Alcatel·Lucent

STRATEGIC WHITE PAPER

Targeted Investment in Broadband Infrastructure

Addressing key issues for revitalizing the United States economy and regaining broadband leadership

Broadband infrastructure is a major driver of the 21st-century global economy, but the United States has steadily fallen behind other countries in broadband penetration and capabilities. Investment in an infrastructure with high capabilities can turn this trend around — while boosting the economy and generating new jobs. To gain the greatest benefit from this investment, the United States must focus on three areas: extending broadband to underserved regions, improving service affordability, and upgrading network capability levels so they can support applications that are crucial to economic recovery and growth. Well crafted public policies can provide valuable support for these goals by helping to overcome long-standing barriers to universal broadband deployment.

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Introduction

In the short term, United States investment in broadband infrastructure is expected to create thousands of new jobs across the construction, engineering, manufacturing and high-tech sectors — as well as the communication, service, entertainment and retail businesses enabled by broadband networks. As many as 498,000 new jobs can be generated by a $10 billion investment in broadband, according to the Information Technology and Innovation Foundation.[1]

In the longer term, broadband infrastructure will remain a major driver of the 21st-century global economy, making it critical for the United States to regain leadership in broadband as the core of a broader economic recovery. Once broadband networks are deployed, their primary economic stimulus results from what Americans can *do* with them: As a business tool, high-speed networks enable telecommuting, videoconferencing, remote medicine, government services and education — and open the door to ongoing business innovation. In addition, they support a wide range of multimedia consumer services that provide powerful fuel for the economy.

Though the United States has fallen to 19th[2] place worldwide in broadband penetration, investment in high-performing infrastructure can turn this trend around by giving the nation the technological capabilities it needs to enhance productivity, deliver better health care, reduce carbon footprint and streamline access to public services.

The Obama administration clearly recognizes the economic potential of investing in broadband infrastructure. But to generate a solid return on this investment for the American public, a targeted strategy is needed — which applies funds where they can clearly accomplish the most for an economic turnaround. In particular, the United States must extend broadband to underserved areas, especially rural areas. Additionally, the nation must improve the bandwidth capability of new and existing networks, so they can support multimedia applications that will play a leading role in ongoing economic growth.

Developing this strategy requires an understanding of deployment cost issues in the United States, along with recognition of the critical importance of network speeds for stimulating the economy in the longer term. This paper provides an overview of these key investment issues, along with examples of how other governments have successfully promoted next-generation broadband.

Regaining broadband leadership

Since 2001, the United States has steadily fallen behind other countries in broadband penetration. Even worse, the nation's nineteenth-place ranking would actually be lower if the United States applied a more updated definition of broadband. The FCC's current definition is still"768 kilobits per second downstream," which is far lower than the standards used by many other nations.

The United States lags in network capacity as well as penetration. Because today's multimedia applications often require upload and download speeds greater than 10 Megabits per second (Mb/s), global broadband leaders in Asia, urban France and the Netherlands[3] are investing in next-generation fiber-based or coaxial cable fixed networks. These technologies can support key business applications such as telecommuting and videoconferencing — and meet consumer demand and business needs for streaming video. At the end of 2007, Japan had the world's highest percentage of fiber connections incorporated into broadband subscriptions — 40 percent. In sharp contrast, the United States used fiber in only 3 percent of subscriptions.[4]

