

GAO

Report to the Chairman, Committee on
Energy and Commerce, House of
Representatives

May 2009

TELECOMMUNICATIONS

Broadband Deployment Plan Should Include Performance Goals and Measures to Guide Federal Investment



GAO

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Highlights of [GAO-09-494](#), a report to Chairman, Committee on Energy and Commerce, House of Representatives

Why GAO Did This Study

The United States ranks 15th among the 30 democratic nations of the Organisation for Economic Co-operation and Development (OECD) on one measure of broadband (i.e., high-speed Internet) subscribership. The Federal Communications Commission (FCC) has regulatory authority over broadband, and several federal programs fund broadband deployment. This congressionally requested report discusses (1) the federal broadband deployment policy, principal federal programs, and stakeholders' views of those programs; (2) how the policies of OECD nations with higher subscribership rates compare with U.S. policy; and (3) actions the states have taken to encourage broadband deployment. To address these objectives, GAO analyzed the broadband policies of the United States and other OECD nations, reviewed federal program documentation and budgetary information, and interviewed federal and state officials and industry stakeholders.

What GAO Recommends

In developing the required broadband plan, the Chairman, FCC, should work with the Departments of Agriculture and Commerce to specify performance goals and measures for broadband deployment and to define the departments' roles and responsibilities in carrying out the plan. FCC generally agreed with GAO's recommendations.

View [GAO-09-494](#) or key components. For more information, contact Mark L. Goldstein at (202) 512-2834 or goldsteinm@gao.gov.

TELECOMMUNICATIONS

Broadband Deployment Plan Should Include Performance Goals and Measures to Guide Federal Investment

What GAO Found

According to federal officials, the federal approach to broadband deployment is focused on advancing universal access. Federal officials said that historically the role of the government in carrying out a market-driven policy has been to create market incentives and remove barriers to competition, and the role of the private sector has been to fund broadband deployment. Under this policy, broadband infrastructure has been deployed extensively in the United States. However, gaps remain, primarily in rural areas, because of limited profit potential. Eleven federal programs help fund telecommunications infrastructure deployment, particularly in rural areas, and two of these programs, administered by the Department of Agriculture's Rural Development Utilities Program (RDUP), focus specifically on broadband infrastructure deployment. Industry stakeholders credit federal programs with helping to increase broadband deployment, particularly in rural areas, but told GAO that because of the high cost and low profit potential of providing broadband services in rural areas, the federal government will likely need to provide additional funding to achieve universal access. The American Recovery and Reinvestment Act of 2009 provides more than \$7 billion to the Department of Commerce's National Telecommunications and Information Administration (NTIA), FCC, and RDUP, to map broadband infrastructure in the United States, develop a plan for broadband deployment, and issue loans and grants to fund broadband access and availability in rural areas. This funding will greatly increase the potential for achieving universal access, but overlap in responsibilities for these new broadband initiatives makes coordination among the agencies important to avoid fragmentation and duplication. Current administration officials said they are still formulating their telecommunication agenda.

In comparison to the policies of several other OECD countries with higher broadband subscribership rates per 100 inhabitants, the U.S. policy lacks elements identified by the Government Performance and Results Act of 1993 as essential to achieving effective and efficient policy outcomes. Specifically, according to officials of these countries' governments, several of the OECD nations with higher rankings have written broadband policies, action plans, goals, and performance measures. A number of these other countries also have provided financial support, created financial incentives, or taken other steps to promote broadband.

In interviews with state officials, GAO learned that states vary in their actions to encourage deployment. Officials in more than half the states cited gaps in broadband deployment and said their states were considering or had taken actions to address these gaps. Officials in 12 states said they had mapped their states and 13 more said they had plans to map; officials in 12 states said they have broadband deployment plans; and officials in 14 states said they have provided some type of financial support for broadband deployment.

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Abbreviations

| | |
|--------------|--|
| ADSL | asymmetric digital subscriber line |
| BRAND | Broadband for Rural and Northern Development |
| CIO | Chief Information Officer |
| CRS | Congressional Research Service |
| DSL | digital subscriber line |
| EDA | Economic Development Administration |
| Farm Bill | Food, Conservation, and Energy Act of 2008 |
| FCC | Federal Communications Commission |
| GPRA | Government Performance and Results Act of 1993 |
| ITIF | Information Technology and Innovation Foundation |
| kbps | kilobits per second |
| Mbps | million bits per second |
| NTIA | National Telecommunications and Information Administration |
| OECD | Organization for Economic Co-operation and Development |
| RDUP | Rural Development Utilities Program |
| Recovery Act | American Recovery and Reinvestment Act of 2009 |
| USDA | U.S. Department of Agriculture |
| Wi-Fi | wireless fidelity |

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United States Government Accountability Office
Washington, DC 20548

May 12, 2009

The Honorable Henry Waxman
Chairman
Committee on Energy and Commerce
House of Representatives

Dear Mr. Chairman:

Universal access to the Internet via broadband technologies—commonly referred to as broadband Internet access—is considered a critical economic engine, a vehicle for enhanced learning and services, and a central component of 21st-century news and entertainment. For example, broadband technology makes it possible for patients to go to clinics near their homes and receive medical attention from specialists hundreds of miles away; allows students to access information not available from their local libraries; and gives school systems a means of using one teacher to provide advanced courses to students in multiple schools. The Telecommunications Act of 1996 directed the Federal Communications Commission (FCC) and state public service commissions to encourage the deployment of advanced telecommunications capability, including broadband.¹ Additionally, in 2004, President Bush stated as a national goal that there should be universal, affordable access to broadband technology. Similarly, in January 2009, President-elect Obama spoke of expanding broadband lines across rural America.

Despite the importance Congress and past and current administrations have placed on access to broadband, the United States has not achieved universal access to broadband technology and lags behind other countries in terms of subscribership. For example, the United States slipped from 4th in 2001 to 15th in 2007 and 2008 among the 30 democratic nations that make up the Organisation for Economic Co-operation and Development (OECD)² in the number of broadband subscribers per 100 inhabitants.³ Although this measure is only one of five criteria for evaluating broadband

¹Telecommunications Act of 1996, Pub. L. No. 104-104, § 706(a), 110 Stat. 56, 153 (1996).

²The OECD is a unique forum through which the governments of 30 democracies work together to address the economic, social, and environmental challenges of globalization.

³Taylor Reynolds and Sacha Wunsch-Vincent, *Broadband Growth and Policies in OECD Countries*, a special report prepared at the request of OECD, July 2008, 24-25.

markets, the decline of the United States in OECD's rankings caught the attention of policy makers.⁴ In October 2008, the Broadband Data Improvement Act initiated a variety of measures to improve the quality of federal and state data regarding the availability and quality of broadband services and to promote the deployment of affordable broadband services to all parts of the nation.⁵ In February 2009, the American Recovery and Reinvestment Act of 2009 (Recovery Act) authorized \$7.2 billion for the development of a national broadband plan, the nationwide mapping of broadband availability, and the deployment of infrastructure to unserved and underserved areas.⁶

Most federal programs that help fund broadband focus on improving broadband deployment—that is, building the infrastructure on which broadband services can be provided—because the infrastructure must be built before the services can be delivered. You asked us to examine these federal efforts. Accordingly, this report discusses (1) the current federal broadband policy, the principal federal programs that support the deployment of broadband infrastructure, and stakeholders' views of those programs; (2) how the policies of those OECD nations currently ranked ahead of the United States in terms of subscribership compare with the U.S. policy; and (3) actions the states have taken to encourage broadband deployment.

To address these issues, we analyzed relevant laws, regulations, policies, and programs pertaining to broadband deployment; interviewed federal officials about the policies and programs supporting broadband deployment; and obtained information from officials and from Web sites of some of those OECD nations currently ranked ahead of the United States in terms of subscribership about their nations' broadband policies and programs. We reviewed federal programs identified by the Congressional Research Service (CRS) as funding some kind of domestic assistance related to telecommunications that have provided federal funds to deploy broadband infrastructure. To compare the current federal broadband policy to the policies of those OECD nations that currently rank ahead of the United States in terms of subscribership, we assessed the extent to which each incorporated such elements as a written policy, an action plan,

⁴See app. I for more information about the OECD rankings and the Department of State's views of these rankings.

⁵Pub. L. No. 110-385, title I, 122 Stat. 4096 (2006).

⁶Pub. L. No. 111-5, 123 Stat. 115 (2009).

and measurable goals. For more information on OECD rankings, see appendix I. To obtain the views of stakeholders and states, we interviewed representatives of U.S. broadband provider associations and consumer organizations and interviewed the Chief Information Officer (or his or her designee) in 48 of the 50 states⁷ and the District of Columbia. We conducted our work from March 2008 through May 2009 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. See appendix II for more information about our scope and methodology.

Background

The Internet became widely accessible to U.S. households by the mid-1990s. For a few years, the primary means to access the Internet was a dial-up connection, in which a standard telephone line is used to make an Internet connection. A dial-up connection offers data transmission speeds of up to 56 kilobits per second (kbps⁸). Broadband access to the Internet became available by the late 1990s. Broadband differs from a dial-up connection in certain important ways. First, broadband connections offer a higher-speed Internet connection than dial up. For example, some broadband connections offer speeds exceeding 1 million bits per second (Mbps) both upstream (data transferred from the consumer to the Internet service provider) and downstream (data transferred from the Internet service provider to the consumer). These higher speeds enable consumers to receive information much faster and thus enable certain applications to be used and content to be accessed that might not be possible with a dial-up connection. Second, broadband provides an “always on” connection to the Internet, so users do not need to establish a connection to the Internet service provider each time they want to go online. The higher transmission speeds that broadband offers cost more than dial up, and some broadband users pay a premium to obtain very-high-speed service.

