N A S C I O Representing Chief Information Officers of the States

Issue Brief

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Bowling for Broadband: Promoting High-Speed Internet Access for Economic Development

Introduction

The origin of the term "last mile" might be in the fact that America's vast fiber-optic backbone infrastructure comes within one mile of 90% of U.S. businesses with more than 100 workers.[1] However, the term has come to mean the gap between any current or potential broadband service provider's wholesale infrastructure and individual consumers. This is the most challenging aspect of infrastructure expansion. Bridging these gaps will be vital to the nation's economic growth. This issue brief will address how the state CIO, as state government's primary strategist for leveraging technology for business purposes, can promote high-speed Internet access for economic development. This issue brief is a follow on to an earlier NASCIO issue brief, titled "The Role of the State CIO in Economic Development."

What's At Stake?

The United States is not even close to being the world leader in terms of either broadband use or of speeds available to users. According to the Organization for Economic Co-operation and Development (OECD), America ranked tenth in broadband access per 100 inhabitants (as of June 2003). Among the most populous nations, the U.S. lagged slightly behind Japan (9th), noticeably behind Canada (2nd), and significantly behind South Korea (1st).[2] Fortunately, more than 50 million U.S. households are expected to subscribe to some sort of broadband service by 2008.[3]

While issues of overall population density and population clustering have a significant impact on the infrastructure costs of making broadband available, America certainly faces no unique geographic or population characteristics when compared to Canada. In fact, a comprehensive Gartner study as to why Canadian broadband subscribership is twice that of the United States (as of August 2003) found that "the only variable between the two nations is that Canada has a public policy for broadband access that is part of its national agenda."[4] With the 2002 Farm Bill, the Bush Administration made more than $2 billion in loans available for rural

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[1] Anthony Acampora, "Last Mile by Laser," *Scientific American*, 17 June 2002, <http://www.sciam.com/article.cfm?articleID=0008069E-808A-1D06-8E49809EC588EEDF> (20 July 2004).
[2] Organization for Economic Co-operation and Development, "Broadband access in OECD countries per 100 inhabitants," June 2003, <http://www.oecd.org/document/60/0,2340,en_2825_495656_2496764_1_1_1_1,00.html> (4 August 2004).
[3] The Yankee Group, "Broadband Subscriber Forecast,"30 June 2004, <http://www.yankeegroup.com/public/products/research_note.jsp?ID=11720> (4 August 2004).
[4] Amanda Sabia, "Broadband Penetration in North America: Public Policy Tips the Scale (Executive Summary)," 14 August 2003, 2.

broadband development through the U.S. Department of Agriculture's Rural Development section.[5] Moreover, TechNet, a national network that includes chief executive officers and senior executives of the nation's leading information technology companies, has called for "an affordable 100 Mbps broadband connection to 100 million American homes and small businesses by 2010, and a national strategy to achieve this goal."[6]

All of this seems like so much high-tech posturing until the economic consequences are considered. A Gartner study conducted for the Corporation for Education Network Initiatives in California's (CENIC) One Gigabit or Bust Initiative asserts that "the speed of next generation broadband can realistically be a goal of One Gigabit per household by 2010."[7] The study adapted a method that considers the correlation between penetration (or "density") of an advanced communications technology and gross domestic product (GDP) per capita to estimate that such pervasive broadband speeds could yield a $376 billion increase in the incremental gross state product (GSP) and two million additional jobs over the same timeframe.[8]

Michigan's Broadband Development Authority (MBDA) has taken a non-bandwidth-specific approach to "affordable broadband service to each corner of the state" by 2007 by offering public- and private-sector organization "low-cost financing for the acquisition of hardware, software and services that will improve or increase their use of broadband technologies." For example, the MBDA recently closed a $1.3 million loan that will help a wireless broadband service provider "extend and improve wireless broadband service" in a 10,000 square mile region of northeast Michigan that includes 158,500 households and 9,700 businesses in an underserved region of the state.[9] In 2001, Gartner projected a potential statewide broadband boost of nearly half a million jobs and a $440 billion in GSP over ten years.[10]

The State of the Broadband Nation

Demographics

Given the variety of available technologies, virtually every American household *could* have some type of high-speed/broadband Internet access if cost and inconvenience were not factors. (For purposes of this issue brief the terms "high-speed" and "broadband" will be used interchangeably and will be defined as any connections to the Internet providing downstream transmission speeds of at least 200 kbps per Hackler and Cowles.[11]) Much debate and research has been invested in determining what will maximize the take-up of broadband service in the United States. As of June 2004, approximately 49.5% of "active Internet users" in America had

[5] U.S. Department of Agriculture, "2002 Farm Bill Initiative: the Rural Broadband Loan and Loan Guarantee Program," n.d., <http://www.rurdev.usda.gov/rd/farmbill/6103resources.html> (19 August 2004).
[6] TechNet, "TechNet CEOs Call for National Broadband Policy ," press release, 15 January 2002, <http://www.technet.org/press/Press_Releases/?newsReleaseId=374> (19 August 2004).
[7] CENIC, "The Need for a Gigabit," One Gigabit or Bust Initiative, n.d., <http://www.cenic.org/GB/gartner/NeedGigabit.htm> (17 August 2004).
[8] –, "A $376-Billion Opportunity for California," n.d., <http://www.cenic.org/GB/gartner/376Billion.htm> (17 August 2004).
[9] MBDA, "$1.3 Million Loan Advances Governor's Broadband Goal," press release, 22 April 2004, <http://www.michigan.gov/documents/prm33pdf_89307_7.pdf> (17 August 2004).
[10] Gartner, "E3 Ventures for Michigan Economic Development Corporation – LinkMichigan," PowerPoint presentation, 20 November 2001, 13-15.
[11] Kathie Hackler and Ron Cowles, "Harnessing Broadband for Economic Growth," Gartner PowerPoint presentation, 24 June 2003, 9.

a broadband connection at home. The remainder uses some type of dial-up connection.[12] In addition, 79.5% of "users at work" have access to a broadband connection.[13] When considering web usage statistics, state CIOs should keep in mind how each survey defines more active versus less active Internet users and so forth as it is difficult to find two surveys that define user categories the same way.

