Infrastructure Programs: What's Different About Broadband?

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Summary

Broadband network deployment projects represent large scale, long term investments that affect the overall productivity of economic activity in the geographic areas in which they are built, and thus fit the conventional definition of infrastructure. But they also have several characteristics that distinguish them from traditional infrastructure projects. These unique characteristics may dictate that government programs in support of broadband deployment be structured differently than conventional infrastructure programs.

Virtually all broadband networks in the United States are privately owned and financed through private capital markets. In most geographic markets, there are two or more broadband networks offering competing services over their own facilities, rather than a single provider. The competing broadband networks generally employ different technologies. Currently, each of these technologies has somewhat different capabilities. But each also is experiencing rapid technological progress, so it is not possible to predict which technology will prove most successful from a technical or commercial perspective. Because the capabilities of these technologies are at various stages of development, some broadband network technologies may be better able than others to meet a stimulus package requirement to be quickly deployable, though perhaps at the expense of long term productivity and innovation. Most broadband network providers are vertically integrated into the production of downstream services (applications) that they provide to customers over their own networks. These applications compete with the offerings of independent applications providers that also must ride over the broadband networks to reach customers and therefore are dependent on access to those networks.

In some rural areas, a combination of limited demand and high costs preclude private capital markets from funding broadband network infrastructure absent government intervention. In these areas, where even a single network provider might not be able to achieve sufficient scale economies to be able to offer "affordable" service, it would be inefficient to subsidize multiple providers. Not to do so, however, might leave residents with inferior broadband service choices relative to urban residents.

While upgrades to traditional infrastructure tend to have a *quantitative* impact on the services that ride over that infrastructure (for example, increasing the number of cars that can ride over a highway or the speed of a train riding over a rail bed), upgrades to broadband infrastructure also potentially have a *transformative* impact on the services that ride over that infrastructure, by allowing for the creation of entirely new applications.

The leadership in both houses of Congress as well as the Obama administration have announced plans to include a broadband component in the infrastructure portion of any economic stimulus package. At the least, the unique characteristics of broadband infrastructure impose very complex policy objectives for any broadband infrastructure program – to foster infrastructure investment that would not otherwise be made and to create additional jobs and spending, without distorting competition among the different broadband network technologies, without discouraging investment and innovation by independent applications providers that need access to broadband networks, and without subsidizing multiple inefficient providers unnecessarily.

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Introduction and Overview

The leadership in both houses of Congress as well as the Obama administration have announced plans to include a broadband component in the infrastructure portion of any economic stimulus package.[1] The House Appropriations Committee has released a proposed bill that includes a number of broadband infrastructure spending provisions,[2] but it is not yet possible to assess their scope and impact because some of the spending is targeted to "underserved areas" that are to be defined by the Federal Communications Commission (FCC) or restricted to "open access" networks that, also, are to be defined by the FCC. At the same time, interested parties – broadband equipment manufacturers; large, mid-sized, and small wireline and wireless service providers; satellite operators; telecommunications unions; consumer groups; education groups; public safety organizations; etc. – and think tanks have unveiled a multitude of specific proposals for government support of broadband infrastructure.[3]

Many of these proposals would extend far beyond traditional grant, loan, loan guarantee, and tax incentive (accelerated depreciation or tax credit) programs.

- Some would create novel new approaches to broadband funding, for example by floating long-term federal government "broadband bonds" to finance private sector broadband infrastructure construction,[4] by creating a government program that would pay the interest on qualifying short- to medium-term corporate bonds issued specifically for certain types of broadband infrastructure investment,[5] or by allowing private companies to issue "tax-credit bonds" that would qualify bondholders to receive tax credits from the U.S. Treasury, thereby effectively reducing the bondholders' tax liability by an amount equal to the tax credit.[6]
- Other proposals would attempt to foster broadband infrastructure deployment by expanding or limiting the current regulatory framework for broadband networks. For example, some parties argue that network neutrality or open access requirements discourage infrastructure investment and therefore include explicit prohibitions or constraints on such requirements in their proposals.[7] Other parties

[1] See, for example, Corey Boles and Fawn Johnson, "Stimulus Plan to Include Internet-Access Funds," *The Wall Street Journal*, December 2, 2008; Anne Veigle, "House Telecom Leaders Meeting on Broadband Stimulus," *Communications* Daily, December 19, 2008, and Anne Veigle, "Reid Wants Stimulus Package to Stress Jobs, Spending," *Communications Daily*, December 23, 2008.

[2] The bill is available at [http://appropriations.house.gov/pdf/RecoveryBill01-15-09.pdf].

[3] A representative list of proposals is appended to this report.

[4] See John Rintels, *An Action Plan for America: Using Technology and Innovation to Address Our Nation's Critical Challenge*, Benton Foundation, 2008, at p. 38, available at http://www.benton.org/sites/benton.org/files/Benton_Foundation_Action_Plan.pdf.

[5] See S. Derek Turner, *Down Payment on Our Digital Future: Stimulus Policies for the 21st-Century Economy*, Free Press, December 2008, at p. 5, available at [http://www.freepress.net/files/DownPayment_DigitalFuture.pdf].

[6] See Jeffrey A. Eisenach, Hal J. Singer, and Jeffrey D. West, *Economic Effects of Tax Incentives for Broadband Infrastructure Deployment*, prepared on behalf of the Fiber-to-the-Home Council, January 5, 2009, at p. 3, available at [http://www.ftthcouncil.org/UserFiles/File/Economic%20Effects%20of%20Broadband%20Tax%20Incentives%20010509%20FINAL.pdf].

[7] See, for example, "Promoting Broadband – USTelecom's Advocacy Priority: Pro-investment policies and innovative partnerships that connect all Americans to the broadband future," USTelecom - The Broadband Association, available at [http://www.ustelecom.org/Issues/PromotingBroadband/PromotingBroadband.html].

claim that, left to their discretion, broadband network providers would constrain network access in a fashion that is inconsistent with public objectives, and therefore propose tying the level of support infrastructure providers receive to meeting certain statutory or regulatory access requirements.[8]

- Yet other proposals would foster broadband deployment by boosting demand for broadband services through subsidies for customer purchases of computers and Internet access service.[9]
- Even where the proposals involve traditional grant, loan, or tax incentive programs, some would provide higher levels of support for investment in broadband networks that met certain threshold download and upload speeds.[10]

All the above parties favor government support of broadband infrastructure, though they disagree about the form that support should take, the extent to which such support should be targeted to specific situations, and what commitments or requirements should be attached to receipt of the support.

Broadband network deployment projects represent large scale, long term investments that affect the overall productivity of economic activity in the geographic areas in which they are built, and thus fit the conventional definition of infrastructure. But they also have several characteristics that distinguish them from traditional infrastructure projects.

- Virtually all broadband networks in the United States are privately owned and financed through private capital markets.
- In most geographic markets, there are two or more broadband networks offering competing services over their own facilities, rather than a single provider.
- The competing broadband networks generally employ different technologies.
  - Currently, each of these technologies has somewhat different capabilities.
  - But each also is experiencing rapid technological progress, so it is not possible to predict which technology will prove most successful from a technical or commercial perspective.
  - Because the capabilities of these technologies are at various stages of development, some broadband network technologies may be better able than

[8] See, for example, the proposed "Competitive Fiber Tax Incentive Program," which would award higher levels of investment tax credits and accelerated depreciation to entities that deploy more than a single strand of fiber to an end-user for the purpose of selling the fiber to a competitive provider, included in S. Derek Turner, *Down Payment on Our Digital Future: Stimulus Policies for the 21st-Century Economy*, Free Press, December 2008, at pp. 19-20, available at [http://www.freepress.net/files/DownPayment_DigitalFuture.pdf] or the call for federal legislation to preserve open, nondiscriminatory access to network applications and content in John Windhausen Jr., *A Blueprint for Big Broadband*, an EDUCAUSE White Paper, January 2008, available at [http://net.educause.edu/ir/library/pdf/EPO0801.pdf].