Key obstacles to overcome

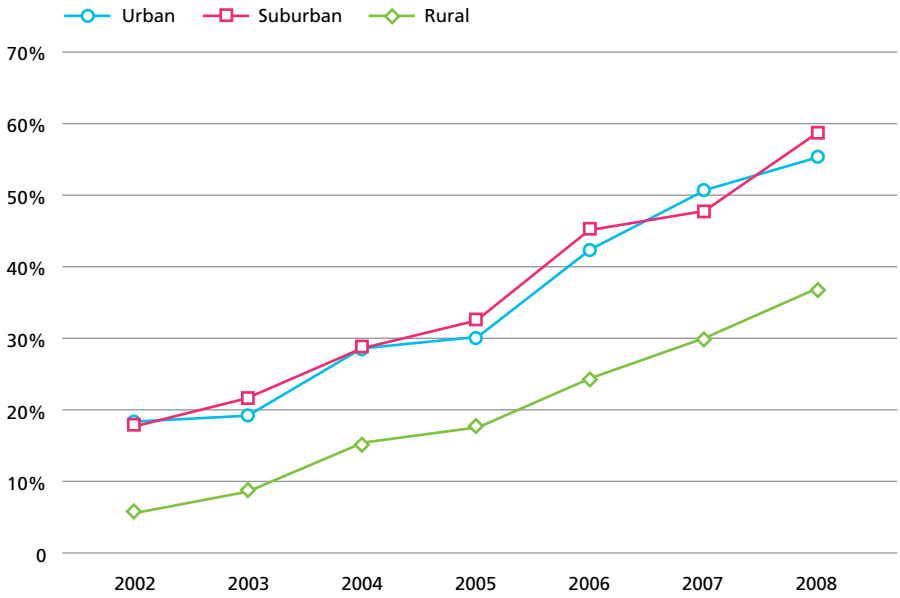
How has the United States lost its broadband leadership position — delivering services that are much slower and more expensive than those found in many other countries? The root of this decline lies in the existing business model for United States broadband markets, in which private companies bid on licenses to compete across diverse geographic regions. In this scenario, providers bear the full cost burden of deploying and maintaining the broadband infrastructure, in return for "owning" the subscriber relationships in the area.

This business model has consequences for the availability, affordability and capacity of United States broadband services:

The "digital divide"

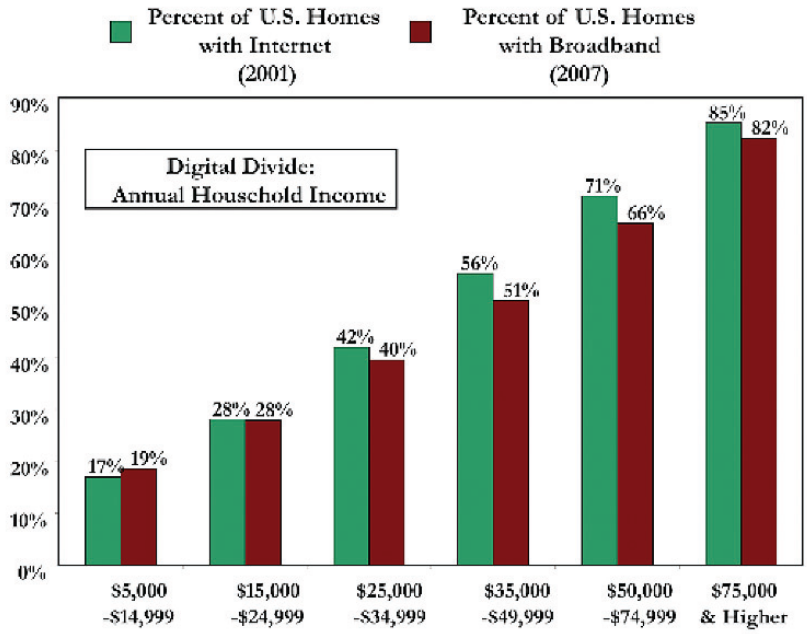
In the United States, 61 percent of the population resides in only one percent of the land. The rest of the population is widely dispersed in rural areas that average 4.6 households or 31 people per square mile. The labor involved in bringing broadband to these households can be extremely costly, while the low-density population presents little revenue potential. As a result, providers focus on locations offering a better return on investment — and leave low-density areas underserved. Consequently, around six to nine percent[5] of American household have no access to broadband services or the social and economic benefits they offer.

Figure 1: Home broadband penetration by community type[6]



Low-income households also find it difficult to take advantage of broadband services, because the demands of private enterprise affect their affordability: When providers set rates, they must make sure they can recover the initial high costs of deployment, as well as the expense of maintaining and upgrading their infrastructure. The resulting monthly fee can be too high for many household budgets, or residents may be unwilling to pay $30 or more per month for what they see as an "inessential" service. Affordability then becomes the second factor in the "digital divide"— affecting suburbs and large cities, as well as rural areas.