Using 2002 Pew Internet and American Life Project survey data, Lenhart and Horrigan have suggested a useful spectrum for categorizing the universe of active and less active Internet users as follows:

"Online" Categories:

- Home Broadband and Uninterrupted Dial-Up Users:
  This group anchors all Internet usage and represents a plurality of the entire spectrum—that is, between 33% and 43% in 2002—with a minority (13% in 2002) being broadband users.[14]

- Intermittent Users:
  The next largest segment of the entire user population (16% to 28% in 2002), they are "disproportionately young, single, students, minorities, and not full-time workers." They drop offline as a result of technology problems, boredom with online content, and lack of time.[15]

"Not Online" Categories:

- Net Dropouts:
  This group (17% in 2002) has discontinued use of the Internet. They tend to be A) frustrated young people—especially women—who have had technical difficulties, B) parents with little time, C) minorities, D) lower-income, and E) urban. They are the most employed and computer savvy among non-users and the most likely to know other Internet users and are aware of public access points (e.g., libraries). In addition to technical difficulties, they tend to drop off due to relocation or lost access to the Internet, financial difficulties, and disinterest.[16]

- Net Evaders:
  This group (8% in 2002) live in households that contain at least one other Internet user. Almost evenly divided among men and women, they tend to be between 30 and 49 years old and believe that they will go online "someday" but are not interested in the Internet now and can rely on others to use it for them.[17]

- The Truly Unconnected:
  The largest segment of the non-user spectrum (24% of Americans in 2002) has no connection with the Internet and know very few people who do. They tend to be over 50 years old, female (59%), very low income, less educated (i.e., high school

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[12] WebsiteOptimization.com, "Hawaii Homes Hot for Broadband – US Broadband Penetration Nears 50% Among Active Internet Users," *The Bandwidth Report*, June 2004, <http://www.websiteoptimization.com/bw/0407/> (21 July 2004).

[13] *Ibid*.

[14] Amanda Lenhart and John B. Horrigan, "Re-visualizing the Digital Divide as a Digital Spectrum," *IT&Society*, Summer 2003, 25.

[15] *Ibid*., 26.

[16] *Ibid*., 27-28.

[17] *Ibid*., 28-29.

education or less), and white. A nuanced understanding geographic, income, age, and racial factors among this group is imperative to overcoming their disengagement—that is, if it can be overcome at all, which is unlikely for at least some portion of this demographic.[18]

The data above shows that providers of high-speed Internet access have built on a solid base of users since 2002, converting many uninterrupted dial-up users into broadband users, although the second quarter of 2004 showed a decline in new subscribers.[19] A still-large number of intermittent users and net dropouts churns, awaiting enough time, money, user-friendliness, and interest to get back online—maybe with broadband. Net evaders are likely awaiting enough user-friendliness and interest to go online since they will generally have someone else to hook them up with the Internet when the time comes. Lenhart *et al.* revisit the non-user portion of the spectrum along with people with disabilities in the spectrum approach provides a useful framework for future national- and state-level studies.

Technologies

The average South Korean broadband user enjoys 8 Mbps Asynchronous Digital Subscriber Line (ADSL) connectivity while up to 20 Mbps Very-High Bit-Rate DSL (VDSL) connectivity is the government's target for 84% of households by 2005.[20] While the Korean case is an interesting example of what is possible, the lesson lies more in the pervasiveness of access rather than the speed. But, while speed isn't everything, it cannot be ignored. Today's broadband will be tomorrow's narrowband and the NII, being evolutionary, will need generational upgrades.

Emerging trends point toward widespread grid computing, storage area networks (SANs), real-time video gaming, remote thin clients, full-screen video-on-demand (VoD), interactive digital television (DTV), high-definition television (HDTV), and voice-over-Internet (VoIP) service. However, Hackler and Cowles warn that "(f)ocusing on speed, bandwidth, capacity or a 'Killer Application' ignores the real opportunity" and suggest that "(t)he opportunity is million of ordinary tasks and events that are made better, easier or more productive."[21] Toward that end, they recommend a long-term, national investment toward a 1 Gbps infrastructure.[22] So, for now, states will need multi-faceted broadband plans that promote generalized, low-end broadband access statewide and encourage higher bandwidth connectivity where particular communities (e.g., research parks and schools) or services (e.g., telemedical clinics and remote classrooms) will demand them.

The common and emerging broadband technologies, including passive optical networking (PON), hybrid fiber coaxial (HFC) digital cable, ADSL, VDSL, satellite, 802.16x microwave (WiMax), and broadband over power lines (BPL) are described in Appendix B of this document.

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[18] *Ibid.*, 29-30.

