provide a nexus for education, public health, and cultural/social life and have long been recognized as central to the goals of community building and regeneration. Communities with strong anchor institutions are stronger as a result, and more attractive for investment and as growth attractors for jobs and economic activity.

Just like households, businesses, and government agencies, anchor institutions need advanced telecommunications services, including broadband Internet access, to accomplish their missions. Broadband is needed to enhance the efficiency of back-office operations²⁶ and to expand communications and community outreach efforts. The teachers and students in our schools need broadband to access Web-based research content and applications, to support electronic communications among staff and students,

²⁶ Anchor institutions have to deal with the same back-office functions as businesses: they have to manage personnel, prepare budgets and financial statements, procure supplies, manage facilities, and communicate with employees and other institutions. Today, all of these activities involve use of data communications and Internet-based services.

and as a platform for on-line and distance learning. As a growing proportion of content is now digital, and potentially will be only available digitally, the importance of broadband for education and for building the skills that are needed to be successful in our global information economy is growing. Hospitals and public safety providers need broadband to ensure they have the timely and relevant information they need to keep our communities safe and healthy. Broadband supports online access to clinics, allows community healthcare providers and patients better access to remote experts, and can provide faster and more flexible response to emergency situations. Our libraries and cultural institutions need broadband to support their missions and service offerings, and to expand access to the growing volume of local and remote digital and digital-only content.

Because anchor institutions are among the largest employers in communities, their demand for broadband services contributes to the formation of a critical mass of sustainable and predictable demand, which helps build the economic case for for-profit service providers to extend broadband services to communities.

Additionally, anchor institutions can provide a very valuable form of broadband access for users who either do not have broadband at home, who are currently away from home, or cannot afford broadband-capable equipment for all who need access in the household. While the ultimate national goal is to ensure that broadband access is ubiquitously available to and adopted by all or nearly all households, a baseline level of universal broadband service may be met by ensuring that broadband is available to anchor institutions in every community in the United States. Such access is especially important in ensuring the availability of broadband Internet services to underserved

citizens even in communities where home broadband is widely available and adopted. For low-income users who may be homeless, who cannot afford home broadband service or a computer, or who lack the digital literacy or experience with the Internet to understand its value, using a public access terminal in an anchor institution like a public library or school might be the only way for those users to access the Internet. Through such use, some of those who have lacked the digital literacy skills may develop the requisite skills and experience to induce them to become home broadband users. Thus, broadband provided to anchor institutions will contribute to realizing the goal of universal broadband adoption.²⁷

Furthermore, the non-profit research and education networks (R&E networks) that exist in many states play an important role in providing middle-mile access and a non-commercial alternative for connecting anchor institutions and the communities they serve to the Internet.²⁸ These R&E networks help aggregate traffic and are key participants in helping to realize the goal of achieving affordable universal access to broadband. They have a legacy that extends back to the origins of the Internet as a public-funded, research network that was implemented on top of the public switched telephone network. The R&E networks are often at the forefront in the deployment of novel Internet enhancements and services that ultimately spread to the commercial Internet, and have helped sustain U.S. international competitiveness and innovation. These networks

²⁷ Goalsee and Klenow (2002) observed such spillover benefits in finding that households in communities with higher computer usage were more likely to also become computer users (see, Goolsbee, A. and P. Klenow (2002) "Evidence on Learning and Network Externalities in the Diffusion of Home Computers," *Journal of Law and Economics*, 45(2), 317-43).

²⁸ See CSMG (2011), "Connections, Capacity, Community: Exploring Potential Benefits of Research and Education Networks for Public Libraries," a study by Boston-based consultancy CSMG commissioned by the Bill & Melinda Gates Foundation, February 21, 2011, available at: <http://www.library.state.ak.us/pdf/anc/owl/CCCRENetworkPaper21Feb11.pdf>.

provide an affordable access option in many cases where commercial services are either unavailable or too expensive.

5. Public Investment in Broadband and Anchor Institutions

In light of the importance of broadband and the special role of anchor institutions in community health and development *and* in ensuring universal access to broadband, ensuring appropriate access to broadband Internet access should be a priority for broadband policy and anchor institutions should be priority candidates for public funding and support.