Figure 2: The economic digital divide (2001 and 2007)[7]



Lagging network capacity

The Internet was launched in the United States, but consumers here are currently unable to benefit from its full potential. Although broadband services in other countries deliver symmetrical transmission speeds of 100 Mb/s for under $30 per month, few Americans have access to broadband speeds over 10 Mb/s, even if they are willing to pay a substantial price[8]. This limited network capacity is, once again, a consequence of the existing broadband business model.

Although the digital economy is one of the most dynamic sectors worldwide, United States private enterprise still offers little incentive for broadband providers to build truly high-speed backbone networks. So far, it remains more financially rewarding for providers to make incremental investments in infrastructure.

Three elements of effective broadband investment

As America faces its most serious economic crisis since the Great Depression, how can investment in broadband deliver the greatest economic stimulus, in both the short and long term? A targeted strategy is needed, along with support from public policy: That is, investments should be aimed at areas where the United States has fallen behind in broadband leadership — to improve availability, affordability and network capacity. But because these problems all have roots in the existing business model, public policies are also needed to offer new business incentives or present other alternatives to private enterprise. The key elements of this strategy are explained further in the following sections.

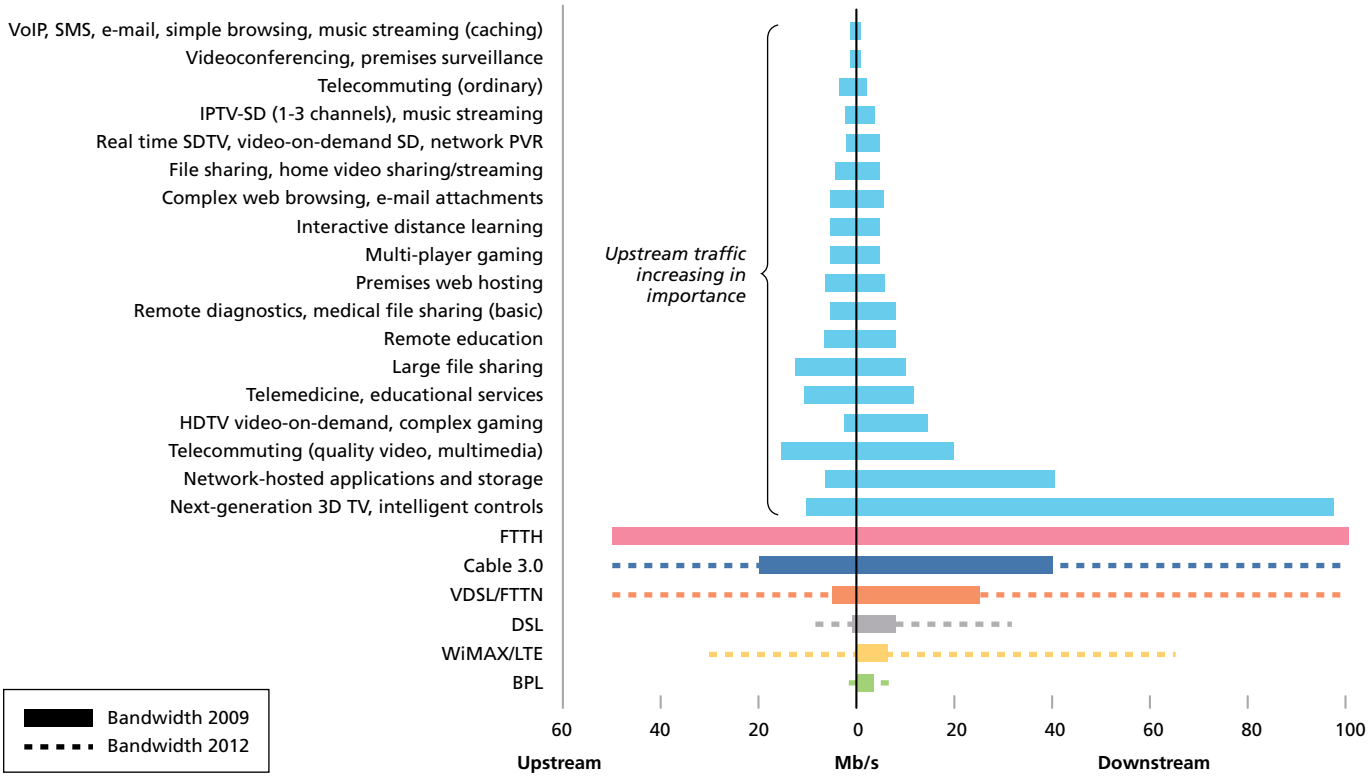
The economic value of high-speed networks