[19] Leichtman Research Group, "Broadband Internet Grows to 29 Million in the U.S.," 17 August 2004, <http://www.leichtmanresearch.com/press/081704release.html> (19 August 2004).

[20] John Borland and Michael Kanellos, "South Korea leads the way," *CNET News.com*, 28 July 2004, <http://news.com/South+Korea+leads+the+way/2009-1034_3-5261393.html?tag=nl> (4 August 2004) and Republic of Korea Ministry of Information and Communication, "e-Korea Vision 2006," April 2002, 60.

[21] Hackler and Cowles, 10.

[22] *Ibid.*, 9.

Strategic Options

TechNet's "State Broadband Index" provides a comprehensive list of strategic options for state government's seeking to expand broadband availability, including recommendations that states…

- "standardize and expedite" right-of-way (ROW) permitting
- "limit fees imposed for ROW access"
- adopt a "broadband strategy and formal plan"
- assess "broadband status" through mapping and cataloguing of existing infrastructure
- "allow municipalities to provide wholesale services"
- undertaking "innovative supply-side initiatives"
- provide "financial incentives for broadband deployment, especially for underserved communities"
- provide incentives for public- and private-sector users to access broadband networks
- "encourage broadband usage by citizens through e-government initiatives"
- "encourage government usage of broadband applications"
- provide "financial support that encourages the development of broadband applications that improve government services or support next-generation technologies"[23]

Annex B to the TechNet report details the methodology used to evaluate all of the states against these policy recommendations. This methodology can also be used by states to benchmark their broadband status against the TechNet policy recommendations. NASCIO has compiled links to more information and legislation from some of the states ranked in TechNet's list of 25, which can be found in Appendix A to this document.

The Alliance for Public Technology (APT) has catalogued the policy approaches of all 50 states and identified six different categories, including state broadband authorities/agencies, tax credits, statewide networks, funding programs, demand-aggregation programs, and public-private partnerships.   The report, "A Nation of Laboratories – Broadband Policy Experiments in the States," also contains links to the primary website for each state's broadband effort.

Finally, Hackler and Cowles offer a few additional public policy recommendations that aren't cited above, including…

- "Encourage collaborative efforts of the State, counties, and municipalities"
- "Establish a clearinghouse for best practices"
- "Create 'regulatory free' zones"
- "Participate in solving intellectual property (IP) issues at the national level"
- "Require new housing developments to include fiber or conduits to fiber"
- "Require broadband be capable of replacing existing communications services"[24]

Together, these three studies provide a fairly comprehensive survey of the strategic options and approaches for expanding broadband availability at the state level. The links to state programs and legislation provided in Appendix A of this document provide real-world examples

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[23] TechNet, "The State Broadband Index – An Assessment of State Policies Impacting Broadband Deployment and Demand," n.d., 3-4.

[24] Hackler and Cowles, 14.

addressing nearly all of the recommendations and approaches listed above. Examples of several municipal broadband efforts can be found in a report, "Municipal Telecommunications and the Digital Divide," produced by The Shpigler Group for the Rural Broadband Coalition (RBC). Another municipal project worth watching is the Utah Telecommunications Open Infrastructure Agency (UTOPIA), which is "a consortium of 14 Utah cities engaged in deploying and operating a 100% fiber optic network to every business and household (about 140,000) within its footprint."[25] The National Telecommunications and Information Agency (NTIA) has compiled numerous resources regarding rights-of-way and siting, which appear to be current as of 2002.

One option for fostering broadband expansion that is not completely articulated in the examples is the August 2000 case between the Kentucky Public Service Commission (PSC) and BellSouth, which might be referred to as "reinvestment of telecommunications productivity gains." In this case, BellSouth had begun to take in excess revenue based upon productivity gains as determined by a part of the PSC's regulatory methodology. Based upon a request by BellSouth, the PSC allowed the company to reinvest the accrued productivity gains in expanded broadband coverage rather than return the excess to the customers in miniscule increments. As a result BellSouth promised to broadband-enable 35 more wire centers by December 2002, expanding service to economically distressed communities in a significant portion of BellSouth's service area. The expansion also pushed broadband into nearly every community that was home to one of the state's community and technical colleges.[26] As broadband take-up increases, it is possible that broadband providers across the nation will capture similar productivity gains that could be reinvested this way.

Leadership Role – Opportunities for State CIO Impact

The state CIO should not underestimate his or her role in serving as an evangelist for greater statewide broadband availability. Looking for government information was the tenth fastest growing web pursuit between 2000 and 2002 with an estimated 66 million users (a 56% increase) going online for this purpose specifically. (Twelve million were estimated to do so every day!)[27] So, anything a state CIO can contribute along these lines will be another value-added item for Internet users. (A follow on brief this one will address the opportunities for CIOs to maximize the impact of e-government on economic development.) Thus, in order to advise policy makers, state CIOs should be familiar with the broadband landscape of the state in terms of availability and the demographics of the potential user community as well as the legislative and regulatory issues.

