



The New Mexico Broadband Program

Community Broadband Master Plan Guidebook

Version 1.1, March 2013
Version 1, December 2012

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Table of Revisions

Version 1 to Version 1.1	
Section	Revision
Chapter 1	New Mexico Broadband Map: Enhanced editing. Added explanatory text and figures to clarify or illustrate concepts.
Chapter 1	National Broadband Map: Enhanced editing. Added explanatory text and figures to clarify or illustrate concepts.
Appendix B	Broadband Definitions: New section.
Appendix C	Table of Abbreviations and Acronyms: New section.

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Introduction

The State of New Mexico Broadband Program was founded on the belief that the Internet is an important tool for economic, educational, and civic growth and discourse—and that it is imperative that *all* residents have broadband connectivity. To that end, we seek to build broadband capacity and enhance broadband adoption by providing municipal and tribal entities across the state with tools that will help them plan for their broadband futures.

In straightforward language and with action-oriented summaries, this guidebook explores a range of proven technical, business, and partnership models—as well as some that are more cutting edge. Importantly, the guidebook also frankly assesses the benefits and risks of each model, so that communities can determine the best approach for their unique circumstances.

This guidebook is not meant to be a comprehensive guide—because every community that considers the feasibility of broadband networking must customize the analysis of its own needs, potential benefits, and risks. Instead, the guidebook focuses on empowering native nations, towns, cities, and counties by helping them understand the type of questions they need to be asking. It also lists “next steps” and offers actionable advice on issues such as where communities can look for partners, what type of funding opportunities exist, and what the risks and rewards of broadband networking might be for the government and its citizens.

Who Should Be at the Table?

Local elected officials and their staffs often have the necessary experience to oversee significant local infrastructure initiatives. Community broadband initiatives, however, typically require involvement from many agencies and departments, and benefit from the inclusion of public institutions and potential private sector partners. Such an initiative would also benefit from the inclusion of team members who have hands-on experience with telecommunications initiatives, if such expertise exists within the community.

As communities embark on broadband projects, we recommend that the project leader build a team that includes both potential users and potential beneficiaries of a communications network. Typically, these stakeholders will include representatives—often the chief information officer, chief technology officer, or IT director—from among the following types of organizations:

- Municipal/tribal departments of information technology (IT)
- Public and private schools and school systems
- Public library systems
- Community colleges and technical/vocational colleges
- Major hospital/healthcare providers

Stakeholders will also often include representatives of:

- Police, fire, homeland security, and other public safety departments
- Municipal/tribal department of economic development
- Public and private electric utilities
- Community support organizations
- Chambers of commerce
- Economic Development authorities
- Regional governmental committees
- Elected officials (mayors, councilmembers)

By including members who bring not just technical experience, but the ability to speak for various groups and interests, the team will reflect true community engagement. Such broad involvement will ultimately lead to better outcomes, because the team's initiative will be the result of collaboration and compromise among a variety of potentially competing interests.

What's Next?

This concise guide has been written to help communities plan broadband initiatives, and become more knowledgeable evaluators of broadband plans. Because vendors have an interest in presenting their products and services in the best light, for example, the guide offers the tools communities need to appraise the promises they hear about proposed broadband projects.

The guidebook is divided into chapters that survey a wide range of community broadband issues that public sector entities have faced nationwide:

Chapter 1: Determining Your Broadband Needs

Broadband is not an end in itself. The value of broadband to local government and its citizens is its ability to reliably and consistently deliver applications—from Internet content and e-mail to videoconferencing, Voice over Internet Protocol (VoIP), and distance learning. This chapter offers guidance to local governments on understanding their communities' broadband needs, both on the supply side (broadband availability) and the demand side (broadband use and adoption). It includes information about using the New Mexico Broadband Map to explore a community's broadband services, a checklist-type matrix for listing the community's current providers and services, and the potential aggregate demand among government, public institutions, businesses, and other relevant users.