Once a broadband network is deployed, it stimulates the economy by giving Americans new business tools, by opening the door to ongoing business innovation and by supporting a wide range of multimedia consumer services that are driving the 21st century economy. In a majority of OECD countries, investments in information and communication technologies were more important for economic growth than other types of investments, from 1986 to 2006.[9] Even during the economic downturn of 2001 to 2002, Australia's Internet economy contributed 6.4 percent of Gross Domestic Product (GDP).

Videoconferencing, for example, contributes to the economy by allowing large businesses to maintain their global reach, while reducing travel time and expense. Telecommuting enables major productivity gains by supporting flexible schedules and better use of employee time. Yankee Group Research found that employees consider working at home to be the number one thing their employers could introduce to make them more productive.[10] Remote medicine also has the potential to enhance productivity, while simultaneously reducing health care costs and improving access to care in remote areas. In addition, these broadband applications all reduce energy usage and carbon emissions, contributing to a healthier environment. Alcatel-Lucent research has found broadband networks could reduce carbon emissions by four billion tons by 2020.[11]

As shown in Figure 3, many of today's most productive and popular applications require symmetric speeds greater than 10 Mb/s, which is far faster than the "768 kilobits per second downstream" that the FCC still uses to define broadband. Proposals are underway to change this outdated standard, but a targeted broadband investment strategy needs to address the issue of performance now — through an understanding that low-speed networks cannot deliver the capabilities that America needs for economic growth.

Figure 3: A comparison of speeds required by broadband applications — and delivered by broadband technologies[12,13]