As already noted, most of the investment in broadband is by the private sector which is profit motivated. In most situations that is sufficient to ensure the availability of high quality and affordable broadband service for households and businesses. But, as I have already noted, digital divides, both in terms of quality and coverage, remain. The costs of providing broadband in less-dense rural areas are higher and the ability-to-pay and skills in these areas and many poorer urban or minority communities are lower, making the economic for-profit case more challenging. Even when broadband is available, it is not adopted in such less advantaged areas at as high rates as among richer and better-educated communities. These digital divides are likely to persist because broadband continues to evolve: richer, urban, better educated households will likely have better access to better quality broadband as it continues to improve. It is only to be expected that as broadband evolves that newer, higher quality services will be available first in more economically attractive urban/suburban markets (e.g., FTTH and other forms of high-speed access). A lack of access to higher-quality services will mean a lack of exposure to the highest quality content and applications available over the Internet.

Providing access to anchor institutions will not undo these economics, but they can help in speeding catch-up by allowing citizens in less provisioned communities and less-advantaged segments of the population a way to access broadband and higher-quality broadband sooner than they might otherwise be able to. (Of course, this assumes that the commitment to improve the quality of broadband access to anchor institutions keeps pace with advances in the quality of broadband.)

Furthermore, it is perhaps worth noting that in communities where broadband is available and adopted, there is also an obvious need for anchor institutions to have high-capacity broadband to ensure they are capable of supporting and meeting the broadband-enabled capabilities of all of their citizens. Whether broadband to anchor institutions is more valuable for communities where such broadband may be the only option for such access or in communities where household broadband is the norm (and hence the anchor institutions have even more opportunities and need for broadband to expand services to the broadband households in the community) is not the issue. We need to ensure all of our anchor institutions have sufficient broadband.

Moreover, because the broadband to anchor institutions will serve many people and many computer terminals, the broadband should be of higher quality (faster data rate) than is available to the typical household. Whereas current broadband services are in the range of 10Mbps, anchor institutions often require 100Mbps or faster connections to support adequate performance for all of their users. Once again, middle mile investments and investments in R&E networks can contribute to making this possible.

Where for-profit economics do not yet provide adequate incentives for private investment in broadband, public subsidies may be needed since there is a public interest and obligation to ensure ubiquitous and affordable access to basic infrastructure, which like clean water, safe roads, and reliable electric power, now includes broadband Internet access. Because anchor institutions are typically non-profits with more stringent budget constraints than for-profit businesses, anchor institutions are less likely to be able to meet their requirements for broadband without additional public funding support.

Where public investment in broadband is warranted, anchor institutions can play a special role in amplifying and leveraging such investment to achieve the wider goals of broadband policy and to enhance the mission-effectiveness of the anchor institutions. The contribution that anchor institutions may make in developing complementary skills like digital literacy and in meeting the needs of those without home broadband alternatives have already been noted. Additionally, public investments that extend appropriate high-quality service to anchor institutions will contribute to solving the second-mile infrastructure challenge, thereby also making it easier to enable last-mile access for everyone else in the community.

Typically, anchor institutions have commercial-grade structures and related infrastructure (power, heating, access, and security) that make such institutions logical nodes for terminating second-mile infrastructures. These islands of connectivity may then provide the basis for expanding last-mile access services to provide ubiquitous community coverage. There are a number of wireless technologies that are already commercially available or under development that might be used to expand community-

based broadband deployments in cases where the private-sector service provider community is not sufficiently motivated to provide adequate service.

Even when private sector providers do offer broadband in a community, anchor institutions can improve the economics of community-based broadband alternatives that expand consumer choice options. Anchor institutions can prove useful for locating antennas for the deployment of novel wireless broadband infrastructures. Although such community-based networking have not been widely deployed yet, preserving the option for such deployments can contribute to providing an important vector for potential or actual broadband competition.

Finally, it is likely that anchor institutions by their nature as non-profits may be more likely to support open access architectures. Adoption of such architectures may be required by regulation (e.g., publicly-supported community infrastructure is often subject to various types of open-access obligations), motivated by an institution's mission (i.e., public schools and libraries are intended to provide non-discriminatory access to information and educational opportunities), or motivated by economics (i.e., open source and open access architectures offer better economics for distributed deployment).

6. Further Research Needed

While it is understandable that most of the research interest to date has focused first on trying to document gaps in broadband availability, and secondarily, in trying to assess the economic impact of broadband on job creation and economic growth, additional research is needed, and in the case of anchor institutions, there are special challenges and opportunities.

As already noted, even with much better data available, we would not expect to be able to measure the full benefits of broadband today since many of those benefits will only be realized in the future, in the form of the new forms of economic activity that broadband and enhanced information technology infrastructures enable. Our investment in broadband today is motivated by the recognition that enabling this future is critical to the health of our economy, but we cannot fully justify our investments in broadband based on empirical analyses of current and past data.