⁷Officials in two states were unable to accommodate our request for an interview.

⁸In digital telecommunication, the bit rate is the number of bits that passes a given point in a telecommunication network in a given amount of time, usually a second. Thus, a bit rate is usually measured in some multiple of bits per second—for example, kilobits, or thousands of bits per second.

Consumers can receive a broadband connection to the Internet through a variety of technologies, including, but not limited to, the following:

- *Cable modem.* Cable television companies first began providing broadband service in the late 1990s over their cable networks. When provided by a cable company, broadband service is referred to as cable modem service. Cable modem service is primarily available in residential areas. Cable modem service enables cable operators to deliver broadband service by using the same coaxial cables that deliver pictures and sound to television sets. Most cable modems are external devices that have two connections, one to the cable wall outlet and the other to a computer. Although the speed of service varies with many factors, download speeds of up to 6 Mbps are typical. Cable providers are developing even higher-speed services.
- *DSL.* Local telephone companies provide digital subscriber line (DSL) service, another form of broadband service, over their telephone networks on capacity unused by traditional voice service. To provide DSL service, telephone companies must install equipment in their facilities and install or provide DSL modems and other equipment at customers' premises and remove devices on phone lines that may cause interference. Most residential customers receive older, asymmetric DSL (ADSL) service with download speeds of 1.5 Mbps to 3 Mbps. ADSL technology can achieve speeds of up to 8 Mbps over short distances. Newer DSL technologies can support services with much higher download speeds.
- *Satellite.* Three providers currently offer broadband service in the United States. These providers use geosynchronous satellites that orbit in a fixed position above the equator and transmit and receive data directly to and from subscribers.⁹ Satellite companies provide transmission from the Internet to the user's computer and from the user's computer to the Internet, eliminating the need for a telephone connection. Typically a consumer can expect to receive (download) at a speed of about 1 Mbps and send (upload) at a speed of about 200 kbps. Transmission of data via satellite causes a slight lag in transmission, typically one-half to three-fourths of a second, thus rendering this service less suitable for certain Internet applications, such as videoconferencing. While satellite broadcast service may be available throughout the country, it generally costs more than most other broadband modes and its use requires a clear line of sight

⁹There also are low earth orbit satellite providers such as GlobalStar and Iridium that provide some level of broadband service. These satellite systems are in a nonstationary orbit and are between 250 and 600 miles in orbit.

between the customer's antenna and the southern sky. Both the equipment necessary for service and recurring monthly fees are generally higher for satellite broadband service, compared with most other broadband transmission modes.

- *Wireless.* Land-based, or terrestrial, wireless broadband connects a home or business to the Internet using a radio link. Some wireless services are provided over unlicensed radio spectrum and others over spectrum that has been licensed to particular companies.¹⁰ In licensed bands, some companies are offering fixed wireless broadband throughout cities. Also, mobile telephone carriers—such as the large companies that provide traditional cell phone service—have begun offering broadband mobile wireless Internet service over licensed spectrum—a service that allows subscribers to access the Internet with their mobile phones or laptops in areas throughout cities where their provider supports the service. A variety of broadband-access technologies and services also are provided on unlicensed spectrum—that is, spectrum that is not specifically under license for a particular provider's network. For example, wireless Internet service providers may offer broadband access in particular areas by establishing a network of subscriber stations, each with its own antenna that relays signals throughout a neighborhood and has a common interface to the Internet. Subscribers place necessary reception equipment outside their homes that transmits and receives signals from the nearest antenna. Also, wireless fidelity (Wi-Fi) networks—which provide broadband service in so-called “hot spots,” or areas within a radius of up to 300 feet—can be found in cafes, hotels, airports, and offices. Hot spots generally use a short-range technology that provides speeds up to 54 Mbps. Some technologies, such as Worldwide Interoperability for Microwave Access (known as WiMAX), can operate on either licensed or unlicensed bands, and can provide broadband service up to approximately 30 miles.
- *Fiber.* This technology, also known as fiber optic, is a newer technology for providing broadband service. Fiber optic technology converts electrical signals carrying data to light and sends the light through transparent glass fibers about the diameter of a human hair. Fiber can transmit data at speeds far exceeding current DSL or cable modem speeds,

¹⁰Radio spectrum is a natural resource used to provide an array of wireless communication services. FCC regulates commercial entities' use of spectrum. With unlicensed spectrum, a number of users without licenses share a portion of the spectrum, adhering to certain technological specifications. In contrast, with licensed spectrum, FCC licenses entities to use a specific portion of the spectrum. GAO, *Telecommunications: Broadband Deployment Is Extensive throughout the United States, but It Is Difficult to Assess the Extent of Deployment Gaps in Rural Areas*, [GAO-06-426](#) (Washington, D.C.: May 5, 2006).

typically by tens or even hundreds of megabits per second. Fiber optic technology may be provided in several ways, including fiber to a customer’s home or business or to a location somewhere between the provider’s facilities and the customer. In the latter case, the last part of the connection to the customer’s premises may be provided over cable, copper loop, or radio technology. Such hybrid arrangements may be less costly than providing fiber all the way to the customer’s premises, but they generally cannot achieve the high transmission speed of a full fiber-to-the-premises connection.

Although broadband often is referred to as a singular entity, a variety of data speeds—ranging from 768 kbps to greater than 100 Mbps—are defined as broadband. FCC’s new categories for collecting data on broadband Internet access service are provided in table 1.

Table 1: FCC Broadband Tiers and Speeds

| Tier | Speed |
|------------------------|-----------------------|
| Basic Broadband Tier 1 | 768 kbps to 1.5.Mbps |
| Broadband Tier 2 | 1.5.Mbps to 3 Mbps |
| Broadband Tier 3 | 3 Mbps to 6 Mbps |
| Broadband Tier 4 | 6 Mbps to 10 Mbps |
| Broadband Tier 5 | 10 Mbps to 25 Mbps |
| Broadband Tier 6 | 25 Mbps to 100 Mbps |
| Broadband Tier 7 | Greater than 100 Mbps |

Source: FCC.

FCC has primary responsibility for regulating broadband. Section 706 of the Telecommunications Act of 1996 directs FCC to encourage the deployment of advanced telecommunications capability, which includes broadband, to all Americans.¹¹ Under this authority, FCC has established a minimal regulatory environment for broadband Internet access services, stating that less regulation will promote the availability of competitive broadband services to consumers. FCC, through a number of proceedings, classified broadband Internet access (regardless of the platform) as an information service—a classification that reduces regulatory requirements

¹¹Pub. L. No. 104-104, § 706(a), 110 Stat. 56, 153 (1996). Section 706(c) of the act describes advanced telecommunications capabilities as “high-speed, switched, broadband telecommunications capability that enables users to originate and receive high-quality voice, data, graphics, and video telecommunications using any technology.”

applicable to broadband.¹² FCC does not have explicit statutory authority to regulate the provision of information services; however, FCC has the authority to impose regulations under what is termed its ancillary jurisdiction to regulate services that are reasonably related to its existing statutory authority.¹³ FCC has concluded that it has ancillary jurisdiction to promulgate regulations on broadband through its rule-making procedures, but it has not yet exercised this authority.¹⁴ FCC also has the authority to adopt broadband regulations to ensure that broadband providers are capable of providing authorized surveillance to law enforcement agencies.¹⁵

As part of its responsibilities, FCC has periodically issued a report to Congress on the status of advanced telecommunications capability in the United States.¹⁶ To assist in the preparation of this report, in 2000, FCC adopted a semiannual reporting requirement for facilities-based broadband Internet service providers.¹⁷ In November 2004, FCC modified its rules on filing this information, and the revised rules went into effect for the companies' second filing in 2005. Specifically, FCC removed existing reporting thresholds, and companies were required to report their

¹²See e.g., FCC-02-77, Mar. 15, 2002, FCC 05-150, Sept. 23, 2005, and FCC-07-30, Mar. 23, 2007.

¹³See *National Cable Telecomm. Ass'n. v. Brand X Internet Services*, 545 U.S. 967, 976 (2005) (FCC has jurisdiction to impose additional regulatory obligations under its Title I ancillary jurisdiction to regulate interstate and foreign communications).

¹⁴FCC, however, has relied on its ancillary jurisdiction in adjudicatory proceedings, for example, in the proceeding in which it found Comcast in violation of FCC's open-access guidelines. Memorandum Opinion and Order, Formal Complaint of Free Press and Public Knowledge Against Comcast Corporation for Secretly Degrading Peer-to-Peer Applications, FCC 08-183 (Aug. 1, 2008). Comcast filed a petition appealing this order on Sept. 4, 2008, with the U.S. Court of Appeals for the D. C. Circuit.

¹⁵Federal courts have upheld FCC's authority to regulate broadband Internet service providers under the Communications Assistance for Law Enforcement Act. Pub. L. No. 103-414, 108 Stat. 4297 (1994). See, e.g., *American Council on Education v. FCC*, 451 F.3d 226 (2006).

¹⁶See 47 U.S.C. § 157 nt.; see, e.g., *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*, GN Docket No. 07-45, Fifth Report, 12 FCC Rcd 9615 (2008).