Broadband-Friendly Services

However, state government does offer a few information products that can contribute to overall broadband demand. Ohio Government Telecommunications offers live video streaming of the state house and senate during sessions at http://www.ogtv.org/. Kentucky Educational Television (KET) at http://www.ket.org, the nation's first statewide, digital public television network, offers online video, two digital (DTV) channels, one high-definition (HDTV) channel, and two virtual digital channels that broadcast (i.e., "datacast") wireless coverage of the state legislature as well as weather information and health-department information (for official use

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[25] UTOPIA, website home page, n.d., <http://www.utopianet.org/index.htm> (19 August 2004).
[26] Kentucky Public Service Commission, "Review of BellSouth Telecommunications, Inc.'s Price Regulation Plan – Case No. 99-434," 3 August 2000, 4-8.
[27] Mary Madden, "America's Online Pursuits," *Pew Internet and American Life Project*, 22 December 2003, vii-viii.

only) to specially-equipped receivers. KET is currently working on educational and homeland security-related information streams for its virtual channels. Finally, South Dakota Public Broadcasting (SDPB), which falls under the domain of the state CIO, offers a variety of online programming, including archived video, web cams, live audio from public radio, and archived audio from the state legislature at http://www.sdpb.org/net/index.html.

Geographic Information Systems (GIS)

Publicly accessible government GIS systems are becoming very prevalent at the state and local levels. These systems offer a dual benefit. First, being data- and graphics-intensive, they are most useful to citizens, entrepreneurs, and business owners when they are accessed via high-speed connections. Second, they can provide economic-development specific services, such as siting for businesses and travel information for citizens, tourists, and commercial drivers. Other GIS applications with indirect economic development impact include community data for health and human services and trends for public safety and law enforcement purposes. Many state CIOs directly oversee the sate GIS office.

Telehealth

The Kansas University Center for Telehealth and Telemedicine (KUCTT) is conducting unattended medical consultations with remote patients via 384-768 Kbps broadband, depending on whether video is needed.[28] Since 1991, KUCTT has grown to include 60 locations across the state and has conducted more than 13,000 consultations across 300 specialties.[29] While tele-healthcare services are becoming more widespread, they will likely be slow to expand until questions of Medicare and Medicaid coverage are settled. As the Baby Boomers age, particularly in the great expanse of America between the Appalachian and Rocky mountains, the issue of reimbursement for tele-healthcare services, including broadband connectivity, will come to the forefront of a policy discussion driven by the need to contain costs.

Distance Learning

The number of accredited online learning programs offered by established and start-up high-schools, colleges, and universities is rapidly growing. Unfortunately, no data is readily available as to how many states (if any) have negotiated statewide student discounts for broadband access. Students at Central Michigan University, which also has an extensive online learning program, have benefited from discounted prices (i.e., $24.95/month) for adequate, but less-than-business-grade Wi-Fi services (i.e., 256 to 512 Kpbs connectivity) provided by a local company.[30] But, that is local to the campus only. While states could negotiate statewide discounts, a universally available discount would have to be the product of a national policy.

Conclusion

Many issues outside of the state CIO's purview will dictate the rate of uptake of broadband services by citizens. Will broadband over power lines (BPL) be a major contributor to access in rural communities and other places where cable and DSL service offerings are not very

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[28] KUCTT, "KUCTT Technology Guide," n.d., <http://www2.kumc.edu/telemedicine/technology/> (23 August 2004).

[29] –, "About the Center," n.d., <http://www2.kumc.edu/telemedicine/index.html> (23 August 2004).

[30] Ed Sutherland, "Michigan Students Get Wireless Broadband," *Wi-Fi Planet*, 5 May 2004, <http://www.wi-fiplanet.com/columns/article.php/220114> (21 August 2004).

profitable? Will the RBOCs use VDSL and fiber-to-the-premises—at least, the passive optical networking variety—to compete with the cable companies' bundled video, VoIP, and broadband product offerings? How long will it take for WiMax to mature into a viable market offering? The answers to these questions will decide what the U.S. broadband environment of 2010 will look like. Therefore, state CIOs should be skeptical of any technology-specific market forecast and focus on promoting technology-neutral policies and financial arrangements that will allow this and the next generation of broadband to take shape based on user demands and technological advancements.

In summary, state CIOs have the following options available to them when promoting high-speed Internet access:

- Stimulate supply via regulatory reform and demand aggregation
- Scour state government for potential broadband-friendly services in order to stimulate demand
- Address citizens' privacy and security concerns over the Internet using on-line state services in general and promote good security practices

This issue brief was produced under the guidance of the Economic Development Subcommittee of NASCIO's Strategic Business and Services Committee.

Additional Resources

Broadband Overview Research
- Gartner's "Harnessing Broadband for Economic Growth" (June 2003)
  http://www4.gartner.com/2_events/audioconferences/2003/june/jun24tcm104.jsp
- U.S. Technology Administration's report "Understanding Broadband Demand – A Review of Critical Issues" (September 2002)
  http://www.technology.gov/reports/TechPolicy/Broadband_020921.htm

Broadband User Demographic Research
- Amanda Lenhart and John B. Horrigan's study "Re-visualizing the Digital Divide as a Digital Spectrum"
  http://www.stanford.edu/group/siqss/itandsociety/v01i05.html (Scroll down to article #2.)
- One Economy Corporation
  http://www.one-economy.com/
- Pew Research Center's "Internet and American Life" Project site
  http://www.pewinternet.org/index.asp (See broadband related reports.)
- Rural Broadband Coalition
  http://www.ruralbroadbandcoalition.net
- TechNet's "Broadband Primer"
  http://www.technet.org/press/Press_Releases/?newsReleaseId=357

Broadband Policy
- Alliance for Public Technology's "A Nation of Laboratories – Broadband Policy Experiments in the States"
  http://www.apt.org/publica/