Identifying measurable economic outcome impacts associated with anchor institutions pose additional difficulties, in part, because of the central role that anchor institutions play in our communities, and the fact that anchor institutions have a greater need for higher-speed, higher-quality broadband connections than does the typical household. Thus, one would expect that anchor institutions should be early adopters of the highest quality broadband services available in a community, and that the quality of their service will need to improve as broadband continues to evolve. This poses a challenge for measuring broadband inputs appropriately since the quality (and price) of broadband used by an anchor institution matters. Furthermore, because of the nature of the activities that most anchor institutions are engaged in and the fact that they operate as non-profits, it is more challenging to measure outcome metrics that map easily to traditional indicators of economic activity such as household incomes, business revenues, or employment.

What we really need to understand and address with future research, however, are how to make sure we are using broadband resources effectively to maximize the realized benefits in our anchor institutions, at work, and inside and outside our homes. This implies a greater focus on understanding how users are using broadband, and how such

use may change user behavior in productive and leisure activities. We need to understand how broadband usage behavior changes over time with experience and with changes in the larger ecosystem so that we can stay abreast of evolving requirements for upgrading and supporting our broadband infrastructure. For example, broadband in a home makes it feasible for broadband in a school or public library to support new models for community outreach and interactivity that will grow and evolve over time – raising the bar for what may be expected in the way of on-line accessibility for services and content.

Anchor institutions can play a special role in facilitating such research and promulgating lessons learned. As centers for education and public information sharing, anchor institutions can help facilitate the dissemination of information about new on-line services and assist in moving folks up the learning curve. Additional research on what users are doing with broadband in anchor institutions of different types will help us ensure that these critical institutions are using broadband effectively and will contribute to our understanding of best practices for broadband usage more generally. Such research may take several forms: end-user surveys, analysis of the full costs of broadband for anchor institutions (e.g., for service, equipment, and support personnel), and traffic data analyses would all be useful. Even if we cannot fully document the benefits from broadband for our communities, we can benchmark comparable investments to ensure that we are not spending more than we need to meet our goal of universal broadband access.

In the near-term, as active collaborators and as "broadband research laboratories," anchor institutions can play an important role in helping advance our national goal for promoting broadband adoption and accelerating the realization of broadband benefits. For

example, recent investments in middle-mile infrastructures require investments in last-mile infrastructures to make broadband actually available in a community, and adoption by households, to begin to yield measurable benefits. As already noted, anchor institutions should and are likely to be among the first customers for such middle-mile investments and can play an important role in expanding last-mile options and helping to aggregate and stimulate demand for wider broadband adoption. Further research, including detailed case studies, documenting the effects of alternative technical and organizational structures for interconnecting with such second-mile infrastructures would help ensure that such investments realize their full potential.

7. Conclusion

In this essay, I have explained why broadband has come to be regarded as essential infrastructure for our economy and society, and in so becoming, gives rise to a public policy obligation to ensure affordable universal access to all. Just as our communities need good roads, clean water, and reliable electric power to be healthy, so also do they need broadband to be socially and economically healthy in today's modern Internet-dependent, Information Age. The early evidence shows that broadband contributes to the economic health of our communities, but as with other basic infrastructures for which ubiquitous availability and adoption have become the norm, those economic benefits may be most obvious when they are lacking. For example, we seldom talk about the value of clean water, reliable electric power, or good roads, unless problems with access to these arise.

Given the unique role that anchor institutions play in the economic and social life of our communities, it is reasonable to expect that they should assume a priority position

when we assess our needs for ensuring access to high-quality broadband. Anchor institutions need broadband to accomplish their mission goals: our schools need broadband to help students develop the skills they need to keep our economy strong, our hospitals need broadband to keep our communities healthy, and our libraries need broadband to keep pace with the growth of digital media and content. Anchor institutions help anchor and build demand for broadband services in a community, which may contribute to improving the economics for commercial broadband deployment. Anchor institutions are more likely to adopt open access architectures and can provide structures and key assets of use in deploying commercial or community-based broadband alternatives. Broadband to anchor institutions contributes to improving citizen access to and choices for broadband services.

If there is no broadband in a community, then our first focus should be on ensuring adequate access to broadband for anchor institutions. But even if household broadband is available in a community, we must still ensure adequate access to anchor institutions. In addition to meeting the needs of those in the community who still do not have home access, the anchor institutions can leverage the availability of home broadband to enhance and extend the anchor institutions' services to the community. In either case, anchor institutions need better broadband than the typical household since each anchor institution's connection is likely to be supporting a larger number of end-users. Ensuring adequate broadband service to anchor institutions will help meet our needs for ensuring universal access to all citizens, wherever they may live and whatever their economic circumstances.