[9] See, for example, Letter of December 16, 2008, from Grant Seiffert, President, Telecommunications Industry Association (TIA), to the Honorable Nancy Pelosi, Speaker of the House, the Honorable Harry Reid, Majority Leader of the U.S. Senate, the Honorable John Boehmer, Republican Leader of the House, and the Honorable Mitch McConnell, Republican Leader of the Senate, available at [http://www.tiaonline.org/gov_affairs/fcc_filings/TIA_Broadband_Stimulus_Letter_FINAL.pdf].

[10] See, for example, Robert D. Atkinson, Daniel Castro, and Stephen J. Ezell, *The Digital Road to Recovery: A Stimulus Plan to Create Jobs, Boost Productivity and Revitalize America*, The Information Technology & Innovation Foundation, January 2009, at p. 6, available at [http://www.itif.org/files/roadtorecovery.pdf].

others to meet a stimulus package requirement to be quickly deployable, though perhaps at the expense of long term productivity and innovation.

- Most broadband network providers are vertically integrated into the production of downstream services (applications) that they provide to customers over their own networks. These applications compete with the offerings of independent applications providers that also must ride over the broadband networks to reach customers and therefore are dependent on access to those networks.
- In some rural areas, a combination of limited demand and high costs preclude private capital markets from funding broadband network infrastructure absent government intervention. In these areas, where even a single network provider might not be able to achieve sufficient scale economies to be able to offer "affordable" service, it would be inefficient to subsidize multiple providers. Not to do so, however, might leave residents with inferior broadband service choices relative to urban residents.
- While upgrades to traditional infrastructure tend to have a *quantitative* impact on the services that ride over that infrastructure (for example, increasing the number of cars that can ride over a highway or the speed of a train riding over a rail bed), upgrades to broadband infrastructure also potentially have a *transformative* impact on the services that ride over that infrastructure, by allowing for the creation of entirely new applications.

These unique characteristics may dictate that government programs in support of broadband deployment be structured differently from conventional infrastructure programs. At the least, they result in very complex policy objectives – to foster infrastructure investment that would not otherwise be made and to create additional jobs and spending, without distorting competition among the different broadband network technologies, without discouraging investment and innovation by independent applications providers that need access to broadband networks, and without subsidizing multiple inefficient providers unnecessarily.

Public vs. Private Infrastructure

Infrastructure refers to those capital structures that facilitate economic and social activity in a society, contributing to both the private production of goods and services and the public provision of services as varied as education, public safety, and defense. Most infrastructure – roads, highways, mass transit, bridges, ports, airports, dams, flood control systems, drinking water systems, wastewater systems, etc. – is owned and managed by governmental entities at the federal, state, or local level.

There are several reasons why most infrastructure is "public" rather than "private." In many situations, there may be no efficient mechanism for directly collecting revenues from users and other beneficiaries of the infrastructure or, even if such a mechanism exists, it might be difficult to place a monetary value on the positive "externalities" associated with the infrastructure, such as reduced travel time or increased economic development that redounds to the benefit of all residents. For example, although advances in computers and electronic sensor technology might make it feasible sometime in the near future to collect fees from vehicles that travel over city streets, it might continue to be difficult to collect fees from other beneficiaries, such as shop owners, or to determine the appropriate price to charge the beneficiaries of the positive

externalities. In such situations, it often will be more efficient for a government entity to fund the infrastructure project from general or targeted tax revenues (perhaps supplemented by revenues generated from government or quasi-government bond issues or user fees), than for a private company, which cannot readily capture the economic value of the externalities, to attract private equity and debt funding for the project (even with some government subsidy to cover the social benefits).[11]

Even where a private company likely could attract the necessary private equity and debt funding for an infrastructure project, a government entity might believe that public ownership of that infrastructure would better facilitate the attainment of other public objectives, or that the particular infrastructure is so closely tied to specific public objectives that it should be publicly owned. For example, a government entity might believe that it would be easier to coordinate planning across multiple publicly owned transportation systems that are all focused on attaining a regional transportation goal than to coordinate with private systems that have their own profit maximization goals. Or a government entity concerned about providing equal service to all residents in a jurisdiction might believe that it would be easier to do so by extending government owned infrastructure into areas where there is insufficient underlying demand to justify investment absent government support than to create incentives for private entities to serve those areas. Or where the underlying cost structure is likely to yield only a single, natural monopoly – where scale economies will allow for only a single efficient provider – the government entity might believe that a government-owned entity would be more sensitive to public objectives than a government-regulated private company. In most of these cases, the public infrastructure projects nonetheless will have a private sector component in that usually private companies compete for government contracts to construct, maintain, and sometimes even operate these facilities.

Despite the preponderance of public infrastructure, there is a significant – and growing – amount of privately owned infrastructure. Historically, such infrastructure most commonly has been provided in a regulated monopoly environment, for two reasons. Given the scale economies associated with much infrastructure, often only one provider can attain efficient scale. A government frequently will choose to regulate that provider to protect customers from possible price gouging. Alternatively, where it might not even be viable for a single provider to deploy the infrastructure without some government subsidy, or where the potential for market growth is so limited that private equity and debt markets are unlikely to come forward with funds absent some government guarantee, it might be easier for a private firm to attract the necessary funds if it were granted a government-sanctioned monopoly with a guaranteed rate of return.

Most oil and gas pipelines and most of the electric transmission grid are privately owned, but these private infrastructure investments generally have been provided under a common carrier regime, where the providers operate as government regulated monopolies, typically subject to rate of return regulation or some other form of price regulation and mandatory non-discriminatory access to the facilities. When the government has sought to foster investment in these privately

[11] There may be exceptions, for example under certain circumstances private investors will have the incentive to invest in toll roads that might otherwise be built and operated by a governmental agency. But even in these situations, typically such projects only involve the maintenance and operation of an already existing road or only move forward if the governmental agency has provided the investors with rights-of-way to the land the highway is occupying and the private investors are not required to purchase that land. As explained by Felix Rohatyn and Everett Ehrlich in "A New Bank To Save Our Infrastructure," *New York Review of Books*, Volume LV, Number 15, October 9, 2008, at p. 27, "Under these arrangements, the state or city sells the road and the right to set and collect tolls on it to a private company – in essence, a new form of government borrowing."

owned infrastructure systems, one means used was to increase the provider's allowed rate of return to a premium over a competitive level, to help attract capital.[12]

As the users of privately owned infrastructure have begun to have access to alternative facilities, some government regulators have begun to ease some of their regulations. For example, privately owned on-shore liquefied natural gas (LNG) import regasification terminals are no longer subject to non-discriminatory access requirements. In its 2002 Hackberry decision, FERC eliminated the requirement for terminal owners to offer tariffed, non-discriminatory rates,[13] concluding that such deregulation (which was not extended to pipelines) would increase the incentive for private investment in LNG terminals while potential anticompetitive abuses would be constrained by the existence of competing off-shore terminals.[14]

Still, the deployment of competing privately-owned infrastructure networks is relatively rare. In the 19th century, competing privately-owned intercontinental and regional railroads were built, although those railroads often were provided government support through land grants or rights of way to land (primarily west of the Mississippi River). The Pacific Railway Act of 1862 provided extensive land grants and created 30-year government bonds to support construction of the first intercontinental railroads. Despite the existence of multiple railroads in many communities, widespread price collusion kept transport rates high and in 1887 Congress passed the Interstate Commerce Act, creating the Interstate Commerce Commission, which was given authority to regulate rates and service.