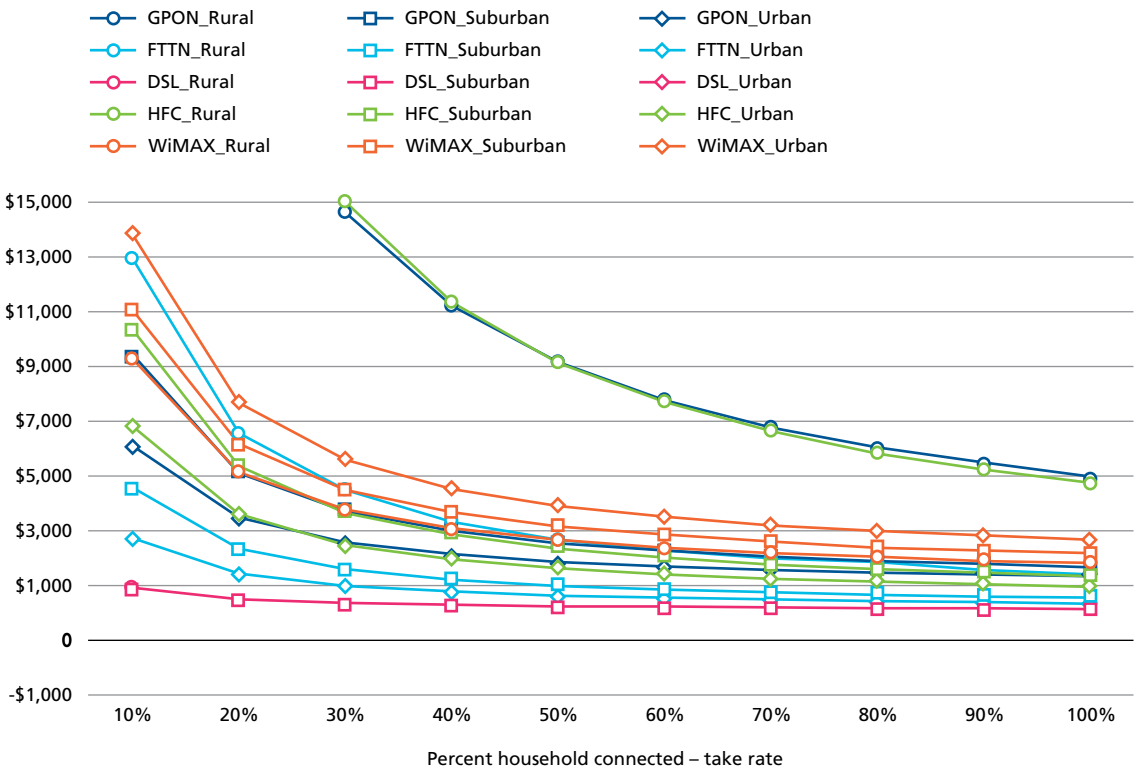


In addition, lower-speed infrastructure is more likely to be outdated in just a few years, because it is already performing at a minimum level and communications technologies evolve rapidly. While investment in next-generation networks may be more costly initially, these investments can continue to provide a return over the longer term.

Accessibility, capacity and affordability

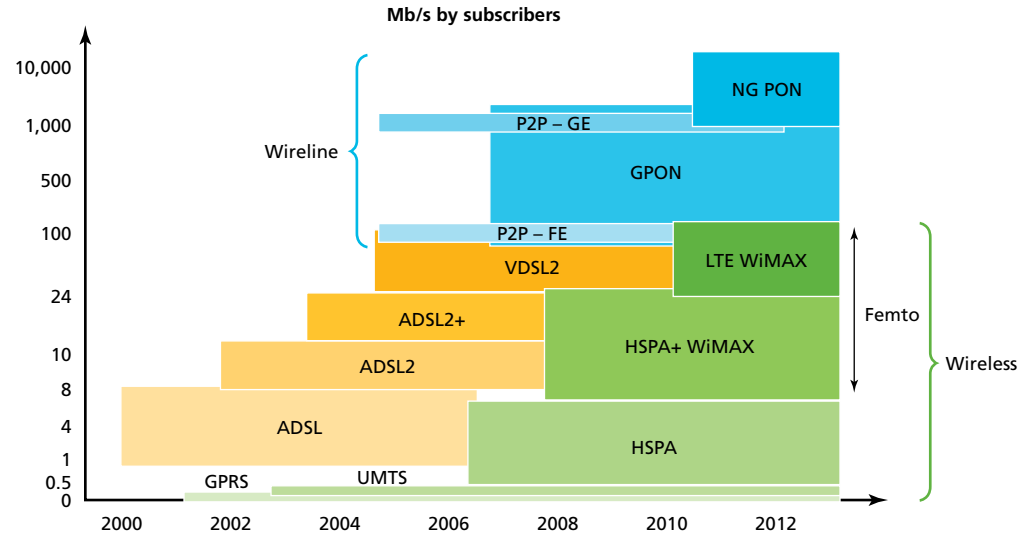
A targeted investment strategy must start by meeting the needs of the seven to ten million American households that still have no access to broadband services[14]. Most of these homes are located in rural areas, where labor costs for first-time deployments will be particularly high. However deployment costs will vary, depending on which technology is selected to satisfy environmental, performance and budget requirements, as shown in Figure 4.

Figure 4: Cost of broadband deployment per household connected (HHC)



Although wireless technologies are currently trailing wireline technologies in performance, they offer some options for meeting the needs of rural regions. For example, WiMAX technology becomes increasingly productive in lower-density areas. Broadband providers could also use a combination of wireline and wireless technologies to meet complex deployment requirements, as shown in Figure 5.