Chapter 2: Identifying and Collaborating with Existing Broadband Providers

While the incumbent cable and telephone providers are easy enough to identify, many local governments do not know about the full range of entities that are capable of delivering services, possibly in partnership with the community. This chapter explains what private providers may be available to public entities; how to approach them; and what to ask of them. The list of potential providers includes community non-profits, national non-profits, incumbent cable and telephone operators; entrepreneurial local and regional service providers; and others.

Chapter 3: Understanding the True Availability of Broadband in Your Community

Delving deep into the supply side of the broadband equation, we offer guidance on accurate broadband mapping. Specifically, we explain the basic steps for how to ascertain the true availability of broadband in a given community and how to verify the accuracy of the data collected by the state and published by the federal government through the National Broadband Map. This is a critical issue, because in many cases the mapping data, which are published jointly by the National Telecommunications and Information Administration (NTIA) and the Federal Communications Commission (FCC), have been insufficiently granular to give a local community a full picture of its broadband supply.

As in other chapters, we provide a concise overview of the issue, and action-oriented checklists/matrices to help readers capture the essential information about their communities.

Chapter 4: Broadband Technologies

This chapter provides a high-level primer of broadband technologies, from fiber-to-the-premises (FTTP) to satellite, with particular attention to fiber optics and emerging wireless broadband. We review the advantages and disadvantages of the technologies, and discuss their abilities to support both evolving communications requirements and consumer expectations.

Chapter 5: Public-Private Partnerships

This section of the guidebook surveys a range of factors to be analyzed as a community considers entering into a public-private partnership to develop a broadband network. The variety of public-private partnership models reflects the diversity of interests, goals, and resources among the many communities seeking to build high-speed networks for their citizens.

Chapter 6: Broadband Funding Mechanisms

The natural extension of a discussion of broadband network partnerships and business models is a discussion of project funding mechanisms. This chapter presents strategies that local governments can take to identify funding sources for community broadband projects, including federal E-rate subsidies, the U.S. Department of Agriculture's Rural Utilities Service (RUS) loan and grant programs, other federal grant programs, and other current and potential funding sources.

Chapter 7: Benefits On and Off the Balance Sheet

As with any significant public investment, a broadband initiative requires detailed financial analysis and a calculation of the potential return on investment. However, we believe that local governments should also consider the "benefits beyond the balance sheet"—the intangible rewards that broadband offers the community as a whole and might deliver to individual citizens. This chapter provides a general discussion of the full range of quantifiable and non-quantifiable benefits that may inform a robust public discussion of a community broadband initiative. The off-the-balance-sheet benefits include economic development, positive environmental impacts created by increased telecommuting, and improved educational outcomes realized through delivery of innovative multimedia lessons.

Chapter 8: Risks of Broadband Initiatives

Understanding the risks inherent in pursuing a community broadband initiative is essential to a successful outcome. This chapter briefly introduces a range of potential risk factors that project

stakeholders should consider before as part of their planning process, including political, legislative/regulatory, legal, market/competitive, operational, and financial.

Chapter 9: Community Engagement

The final chapter of the guidebook shares some of the lessons learned in other communities nationwide about how to maximize the chances of success by engaging a broad range of community partners as stakeholders in the initiatives—ranging from the Chamber of Commerce and business community to local non-profits and unions. This chapter will emphasize that every part of the community can be part of improving broadband outcomes.

Chapter 1: Determining Your Broadband Needs

Broadband refers to a high-speed, always-on connection to the Internet, providing two-way data transmission. Common broadband technology types include DSL (digital subscriber line), cable, fiber, and wireless. The value of broadband to local government and its citizens is its ability to reliably and consistently deliver applications, from Internet content and e-mail to videoconferencing, Voice over Internet Protocol (VoIP), and distance learning. In other words, broadband is not an end in itself—it is a tool that local and tribal governments can use to meet their internal needs, and the needs of their communities.