Today, electric power plants are another example of competitive privately-owned infrastructure, with interesting public interest ramifications. Because the government would like to foster low polluting electricity generation, but the market has not yet internalized the costs of pollution, government programs have been proposed to foster low polluting technologies. There are a number of alternative power plant technologies (nuclear, wind, sun, geothermal, natural gas) potentially capable of generating electricity cleanly. As discussed in CRS Report RL34746, *Power Plants: Characteristics and Costs*, by Stan Mark Kaplan, because of the different cost

[12] For example, section 1241 of the Energy Policy Act of 2005 amended the Federal Power Act to direct the Federal Energy Regulatory Commission (FERC) to establish rules for incentive-based rate regulation of electric transmission, stating that the rules can provide a higher return on equity to attract new investment. FERC issued Order 679 to implement section 1241, allowing for broad use of incentive regulation on the grounds that section 1223 of the Energy Policy Act directs FERC to encourage deployment of advanced transmission technologies (available at [http://www.ferc.gov/industries/electric/indus-act/section-1241.pdf]). Subsequently, FERC has approved incentive rates of return that exceed the competitive rate of return for a number of electric transmission projects. Some observers, including two FERC commissioners, have complained that FERC has been too quick to approve premium rates of return. See, for example, Esther Whieldon, "FERC grants incentive rates for two major grid projects proposed in New England," *Inside FERC*, November 24, 2008; Craig S. Cano, "Tussle over transmission rate incentives persists as FERC receives more petitions," *Inside FERC*, August 25, 2008; Esther Whieldon, "FERC grants incentive rate treatment for transmission projects in West, Mid-Atlantic," *Inside FERC*, April 21, 2008.

[13] See, for example, Energy Information Administration, "FERC's Hackberry Decision (2002)," available at [http://www.eia.doe.gov/oil_gas/natural_gas/analysis_publications/ngmajorleg/ferc.html], viewed on December 22, 2008.

[14] In recent years, the broadband network providers also have largely succeeded in freeing themselves of open access and non-discrimination requirements. See, for example, *In the Matter of Inquiry Concerning High-Speed Access to the Internet Over Cable and Other Facilities; Internet Over Cable Declaratory Ruling; Appropriate Regulatory Treatment for Broadband Access to the Internet Over Cable Facilities*, 17 FCC Rcd. 4798, 4799 (March 15, 2002), and *In the Matter of Appropriate Framework for Broadband Access to the Internet Over Wireline Facilities*, Report and Order and Notice of Proposed Rulemaking, 20 FCC Rcd. 14853 (September 23, 2005).

structures and fuel inputs of the various alternatives, government grant, loan, loan guarantee, tax incentive, and other programs will affect these potentially competing technologies differently.

A number of providers have been attracted to the broadband network market by the potential for substantial market growth and profitability. Private companies have raised investment funds and deployed the broadband networks that serve the vast majority of Americans. According to the FCC, telecommunications companies expect to make $50 billion in capital expenditures in 2008 and 2009,[15] although a UBS analyst recently predicted that the economic downturn might reduce those capital expenditures by 5 to 10%.[16] Although systematic and accurate data on U.S. households currently served by broadband networks are not available,[17] based on available data the media reform organization Free Press estimates about 7% of U.S. households are unserved.[18] Most U.S. households are served by two or more broadband networks. In only a miniscule number of cases are these networks municipally provided.

These competing broadband networks employ a wide variety of technologies or combinations of technologies, all of which are experiencing rapid technological advances that are substantially increasing their capabilities. The incumbent landline (telephone and cable) networks are at varying stages of migration from copper or coaxial cable networks with limited data transmission capabilities to hybrid copper-optical fiber or coaxial cable-optical fiber or all-fiber networks (and increasingly incorporating Internet Protocol (IP) technologies) with high speed data capabilities. Wireless carriers will be using newly available spectrum to deploy fourth generation wireless technologies capable of high speed data transmission for both mobile and fixed services. Satellite operators, too, intend to offer high speed services in the near future, though they still face technological challenges.

While there has been substantial private sector investment in broadband networks, network deployment has been relatively limited in very rural and other high cost areas. Data from the FCC,[19] the Pew Internet and American Life Project,[20] and the Government Accountability Office (GAO)[21] indicate that broadband infrastructure is most lacking in rural and lower-income areas in which there is less economic incentive for companies to invest. This is not surprising given that broadband networks, no matter what technology is used, are characterized by very substantial economies of scale; it is far more difficult to develop a business case for broadband deployment in sparsely populated areas where there are relatively few potential customers to generate the revenues needed to cover the high fixed upfront costs. Here, it often is difficult to justify

[15] *In the Matter of Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996*, Fifth Report, GN Docket No. 07-45, adopted March 19, 2008 and released June 12, 2008, at p. 37, available at [http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-08-88A1.pdf].

[16] "UBS predicts 10 percent carrier capex cutback," December 13, 2008, available at [http://www.fiercetelecom.com/story/ubs-predicts-10-percent-carrier=capex-cutback/2008-12-03].

[17] Congress recently passed the Broadband Data Improvement Act (P.L. 110-385) that instructs the FCC to collect information on unserved areas.

[18] S. Derek Turner, *Down Payment on Our Digital Future: Stimulus Policies for the 21st-Century Economy*, Free Press, December 2008, at p. 12, available at [http://www.freepress.net/files/DownPayment_DigitalFuture.pdf].

[19] *High Speed Services for Internet Access: Status as of June 30, 2007*, Federal Communications Commission, March 2008.

[20] Horrigan, John B., *Home Broadband Adoption 2008*, Pew Internet & American Life Project, July 2008.

[21] *Broadband Deployment is Extensive Throughout the United States, but It Is Difficult to Assess the Extent of Deployment Gaps in Rural Areas*, U.S. Government Accountability Office, GAO-06-426, May 2006.

broadband infrastructure projects, despite their positive effects on economic development, absent some sort of government support. Broadband deployment also has been slower in areas where relatively low household income and education levels have constrained penetration of household computers, which in turn has dampened demand for high speed Internet access.

Some observers also have noted that the broadband networks that have been, and continue to be, deployed in the United States tend to provide customers with less bandwidth/slower upload and download rates than those deployed in many developed countries.[22] Since there has been greater government support of broadband investment in many of those countries, these observers have claimed that this demonstrates that private markets, on their own, cannot provide the United States with the most advanced networks needed to remain internationally competitive. They would have the government support upgrades of existing broadband networks – build-outs of fiber optic networks or other very high speed networks – through tax incentives or other programs. Others argue that such government intervention is not needed, that the lag in deployment of higher speed networks can be explained in part by providers not wanting to get out in front of demand, which has not developed sufficiently yet to support these upgrades, and in part by past delays in making spectrum available for advanced wireless services. [23] The latter, in turn, led to decisions by wireless carriers to delay network investment in order to leapfrog from second generation to fourth generation wireless technologies, bypassing the third generation technologies used in Europe and Asia.

Technology Generations and Their Capabilities

In the late 1990s, cable television companies began offering cable modem broadband access service to residential (and, to a lesser extent, business) customers. This placed market pressure on telephone companies, which began to add digital subscriber line (DSL) equipment to their existing copper telephone lines in order to offer competing broadband access service. (DSL technology had been available for more than a decade, but the telephone companies had not had the incentive to deploy it, in part because there was not perceived demand for high speed access service and in part because of concern that such a service offering might cannibalize their highly profitable T-1 services that provided large capacity "pipes" to business customers.) Subsequently, demand for broadband access service has grown quickly; the FCC has reported that the number of broadband access lines increased from 2.8 million as of December 1999 to 121.2 million lines as of December 2007.[24]

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[22] See, for example, *Speed Matters: A Report on Internet Speeds in All 50 States*, Communications Workers of America, August 2008, available at [http://www.speedmatters.org/documentlibrary/sourcematerials/cwa_report_on_internet_speeds_2008.pdf

[23] See, for example, Wayne A. Leighton, *Broadband Deployment and the Digital Divide: A Primer*, Cato Institute Policy Analysis No. 410, August 7, 2001, available at [http://www.cato.org/pubs/pas/pa410.pdf] and Steve Titch, "California Proposes 'Broadband Bonds,'" posted on February 11, 2008 at [http://www.reason.org/archives/2008/02/california_prop.html].