Figure 5: Broadband everywhere: the art of combining technologies.[15]



A conservative approach to investment might choose economical ADSL, FTTN or WiMAX to meet minimal performance requirements, delivering transmission speeds no lower than 2 Mb/s. Assuming a best case of 100 percent take rate (which can be achieved with subsidies for low-income households), an investment of a minimum of $6 to $10 billion would be required to provide this coverage nationwide.[16]

Fiber, in comparison to ADSL, requires greater upfront investments, but offers both short-term and long-term benefits for the economy. In this case, 70 percent to 96 percent of the investment goes to labor — providing immediate job stimulus for construction workers, technicians and equipment manufacturers. For ADSL, only 9 percent to 10 percent of deployment costs go to labor, as shown in Table 1.

Table 1. Percentage of deployment costs going to job stimulus – by technology

DIRECT IMPACT ON EMPLOYMENT	LABOR COST PER HOUSEHOLD PASSED			LABOR COST PER HOUSEHOLD CONNECTED		
	RURAL CLUSTER	SUBURBAN	URBAN	RURAL CLUSTER	SUBURBAN	URBAN
GPON (25 Mb/s)	96%	83%	71%	93%	77%	68%
FTTN-VDSL2 (25 Mb/s)	58%	50%	36%	58%	50%	38%
ADSL2	10%	10%	10%	9%	9%	9%
HFC (peak 40 Mb/s)	91%	73%	60%	90%	69%	57%
WiMAX	47%	54%	61%	29%	34%	39%
Assuming HHC take rate of 50%						

Once the networks are in place, fiber's exceptional speeds deliver a longer term return on this investment by enabling a wide array of new business and entertainment services — and by ensuring that the infrastructure continues to support leading broadband services well into the future.

Upgrades to capacity

The next step in a targeted investment strategy is to upgrade the speed of existing broadband networks to at least 10 Mb/s. The most economical approach to this upgrade uses fiber to the node with VDSL connections to the home — across urban, suburban and rural locations. Assuming a more conservative 75 percent take rate, the average cost of deployment per household is about $1100.

- If this upgrade is limited to networks where speeds fall below 2 Mb/s, then 29 percent of all United States households need network enhancements — requiring an investment of at least $32billion.
- If the upgrade is extended to networks where speeds fall below 5 Mb/s, then 74 percent of United States households need new infrastructure — requiring an investment of over $86 billion.[17]

Options for affordability

The nation's broadband investment strategy also needs to address the issue of affordability, if it is not adequately covered by other programs. One common approach is to subsidize service charges for households that fall below the poverty level. Based on 2007 Census figures, 7 percent to 10 percent of the United States population would qualify for these subsidies. To provide a monthly subsidy of $30 per household, an investment of $12 billion to $17 billion would be required over a five-year period (with 5 percent discounting). This is the minimum requirement, because to really address affordability and the lack of willingness to pay, a socially responsible policy would also provide financial assistance to low income households with school-age children, and educational programs to increase the Internet literacy within affected groups or government agencies.

Coordinated federal and local government policies are critical

After reviewing the key reasons for a decline in United States broadband leadership, it's important to recognize that many other countries have improved their competitive position through government policies. And the United States now has a valuable opportunity to enhance broadband investments with well-crafted public-private partnership models that avoid over-regulation and do not stifle competition. These models could improve the existing business case for broadband by offering new ways to share deployment costs and encourage open access, so that all parties benefit, including consumers, the government, investors and broadband providers.

The following policy recommendations and success stories from OECD countries illustrate the broad array of options that are available when businesses, municipalities, third parties and national governments work together to promote broadband.

Supply and demand-side broadband policy recommendations from OECD countries[18]