- CENIC's "Self-Assessment Guide for Communities" (California): http://www.cenic.org/guide
- CTIA's research brief on model state wireless-siting efforts http://www.wow-com.com/content/index.cfm/AID/247
- CTIA's model municipal wireless-siting ordinance http://www.wow-com.com/content/index.cfm/AID/234
- Lonestar Broadband's "How-To Guide" for Communities (Texas): http://www.lonestarbroadband.org/howtoguide/howtoguide.htm
- National Association of Regulatory Utilities Commissioners (NARUC) Telecommunications Committee http://www.naruc.org/displaycommon.cfm?an=1&subarticlenbr=86
- NCSL's "Telecommunications and the Tangle of Taxes" article http://www.ncsl.org/programs/pubs/200tele.htm
- NTIA's Federal Rights-of-Way website for telecommunications projects http://www.ntia.doc.gov/frowsite/index.html
- NTIA's "State and Local Rights-of-Way" resource page http://www.ntia.doc.gov/ntiahome/staterow/statelocalrow.html
- Progress and Freedom Foundation's (PFF) discussion transcript for Randolph May *et. al.* "The Next Step in Telecom: Deregulation of Rates" (March 2004) http://www.pff.org/publications/communications/ [NOTE: Scroll down to 2004 reports.]
- The Shpigler Group's report "Municipal Telecommunications and the Digital Divide" http://www.ruralbroadbandcoalition.net/pdf/MunicipalTelecommunications.pdf
- TechNet's "The State Broadband Index" http://www.technet.org/press/Press_Releases/?newsReleaseId=2527
- USDA's Rural Broadband Loan and Guarantee Program application site: http://www.usda.gov/rus/telecom/broadband.htm

Broadband-Friendly Services

- American Distance Education Consortium (Post-Secondary) http://www.adec.edu/
- CMS's "Medicaid and Telemedicine" page http://www.cms.hhs.gov/states/telemed.asp?
- The Kansas University Center for TeleMedicine and TeleHealth http://www2.kumc.edu/telemedicine/
- National States Geographic Information Council (NSGIC) http://www.nsgic.org/
- NIH's "Telemedicine for the Medicare Population" page http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=hstat1.chapter.33002
- North American Council for Online Learning (K-12) http://www.nacol.org/
- OAT's "Report to Congress on Telemedicine" http://telehealth.hrsa.gov/pubs/report2001/pay.htm
- Telemedicine Information Exchange: http://www.telemed.org

- U.S. Office for the Advancement of Telehealth
  http://telehealth.hrsa.gov/index.htm

Appendix A: Additional State Resources

Below are links to more detailed information about the broadband efforts for 17 states, most of which are listed in the overall rankings of TechNet's "The State Broadband Index." An excellent summary of the approaches being used by all 50 states along with additional links for each state can found in the Alliance for Public Technology's "A Nation of Laboratories – Broadband Policy Experiments in the States" report, which can be found at http://www.apt.org/publica/. Also, see TechNet's summary findings for the top ten states in the overall rankings at http://www.technet.org/resources/SummaryFindings_BB_Top10_States.doc.

State	Broadband Effort	Resources
California	CENIC's One Gigabit or Bust Initiative™	▪ One Gigabit or Bust Initiative™: http://www.cenic.org/GB/index.html ▪ Gartner's "One Gigabit or Bust™ Initiative — A Broadband Vision for California" report: http://www.cenic.org/GB/gartner/index.htm
Colorado	Multi-Use Network Project, Rural Technology Enterprise Zone(s), High-Speed Digital Network	▪ Multi-Use Network Project (MNT): http://www.colorado.gov/dpa/doit/mnt/ ▪ Rural Technology Enterprise Zone tax credits: http://www.revenue.state.co.us/fyi/html/income36.html ▪ High-Speed Digital Network (map): http://www.gjep.org/bus_env/network_map.html
Florida	Digital Divide Council	▪ Digital Divide Council: http://www.digitaldividecouncil.com ▪ Legislation creating the Digital Divide Council: http://www.digitaldividecouncil.com/digitaldivide/creating_legislation.html
Idaho	Income Tax Credit	▪ House Bill 536 creating an income-tax credit for investment in broadband equipment: http://www3.state.id.us/oasis/H0536.html
Indiana	ILight2	▪ Indiana Telecommunications Network: http://www.in.gov/itn/ ▪ "Broadband in Indiana" presentation: http://www.in.gov/itn/images/BroadbandinIndiana.ppt
Iowa	Iowa Communications Network (ICN)	▪ Iowa Communications Network (ICN): http://www.icn.state.ia.us/ ▪ Iowa code chapter 476.97 "Iowa Broadband Initiative" http://www.legis.state.ia.us/IACODE/2003SUPPLEMENT/476/97.html (Scroll down to part 12. *a*. beginning "The Iowa broadband initiative...")
Kansas	Kan-Ed	▪ Kan-Ed http://www.kan-ed.org/ ▪ Press release regarding USDA funding for rural broadband in Kansas: http://www.rurdev.usda.gov/ks/2004%20Pages/050404-Broadband%20PR.htm