[24] See *High Speed Services for Internet Access: Status as of June 30, 2007*, Federal Communications Commission, March 2008, at pp. 1-2, and "Federal Communications Commission Releases Data on High-Speed Services for Internet Access: High-Speed Connections to the Internet Increased by 20% in the Second Half of 2007," FCC News Release, January 16, 2009. According to the FCC, as of December 31, 2007 (the most recent FCC data available), 74.0 million of the 121.2 million total high speed lines (defined as 200 or more kbps in at least one direction) served primarily residential end users, and of these 47.8% used cable modem technology, 35.9% used DSL, 2.3% used fiber connections to the end user premises, and 14.0% used other types of technology, including satellite, terrestrial fixed or mobile (continued...)

Along with the increase in the number of broadband access lines, there has been an increase in the capability of those lines, in terms of their upload and download capabilities. This progress has occurred, and continues to occur, in all the technologies offering broadband access. In policy debates today, a distinction often is made between "current generation" and "next generation" broadband. Current generation typically refers to currently-deployed cable, DSL, and wireless systems, while next generation typically refers to technologies capable of offering dramatically faster download and upload speeds. Some telephone companies, most notably Verizon, already are replacing their legacy copper/DSL networks with fiber optic networks all the way to the customer premise (known as "fiber-to-the-home"). Other telephone companies, such as AT&T, are upgrading their networks by deploying optical fiber to a neighborhood node, and then using Internet Protocol technology and improved DSL equipment to offer very high speed service. Cable companies are beginning to install network equipment that conforms to the international standard DOCSIS 3.0 (the third generation Data Over Cable Service Interface Specification) developed by the industry to offer very high speed service. Now that the major wireless carriers have acquired through FCC auctions the substantial amounts of spectrum needed to provide fourth generation wireless service, they, too, are beginning to develop networks with substantial broadband capabilities. Satellite technology has not yet evolved this far, so for the foreseeable future its use for broadband service probably will be restricted to lower speed service to very remote areas that none of the other technologies can viably serve. The next generation capabilities of these technologies are at various levels of deployment readiness; some are already being deployed, some are close to deployment, and some more distant from deployment.

In general, the greater the download and upload speeds offered by a broadband connection, the more sophisticated (and potentially valuable) the applications that can be provided over the connection. In its most recent statutorily mandated report on the deployment of advanced services, the FCC found that "In the future, we anticipate ever-greater demand for services and applications requiring greater bandwidth over an ever-expanding area."[25] **Table 1** presents a compilation by the California Broadband Task Force showing different broadband speed ranges and the applications they make possible. Upgrading networks potentially allows for a transformative, not just quantitative, jump in the applications that can be offered. This has led to a policy debate about whether government support should be limited to infrastructure investments capable of providing specific download and upload speeds or whether providers should get more support for deploying networks that can offer higher download and upload speeds – or if such requirements would distort the market in favor of particular technologies that happen to be capable of providing such speeds at this particular point in time.[26]

(...continued)

wireless, and electric power lines.

[25] *In the Matter of Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996*," Federal Communications Commission, Fifth Report, GN Docket No. 07-45, FCC 08-88,adopted March 19, 2008 and released June 12, 2008, at p. 36, available at: [http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-08-88A1.pdf].

[26] See, for example, Cecilia Kang, "Internet Service Speed is Fast-Track Issue for New Administration," *The Washington Post*, January 13, 2009, at p. D4.

Table 1. Broadband Speeds and Applications

Upstream and Downstream Speeds	Applications
500 kbps – 1 Mbps	voice over IP, SMS, basic email, web browsing (simple sites), streaming music (caching), low quality video (highly compressed)
1 Mbps - 5 Mbps	web browsing (complex sites), email (larger size attachments), remote surveillance, IPTV-SD (1-3 channels), file sharing (small/medium), telecommuting (ordinary), digital broadcast video (1 channel), streaming music
5 Mbps – 10 Mbps	telecommuting (converged services), file sharing (large), IPTV-SD (multiple channels), switched digital video, video on demand SD, broadcast SD video, video streaming (2-3 channels), HD video downloading, low definition telepresence, gaming, medical file sharing (basic), remote diagnosis, (basic), remote education, building control & management
10 Mbps - 100 Mbps	telemedicine, educational services, broadcast video SD and some HD, IPTV-HD, gaming (complex), telecommuting (high quality video), high quality telepresence, HD surveillance, smart/intelligent building control
100 Mbps - 1 Gbps	HD telemedicine, multiple educational services, broadcast video full HD, full IPTV channel support, video on demand HD, gaming (immersion), remote server services for telecommuting
1 Gbps – 10 Gbps	research applications, telepresence using uncompressed HD video streams, live event digital cinema streaming, telemedicine remote control of scientific/medical instruments, interactive remote visualization and virtual reality, movement of terabyte datasets, remote supercomputing

Source: California Broadband Task Force, January 2008. (kbps or kilobits per second = 1,000 bits per second; mbps or megabits per second = 1,000,000 kilobits per second; gbps or gigabits per second = 1,000,000,000 bits per second)

Multiple, Potentially Conflicting, Public Policy Objectives

Proposals for government support of broadband network infrastructure investment are being made within the context of economic stimulus legislation. They also are being made within the context of growing support for some sort of "national broadband policy." This concept has been endorsed by the Obama campaign and transition team in its policy blueprint for technology and innovation, which includes as objectives the deployment of next-generation broadband networks and raising the level of U.S. broadband penetration to the highest in the world.[27] A national broadband policy or strategy also has been advocated by a broad and diverse coalition of stakeholders – ranging from telecommunications providers to public interest groups to state and

[27] Barack Obama, *Connecting and Empowering All Americans Through Technology and Innovation*, 2008, available [http://obama.3cdn.net/780e0e91ccb6cdbf6e_6udymvin7.pdf].

local governments – who have publicly issued a "Call to Action for a National Broadband Strategy," which endorses broad goals and identifies the need for policies to stimulate high-speed broadband network investment and high-speed broadband adoption and use.[28]

Broadband infrastructure components of a stimulus package are intended to provide short term benefits by generating jobs and spending and long term benefits by increasing the overall productivity of the economy and promoting innovations in commercial, non-profit, and household settings. Even the most effective government programs will have associated costs that ultimately must be borne by someone – direct costs to current taxpayers, costs associated with government borrowing to pay for current expenditures, costs imposed on future taxpayers when there is deficit spending, opportunity costs imposed on other industries whose costs of capital increase when funding is diverted through favorable government treatment to the broadband sector, social costs if potentially conflicting social objectives are sacrificed, among others. Effective programs are thought to directly and indirectly stimulate the economy sufficiently for the benefits to outweigh the costs. Ineffective programs spend government funds, or reduce tax revenues, or sacrifice other social objectives without a commensurate short term and/or long term impact on the economy.

The broadband component of an economic stimulus package should, to the extent possible, be consistent with both the short term goal of rapid stimulation of the economy and the longstanding, long term goals and objectives of U.S. telecommunications policy,[29] infrastructure policy, and budgetary policy. There may be tensions among these goals and objectives, which include:

- generating rapid job creation at a time of growing unemployment;
- generating spending at a time that consumer and industry spending is falling;
- fostering the build-out of infrastructure that has positive economic development externalities;
- fostering international competitiveness;
- providing affordable broadband access to all Americans;[30]
- fostering the competitive provision of broadband services;
- fostering innovation through a technologically- and competitively-neutral regulatory framework;
- fostering efficient investment decisions; and
- minimizing open-ended budgetary commitments.