¹⁷A facilities-based carrier is one that owns most of its facilities, such as switching equipment and transmission lines. A non-facilities based carrier is one which leases most of its switching and lines from others.

total state subscribership by technology. In 2006, we reported that the approach FCC then used to collect data on broadband deployment, which counted broadband service providers with subscribers at the ZIP code level, resulted in inadequate information about broadband deployment.¹⁸ Subsequent to our recommendation, in March 2008, FCC acted to increase the precision and quality of its broadband data by revising its methodology and requiring that broadband providers report the number of broadband connections in service by Census Tract.¹⁹ Furthermore, the Broadband Data Improvement Act calls for additional actions to improve the quality of data available on broadband deployment. Among other things, the Act directs FCC to

(1) shift its assessments of broadband deployment from a periodic basis to an annual basis;²⁰

(2) periodically survey consumers to collect information on the types of technologies used by consumers to access the Internet, the applications or devices used in conjunction with broadband service, and the actual connection speeds of users;

(3) collect information on reasons why consumers have not subscribed to broadband services;

(4) determine certain demographic data for geographical areas not served by any provider of advanced telecommunications capability (i.e., areas where broadband has not yet been deployed); and

(5) provide information on the speed and price of broadband service capability in 25 other countries.

Two other federal agencies have responsibility for telecommunications policies. The Office of Science and Technology Policy (OSTP) within the Executive Office of the President has a broad mandate to advise the President and the federal government on the effects of science and technology on domestic and international affairs and has led interagency

¹⁸[GAO-06-426](#).

¹⁹See FCC-08-89, Mar. 19, 2008.

²⁰The Broadband Data Improvement Act, Pub. L. No. 110-385, § 103(a), 122 Stat. 4096, 4096 (codified at 47 U.S.C. §§ 1301-1304).

efforts to develop science and technology policies and budgets. The Department of Commerce's National Telecommunications and Information Administration (NTIA) is the President's principal telecommunications and information adviser and works with other executive branch agencies to develop the administration's telecommunications policies.

Market-Based Federal Approach to Broadband Deployment Focuses on Achieving Universal Access

Current Market-Driven, U.S. Broadband Policy Was Articulated in Multiple Sources

Agency officials we spoke with during the Bush Administration told us that the market-based U.S. policy on broadband deployment could be found in, or had been shaped by, various statutes, presidential speeches, regulations, and reports. For example:

- Congress passed the Telecommunications Act of 1996 to encourage the deployment of advanced telecommunications capability, which includes broadband, “[and to] preserve the vibrant and competitive free market that presently exists for the Internet and other interactive computer services, unfettered by Federal or State regulation.”²¹
- In a speech delivered in March 2004, President Bush stated “that there should be universal, affordable access to broadband by 2007 and that, as soon as possible thereafter, the country should make sure that consumers have got plenty of choices for their broadband carriers.”²²

²¹Telecommunications Act of 1996, Pub. L. No. 104-104, § 509, 110 Stat. 56, 138 (1996) (amending the Communications Act of 1934).

²²Remarks by President George Bush at Expo New Mexico, Albuquerque, New Mexico, Mar. 26, 2004.

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- In 2004, FCC modified regulations applicable to local telephone companies in order to expand incentives for them to invest in network upgrades. In a series of orders, FCC ruled that incumbent local telephone companies did not have to make certain elements of their fiber networks serving residential customers available to competitors at cost-based rates.
 - A 2008 NTIA report reaffirmed President Bush’s vision of universal broadband access by noting, “[f]rom its first days, the [Bush] Administration has implemented a comprehensive and integrated package of technology, regulatory, and fiscal policies designed to lower barriers and create an environment in which broadband innovation and competition can flourish.”²³
 - The Broadband Data Improvement Act of 2008 was enacted to “improve the quality of Federal and State data regarding the availability and quality of broadband services and to promote the deployment of affordable broadband services to all parts of the Nation.”²⁴

Officials at OSTP, FCC, and NTIA during the Bush Administration told us that the current federal broadband policy was market-based; OSTP told us that the Bush Administration had implemented fiscal, technology, and regulatory policies based on the recognition that a competitive marketplace provides the best environment for achieving the United States’ broadband goals, and competitive markets should be deregulated; an official at FCC characterized FCC’s broadband policy in recent years as one that reduced barriers to entry, lessened regulation of broadband, and encouraged investment; and NTIA told us that federal broadband policies of the past few years flow from an early speech made by President Bush that emphasized the deployment of broadband, and that NTIA has executed initiatives to remove economic disincentives.

Furthermore, according to these officials, the role of the government in carrying out this policy was to create market incentives and remove barriers to competition; the role of the private sector was to fund the deployment of broadband. Accordingly, FCC, OSTP, and NTIA officials told us they took a number of steps to open markets and encourage competition. OSTP officials told us their agency has played the leading role in crafting and coordinating the administration’s broadband policy,

²³Department of Commerce, National Telecommunications Information Administration, *Networked Nation: Broadband in America 2007* (Washington, D.C., January 2008).

²⁴Pub. L. 110-385, title 1, 122 Stat. 4096 (2008).

including federal efforts to support new wireline and wireless broadband technologies. Moreover, OSTP has recommended policies to make additional spectrum available for new wireless broadband technologies.²⁵ In addition, FCC, through a number of proceedings, classified broadband Internet access (regardless of the platform) as an information service. This classification reduces regulatory requirements applicable to broadband, which FCC stated would encourage broadband deployment and promote local competition. NTIA also took action to encourage broadband deployment by increasing the amount of spectrum available for advanced services and by clearing away regulatory obstacles to promote investment.

Under this market-based policy, broadband infrastructure has been extensively deployed in the United States. Representatives of broadband providers told us this market-based approach to deployment has encouraged investment in broadband infrastructure and has been instrumental in getting this technology deployed to most of the homes in the United States. Although a precise assessment of broadband deployment in the United States is not possible because of data limitations, federal officials and industry representatives estimate that about 90 percent of American homes now have access to broadband. However, gaps remain, primarily in rural areas, because the market does not support private broadband infrastructure investment in low-density areas. For example, officials from several states said that rural areas in their states often lack broadband service. Representatives of both a provider association and a consumer organization told us that these areas lack broadband infrastructure because they offer little profit potential. To ensure broadband access to all Americans, in the Food, Conservation, and Energy Act of 2008 (the Farm Bill), Congress required FCC to develop, in consultation with the Secretary of Agriculture, a comprehensive rural broadband strategy.²⁶ FCC must submit a report to Congress by the end of May 2009 that describes a comprehensive rural broadband strategy.²⁷ The report is to include, among other things, recommendations on how to coordinate federal rural broadband initiatives and how federal programs can best respond to rural broadband requirements and overcome obstacles that currently impede rural broadband deployment.

²⁵Executive Office of the President, President's Council of Advisors on Science and Technology, "Building Out Broadband," Dec. 13, 2002.

²⁶Pub. L. 110-246 § 6112, 122 Stat. 1651, 1966 (2008).

²⁷On Mar. 10, 2009, FCC issued a public notice requesting comments on how FCC and the Department of Agriculture should implement this requirement.

In March 2009, FCC and NTIA officials told us that the federal policy on broadband deployment is changing as a new administration and Congress form their telecommunications agenda and as federal agencies work to implement recent legislation. As evidence of this change in focus, FCC and NTIA officials highlighted the new funding and responsibilities the Recovery Act has given to federal agencies to increase broadband availability, including developing a national broadband plan. The Recovery Act broadband provisions will be discussed later in this report.

Multiple Federal Programs Support Telecommunications Infrastructure Deployment, Primarily in Rural Areas, with Two Programs Specifically Funding Broadband

Eleven federal programs administered by six federal agencies help fund telecommunications infrastructure deployment, but just 2 of these programs—Rural Broadband Access Loans and Loan Guarantees program and the Community Connect Grant program—focus specifically on broadband infrastructure deployment. Both programs are administered by the Department of Agriculture’s Rural Development, Utilities Program (RDUP). In 2008, these 2 programs provided a combined total of about \$300 million for broadband infrastructure deployment. The remaining 9 programs provided over \$7 billion for the deployment of various types of telecommunications infrastructure, including broadband, in 2008. However, because these 9 programs fund telecommunications infrastructure deployment generally, and not broadband specifically, the responsible federal agencies do not systematically track the amount of funding provided for broadband infrastructure deployment. Most of these 11 federal programs focus on helping deploy telecommunications infrastructure, including broadband, to rural areas. For example, the largest program at FCC, the Universal Service High Cost program, and the largest program at RDUP, Telephone Loans and Loan Guarantees program, help incumbent local exchange carriers pay for the installation of and upgrades to telecommunications infrastructure, such as poles, lines, and switches, in rural areas. Table 2 provides additional information about all 11 programs.