State	Broadband Effort	Resources
Kentucky	ConnectKentucky	▪ ConnectKentucky: http://connectkentucky.org/ ▪ Press release regarding Kentucky House Bill 627, deregulating broadband service in the Commonwealth: http://connectkentucky.org/u_press/GovernorFletcherSignsHB627.pdf ▪ Kentucky House Bill 627 relating to the provision of broadband service: http://www.lrc.state.ky.us/record/04rs/HB627.htm
Michigan	LinkMichigan	▪ Michigan Broadband Development Authority (MBDA): http://www.broadbandauthority.org ▪ Michigan Legislature Public Acts page: http://www.michiganlegislature.org/mileg.asp?page=PublicActs (Search for public acts 48, 49, and 50 of 2002 for more information about the METRO Act, the creation of the MBDA, and tax credits for rights-of-way fees.) ▪ Gartner's November 2001 "LinkMichigan Presentation": http://medc.michigan.org/keywordsearch/?word=LinkMichigan&action=Submit (See "LinkMichigan Presentation 112001".)
Mississippi	Income Tax Credit	▪ Broadband Technology Development Act: http://www.mscode.com/free/statutes/57/087/index.htm
Missouri	MOREnet	▪ MOREnet: http://www.more.net
North Carolina	e-NC Initiative	▪ e-NC Initiative: http://www.e-nc.org/ ▪ Senate Bill 1343 creating the Rural Internet Access Authority: http://www.e-nc.org/Webpage.asp?page=16 (Click on bolded text, "Senate Bill 1343.") ▪ House Bill 1194 creating the e-NC Authority and extending the work of the Rural Internet Access Authority: http://www.e-nc.org/Webpage.asp?page=16 (Click on bolded text, "House Bill 1194.")
Ohio	Third Frontier Project	▪ Third Frontier Project: http://www.thirdfrontier.com/index.asp ▪ Ohio Broadband Initiative press release: http://www.thirdfrontier.com/pressreleases/092602broadband.asp ▪ Ohio Access Appalachia press release: http://www.thirdfrontier.com/PressReleases/092702accessapp.asp ▪ Ohio Revised Statutes, Chapter 184 "Third Frontier Commission": http://onlinedocs.andersonpublishing.com/oh/lpExt.dll?f=templates&fn=main-h.htm&cp=PORC (Search for "Third Frontier".)
Texas	Lonestar Broadband	▪ Lonestar Broadband: http://www.lonestarbroadband.org/
Utah	UTOPIA	▪ Utah Telecommunications Open Infrastructure Agency (UTOPIA): http://www.utopianet.org/

State	Broadband Effort	Resources
Virginia	COVANET, Network Virginia	▪ COVANET: http://covanet.state.va.us/ ▪ Network Virginia (NWV): http://www.networkvirginia.net/ ▪ Code of Virginia § 15.2-2160 relating to provision of telecommunications services by localities: http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+15.2-2160 ▪ Code of Virginia § 58.1-400.1 setting minimum tax on telecommunications companies: http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+58.1-400.1
Washington	Center to Bridge the Digital Divide	▪ Center to Bridge the Digital Divide: http://cbdd.wsu.edu/

Appendix B: Common and Emerging Broadband Technologies

Fiber-Optic Technologies

Definitions

Before any discussion of current and emerging broadband options can be had, we should clarify the various fiber-optic cabling options since each of them presents a specific challenge to anyone seeking to expand broadband access.

- Fiber-to-the-Neighborhood (FTTN):
  Usually refers to communications system that uses fiber optic cable to link the telephone company's central office (CO) or the cable company's distribution center (or "headend") to a hub, exchange, or other service area interface (SAI) that, in turn, connects to hundreds or thousands of subscribers via copper cabling. FTTN is widely used in hybrid fiber coaxial (HFC) cable, or "digital cable," and very high bit rate DSL (VDSL) services (described below).

- Fiber-to-the-Curb (FTTC):
  Often used interchangeably with FTTN, it should be used more specifically to refer to systems that run fiber optic cables within a few yards of each subscriber's home or office. This technology is rarely used in mass broadband deployments due to extensive trenching costs for burying the cables, although some cable companies do run fiber optic cabling overhead as with phone and power lines in order to service interactive and high-definition television customers where extremely high bandwidth (20 Mbps or greater) where low noise, low interference, and, thus, shorter copper cable lines are needed.

- Fiber-to-the-Premises/Home (FTTP/FTTH):
  Refers to fiber-optic cabling that is run directly into the home or business of the subscriber, which can provide the customer with nearly 3 Gbps bandwidth. This technology is rarely used in mass broadband deployments due to extensive trenching costs for burying the cables (although they can be run overhead) and the need for very expensive optical signal transceivers, or "optical modems," at the user end. [NOTE: Some business do subscribe to optical carrier (OC) class communications services as defined by the synchronous optical network (SONET) standard with OC-3 being the most common signal rate at 155.52 Mbps. However, dedicated phone lines at the T-1 (1.544 Mbps) and T-3 (43 Mbps) rates are more common.]

Passive Optical Networking (PON) FTTP

(less than 1% of home users as of 31 December 2003)[31]
- Customers: no market data readily available
- Addressable market: no market data readily available

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[31] The Yankee Group, "Broadband Subscriber Forecast,"30 June 2004, <http://www.yankeegroup.com/public/products/research_note.jsp?ID=11720> (4 August 2004).