Sometimes these goals conflict with one another. For example, because there are substantial economies of scale in the provision of broadband networks, it may not be efficient to support more than one provider in sparsely populated areas where demand is

[28] The "Call to Action for a National Broadband Strategy" and a list of signatories are available at [http://www.bb4us.net/].

[29] These are articulated in the Communications Act of 1934, as amended by the Telecommunications Act of 1996 and other telecommunications-related laws.

[30] This has not been a formal goal of U.S. telecommunications policy, but both the Federal Communications Commission and the National Association of Regulatory Utility Commissioners have been considering expanding the longstanding policy objective of universal affordable telephone service to universal affordable broadband access service.

too limited to support even one provider without a subsidy. Multiple competing providers would reduce the scale that any provider could attain, thereby increasing provider costs and increasing the level of subsidy needed to serve these areas. [31] Both the National Association of Regulatory Utility Commissioners (NARUC), the organization of state regulators, and the FCC have been concerned about the costs and inefficiencies associated with subsidizing multiple providers in high cost areas and have sought public comment on proposals that would restrict subsidy funding to a single provider that agrees to be the carrier of last resort for all customers in a geographic area.[32] Since these proposals have tended to give incumbent wireline carriers preferential access to the subsidy funds, they have been criticized by rural wireless carriers that have more recently entered the market, who claim they would be placed at an artificial competitive disadvantage.[33]

The Rural Utilities Service (RUS) of the U.S. Department of Agriculture (USDA) has had to address the complexity of dealing with these conflicting policy objectives while implementing its Rural Broadband Access Loan and Loan Guarantee Program.[34] The USDA Rural Broadband Access statute[35] specifies that the program "shall give priority to eligible rural communities in which broadband service is not available to residential customers." RUS has awarded loans for companies to serve areas in which there already was a broadband provider. Some incumbent broadband providers, typically cable operators, have complained that they deployed their broadband networks without government support, that RUS support of competing broadband networks places them on an artificially uneven playing field, reduces the financial viability of their existing networks by taking away customers needed to achieve scale economies, and thus discourages additional investment in their broadband networks. They argue that such support therefore should be restricted to areas with no existing broadband service. The new entrants typically have been wireless carriers whose network architectures and business plans require them to serve broader geographic areas that include both unserved

[31] For example, it is possible that, in a sparsely populated area, aggregate demand is insufficient for either a wireline broadband network or a wireless broadband network to attain the scale economies needed to operate efficiently. To the extent that customers in that area would view a broadband wireline service and a broadband wireless service as substitutes, and hence only choose to purchase service from one, then the existence of both a wireline network and a wireless network would decrease the efficiency – and, without government support, viability – of both networks, and customers might not gain much benefit from having a second network. To the extent that customers in the area view broadband wireless service as different from – more of a complement to than a substitute for – broadband wireline service, then those customers would be more likely to subscribe to both networks, and even though neither network might be able to achieve sufficient scale to operate without some government subsidy, the total subsidy needed would be smaller and the benefit to customers from access to the second network would be greater.

[32] *In the Matter of High-Cost Universal Service Support; Federal-State Joint Board on Universal Service; Lifeline and Link Up; Universal Service Contribution Methodology; Implementation of the Local Competition Provisions in the Telecommunications Act of 1996; Developing a Unified Intercarrier Compensation Regime; Intercarrier Compensation for ISP-Bound Traffic; IP-Enabled Services; and Numbering Resource Optimization*, Order on Remand and Report and Order and Further Notice of Proposed Rulemaking, Appendices A, B, and C, released December 2008, available at [http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-08-262A1.pdf].

[33] See, for example, *In the Matter of High-Cost Universal Service Support; Federal-State Joint Board on Universal Service; Lifeline and Link Up; Universal Service Contribution Methodology; Implementation of the Local Competition Provisions in the Telecommunications Act of 1996; Developing a Unified Intercarrier Compensation Regime; Intercarrier Compensation for ISP-Bound Traffic; and IP-Enabled Services*, Reply Comments of the Universal Service for America (USA) Coalition and the Rural Cellular Association (RCA), posted online at the FCC on 12/22/08.

[34] For a detailed discussion of this, see CRS Report RL33816, *Broadband Loan and Grant Programs in the USDA's Rural Utilities Service*, by Lennard G. Kruger.

[35] 7 U.S.C. 950bb.

areas and more populous areas that are already served by a broadband provider in order to be viable. The RUS has justified granting the loans to these wireless carriers and others on the grounds that these firms would not meet its financial requirements for a loan if they could not use the funding to support their infrastructure investments that are used to provide service jointly in served and unserved areas and also on the grounds that increased competition is valuable to consumers.

As another example of conflicts among the policy objectives, where broadband service potentially could be provided over a number of networks that each employ different technologies, some of which could be deployed more quickly than others, strict adherence to the goal of technological neutrality may slow down the speed at which support funds are spent and jobs are created. At the same time, strict adherence to the goal of rapid job creation could result in steering support to less efficient, but quick to deploy, technologies, thus distorting capital investment decisions and potentially harming both competition and innovation. The latter could be very significant if government support also were conditioned upon the broadband network providing upload or download speeds significantly higher than those available in most currently deployed networks, as proposed by some parties.[36] Such technical requirements combined with a short deployment schedule could effectively minimize or exclude support to wireless and satellite technologies, and perhaps also to cable networks. More generally, it may be important to ensure that any proposal that would impose multiple eligibility requirements not, in effect, limit support to a single technology.

Economic regulations generally are implemented to constrain particular behavior or activity that is perceived not to be in the public interest, or to require other behavior or activity that is perceived to be in the public interest, but that might not occur if left to market forces. Some of these regulations may reduce the incentive for firms to invest in plant and equipment because they constrain potentially profit-maximizing avenues of activity. Providers will have the incentive to eliminate such constraining regulations. Since there may be tradeoffs between the goals of these regulations and the goal of fostering investment, a public policy calculus should be performed, implicitly if not explicitly, to determine if the regulations remain in the public interest. During troughs in the general economic business cycle, when the potential public benefits from eliminating any impediments to investment are larger, that calculus may shift toward elimination of existing regulations, and providers that have been constrained by certain regulations will see an opportunity to propose such elimination as part of a stimulus package. One of the challenges of constructing a broadband infrastructure component of an economic stimulus package is to carefully weigh the long term as well as short term consequences of any proposals to eliminate or modify longstanding regulations and, if change is deemed appropriate, to construct such change in a fashion that minimizes the long-term impact of a change intended to address short-term economic considerations.

There are a number of regulations, and attendant on-going public policy debates, in the telecommunications area that address such long term objectives as competition, innovation, and consumer welfare. These include, among other issues, the rights and obligations of

[36] For example, the proposal of the Fiber to the Home Council, which would provide substantially more generous tax incentives for infrastructure providing 100 megabit downstream/20 megabit upstream service. See Jeffrey A. Eisenach, Hal J. Singer, and Jeffrey D. West, *Economic Effects of Tax Incentives for Broadband Infrastructure Deployment*, prepared on behalf of the Fiber-to-the-Home Council, January 5, 2009, available at [http://www.ftthcouncil.org/UserFiles/File/Economic%20Effects%20of%20Broadband%20Tax%20Incentives%20010509%20FINAL.pdf].

interconnecting networks, the obligations of network providers to make their networks available to independent applications providers who must use these networks to reach their customers, the rights of customers to attach their own equipment to networks and to receive the services of their choice over those networks, and appropriate levels of consolidation of ownership or control. As explained earlier, some parties have proposed that the modification or elimination of some of these longstanding telecommunications regulations (or, where deregulation already has occurred, prohibitions on re-regulation) be included among the broadband infrastructure elements in an economic stimulus package, in order to stimulate broadband infrastructure investment. The benefits of increased infrastructure investment should be weighed against any harm to other policy objectives, including the potential creation of disincentives for investment and innovation by independent applications providers or restrictions on consumer access to applications. Other parties claim that the interconnection, open network access, and ownership requirements in the current regulatory framework are insufficiently strict, and have proposed broadband infrastructure programs that would tie government support to more restrictive requirements in these areas. Here, too, a federal broadband infrastructure program should not incorporate changes in the existing regulations unless analysis demonstrates that those changes are needed to make the support programs effective and consistent with the overall public policy calculus.