- Functional separation of the physical infrastructure from retail services offers a way to ensure fair and nondiscriminatory access to "last mile" infrastructure. The wholesale and retail arms of an incumbent may also be separate, or neutral parties can install fiber and lease it to any service provider. For example, the Czech Republic supports municipally owned networks where the town "owns the infrastructure."
- Governments should not prohibit municipalities or utilities from entering telecommunication markets. However, if there are concerns about market distortion, policy makers could limit municipal participation to the basic elements only (for example, the provision of dark fiber networks under open access rules).
- Any new infrastructure built with government funds should be open access — meaning that access to that network is provided on nondiscriminatory terms.
- Any government intervention in markets that involves funding should follow a set of basic rules. Requests for proposals should be technologically neutral and simply specify the minimum criteria for the project.
- While competition and choice between wireless and wired options may be good in urban areas, this kind of competition may not be a realistic goal for rural and remote areas where there is only one high-speed provider.
- Access to spectrum remains a significant market barrier to wireless broadband provision. Policy makers should adopt more market mechanisms to promote more efficient spectrum use.
- To minimize any divide between urban and rural areas, high-capacity fiber should reach as widely as possible into rural areas to feed wireless connections.
- Because civil costs — such as building roads and obtaining rights of way — are among the largest investment barriers facing telecommunication firms, governments should encourage investment by taking steps to improve access to passive infrastructure, such as conduits, poles and ducts and coordinate civil works. Access to rights-of-way should be fair and non-discriminatory. Governments should also encourage and promote the installation of open-access, passive infrastructure any time they undertake public works.
- Government should provide training to influence the uptake and use of broadband — and promote its use in public institutions, businesses and households.
- Government can enable more affordable broadband services through policies specifically addressed at reducing rates; for example through spectrum allocation policies or public-private partnerships designed to lower the broadband provider's costs — with savings passed along to subscribers.

Broadband success stories

These case histories illustrate the effectiveness of three different business models for improving broadband availability. They offer very different approaches to balancing infrastructure ownership, open access and competition.

KOREA

The Korean government has taken a very active role in promoting broadband development:

- By creating the right environment — mainly through pro-market policies that liberalized telecommunications and enabled privatization.
- By providing $24 billion in funding for a public Internet backbone, the Korean Information Infrastructure known as KII. Low-cost loans worth $1.76 billion were also provided, between 2000 and 2005, to spur privately funded construction of an access network for homes and businesses, with the goal of stimulating last-mile broadband deployment.

Korea's broadband success was driven by government vision, which included funding for a public Internet backbone, pro-market policies and IT training.

- By stimulating broadband usage with IT training for approximately ten million Koreans, in occupations ranging from the government and the military to teaching and homemaking.
- For the first phase of the country's Broadband Convergence Network (BCN), the Ministry of Information and Communication generated private investment worth 12.8 trillion KRW.

Sources: "Broadband Korea: Internet Case Study," ITU, March 2003, and "Broadband Growth and Policies in OECD Countries," June 2008.

NORWAY

The Norwegian government implemented a plan to offer all citizens of Norway a broadband connection by the end of 2007, based on the Høykom Program. This program laid out very precise criteria for funding and reached out to municipalities, local businesses and firms in Norway's regions. A subprogram, called Høykom district, promoted broadband for outlying districts, which have a widely dispersed population much like United States rural areas.

The Norwegian government established partnerships with local governments and businesses to achieve 99 percent broadband coverage — including households in low-density areas that are similar to the rural United States

By 2007, the Norwegian government had spent a total of 355 million NOK to subsidize infrastructure in areas where it was previously unavailable. State funds were combined with local funding of at least 50 percent. With this approach to investment, Norway expected to reach 99 percent broadband coverage using fixed access — with some mobile broadband solutions included to offer higher speeds and greater coverage.

Sources: Broadband Growth and Policies in OECD Countries, June 2008, and Broadband Korea: Internet Case Study, ITU, March 2003.

AUSTRALIA

The Connect Australia program included the following objectives and funding:

- A communications package worth 1.1 billion AUD for regional access to telecommunications services.
- A contract awarded to OPEL Networks in 2007 — to provide broadband connectivity across the country, using a combination of DSL and WiMAX technologies.
- The National Broadband Network (NBN) will:
  - ¬ Deliver a minimum of 12Mb/s to 98 percent of Australian homes and businesses
  - ¬ Progressively roll out the network over five years, using FTTP and FTTN technology
  - ¬ Support high-quality voice, data and video services, including symmetric applications
  - ¬ Provide capacity to meet foreseeable demand with a clear upgrade path
  - ¬ Earn a return on investment of up to 4.7 billion dollars.(AUD]
  - ¬ Facilitate competition through open access and allow service providers access on equivalent price and non-price terms
  - ¬ Enable uniform and affordable retail prices on a national basis
  - ¬ Enable low access prices

Australia adopted a public-private partnership to implement their broadband plans.