- Speed: Generally between 15 and 60 Mbps downstream (or synchronous if a fiber optic pair has been run to the premises)
- Cost: $35-50 depending on packages[32]
- Notes:
  o PON has potential to bring fiber closer to the premises due to the fact that the splitters and couplers that route light from the CO or headend to the customer and back are "passive"—that is, the do not require power—and, thus, save the service provider money in power and maintenance costs.[33]
  o Verizon is one of the first companies to attempt a significant PON FTTP deployment, seeking to pass one million premises in nine states by the end of 2004.[34]

Copper Wire Technologies

Hybrid Fiber Coaxial (HFC) Cable, or "Digital Cable"

(54% of home users as of April 2004)[35]
- Customers: 17.3 million (as of 31 March 2004)[36]
- Addressable market: 95.6 million homes passed (as of 31 December 2003)[37]
- Speed: Internet service is provided by using a portion of the coaxial cable bandwidth to provide up to 5 Mbps downstream and 128-512 kbps upstream, although (according to user tests at DSLReports.com) downstream speeds in most markets generally exceed 1.5 Mbps.
- Cost: Between free and $200 for installation and between $25 and $40/month for service depending on service offerings
- Notes:
  o The U.S. is the only nation where more households subscribe to cable broadband versus ADSL.
  o At least one company has broken the 4 Mbps barrier in downstream speeds.[38]
  o HFC deployments generally use fiber-to-the neighborhood (FTTN) or fiber-to-the-curb (FTTC) and then copper coaxial cabling to the premises. PON can be used for HFP deployments.
  o The Yankee Group has forecast that cable broadband service providers will have approximately 30 million subscribers in the U.S. market by 2008.[39]

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[32] Ben Charny and Jim Hu, "Verizon's fiber race is on," *CNET News.com*, 19 July 2004, <http://news.com.com/Verizon's+fiber+race+is+on/2100-1034_3-5275171.html> (18 August 2004).
[33] The Passive Optical Networks Forum, "What is a PON?," n.d., <http://www.ponforum.org/technology/default.asp> (18 August 2004).
[34] Jim Duffy, "Verizon feeds fiber to Texas," *NetworkWorldFusion*, 19 May 2004, <http://www.nwfusion.com/edge/news/2004/0519foa.html> (18 August 2004).
[35] John B. Horrigan, "55% of adult Internet users have broadband at home or at work," *Pew Internet Project Data Memo*, April 2004, 2.
[36] National Cable and Telecommunications Association, "Statistics and Resources," Industry Overview, n.d., <http://www.ncta.com/Docs/PageContent.cfm?pageID=86> (3 August 2004).
[37] *Ibid*.
[38] Jennifer Davies, "Cox, SBC speed up Internet services," *San Diego Union-Tribune*, 11 August 2004, <http://www.signonsandiego.com/news/business/20040811-9999-1b11cable.html> (12 August 2004).
[39] The Yankee Group, *Ibid*.

Asynchronous Digital Subscriber Lines (ADSL, or "DSL")

(42% of home users as of April 2004)[40]

- Customers: 10.5 million (as of 31 March 2004)[41]
- Addressable market: No definite statistics are readily available. However, an average of 60 to 65% of telephone customers will qualify for DSL service—that is, by being within three miles of a central office (CO) equipped with a DSL access multiplexer (DSLAM).[42] This equates to approximately 36 million potential residential customers based on International Telecommunications Union (ITU) statistics from 2003.[43]
- Speed: up to 3 Mbps downstream; 128-512 kbps upstream, although downstream speeds (according to user tests at DSLReports.com) in most markets are generally well under 1.5 Mbps
- Cost: Between free and $150 for installation and around $50/month for service (including taxes and ISP charges) depending on service offerings
- Notes:
  - At least one company has overcome the three-mile "long-loop" barriers with a technology that will allow ADSL deployments from the service-area interface (SAI), which could extend the potential market for ADSL service to virtually every telephone customer within nine miles of the CO.[44]
  - The Yankee Group has forecast that ADSL broadband service providers will have approximately 21 million subscribers in the U.S. market by 2008.[45]
  - The second quarter of 2004 was the first quarter ever in which the number of new ADSL subscribers exceeded the number of new cable broadband subscribers.[46]

Very-High Bit-Rate DSL (VDSL)

(less than 1% of home users as of 31 December 2003)[47]

- Customers: less than 100,000 (as of 31 December 2003)[48]
- Addressable market: No definite statistics are readily available. However, customers must be within 4,000 to 5,000 feet (depending on the gauge of their twisted-pair telephone wire) of a Universal Service Access Multiplexer (USAM)-equipped service-area interface (SAI) that is connected to the telephone company's central office (CO) via a fiber optic connection. (This represents a fiber-to-the-neighborhood, or FTTN, deployment.)[49]

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[40] Horrigan, *Ibid*.

[41] Converge! Network Digest, "DSL Continues Record Growth -- Now 73.4 Million Lines Worldwide," n.d., <http://www.convergedigest.com/DSL/lastmilearticle.asp?ID=11383> (4 August 2004).

[42] DSLAvailability.com, "DSL FAQs," n.d., <http://www.dslavailability.com/dslfaq.htm> (4 August 2004).

[43] International Telecommunications Union, "Free Statistics Home Page," n.d., <http://www.itu.int/ITU-D/ict/statistics/> (4 August 2004).

[44] Converge! Network Digest, "Pedestal Networks Unveils Line-Powered Remote DSLAM," n.d., <http://www.convergedigest.com/Startups/startuparticle.asp?ID=8946> (12 August 2004).

[45] The Yankee Group, *Ibid*.

[46] Leichtman Research Group, *Ibid*.

[47] The Yankee Group, *Ibid*.

[48] *Ibid*.

[49] International Telecommunications Union, "Free Statistics Home Page," n.d., <http://www.itu.int/ITU-D/ict/statistics/> (4 August 2004).