In addition to potential conflicts among goals, there likely will be a limit on the total size, in terms of budgetary impact, of the broadband component of any economic recovery package. This likely will require Congress to implicitly or explicitly set priorities among the public policy objectives being addressed in the package. For example, should preference be given to programs intended to foster broadband deployment in currently unserved areas? And, if so, should such support be limited to a single carrier of last resort or spread among many competitors, none of which could exploit scale economies for efficiency? Or, given the concern expressed by some that the broadband networks deployed to date in the U.S. have much lower bandwidth capacity than those in many other developed countries, which arguably harms our international competitiveness, should equal priority be given to programs to foster the build-out of higher speed networks in geographic areas already served by one or more broadband networks?

Public Objectives vs. Private Objectives

One of the complexities of constructing a program to support privately-owned infrastructure is that the private objectives of each of the providers – to pursue a particular profit maximizing business plan – may not coincide with one another and also may not coincide with public objectives. This can make it difficult to construct effective and competitively neutral government programs to support privately-owned infrastructure.

Government programs are likely to be most effective if they address the most significant impediments to private providers' infrastructure investments in a fashion that motivates the providers to increase their actual investment levels. In markets such as the broadband market where the various providers use different technologies and therefore have different inputs, costs, and business plans, however, the providers may not all benefit equally from the same government actions. For example, providers that use wireless technology might view the release of additional spectrum for their use, which would allow them to offer services with faster download and upload speeds, as the government intervention that would most benefit their business plans and most

encourage additional investment.[37] In contrast, large incumbent telephone companies, which tend to have relatively easy access to capital markets, large cash flows, substantial positive income, and hence sizeable tax liabilities, and also tend to have large infrastructure investment plans, might find tax incentives (tax credits and/or accelerated depreciation) targeting their infrastructure investments the most beneficial government support mechanism.[38] At the same time, competitive local exchange carriers, who are less likely to have large tax liabilities to shelter but may have difficulty obtaining debt financing, especially under current market conditions, might benefit most from a government loan guarantee or a government program to pay the interest on their commercial bonds. Rural carriers who want to build broadband networks in sparsely populated areas, where it is difficult to demonstrate a viable business plan absent government support, might benefit most from direct grants. Also, the interconnection rights and obligations of some parties currently are not explicitly defined in statute or regulation because the 1996 Telecommunications Act that spelled out those rights and obligations could not predict or take into account subsequent market and technological developments. These parties might benefit most from statutory rules – or a Congressional mandate that the FCC construct rules – that fully articulate all providers' interconnection rights and obligations, absent which they may be placed in a weak position when negotiating with incumbent carriers. All of these different primary concerns suggests that a competitively neutral broadband infrastructure program might require multiple components.

In addition to conflicting private objectives, there may be times when private objectives diverge from public objectives and it will be necessary to carefully craft support programs that foster the public objectives. Consider, for example, a situation in which Congress has identified support for unserved areas as its highest priority. Given the substantial scale economies associated with broadband networks, in many situations it will be more profitable for a broadband network provider to employ its available capital to expand and upgrade its network capability in more urbanized areas than to extend its network into more sparsely populated unserved areas. In these situations, if a broadband grant, loan, or tax credit program were created that did not explicitly tie receipt of support to broadband deployment in the unserved areas, providers would have the incentive to use that support for their more profitable urbanized network. The FCC attempted to address this issue in recent proposals to expand the Federal Universal Service Fund (FUSF) to provide support for the deployment of broadband networks in high cost areas, which it placed in the Federal Register for public comment.[39] Under these proposals, FUSF funding would be

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[37] The first item listed by CTIA for facilitating the wireless contribution to broadband and infrastructure goals is "Identifying and allocating additional spectrum for mobile broadband services: Licensed Spectrum = Broadband." See "Facilitating the Wireless Contribution to the Obama Administration's Broadband and Infrastructure Goals," portion of a document dated December 9, 2008. provided by CTIA-The Wireless Association to the Obama-Biden Transition Project, available at [http://otrans.3cdn.net/ 434ec19514a6c44ce1_tfm6bxwzo.pdf]

[38] Although the large telephone companies do have relatively easy access to capital markets, Wall Street has not always reacted well to their large infrastructure capital investment plans. See, for example, Saul Hansell, "Verizon's FiOS: A Smart Bet or a Big Mistake?", *The New York Times*, August 19, 2008, available at [http://www.nytimes.com/ 2008/08/19/technology/19fios.html?_r=1&pagewanted=print]. Substantial tax incentives could ease Wall Street's concerns. On the other hand, these large telephone companies tend to enjoy extremely large cash flows that provide substantial internal funding for infrastructure investment (see, for example, Michael D. Pelcovits, *Debunking the Make-Whole Myth: A Common Sense Approach to Reducing Irrational Telecommunications Subsidies*, MiCRA White Paper #3, commissioned by Comcast, November 17, 2008, available at [httP;//www.micradc.com/news/publications/ pdfs/MP/White_Paper_3_FINAL.pdf]), and therefore substantial tax incentives arguably might not generate additional infrastructure investment.

[39] *In the Matter of High-Cost Universal Service Support; Federal-State Joint Board on Universal Service; Lifeline and Link Up; Universal Service Contribution Methodology; Implementation of the Local Competition Provisions in the Telecommunications Act of 1996; Developing a Unified Intercarrier Compensation Regime; Intercarrier Compensation for ISP-Bound Traffic; IP-Enabled Services; and Numbering Resource Optimization*, Order on Remand (continued...)

limited to the provision of service in specifically identified high cost areas, subject to an upfront commitment by providers to provide broadband service to all customers in the service area within five years, at 20% increments each year, and with denial of future support if that commitment were not met. With the same goal, but employing a different approach, Robert Atkinson, president of the Information Technology and Innovation Foundation (ITIF), has proposed that Congress institute a two-tiered tax credit consisting of a 30% tax credit to bring broadband services to the higher-density areas within rural locales that have a population density greater than 20 dwellings/businesses per square mile and a 60% tax credit to bring broadband services to low-density areas with fewer than 20 dwellings/businesses per square mile.[40] But as the earlier discussion of the RUS programs suggested, when some equipment, such as cellphone towers or backbone facilities, jointly serves customers in both sparsely populated areas and more densely populated areas – or in both unserved areas and already served areas – it may be difficult to identify the extent to which the investment in that equipment qualifies for the preferential government treatment.

More subtly, there likely will be situations in which public and private objectives partially coincide. For example, private providers will benefit from a government program that reduces their costs or uncertainty. But from the perspective of the government, such a program will be meeting its objectives only if that more favorable environment actually induces the private providers to undertake *additional* infrastructure deployment. Bruce Bartlett, a former Deputy Assistant Secretary for Economic Policy at the Treasury Department, explained this recently:

> The trick is to find a way to get people and businesses to spend money over and above what they would have spent anyway. A stimulus is not a stimulus unless it causes an incremental increase in aggregate spending. Simply replacing private spending with public spending doesn't do any good unless total spending increases in the process.
>
> Since it is just as stimulating to invest money as to buy things with it, it may be possible to bring forward the plans for future investments that businesses and governments already have. But, again, it is essential that these investments be marginal – over and above what would otherwise be spent – or else there will be no increase in aggregate spending, and we will be no better off.[41]

Free Press has expressed a similar concern:

> In particular, mechanisms should be established to ensure that any tax incentives or grant monies are used to fund *new* broadband deployment projects. This requirement will ensure that the stimulus funds are used to create new jobs, not to prop up the stock prices of telecommunications companies. (emphasis in original)[42]

(...continued)

and Report and Order and Further Notice of Proposed Rulemaking, Appendices A, B, and C, released December 2008, available at [http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-08-262A1.pdf]. For a detailed discussion of the Federal Universal Service Fund, see CRS Report RL33979, *Universal Service Fund: Background and Options for Reform*, by Angele A. Gilroy.