Broadband is also a vital resource for private sector development and economic growth. The key is to quantify and qualify those requirements. Future chapters will delve deeper into each of these issues. In this chapter, we will offer guidance on understanding your broadband needs, both on the supply side (broadband availability) and the demand side (broadband use and adoption), and information about using the New Mexico Broadband Map to explore broadband services in your community. ‘Chapter 4: Broadband Technologies’ and ‘Appendix B: Broadband Definitions’ contain descriptions of and definitions for broadband technology types and other terms.

Broadband Supply

With regard to supply, it is important to understand what services are available in your market. Developing this picture requires a methodical approach to surveying the marketplace.

New Mexico Broadband Map

The clear starting point for any community that seeks to understand its broadband availability is the New Mexico Broadband Web Map (NMBB Map). The New Mexico Broadband Program (NMBBP) collects data from Internet Service Providers (ISPs) every six months for the NMBB Map. The data, which are based on federal reporting standards, are solicited from broadband service providers across the state. Submitted ISP data are validated and processed; the NMBB Map is then updated to reflect new or revised broadband availability.

Wireline broadband data are aggregated and displayed on the map at the Census-Block level, whereas wireless data are displayed as provided by the ISP. If an ISP does not provide wireless-coverage data, the NMBB Program generates a wireless-data coverage using propagation modeling software with ISP-provided tower specifications; this generated coverage is then displayed on the NMBB Map.

The NMBB Program submits the validated and processed ISP data to the National Telecommunications & Information Administration (NTIA), also every six months, and the NTIA performs additional validation and processing before using New Mexico’s data with the National Broadband Map.

You can use the publicly accessible NMBB Map (<http://nmbbmapping.org/mapping/>) to conduct research and explore broadband coverage and providers. Use the NMBB Web map to:

- View existing broadband coverage for your area.
- Identify broadband providers and available technologies in your area.
- Report inaccuracies in the mapped coverage.

When visitors access the NMBB Map, they are greeted with an opening screen that describes what information is available on the map and how to search the data (Figure 1).

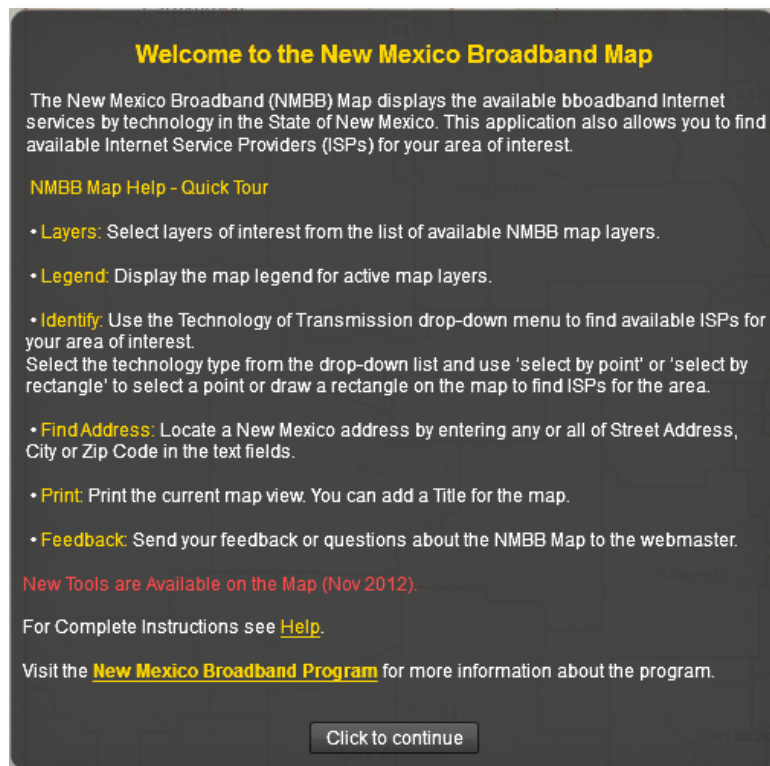


Figure 1: New Mexico Broadband (NMBB) Map—Welcome Screen

The NMBB Map opens with a high-level view of the state (Figure 2); users can then display data layers of interest and zoom in to the map to see a particular region or community. Please review the User Guide (on the 'Help' page), which describes all NMBB Map features and tools.