Table 2: Eleven Federal Programs Supporting Infrastructure of Telecommunications Deployment, Including Broadband

| Responsible agency | Program | Description | Funding amount, and fiscal or calendar year, funding given |
|--|---|---|---|
| Broadband infrastructure deployment programs | | | |
| Rural Development, Utilities Program | Rural Broadband Access Loans and Loan Guarantees Program | Provides loans (and loan guarantees) to eligible applicants, including telephone companies, telephone cooperatives, municipalities, nonprofit organizations, and tribes, to deploy infrastructures that provide broadband service in rural communities that meet the program's eligibility requirements. | \$297.9 million Fiscal year 2008 ^a |
| Rural Development, Utilities Program | Community Connect Grant Program | Provides community access to broadband services in unserved areas through a one-time grant to such organizations as tribes, cooperatives, private companies, and universities, and uses the infrastructure built by the grant to create opportunities for continued improvement. | \$13.4 million Fiscal year 2008 |
| Telecommunications infrastructure deployment programs | | | |
| Rural Development, Utilities Program | Telephone Loans and Loan Guarantees Program | Provides long-term-direct and guaranteed loans to qualified organizations, often incumbent local exchange carriers that finance voice telephone service. Since 1995, every telephone line this program has constructed also has been capable of providing broadband service using digital subscriber line (DSL) technology. | \$685.2 million Fiscal year 2008 |
| Rural Development, Utilities Program | Distance Learning and Telemedicine Loans and Grants Program | Provides loans and grants to rural community facilities (e.g., schools, libraries, hospitals, and tribal organizations) for advanced telecommunications systems that can provide health care and educational benefits to rural areas. | \$29.8 million Fiscal year 2008 |

| Responsible agency | Program | Description | Funding amount, and fiscal or calendar year, funding given |
|--|---|---|--|
| Federal Communications Commission | Universal Service High Cost Program | Provides funding to eligible telecommunications carriers to help pay for telecommunications services in high-cost, rural, and insular areas so that prices charged to customers are reasonably comparable across all regions of the nation. | \$4.5 billion Calendar year 2008 |
| Federal Communications Commission | Universal Service Schools and Libraries Program (i.e., E-rate) | Provides discounts for affordable telecommunications and Internet access services to ensure that schools and libraries have access to affordable telecommunications and information services. | \$1.8 billion Calendar year 2008 |
| Federal Communications Commission | Universal Service Rural Health Care Pilot Program | Provides funds to cover 85 percent of the cost of constructing 66 statewide or regional broadband telehealth networks in 42 states and 3 U.S. territories and of connecting those projects to dedicated nationwide broadband telehealth networks and the public Internet. | \$13.05 million committed for funding year 2008 (July 1 to June 30) |
| Appalachian Regional Commission | Telecommunications Initiative | Provides funds for projects that enable communities to capitalize on broadband access, such as distance learning, telehealth/telemedicine, e-government, and e-business applications and workforce development. | \$3.5 million Fiscal year 2008 |
| Delta Regional Authority | Delta Area Economic Development | Grants for self-sustaining economic development projects of eight states in Mississippi Delta region. | \$687,000 Fiscal year 2008 |
| Economic Development Administration | Economic Development Facilities and Public Works | Provides funding for construction of infrastructure in areas that are not attractive to private investment; most funding is for water and sewer infrastructure but some has been designated for communications projects. | \$1.3 million Fiscal year 2008 |
| Institute of Museum and Library Services | Library Services and Technology Act Grants to States, Native American Tribes, and Organizations That Primarily Serve and Represent Native Hawaiians | Provides funds for a wide range of library services including installation of fiber and wireless networks that provide access to library resources and services. | \$164.4 million Fiscal year 2008 ^b |

Source: GAO.

Note: The 11 programs do not include the new programs, such as the Broadband Technology Opportunity Program, that will be implemented in the coming months with funding from the Recovery Act.

^aThis is the amount that was appropriated only in fiscal year 2008; it does not include the carry-over authority of \$495 million that also was available in fiscal year 2008.

^bThis amount includes approximately \$3 million spent on broadband deployment.

Although several federal programs provide funding for the deployment of telecommunications infrastructure, including broadband, there are processes and procedures in place to help coordinate agency efforts. One of these is the Office of Management and Budget's financial status report form, which must be completed by all applicants for federal funding and requires applicants to disclose sources of funding. Another is the agency application process, such as the one used by the U.S. Department of Agriculture (USDA)/RDUP, which states that applicants must list on their application all sources of federal funding they are currently receiving. Agencies also work closely together, keeping each other informed of current programs and applicants. For example, officials at the Economic Development Administration (EDA) told us that EDA coordinates with RDUP to help establish connections between broadband infrastructures deployed in rural areas, which RDUP can fund, while EDA itself funds infrastructure in more urban areas, which RDUP is prohibited from supporting. Another example of cooperation between agencies is evident in the Web sites. One site dedicated to broadband opportunities in rural America is a joint initiative of FCC and USDA. This site, hosted by FCC, lists programs overseen by USDA as well as FCC, both of which provide funding for broadband deployment in rural areas. Another Web site, used by the Appalachian Regional Commission, provides information about the numerous federal agencies with which the Commission works in the process of administering grants.

In addition to these 11 programs that fund the deployment of telecommunications infrastructure, other federal programs fund various aspects of broadband technology or use, but do not specifically support the deployment of infrastructure. For example, the Department of Education as well as the Institute of Museum and Library Services have programs that provide financial assistance for telecommunications development, but program officials told us these programs are used to develop training for using broadband or to purchase content requiring broadband access, not for broadband deployment. (App. III provides information on these other federal programs.) Finally, other federal agencies fund broadband infrastructure deployment, but this infrastructure is not for public access. For example, the Department of

Defense developed its own nonpublic broadband communications network.

Stakeholders Credit Federal Programs with Advancing Broadband Deployment, but Said More Investment Is Required to Reach Goal of Universal Availability

Industry stakeholders credit federal programs with helping to increase the deployment of broadband infrastructure throughout the United States. In particular, stakeholders noted that FCC's Universal Service High Cost Program and its Universal Service Schools and Libraries (E-Rate) Program, as well as all of RDUP's loans and grants programs have been critical in increasing broadband deployment, especially in rural areas. For example, one industry representative credited FCC's Universal Service High Cost program with helping to finance fiber deployment in rural areas; two industry representatives credit RDUP's programs with helping to deploy broadband, with one representative crediting RDUP's programs with increasing broadband deployment by lowering broadband costs. State officials we interviewed expressed similar views on these programs. For example, Arkansas officials said that federal assistance from RDUP had been useful in deploying broadband to rural and economically challenged areas of their state.

Despite the gains achieved through these programs, provider representatives and consumer advocates both told us that additional federal investment—through such mechanisms as loans, grants, or tax incentives—will likely be required to make broadband universally available. Industry representatives estimate that roughly 90 percent of Americans now have access to broadband at home, work, or through other community access points. However, getting broadband to the remaining 10 percent will be expensive, primarily because they live in rural areas. Representatives of provider companies told us that the cost of deploying broadband infrastructure in rural, low-density areas is the reason some homes do not have access. According to one representative, providing wireline service to the last 5 percent of homes will be too expensive; in low-density areas, he said it would make more sense to provide service via some type of community access program or wireless infrastructure. Although a lack of detailed information on the current state of deployment makes it difficult to determine the costs of deploying broadband infrastructure to unserved or underserved areas, estimates range from

under \$10 billion to over \$30 billion.²⁸ Several factors can influence the cost of deployment, including the terrain, speed of the service provided, and technology employed (e.g., wireline or wireless technology).²⁹ Because companies may not earn a sufficient return on their investment, some industry representatives and state Chief Information Officers (CIO) told us the federal government would likely need to subsidize broadband deployment to certain unserved or underserved areas to achieve universal access.

Additional federal investments in broadband deployment, however, do not necessarily guarantee increased adoption. Representatives from four organizations that provide broadband told us that between 80 percent and 90 percent of the residences in their service areas had access to broadband, but fewer than 60 percent subscribed; for some providers, the subscribership rate was less than 40 percent. A recent study on broadband subscribership found similar patterns. Specifically, the Pew Internet and American Life Project found that 75 percent of Americans use the Internet; 57 percent use the Internet at home through broadband, 9 percent use the Internet at home through dial-up connections, and 8 percent use the Internet from work or the library.³⁰ The report also found that some Americans, particularly elderly or low-income persons, choose not to use the Internet, even when broadband technology is available. The Pew report identified several reasons why people choose not to use the Internet, including cost and lack of interest.

²⁸Philip J. Weiser, *A Framework for a National Broadband Policy*, The Aspen Institute (Washington D.C., 2008, 13-14); *The Rural Broadband Initiative: Deploying Next-Generation Broadband Service to Rural America*, The Digital Policy Institute (Ball State University, Jan. 5, 2009, 3); NECA RURAL BROADBAND Cost Study: SUMMARY OF RESULTS, 06/21/00.

²⁹Although wired networks can usually provide higher speeds than wireless networks, in cost estimates provided by RDUP, the cost of service provided via a wireless network is about 20 percent of the cost of service provided over a wireline network.

³⁰Pew/Internet, Home Broadband Adoption 2008: *Adoption Stalls for Low-income Americans Even as Many Broadband Users Opt for Premium Services that Give Them More Speed*, John Horrigan, (Washington, D.C., July 2008). The remaining 1 percent of Americans was unsure whether their connection was broadband or dial-up.