[40] Robert D. Atkinson, "The Right Broadband Stimulus Package," available at [http://www.huffingtonpost.com/robert-d-atkinson-phd/the-right-broadband-stimu_b_152884.html].

[41] Bruce Bartlett, "How to Get The Money Moving," *The New York Times*, December 24, 2008, at p. A21.

[42] S. Derek Turner, *Down Payment on Our Digital Future: Stimulus Policies for the 21st-Century Economy*, Free Press, December 2008, at p. 6, available at [http://www.freepress.net/files/Down Payment_ DigitalFuture.pdf].

In practice, it may be difficult to project before the fact, or to measure after the fact, the extent to which a tax incentive or a elimination of a regulation induces such incremental spending by the private infrastructure provider. But it may be possible to construct programs that are more likely to achieve this.

One potential way is to create incentives for quick spending by limiting the benefit to providers to investment activities undertaken with a fixed time period of short duration, for example, by providing a tax credit that expires after one year, thus creating the incentive for providers to speed up planned infrastructure deployment where possible. Another potential way is to require tax beneficiaries to provide some proof of increased and/or expedited investment spending. ITIF has proposed that Congress provide a tax credit on capital expenditures for next generation broadband networks, "[b]ut to avoid rewarding companies for investments they would have likely made, the credit should apply to those investments in 2009 capital expenditures that exceed 85 percent of 2008 levels."[43] Similarly, Free Press would require "that any company wanting to take advantage of tax incentive stimulus policies (such as accelerated depreciation) be required to submit previous and current capital deployment plans to the Treasury Department."[44] Using previously planned capital expenditures as a benchmark may be problematic, however, during a period when the economy is experiencing credit restrictions and a recession, both of which could force a provider to slow down or put on hold some of its planned expenditures.

Another potential way to increase the likelihood that a government program will actually generate additional infrastructure investment is to explicitly identify what actions the private providers must undertake to qualify for the support and to set some penalty for failure to perform (and to provide the necessary oversight and auditing). In the 1990s, a number of states, in response to requests from the old Regional Bell Operating Companies (RBOCs) for regulatory relief, replaced rate of return regulation with price cap regulation, which was expected to foster investment by allowing the RBOCs to retain earnings above the competitive level when they reduced costs. In exchange, the RBOCs pledged to deploy optical fiber in the states, but those deployment goals were never contractually mandated. After the fact, some critics have claimed that the RBOCs never met the deployment goals and therefore owe the ratepayers billions of dollars for unmet commitments.[45] But none of the state regulatory commission orders specified what investments the RBOCs had to make incremental to the investments they would have made in the absence of reduced regulation, and even where a build out schedule was implied or identified (in terms of the proportion of the population or land area to be served by the fiber optic network within a particular time period), the orders typically did not include penalty provisions if the deployment schedules were not met. It is likely to be easier to incorporate explicit build out requirements and potential penalties in grant and loan programs that typically are implemented on a project-specific basis than in tax incentive programs or deregulation actions that tend to require generic implementation rules.

[43] Robert D. Atkinson, "The Right Broadband Stimulus Package," available at [http://www.huffingtonpost.com/robert-d-atkinson-phd/the-right-broadband-stimu_b_152884.html], viewed on December 31, 2008.

[44] S. Derek Turner, *Down Payment on Our Digital Future: Stimulus Policies for the 21st-Century Economy*, Free Press, December 2008, at p. 10, available at [http://www.freepress.net/files/Down Payment_ DigitalFuture.pdf].

[45] See, for example, Bruce Kushnick, *$200 Billion Broadband Scandal*, an electronic book that can be purchased at [http://www.newnetworks.com/broadbandscandals.htm].

Demand Considerations

Economic activity generates the need for supporting infrastructure. And, in turn, deployment of infrastructure increases economic productivity and efficiency, which further increases economic activity. This positive cycle exists for both publicly owned and privately owned infrastructure. But large infrastructure projects often cannot be justified, whatever the source of funding, unless some threshold level of demand exists. This has sometimes led governments to create development zones, in which commercial and non-commercial entities are provided tax incentives or reduced rents in order to concentrate enough demand in a particular location to justify the infrastructure investment. This is one of the principles underlying efforts in Kentucky, Tennessee, and other states to create public-private partnerships to foster broadband build-out by clustering enough users in particular locations to create sufficient demand to justify deployment.[46] Legislation enacted in the 110th Congress (P.L. 110-385, the Broadband Data Improvement Act) would, if funded, provide grants to states in order to extend these public-private efforts to identify, and where needed concentrate, sufficient demand to support broadband deployment in areas all around the country that now have limited deployment, as well as assisting states in collecting the sort of demand and supply data needed by these public-private partnerships.

The Benton Foundation has proposed the creation of two federal programs, based on state programs first developed by the California Broadband Task Force – an Anchor Tenancy program and a Collocation Facilities program – that would complement such public-private partnerships. Under an Anchor Tenancy program, the General Services Administration (GSA), which owns or leases numerous facilities throughout the country that require broadband access, would assess whether the government-owned or –leased facilities in areas with little broadband infrastructure could act as anchor tenants, with GSA negotiating telecommunications leases with broadband providers that would require that the providers extend broadband access to businesses and households in a specified portion of the surrounding community.[47] Under a Collocation Facilities program, GSA would make available, at cost, small "collocation" spaces on federally-owned properties in which companies could keep their own equipment needed to connect with both regional networks and other networks that connect to major Internet connection points in metropolitan areas.[48] In effect, the GSA would provide a space with sufficient power and cooling equipment to house networking equipment needed by the various carriers and that space would act as a hub and allow the carriers to enjoy resulting economies of scale or scope.

These programs to create nodes of demand to attract private infrastructure investment likely would still leave many geographic areas with insufficient demand to justify such investment. If the longstanding U.S. telecommunications policy of universal affordable telephone service were to be expanded to a policy of universal affordable broadband service, then that might justify a

[46] For a description of these state-level efforts, see discussion of eCommunity strategies at Connected Nation, available at [http://www.connectednation.org/state_programs/eCommunity_Strategies.php].

[47] See John Rintels, *An Action Plan for America: Using Technology and Innovation to Address Our Nation's Critical Challenge*, Benton Foundation, 2008, at p. 38, available at [http://www.benton.org/sites/benton.org/ files/Benton_ Foundation_Action_Plan.pdf], and *The State of Connectivity: Building Innovation Through Broadband*, Final Report of the California Broadband Task Force, January 2008, at p. 57, available at [http://www.calink.ca.gov/taskforcereport/].