Sources: "Australian Telco Sector: Broadband Politics Unraveled," UBS, April 22, 2008 and Broadband Growth and Policies in OECD Countries, June 2008.

Conclusion

A targeted investment strategy gains the greatest benefit from the Obama administration's commitment to investing in broadband infrastructure.

By recognizing the value of high-speed networks — investment funds can be directed to infrastructure that will create the core of our 21st-century economy. The nation's networks will be able to support key business and consumer applications that help revitalize our economy today — while continuing to provide a solid return on our investment in years to come.

These applications can expand opportunities for innovative new businesses, enhance productivity, improve health care while lowering costs and reduce our carbon footprint by supporting remote workers. They will also continue to fuel creative new communication and entertainment services that are a major element of the thriving global digital economy.

By investing in infrastructure that improves availability — new jobs are created, beginning with construction workers and telecommunications technicians who provide trenching, lay down lines and install wireless towers — followed by a wide array of jobs that grow out of businesses that use or support this core infrastructure.

In addition, this investment plays a crucial role in bridging the digital divide, bringing more Americans into the 21st-century economy. This is particularly important for rural areas, which have been hardest hit by the economic downturn, because it opens up new opportunities to work remotely or build businesses that can reach beyond their local communities.

A wide range of technologies, with differing costs, is available to meet the demands of diverse American terrain, while delivering the required performance. Although fiber has the highest deployment costs, this technology delivers exceptional performance and longevity of the investment — and 70 percent to 96 percent of the initial costs will go directly to jobs.

By supporting investments with carefully crafted government policies — the United States has a valuable opportunity to overcome obstacles resulting from the existing broadband business model. The importance of government policy is now clear, demonstrated by the rise of new global broadband leaders in Asia and Europe. These countries illustrate the array of options available when businesses, municipalities, third parties and national governments work together to promote broadband. In the United States, public-private partnerships can present broadband providers with new incentives, without over-regulation or stifling competition, while still delivering a solid return on investment for the American public.

Notes

[1] "Broadband's Role in Stimulus Plan Sparks Debate," Joelle Tessler, Wireless Week, February 9, 2009.

[2] This global US Ranking is based on the most current ITU-T global indicators database. US ranks fourteenth among the OECD countries, based on the reports issued by the Organisation for Economic Co-

[3] "Digital Britain: The Interim Report," January, 2009.

[4] "Broadband Growth and Policies in OECD Countries," OECD Ministerial Meeting on the Future of Internet Economy, Seoul, Korea, June 2008.

[5] Sources: FCC and the Pew Internet Project.

[6] Home Broadband Adoption, Pew Internet and American Life Project, July 2008.

[7] "Down Payment on Our Digital Future," S. Derek Turner, Free Press, December, 2008.

[8] "Down Payment on Our Digital Future," S. Derek Turner, Free Press, December, 2008.

[9] "The future of the Internet Economy – A Statistical Profile," OECD Ministerial Meeting on the Future of the Internet Economy, Seoul, Korea, 17-18 June 2008.

[10] "Yankee Group Anywhere Enterprise — Large: 2008 U.S. Mobile Blended Lifestyle Survey.

[11] Alcatel-Lucent Analysis of Global eSustainability Initiative and the Climate Group data.

[12] "The State of connectivity: Building Innovation Through Broadband – Final Report of the California Broadband Task Force," January, 2008.

[13] "The Fiber Future: Verizon's FiOS Deployment," Jacquelynn Ruff, Broadband & Beyond conference 2008.

[14] Source: FCC and the Pew Internet Project.

[15] Broadband Fact Book31, Horrigan (2008), Verizon FiOS Internet32, NTIA report33

[16] Source: Bell Labs Business Modeling.

[17] Source: Bell Labs Business Modeling.

[18] "Broadband Growth and Policies in OECD Countries," June 2008.

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