The Recovery Act Provides Funds to Increase Broadband Availability and Establishes New Requirements for FCC and NTIA

The Recovery Act provides \$7.2 billion to increase broadband availability in the United States and establishes universal access to broadband capability as a national goal. More specifically, the Recovery Act provides funding for (1) NTIA to develop a broadband inventory map; (2) FCC to develop a national broadband plan; (3) NTIA, in consultation with FCC, to establish a grants program—referred to as the Broadband Technology Opportunities Program—to expand broadband services to rural and underserved areas and improve access to broadband by public safety agencies; and (4) RDUP to issue loans, loan guarantees, and grants to increase rural broadband availability. The Recovery Act further requires that FCC, in developing the national broadband plan, include benchmarks, a detailed strategy for achieving affordable broadband service, and an evaluation of the progress of projects funded through the Recovery Act. Although the Recovery Act assigns lead responsibilities among the agencies for these different broadband initiatives, these responsibilities are not mutually exclusive. The agencies will need to take each other's efforts into account while carrying out their individually assigned tasks. For example, NTIA's broadband inventory data will enable FCC to identify the areas with the largest unserved or underserved populations, allowing FCC to tailor the plan it develops accordingly.³¹

Given their overlapping responsibilities, it will be important for FCC, RDUP, and NTIA to coordinate their efforts. We have previously reported on the importance of coordinating federal efforts, especially when these efforts target the same population, to prevent duplication and fragmentation of effort.³² This potential for overlap and fragmentation underscores the importance for the federal government of developing the capacity to more effectively coordinate crosscutting program efforts.³³

³¹According to an FCC public notice, FCC also expects that the rural broadband strategy it is developing in response to the Farm Bill will inform its effort to develop a comprehensive national broadband plan.

³²GAO, *Results-Oriented Government: Practices That Can Help Enhance and Sustain Collaboration among Federal Agencies*, [GAO-06-15](#) (Washington, D.C.: Oct. 21, 2005); *Results-Oriented Cultures: Implementation Steps to Assist Mergers and Organizational Transformations*, [GAO-03-669](#) (Washington, D.C.: July 2, 2003); and *Managing for Results: Barriers to Interagency Coordination*, [GAO/GGD-00-106](#) (Washington, D.C.: Mar. 29, 2000).

³³Fragmentation refers to those circumstances in which more than one federal agency (or more than one bureau within an agency) is involved in a mission in the same broad area of national need. See GAO, *Managing for Results: Using the Results Act to Address Mission Fragmentation and Program Overlap*, [GAO/AIMD-97-146](#) (Washington, D.C.: Aug. 29, 1997).

Furthermore, we have noted that agencies can enhance and sustain their collaborative efforts by developing a strategy that includes necessary elements for a collaborative working relationship, such as defining and articulating a common outcome; identifying and addressing needs by leveraging resources; agreeing on roles and responsibilities; establishing compatible policies, procedures, and other means to operate across agency boundaries; and developing mechanisms to monitor, evaluate, and report on results. In commenting on a draft of this report, OSTP stated that the current administration recognizes the need for extensive coordination among the agencies.

The Broadband Policies of a Number of Other OECD Nations with Higher Broadband Subscribership Are More Detailed Than U.S. Market-Based Policy

A number of the OECD nations that lead the United States in subscribership have broadband policies that are more detailed than the U.S. policy and often include timelines, action plans, and some performance metrics. For example:

- South Korea's 2006 E-Korea Master Plan has established a goal that every household, regardless of income, is to be equipped with access to the Internet, with a minimum transmission speed of 1 Mbps. The plan created the following objectives: (1) maximize the ability of all citizens to use information and communication technologies to actively participate in the information society, (2) strengthen global competitiveness, (3) realize a smart government structure with high transparency and productivity by increasing the use of information and communication technologies, (4) facilitate continued economic growth by promoting the information technology industry and advancing the information structure, and (5) become a leader in the global infrastructure by taking a major role in international cooperation. South Korea's plan also established timelines for online services to be expanded to include all civil services and customized digital civil services by 2006, policy plans to achieve a 90 percent penetration rate for the entire population by 2006, and an evaluation system that measured the information utilization and communications technology needed to meet those objectives. Embassy officials noted that as of 2008, 99.82 percent of households in Korea have broadband access.
- Finland's National Broadband Strategy calls for making broadband available to 93 percent of the country's residents by 2009 and established the following goals: (1) promote competition within and between all communications networks, (2) promote the provision of electronic services and content to stimulate demand for broadband services, and (3) continue and develop special support measures in those areas in which there is insufficient demand for the commercial supply of broadband

facilities. Finland's written policy also identified 50 individual measures with timelines and responsible agencies for use as metrics for assessing progress in achieving the defined goals. For example, the Ministry of Education was responsible for ensuring that all schools have access to reasonably priced and efficient telecommunications by 2008. Embassy officials noted that except for the most remote schools in the far north, all schools have broadband access.

In contrast, the current U.S. policy, which is articulated in multiple sources, does not include performance measures and an action plan for implementation. The attributes of the other nations' written policies align with the framework set forth by Government Performance and Results Act of 1993 (GPRA).³⁴ GPRA stresses the importance of having clearly stated objectives, strategic and performance plans, goals, performance targets, and measures in order to improve a program's effectiveness, accountability, and service delivery. Specifically, performance measures allow an agency to track its progress in achieving intended results. Performance measures also can help inform management decisions about such issues as the need to redirect resources or shift priorities. In addition, stakeholders, such as telecommunication providers and consumer groups, can use performance measures to hold agencies accountable for results. In commenting on a draft of this report, OSTP said it was working with several other agencies to develop such metrics.

Several countries such as South Korea, Canada, and Sweden have provided financial support to spur broadband deployment in rural or underserved areas, provided incentives to private companies to build networks, and enacted a number of efforts to increase broadband subscribership and digital literacy. For example, the South Korean government established several agencies to promote broadband access in both the public and the private sector by, for instance, providing training to all citizens, including the elderly and disabled, to increase their "digital literacy" (i.e., knowledge needed to use the Internet). Canada, in 2002, provided support for rural access through the Broadband for Rural and Northern Development (BRAND) program, with funding of \$80 million to eligible communities for broadband infrastructure projects.³⁵ BRAND recommended that the government complement market forces with well-targeted government initiatives, particularly focusing on communities in

³⁴Pub. L. No. 103-62, 107 Stat. 285 (1993).

³⁵The Information Technology & Innovation Foundation, *Explaining International Broadband Leadership* (Washington, D.C., May 2008, app. A).

areas that the market is unlikely to serve. Similarly, Sweden provided subsidies for broadband infrastructure development through grants and tax relief, including funding for rural broadband deployment. In addition, the Swedish government increased demand for broadband through digital literacy programs for small and medium-sized businesses, libraries, and schools.

States Vary in Their Approaches to Increasing Broadband Deployment

Officials from 48 states and the District of Columbia reported wide variation in their approaches to increasing the level of broadband deployment in their states. More than half of the state CIOs (or their designees) we spoke with told us they were aware of gaps in broadband deployment within their states. To address these gaps, CIOs said they were considering or had taken a variety of actions, including mapping, planning, and allocating funds.

- *Mapping broadband deployment.* Twelve state CIOs reported that their states have mapped broadband deployment, and 2 of these states, California and Massachusetts, have each mapped both the speed and the availability of broadband in their state and placed the information on their state's Web site. CIOs from another 13 states told us they were planning to map their states in the near future.
- *Developing broadband deployment plans.* Twelve state CIOs told us their states have publicly available broadband deployment plans, some of which include strategies to increase deployment. For example, Utah's plan provides grants to providers to increase the deployment of broadband in rural areas. Vermont has created the Vermont Telecommunications Authority, designed to build public-private partnerships with service providers, and is working on cellular and broadband models with the goal of 100 percent access by 2010. Lastly, Maryland has defined regions of the state in need of broadband and has provided some funding to the Maryland Broadband Cooperative for the installation of fiber backbone infrastructure. In addition to these existing plans, CIOs from 6 states said they are in the process of developing broadband deployment plans.
- *Allocating funds for broadband deployment.* Fourteen state CIOs told us their states had provided some type of financial support to local providers, state cooperatives, or state agencies for broadband deployment, ranging from bonds to grants to appropriations from state budgets. In addition, some states have provided tax incentives to local providers for the provision of broadband, particularly in unserved or underserved areas. For example, Mississippi provides investment tax credits to those companies investing in the state, ranging from 5 percent to 15 percent over 10 years,

and gives the highest credits for investment in the least populous areas of the state.

- *Stimulating demand for broadband.* CIOs in several states expressed concern about the low level of broadband subscribership in their states and have taken action to stimulate demand. For example, Nebraska is providing information and training to people in rural communities using the Nebraska Business Information Technology mobile classroom for high-speed technology education. South Carolina, to encourage broadband subscribership, has a program to distribute laptops among students in grades 9 through 12 and also offers computer training in its continuing education classes.

Conclusions

With extensive private-sector investment and minimal government intervention, some type of broadband infrastructure has been deployed to approximately 90 percent of U.S. households. Bringing this infrastructure to the remaining unserved or underserved regions will, by most estimates, cost tens of billions of dollars and will likely require federal investment because of the low profit potential in these areas. The recently enacted American Recovery and Reinvestment Act establishes universal access to broadband as a goal and provides federal funding to RDUP and NTIA for grants and loans, to NTIA for mapping broadband infrastructure, and to FCC for developing a national plan for broadband deployment. These efforts will help guide federal involvement in deploying broadband in the coming years. Additionally, the efforts complement each other. NTIA's data will allow all agencies to identify and cost-effectively target federal funds to the areas with the largest unserved or underserved populations and will inform the plan developed by FCC. The Recovery Act requires that the national broadband plan include some of the elements we found in written policies of OECD nations with higher broadband subscribership, including goals and benchmarks. To achieve transparency and accountability in the use of federal funds, FCC will need to include additional elements, such as timelines, specific performance measures, and clearly defined roles and responsibilities for the responsible federal agencies. Increasing accountability for achieving intended results is especially important given the potential costs of expanding broadband deployment to currently unserved or underserved areas.