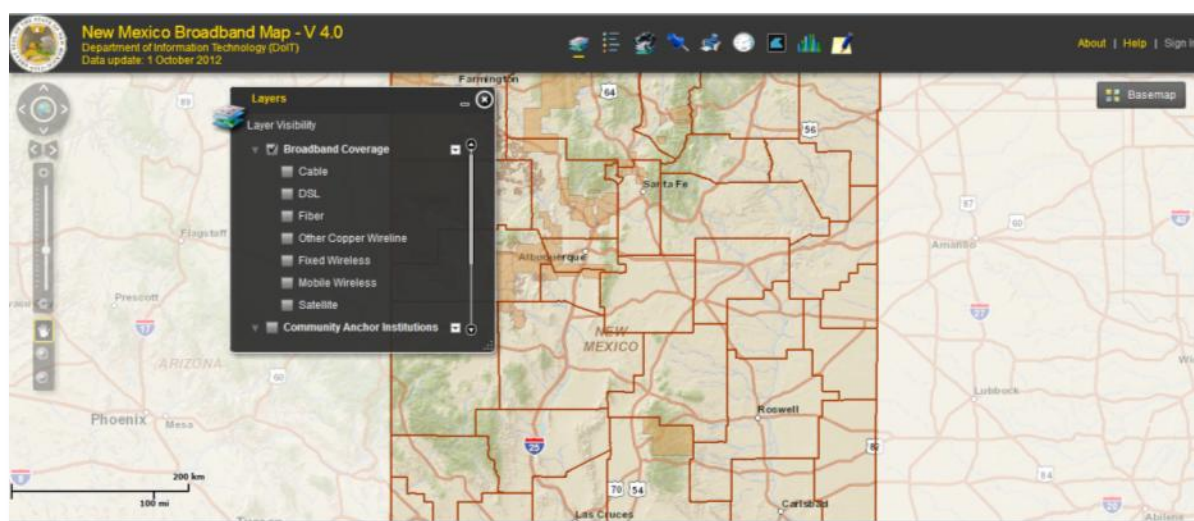


Figure 2: NMBB Map—Opening View

Included in the NMBB Map are the user guide (Help), base-map options, scale bar, and standard zoom in and out, full extent, and pan functions. Tools and functions in the toolbar (

Figure 3) include Layers, Legend, Identify, Find Address, Print Map, Broadband Speed Test, Broadband Footprint, U.S. Census 2010 Estimates, and Feedback. Please use the Feedback tool at any time to report “no broadband availability” or “inaccurate broadband coverage” in the mapped display of broadband resources for a community or neighborhood. This will allow the NMBB Program to correct the map data and to relay areas in question to Internet service providers.



Figure 3: NMBB Map Toolbar; yellow underlines indicate active tools or functions

Selecting a broadband technology type (e.g., cable, DSL, fiber) in the Layers menu updates the statewide map to show the reported infrastructure for that type (Figure 4).