[48] See John Rintels, *An Action Plan for America: Using Technology and Innovation to Address Our Nation's Critical Challenge*, Benton Foundation, 2008, at p. 38, available at [http://www.benton.org/sites/benton.org/ files/Benton_ Foundation_Action_Plan.pdf], and *The State of Connectivity: Building Innovation Through Broadband*, Final Report of the California Broadband Task Force, January 2008, at p. 58, available at [http://www.calink.ca.gov/taskforcereport/].

program to stimulate broadband demand in all geographic locations, not just where demand can be created at specific geographic hubs. According to a recent study by the Pew Internet & American Life Project,[49] as of April 2008 55% of adult Americans had broadband Internet connections at home (vs. 47% in March 2007) and 25% of low-income Americans (those whose household incomes were $30,000 annually or less) had broadband at home. Traditional universal service programs have attempted to make telephone service universally affordable both by keeping the monthly rates for telephone access – in particular, the local subscriber line charge for connecting to the public switched telephone network – affordable for all customers and by instituting "lifeline" and "link-up" program to subsidize the monthly basic local charge and initial connection charge for low income households. Some parties have recommended that a broadband infrastructure program include an analogous program to subsidize the monthly broadband access fee and broadband Installation access fees of low income households.[50] This subsidy could, but need not, be included in the Federal Universal Service Fund (FUSF). A proposal that the FCC published in the Federal Register for public comment, but has not adopted, would create a limited pilot program within the FUSF.[51]

But many observers believe that the cost of a home computer – the customer premise equipment needed to gain access to broadband services – is a greater deterrent to households purchasing broadband access service. According to an October 2008 study by Connected Nation,[52] 74% of all U.S. households own home computers, but computer ownership levels are significantly lower for specific demographic groups: 44% for households with annual income less than $25,000, 44% for older households (65 or older), 51% for people with disabilities, 60% for households headed by adults with no college education, and 64% for African-American households. Some observers therefore have proposed that any broadband infrastructure package include a subsidy program for targeted populations to purchase household computers. For example, Free Press proposes an "e-rate@home program" to subsidize the purchase of laptop computers by schools and libraries that serve students from low-income households and an "every child online tax deduction program" to allow households earning less in $60,000 in taxable income who have children in schools that participate in the e-rate@home program to deduct the cost of home Internet access up to $180 for the year and to deduct up to $200 for expenditures on laptop or notebook computers.[53] In considering these subsidy proposals, however, it is useful to note what the Connected Nation study learned about why households do not subscribe to broadband access service. For all non-broadband households, 44% indicated that they do not need broadband, 32% indicated they don't own a computer, 23% indicated broadband service is too expensive, and 14% indicated

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[49] John B. Horrigan, *Home Broadband Adoption 2008*, Per Internet & American Life Project, July 2008, available at [http://www.pewinternet.org/pdfs/PIP_Broadband_2008.pdf].

[50] See, for example, Robert D. Atkinson, Daniel Castro, and Stephen J. Ezell, *The Digital Road to Recovery: A Stimulus Plan to Create Jobs, Boost Productivity and Revitalize America*, The Information Technology & Innovation Foundation, January 2009, at p. 6, available at [http://www.itif.org/files/roadtorecovery.pdf].

[51] *In the Matter of High-Cost Universal Service Support; Federal-State Joint Board on Universal Service; Lifeline and Link Up; Universal Service Contribution Methodology; Implementation of the Local Competition Provisions in the Telecommunications Act of 1996; Developing a Unified Intercarrier Compensation Regime; Intercarrier Compensation for ISP-Bound Traffic; IP-Enabled Services; and Numbering Resource Optimization*, Order on Remand and Report and Order and Further Notice of Proposed Rulemaking, Appendices A, B, and C, released December 2008, available at [http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-08-262A1.pdf].

[52] *Consumer Insights to America's Broadband Challenge*, a Research Series from Connected Nation, Inc., October 13, 2008, at p. 5. available at [http://www.connection.com/documents/ConsumerInsightsBroadbandChallenge.20081013.pdf].

[53] S. Derek Turner, *Down Payment on Our Digital Future: Stimulus Policies for the 21st-Century Economy*, Free Press, December 2008, at pp. 25-26, available at [http://www.freepress.net/files/Down Payment_ DigitalFuture.pdf].

broadband is not available in their area; among non-broadband rural households, 42% indicated they do not need broadband, 34% indicated they don't own a computer; 22% indicated broadband service is too expensive, and 19% indicated broadband service is not available in their area.[54] It is possible that a survey response of not needing broadband or not owning a computer reflects an underlying issue of lack of education about how to use a computer and how to use broadband services, which in turn might limit the effectiveness of subsidies for the purchase of computers or of broadband access service.

Constraints on Rapid Broadband Infrastructure Build-Out

If a primary objective of a broadband infrastructure program is short term economic stimulation – incremental spending and job creation over and above that otherwise planned by broadband network providers – then policy makers might want to consider targeting those broadband network projects that can be quickly ramped up to generate spending and employment beyond the levels currently in providers' business plans. As discussed earlier, targeting such investment projects could come at the expense of promising technologies and projects that are not ready for immediate deployment.

The availability of deployment-ready technology and financing may not be the only constraint on the ability of network providers to increase deployment beyond planned levels. Verizon has only recently been able to deploy its FiOS network in major urban centers because it has taken awhile for it to find a viable way to bring optical fiber into multi-tenant buildings that have old copper wire clogging up conduits needed for the fiber.[55] It now has received a franchise in New York City with specific build-out requirements, but it is not yet clear how quickly it will be able to deploy its network in those difficult to serve buildings. Similarly, Verizon's efforts to deploy FiOS in suburban markets has suffered initial delays created by the lack of skilled technicians, which frequently resulted in residential installations requiring multiple "truck rolls." The labor skill level required for broadband deployment likely is higher than that for conventional infrastructure deployment. Verizon has been exploring ways to minimize truck rolls, or even avoid them entirely, but to the extent such labor saving actions prove viable primarily when customers are tech savvy, they may be limited to a small subset of customers for a mass market service.

Many broadband network providers have broadband business plans that rely heavily on the projected funds generated by multichannel video distribution services they would provide over those networks. In most cases, these multichannel video distribution services are subject to regulation as cable television providers, and thus must be awarded cable franchises by local or state franchise authorities. Although many states have passed laws to allow new entrants (and, in some cases, incumbent cable companies) to apply for a single state-wide franchise, some incumbent telephone companies and other new entrants into the provision of cable service still face franchise applications procedures that can take months to complete and, to the extent that

[54] *Consumer Insights to America's Broadband Challenge*, a Research Series from Connected Nation, Inc., October 13, 2008, at pp. 7 and 11, available at [http://www.connection.com/documents/ConsumerInsightsBroadbandChallenge.20081013.pdf].

[55] See, for example, Peter Svensson, "Apartments are tougher targets for FiOS," *USA Today*, 3/22/07, available at [http://www.usatoday.com/tech/products/2007-03-22-verizon-fios-apartments_N.htm].

they do not choose to build out their broadband networks absent prior franchise approval, can delay their broadband build-out by months.

As a result, tax incentives might increase the incentives for network providers to speed up their network build-outs, but their actual impact on rapid broadband infrastructure deployment might be constrained at least in the short run by the lack of a skilled technical installation work force and the local or state cable franchising process.

Appendix. Representative List of Proposals for Government Support of Broadband Infrastructure Investment

The following is a representative list of proposals for government support of broadband infrastructure investment.

Jeffrey A. Eisenach, Hal J. Singer, and Jeffrey D. West, *Economic Effects of Tax Incentives for Broadband Infrastructure Deployment*, prepared on behalf of the Fiber-to-the-Home Council, January 5, 2009, available at [http://www.ftthcouncil.org/UserFiles/File/Economic%20Effects%20of%20Broadband%20Tax%20Incentives%20010509%20FINAL.pdf]

The Rural Broadband Initiative: Deploying Next-Generation Broadband Service to Rural America, a White Paper prepared by the Digital Policy Institute, Ball State University, on behalf of the Organization for the Promotion and Advancement of Small Telecommunications Companies (OPASTCO), January 5, 2009, available at [http://www.opastco.org]

Letter of December 18, 2008, from Curt Stamp, President, Independent Telephone and Telecommunications Alliance, to the Honorable Speaker Nancy Pelosi, Speaker of the House of Representatives, and the Honorable Harry Reid, Senate Majority Leader, available at [http://www.ita.us/docs/1218Congress%20Leadership%20Stimulus%20(121808)pdf0001.pdf]

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