Recommendation for Executive Action

To increase transparency and accountability for results, we recommend that the Chairman of FCC, in developing the national broadband plan:

- consult the Secretary of Agriculture and the Assistant Secretary of Commerce and, at a minimum, specify performance goals and measures for broadband deployment, including time frames for achieving the goals and
- work with the Secretary of Agriculture and the Assistant Secretary of Commerce to define the roles and responsibilities for each of these agencies in carrying out the plan.

Agency Comments

We provided a draft of this report to FCC, the Department of Commerce, OSTP, and the Department of Agriculture for their review and comment. FCC and the Department of Commerce provided written comments, which are reprinted in appendixes IV and V, respectively. Both agencies emphasized the current administration's efforts to bring broadband technology to all Americans and discussed the role of the Recovery Act in realizing this goal. In its written comments, FCC recognized the need for a more definitive policy and agreed with our recommendations that performance measures and greater coordination to define roles and responsibilities are important to its implementation. In its written comments, the Department of Commerce emphasized that it is working closely with the Department of Agriculture and FCC to ensure the success of the President's broadband initiatives and noted that, to some extent, the Recovery Act defined the roles and responsibilities of each agency involved in the development and implementation of a national broadband deployment plan. We recognize in the report that the Recovery Act assigns lead responsibilities to the agencies for different broadband initiatives; however, given that these responsibilities are not mutually exclusive, we continue to believe further delineation of the roles and responsibilities is warranted. FCC, the Department of Commerce, and OSTP, through the National Economic Council, provided technical comments, which we incorporated as appropriate. The Department of Agriculture responded through RDUP that it did not have any comments on the draft report.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to the Chairman of the Federal Communications Commission and other interested parties. In addition, the report will be available at no charge on the GAO Web site at <http://www.gao.gov>.

If you have any questions about this report, please contact me at (202) 512-2834 or goldsteinm@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Contact information and major contributors to this report are listed on appendix VI.

Sincerely yours,

A handwritten signature in black ink, appearing to read 'Mark L. Goldstein', with a long horizontal flourish extending to the right.

Mark L. Goldstein
Director, Physical Infrastructure Issues

Appendix I: Comparison of Various Broadband Organization Rankings

Although the Organisation for Economic Co-operation and Development's (OECD) rankings are an important source of information on the status of broadband in many countries, OECD is not the only organization that measures broadband deployment and subscribership, and the OECD metric we have discussed—subscribership per 100 inhabitants—is not the only available metric. Other ranking organizations include the Information Technology and Innovation Foundation (ITIF)¹ and Web Site Optimization,² and their metrics include the percentage of households that subscribe to broadband and the percentage of households that have access to broadband. In addition, OECD uses other metrics to assess the status of broadband in many countries, such as broadband affordability and download speeds. Figure 1 compares broadband rankings for the United States and other OECD countries. The figure includes OECD's second quarter 2008 rankings of subscribership per 100 inhabitants and ITIF's and Web Site Optimization's rankings. The figure shows that while the United States ranks 15th in the number of subscribers per 100 inhabitants, it ranks 10th and 11th in the other reports in the percentage of households that subscribe to or have access to broadband.

As the figure indicates, countries' rankings vary with the metric used. For example, while Japan ranks second in ITIF's composite score of subscribership, speed, and price, it places 17th in OECD's June 2008 ranking of subscribership per 100 inhabitants. Similarly, South Korea, which ITIF ranks first, with 93 percent household penetration, is 7th in OECD's June 2008 ranking of subscribers per 100 inhabitants. In an April 24, 2007, letter to OECD, U.S. Ambassador David Gross took issue with the methodology on which OECD's new ranking was based, particularly because it does not include people who gain access to broadband services through multiple platforms and access points, such as college students and others who use "Wi-Fi hotspots."³

¹ITIF (<http://www.itif.org>) is a nonpartisan research and educational institute—a think tank—whose mission is to formulate and promote public policies to advance technological innovation and productivity internationally, in Washington, and in the states.

²Web Site Optimization (<http://www.websiteoptimization.com>) is a Web performance and Internet marketing firm.

³Ambassador David A. Gross, United States Coordinator, International Communications and Information Policy, United States Department of State, Washington, D.C.

**Appendix I: Comparison of Various
Broadband Organization Rankings**

Figure 1: Comparison of Country Rankings on OECD, ITIF, and Website Optimization Broadband Indexes

| Nation | OECD ranking | ITIF ranking | OECD broadband penetration per 100 inhabitants | ITIF household penetration (subscribers per household) | Website optimization household penetration (percentage) | Countries' percentage of total OECD broadband subscribers |
|----------------|--------------|--------------|--|--|---|---|
| Denmark | 1 | 7 | 37 | 0.76 | 80 | 1 |
| Netherlands | 2 | 4 | 36 | 0.77 | 80 | 2 |
| Norway | 3 | 9 | 33 | 0.68 | 75 | 1 |
| Switzerland | 4 | 10 | 32 | 0.74 | 80 | 1 |
| Iceland | 5 | 8 | 32 | 0.83 | 80 | Less than 1% |
| Sweden | 6 | 6 | 32 | 0.54 | 65 | 1 |
| South Korea | 7 | 1 | 31 | 0.93 | 97 | 6 |
| Finland | 8 | 3 | 31 | 0.61 | 69 | 1 |
| Luxembourg | 9 | 14 | 28 | 0.56 | 77 | Less than 1% |
| Canada | 10 | 11 | 28 | 0.65 | 72 | 4 |
| United Kingdom | 11 | 13 | 28 | 0.55 | 67 | 7 |
| Belgium | 12 | 17 | 26 | 0.57 | 61 | 1 |
| France | 13 | 5 | 26 | 0.54 | 66 | 7 |
| Germany | 14 | 16 | 26 | 0.47 | 58 | 9 |
| United States | 15 | 15 | 25 | 0.57 | 67 | 30 |
| Australia | 16 | 12 | 24 | 0.59 | 78 | 2 |
| Japan | 17 | 2 | 23 | 0.55 | 61 | 12 |
| | | | 0 10 20 30 40 50 60 70 80 90 100 | 0 0.2 0.4 0.6 0.8 1.0 | 0 10 20 30 40 50 60 70 80 90 100 | 0 10 20 30 40 50 60 70 80 90 100 |
| | | | Penetration per 100 households | Subscribers per household | Percentage | Percentage |

Source: GAO presentation of Organization for Economic Cooperation and Development (OECD), Information Technology and Innovation Foundation (ITIF) and Website Optimization data.

Appendix II: Scope and Methodology

To determine the current federal broadband policy, we interviewed officials at the Office of Science and Technology Policy (OSTP), the National Telecommunications and Information Administration (NTIA), and the Federal Communications Commission (FCC), and reviewed recent reports by FCC and NTIA.¹ To learn about the broadband policies of those countries that the OECD, in June 2008, ranked ahead of the United States in broadband subscribership per 100 residents, we contacted each country's embassy in the United States.² We requested information from embassy officials on whether their country's current broadband policy included the following: a written policy, a timeline, an action plan, goals, and performance measures. We selected these items because the Government Performance and Results Act of 1993 (GPRA) emphasizes these elements as important for the effective and efficient management of government programs.

To determine the principal federal programs that support the deployment of broadband infrastructure, we reviewed a Congressional Research Service (CRS) report to Congress, *Broadband Internet Access and the Digital Divide: Federal Assistance Programs*, updated June 4, 2008, which lists federal domestic assistance that can be associated with telecommunications development, including broadband deployment. This list includes 11 federal agencies and 23 federal programs. After an initial review of this list and some preliminary audit work, we reduced this list to 19 programs administered by a total of 8 federal agencies. We interviewed federal officials at all 8 agencies listed by CRS and reviewed information about their programs and determined that 5 agencies and commissions overseeing a total of 10 programs specifically fund the deployment of telecommunications infrastructure, including broadband infrastructure.

To obtain various stakeholders' views on how federal programs have affected broadband infrastructure deployment, we interviewed officials of associations that represented wireless providers and telecommunications and cable companies, large and small, urban and rural. We also

¹U.S. Department of Commerce, National Telecommunications and Information Administration, *Networked Nation: Broadband in America 2007*, Washington, D.C., January 2008; FCC, *High Speed Services for Internet Access: Status as of June 30, 2007*, March 2008.

²We did not assess the reliability of the data used by OECD to rank countries on various indexes because the data are provided to OECD by the governments of the individual countries and the methodology used by each country to compile such data is not presented in the report.

interviewed officials of organizations representing consumers, including those who are economically disadvantaged. For both provider and consumer representatives, we developed and used sets of questions about their views on current federal policy and programs, the current status of broadband deployment and subscribership, the level of competition, the reasons for the lack of access to broadband in some areas, and suggestions for improvements in the current federal programs. The organizations and associations whose representatives we interviewed are as follows:

Alliance for Public Technology (APT)
American Cable Association
Connected Nation
Consumer Federation of America
National Association of State Utility Consumer Advocates (NASUCA)
One Economy
Organization for the Promotion and Advancement of Small Telephone Companies (OPASTCO)
PEW Internet Project
Rural Independent Competitive Alliance (RICA)
The Wireless Association (CTIA)
Wireless Internet Service Providers Association (WISPA)

To learn the states' views on the federal government's efforts to increase broadband infrastructure deployment as well as actions the states have taken to encourage broadband deployment, we developed a set of questions in consultation with GAO methodologists and used them to interview each state's Chief Information Officer (CIO) or designee. We interviewed the CIOs in 48 of the 50 states and the District of Columbia. Two states were unavailable because of internal issues. We conducted these interviews from August 15, 2008, until February 6, 2009, and sought information on state officials' views on the current federal broadband policy and programs, how they could be improved, and what actions the state governments had taken to increase broadband deployment. We selected the CIOs as the most knowledgeable source of information about state broadband activities based on our understanding that broadband is not regulated by state utility commissions and our conversation with representatives of the National Association of State Chief Information Officers.