- Speed: up to 22 Mbps downstream and up to 3 Mbps upstream with larger portions of the bandwidth reserved for on-demand video streaming via several television sets, VoIP telephony, and a smaller portion (256 kbps to 1.5 Mbps) for Internet service[50]
- Cost: $40-50/month plus installation charges
- Notes:
  - Qwest is the only major provider of VDSL in the U.S. with customers in test markets in the Phoenix, Omaha, and Denver areas.
  - A Yankee Group analyst declared in late 2001 that VDSL "will be slow to roll out" and that "the RBOCs and ILECs…may not be ready to become cable companies, but they are going to have to be" in order to save market share.[51]

Broadband over Power Lines (BPL)

(less than 1% of home users as of 31 December 2003)[52]
- Customers: less than 100,000 (as of 31 December 2003)[53]
- Addressable market: Virtually any residence with electric power where the power lines have been modified to support digital communications.
- Speed: Up to 1 Mbps (synchronous)[54]
- Cost: Under $30/month[55]
- Notes:
  - Routers must be attached to the medium- and low-voltage power lines to move data to appropriate points.
  - Digital communications and electric current can travel at different frequencies over the same power line. The data travels between 2 and 80 MHz, which creates a potential for radio interference that has created at least a minor controversy— especially in regard to communications affecting public safety and HAM radio operators.[56]
  - The broadband signal can be received via any electrical outlet in the home that feeds current from the same power line that brings the broadband in to the home. Modem set up is truly plug-and-play.
  - The president of the National Association of Regulatory Utilities Commissioners (NARUC) has declared: ""Broadband over Power Lines may prove to be the third broadband pipe into residential consumers' homes, providing significant competition for cable modem and DSL service."[57]

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[50] Qwest, "Overview," *Qwest Choice™ TV & OnLine – VDSL Technology*, n.d., <http://www.qwest.com/vdsl/learn/overview.html> (12 August 2004).

[51] Kevin Fitchard, "The Battle That Could Spark A VDSL Revolution," *Telephony*, 22 October 2001, <http://telephonyonline.com/ar/telecom_battle_spark_vdsl/> (12 August 2004).

[52] The Yankee Group, *Ibid*.

[53] *Ibid*.

[54] Mary Ann Murray, "Power Play," *Time.com*, 3 May 2004, <http://www.time.com/time/insidebiz/article/0,9171,1101040503-629395,00.html> and Mike Boyer, "Cinergy plugs in as Web provider, *The Cincinnati Enquirer*, 2 March 2004, <http://www.enquirer.com/editions/2004/03/02/biz_biz1acin.html> (6 August 2004).

[55] *Ibid*.

[56] David Coursey, "Broadband from the electric company? No thanks," ZDNet, 13 October 2003, <http://reviews-zdnet.com.com/4520-7297_16-5089730.html> (6 August 2004).

[57] NARUC, "NARUC Task Force on Broadband Over Powerlines," n.d., <http://www.naruc.org/displaycommon.cfm?an=1&subarticlenbr=334> (19 August 2004).

Wireless Technologies

Satellite

(approximately 1% of home users as of 31 December 2003)[58]
- Customers: less than 100,000 (as of 31 December 2003)[59]
- Addressable market: Virtually any residence with an unobstructed view of the southern sky and permission to install an external receiver.
- Speed: up to 256 kbps upstream; up to 512 kbps downstream[60]
- Cost: $500-900 installation; $60/month subscription[61]
- Notes: (none)

802.16x Microwave (WiMAX)

(less than 1% of home users as of 31 December 2003)[62]
- Customers: less than 100,000 (as of 31 December 2003)[63]
- Addressable market: Virtually any residence within receiving distance of a transmitter and permission to install an external receiver.
- Speed: up to 75 Mbps at up to 30 miles[64]
- Cost: undetermined
- Notes:
  - For comparison, the IEEE 802.11x standards cover WiFi (802.11a) and Bluetooth (802.11b) local area wireless networking technologies.
    - 802.11a-compliant technologies provide 54 Mbps at up to 30 feet.
    - 802.11b-compliant technologies provide 11 Mbps at up to 300 feet.
    - 802.11g-compliant technologies provide 54 Mbps at up to 300 feet.[65]
  - *ComputerWorld* reports that "Following on the heels of WiMax is another standard, IEEE 802.20, which addresses wide-area wireless networks and is currently under development; no products supporting 802.20 are expected before 2006."[66]

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[58] The Yankee Group, *Ibid*.
[59] *Ibid*.
[60] James E. Gaskin, "Satellite broadband update," *NetworkWorld*, 9 February 2004, <http://www.nwfusion.com/net.worker/columnists/2004/0209gaskin.html> (4 August 2004) and Jim Hu, "Satellite seeks broadband re-entry," *CNET News.com*, 11 March 2004, <http://news.com.com/Satellite+seeks+broadband+re-entry/2100-1034_3-5172088.html?tag=nl> (13 August 2004).
[61] Gaskin, *Ibid*.
[62] *Ibid*.
[63] *Ibid*.
[64] WiMAX Forum, "Frequently Asked Questions," n.d., <http://www.wimaxforum.org/about/faq/> (5 August 2004).
[65] Russell Kay, "QuickStudy: WiMax," *ComputerWorld*, 1 December 2003, <http://www.computerworld.com/mobiletopics/mobile/story/0,10801,87555,00.html> (5 August 2004).
[66] *Ibid*.