We conducted this performance audit from March 2008 through May 2009 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain

sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix III: Agencies That Fund Some Aspects of Telecommunications, but Not Infrastructure

To determine the principal federal programs that support the deployment of broadband infrastructure, we reviewed the CRS report that identifies federal domestic assistance that can be associated with telecommunications development, including broadband deployment.¹ This report identified a total of 23 programs administered by 11 agencies. Based on information in the CRS report and initial conversations with agency representatives, we removed 7 programs and 3 agencies: We determined that 2 programs should not be included because they did not provide funding for telecommunications infrastructure that could be accessed by any member of the public; we eliminated 3 more programs because the agencies told us they no longer fund any telecommunications infrastructure; lastly we removed 2 programs by subsuming them into another program, which we added at the advice of the agency. We then added 6 more programs for a total of 7 additions to the original list provided by CRS. This left a total of 23 programs administered by 8 agencies. We interviewed federal officials at all 8 agencies and examined program documentation to determine whether these programs provide financial assistance for broadband deployment. Based on our analysis, we determined that 11 programs administered by 6 agencies do provide such funding, as shown in table 2 in the main report, and 12 programs administered by 3 agencies do not (ILMS programs are listed in both tables). Table 3 identifies the agencies and programs that do not fund telecommunications infrastructure.

¹CRS, *Broadband Internet Access and the Digital Divide: Federal Assistance Programs* (Washington, D.C., June 4, 2008).

Appendix III: Agencies That Fund Some Aspects of Telecommunications, but Not Infrastructure

Table 3: Agencies that Fund Some Aspect of Telecommunications, but Not Infrastructure

| Responsible agency | Program | Description | Reason for exclusion |
|---|---|--|--|
| Department of Education | Education Technology State Grants | Grants to states or school districts to use technology to improve student achievement; improve technological literacy of students, and integrate technology into the curriculum. | Does not fund broadband deployment. |
| Department of Education | Star Schools | Grants to use information technology to improve teaching and learning of core academic subjects in schools. | Does not fund broadband deployment. |
| Department of Education | Ready to Teach | Grants to carry out a national telecommunications-based program to improve teaching in core curriculum areas. | Grant money not intended for broadband deployment. Grant money is used for development of online professional development programs. |
| Department of Education | Special Education—Technology and Media Services for Individuals with Disabilities | Supports development and application of technology and education media activities for disabled children and adults. | Grant money not intended for broadband deployment. Grant money supports creation of special educational materials and technologies, such as materials and technologies accessible to and useable by students with physical and sensory disabilities. |
| Department of Health and Human Services, Health Resources and Services Administration | Telehealth Network Grant Program | Provides grant funds to rural health care networks to develop telehealth services that use broadband infrastructure. | Generally does not support deployment of broadband infrastructure but does pay for the purchase of advanced telecommunications services. |
| Department of Health and Human Services, Health Resources and Services Administration | Telehealth Resource Center Grant Program | Provides grants that support establishment and development of telehealth resource centers, which assist health care organizations, health care networks, and health care providers in the implementation of cost-effective telehealth programs to serve rural and medically underserved areas. | Generally does not support deployment of broadband infrastructure. |
| Department of Health and Human Services, Health Resources and Services Administration | Licensure Portability Grant Program | Provides support for state professional licensing boards to develop and implement state policies that will reduce statutory and regulatory barriers to telemedicine. | Generally does not support deployment of broadband infrastructure. |

Appendix III: Agencies That Fund Some Aspects of Telecommunications, but Not Infrastructure

| Responsible agency | Program | Description | Reason for exclusion |
|--|---|--|--|
| Department of Health and Human Services, National Library of Medicine | Medical Library Assistance | Provides funds to train professional personnel and strengthen library information services. Facilitates access to and delivery of health science information. Plans and develops advanced information networks. Supports certain biomedical publications. Conducts research in medical informatics and related sciences. | Generally does not support deployment of broadband infrastructure. |
| Institute of Museum and Library Services, National Foundation on the Arts and Humanities | National Leadership Grants | Supports projects with national impact that advance the ability of museums and libraries to preserve culture, heritage, and knowledge and to enhance learning. | Does not support deployment of broadband infrastructure. |
| Institute of Museum and Library Services, National Foundation on the Arts and Humanities | Laura Bush 21st Century Librarian Program | Supports project to develop library leaders and recruit and educate the next generation of librarians. | Does not support deployment of broadband. |
| Institute of Museum and Library Services, National Foundation on the Arts and Humanities | 21st Century Museum Professionals | Improve the knowledge and skills of museum professionals. | Does not support deployment of broadband. |
| Institute of Museum and Library Services, National Foundation on the Arts and Humanities | Museums for America | Supports projects that build museums' capacity to serve their communities. | Does not support deployment of broadband. |

Source: GAO and CRS.

Appendix IV: Comments from the Federal Communications Commission



OFFICE OF
THE CHAIRMAN

FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON

May 1, 2009

Mr. Mark L. Goldstein
Director, Physical Infrastructure
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Goldstein:

Thank you for the opportunity to review the draft Government Accountability Office (GAO) report regarding federal broadband deployment policy. We welcome GAO's suggestions on advancing the national broadband plan required by the American Recovery and Reinvestment Act.¹

Your draft report takes note of the country's poor standing in the international rankings of broadband penetration. I have been concerned for many years that when it comes to broadband, the United States continues to be far too low in the global rankings. Broadband can be the great enabler that restores America's economic well-being and opens doors of opportunity for all Americans to pass through, no matter who they are, where they live, or the particular circumstances of their individual lives. And yet, as a country, we have been well out of the lead for some time in getting this essential technology out to our citizens. I believe this, in large part, is due to a failure to develop a national plan for broadband advancement.

As your draft report finds, the last administration had a free-market approach to broadband regulation. There was some build-out under this approach, but not nearly enough. Quite simply, the free market alone cannot solve the problems we face. We have gotten away from our all-American tradition of handling infrastructure challenges through public-private partnership, such as the ones that built this country's roads, turnpikes, canals, harbors, railroads and highways. In order to succeed in bringing modern communications to all of our citizens, we must again employ such a concerted approach. I commend the Obama administration for its leadership in establishing broadband as a priority and recognizing that achieving the country's full potential in this area will require a coordinated, multi-faceted effort.

¹ American Recovery and Reinvestment Act of 2009, Pub. L. No. 111-5 (Recovery Act), § 6001(k)(2).

The development of a national plan for achieving universal, nationwide access to broadband capability is a central element of the ongoing federal efforts directed at broadband. I applaud the Congress for mandating that this country develop a national broadband plan by February 2010. I consider this mandate to be one of the most important charges that Congress has bestowed upon this Commission since passage of the Telecommunications Act of 1996, and we are dedicating ourselves to a fulsome, forward-looking, and data-driven approach to making this nation a beacon to the world in broadband deployment and use. The funding that the Recovery Act provided for grants and loans for particular broadband projects is a very important down-payment on this nation's broadband future, and will inform us also as we develop a long-term national broadband plan.

In its draft report, GAO recommends that, in developing the national broadband plan, the Chairman of the Federal Communications Commission (Commission) consult with the Secretary of Agriculture and the leadership of the National Telecommunications and Information Administration (NTIA) and that, working with those leaders, at a minimum: 1) specify performance goals and measures for broadband deployment, including time-frames for achieving them, and 2) define the roles and responsibilities for each of these agencies in carrying out the plan.² I am pleased to note that federal interagency coordination of broadband-related efforts under the Recovery Act and other legislation is well underway. Early on, the Obama administration formed an interagency working group to bring relevant agencies together to talk about broadband issues of common interest. The working group includes representatives from NTIA and the U.S. Department of Agriculture (USDA), as well as the Commission and others. The continuing dialogue facilitated by this forum will enable the Commission and other agencies with broadband-related obligations under the Recovery Act to carry out their efforts in a coordinated fashion, consistent with the recommendations in the draft report.

With regard to the Commission's efforts to develop a plan, on April 8, we unanimously voted to initiate a Notice of Inquiry on the national broadband plan, seeking comment on a wide range of issues associated with its development.³ Many of these issues pertain to the subject matter of the draft report's recommendations to the Commission: creating benchmarks for meeting the Recovery Act's mandate of universal access to broadband capability nationwide,⁴ measuring progress under the national broadband plan,⁵ and coordinating Commission efforts with those of other agencies tasked with broadband-related obligations under the Recovery Act, including the USDA's Rural Utilities Service (RUS) and NTIA.⁶ In particular, the Commission requested comment on how the NTIA grant programs and the RUS rural broadband

² GAO Report at 23-24.

³ *A National Broadband Plan for Our Future*, GN Docket No. 09-51, Notice of Inquiry, FCC 09-31 (rel. Apr. 8, 2009) (*Broadband NOI*).

⁴ *Id.* at paras. 14-28.

⁵ *Id.* at paras. 29-34.

⁶ *Id.* at paras. 62, 112-18.

programs should inform Commission analysis and development of the national broadband plan.⁷ Also in this regard, the Commission asked for comment on the specific steps agencies should take to cooperate with each other to ensure that their broadband programs under the Recovery Act are consistent.⁸

Significantly, the *Broadband NOI* also referenced the Government Performance and Results Act, which requires federal agencies to develop performance measures for major functions and operations,⁹ and GAO's previous recommendation that agency plans articulate a results orientation by creating performance measures that address important dimensions of a program.¹⁰ With regard to the former, the Commission took note of recent guidance issued by OMB covering agencies involved in Recovery Act initiatives.¹¹ This guidance, which was updated on April 3, 2009, requires such agencies to submit finalized program plans by May 15, 2009 that include measures of quantifiable outcomes supported by corresponding quantifiable output measures.¹² The Commission is currently working to develop outcomes and measures for submission to OMB, but has also sought comment in the *Broadband NOI* on outcomes and measures that would be useful in assessing progress toward the goals of a national broadband plan.¹³ In the *Broadband NOI*, the Commission further requested comment on how progress under the plan can be measured relative to progress that would have occurred in the absence of any program, so that we may all better understand the impact of the program.¹⁴

Comments on the issues raised in the *Broadband NOI* are due on June 8, 2009, and reply comments are due on July 7, 2009. We look forward to reviewing the record in this proceeding to gain insight from all stakeholders into the best ways to develop and carry out the national broadband plan. Consistent with the recommendations in the draft report, we intend to continue coordinating closely with the other agencies involved in broadband related initiatives as we move forward with this and other Recovery Act proceedings.

⁷ *Id.* at para. 36.

⁸ *Id.* at para. 113.

⁹ *Id.* at para. 34 (citing Government Performance and Results Act of 1993, Pub. L. No. 103-62, 107 Stat. 285 (GPRA)).

¹⁰ *Broadband NOI* at para. 34 (citing United States Government Accountability Office, "Agency Performance Plans: Examples of Practices That Can Improve Usefulness to Decisionmakers," GAO/GGD/AIMD-99-69 (February 1999) and United States Government Accountability Office, "Telecommunications: FCC Needs to Improve Performance Management and Strengthen Oversight of the High-Cost Program," GAO-08-633 (June 2008)).

¹¹ *Broadband NOI* at para. 34 (citing Office of Management and Budget, "Initial Implementing Guidance for the American Recovery and Reinvestment Act of 2009," Memorandum, M-09-10 (Feb. 18, 2009)).

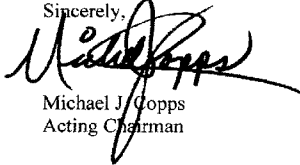
¹² "Updated Implementing Guidance for the American Recovery and Reinvestment Act of 2009," Memorandum, M-09-15 (April 3, 2009).

¹³ *Broadband NOI* at para. 34.

¹⁴ *Id.*

**Appendix IV: Comments from the Federal
Communications Commission**

Thank you again for your recommendations. As I have indicated previously, I view the Commission's charge to spearhead the development of a national broadband plan as an extraordinarily important one, and my colleagues and I are determined to give it our best possible effort.

Sincerely,

Michael J. Copps
Acting Chairman

Appendix V: Comments from the Department of Commerce



THE SECRETARY OF COMMERCE
Washington, D.C. 20230

April 29, 2009

Mr. Mark L. Goldstein
Director, Physical Infrastructure
Government Accountability Office
441 G Street, N.W.
Washington, DC 20548

Dear Mr. Goldstein:

Thank you for the opportunity to comment on the Government Accountability Office's (GAO) draft report entitled "*Telecommunications: Broadband Deployment Plan Should Include Performance Goals and Measures to Guide Investment*," GAO-09-494. While the report focused primarily on the broadband policy goals of the previous administration, I would like to take this opportunity to reiterate President Obama's vision of bringing the benefits of broadband technology to all Americans.

As GAO's report recognizes, in February 2009 the President signed the American Recovery and Reinvestment Act of 2009 (Recovery Act), which authorized \$7.2 billion for the development of a national broadband plan, the nationwide mapping of broadband service availability, and the deployment of broadband infrastructure and services to unserved and underserved areas. To meet the challenge of bringing affordable broadband to all Americans and to meet the statutory mandates of the Recovery Act, this Administration has set five goals for broadband stimulus funding: (1) create jobs; (2) expand broadband access in America; (3) stimulate investment by requiring grantees that take Federal money to invest some of their own funds; (4) ensure that our schools, universities, libraries, community centers, job training centers, hospitals, and public safety personnel have access to high-speed broadband service; and (5) encourage demand for broadband access.

The Department of Commerce's National Telecommunications and Information Administration (NTIA) has a significant role in the President's broadband initiatives. The Recovery Act authorizes NTIA to implement the Broadband Technology Opportunities Program (BTOP), a \$4.7 billion competitive grants program to expand broadband services to unserved and underserved areas. Through the BTOP, NTIA will provide competitive grants to States, nonprofit organizations, and—if it is determined to be in the public interest—broadband service providers. NTIA is working to ensure that BTOP is administered effectively and efficiently. For example, NTIA is focused on creating metrics and reporting requirements that will ensure that the grants we make are effective in moving the country closer to the Administration's broadband goals.

In its draft report, GAO recommends that, to increase transparency and accountability for results, the Chairman of the Federal Communications Commission (FCC) should consult with the Secretary of Agriculture and the Department of Commerce's Assistant Secretary for Communications and Information in developing a broadband plan which, at a minimum, specifies performance goals and measures for broadband deployment, including time frames for achieving the goals. GAO further recommends that the FCC Chairman work with the Secretary of Agriculture and the Assistant Secretary for Communications and Information to define the roles and responsibilities of each of these agencies in carrying out the plan.

Mr. Mark L. Goldstein
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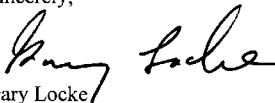
The Recovery Act, to a certain extent, has defined roles for each agency regarding the development and implementation of a national broadband plan. The Recovery Act requires NTIA to establish a national broadband service deployment expansion plan, in consultation with the FCC, and to develop and maintain a comprehensive nationwide inventory map of existing broadband service capability and availability. It also directs NTIA to coordinate with the FCC in establishing non-discrimination and network interconnection obligations for applicants under the BTOP grant program. The Recovery Act directs the FCC to develop a national broadband plan, in consultation with the Department of Commerce, to ensure that all people of the United States have access to broadband capability. It provides for the FCC to have access to mapping data and metrics provided to the Department of Commerce and other government agencies pursuant to the Broadband Data Improvement Act, Public Law No. 110-385, for the purpose of developing the national broadband plan. The Recovery Act also provides new authorization for the Department of Agriculture's Rural Utilities Service (RUS) to continue to provide broadband grants, loans, and loan guarantees to establish broadband service in rural areas without sufficient access to high-speed broadband service.

I am pleased to report that, in the relatively short amount of time since the Recovery Act was signed, the Department of Commerce, the Department of Agriculture, and the FCC have worked very closely to ensure the success of the President's broadband initiatives. NTIA, the FCC, and the RUS have coordinated efforts to provide the public with general information regarding the broadband initiatives, and to receive input from the public on how the agencies should structure their respective broadband grant and loan programs.

On March 10, 2009, senior officials from each of these entities held a kickoff public meeting to discuss aspects of the Recovery Act. Subsequently, NTIA and the RUS held a series of public meetings, including field hearings in Flagstaff, Arizona, and Las Vegas, Nevada, to afford interested Americans the opportunity to help shape the broadband program so that the stimulus funds can be used efficiently and effectively. These meetings entailed discussions on specific topics related to broadband initiatives, including grantee eligibility; interconnection obligations; definitions of broadband and underserved, rural, and unserved areas; and the role of the States. Moreover, on March 12, 2009, NTIA and RUS published a joint Request for Information seeking comments to assist NTIA in establishing and administering BTOP, and RUS in implementing its expanded authority under the Recovery Act. In addition, the FCC recently released a Notice of Inquiry seeking comment on the development of the national broadband plan to further implement the President's broadband initiatives. (See *In the Matter of the National Broadband Plan*, FCC 09-31, Notice of Inquiry, GN Doc. No. 09-51 (rel. April, 8, 2009).)

Thank you again for the opportunity to provide the Department's comments on this draft report. The Obama Administration is committed to meeting the challenges and executing the opportunities provided by the Recovery Act in order to stimulate economic growth, create jobs, and help lay the foundation for long-term prosperity for all Americans.

Sincerely,



Gary Locke

Appendix VI: GAO Contact and Staff Acknowledgments

GAO Contact

Mark L. Goldstein, (202) 512-2834 or goldsteinm@gao.gov

Staff Acknowledgments

In addition to the contact named above, Nikki Clowers and Faye Morrison, Assistant Directors; Stephen Brown; Elizabeth Curda; Sharon Dyer; Kevin Egan; Elizabeth Eisenstadt; David Hooper; Hannah Laufe; Sara Ann Moessbauer; Josh Ormond; Madhav Panwar; and Nancy Zearfoss made key contributions to this report.

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