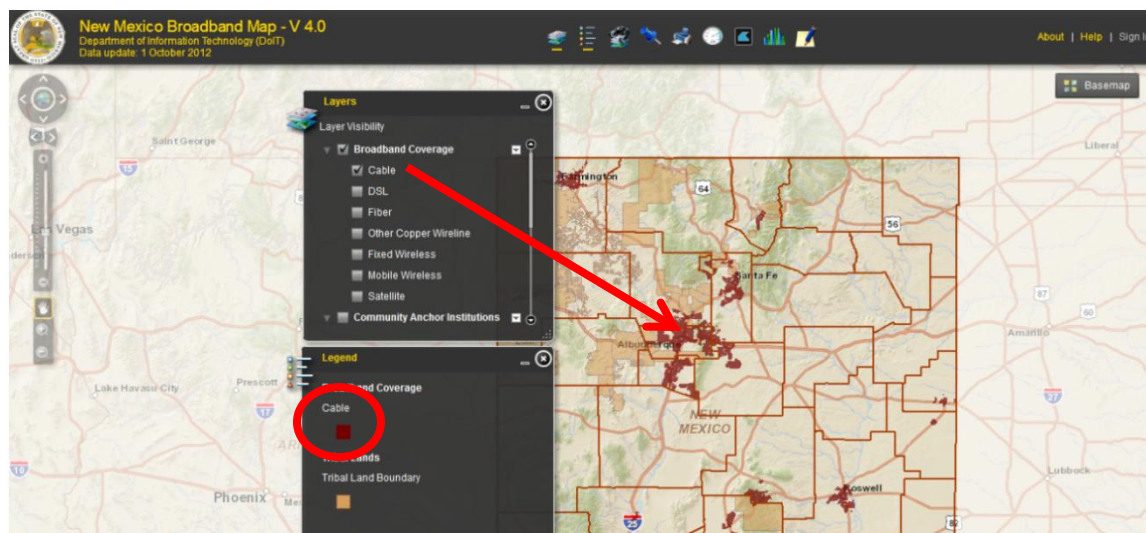


Figure 4: NMBB Map—Broadband Coverage for Cable

Map multiple technology types to further discover broadband availability in a community or area of interest. Figure 5 below shows, on the left, mapped coverage for cable (brown), DSL (green), and copper wireline (cyan) in the Santa Fe area. On the right is a zoomed-in view with a highlighted (selected) area and identified cable providers and coverage for that area. This right-hand image shows results from using the Identify tool, which lists names for broadband providers in a selected area, for a designated technology, such as cable. It also provides a link to each listed provider’s website to allow the user to find that provider’s available broadband plans and pricing information.

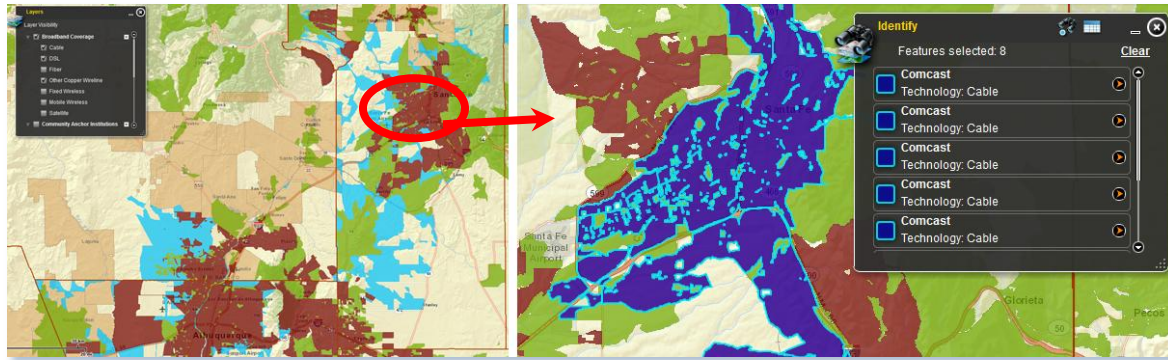


Figure 5: Layers for Cable, DSL, and Other Copper Wireline (left); 'Identify' Cable Providers for Selected Area (right)

Users can also find an address on the map (Figure 6) and then explore the surrounding area for broadband providers and Community Anchor Institutions (CAIs), such as libraries and schools, and the broadband services available to them.

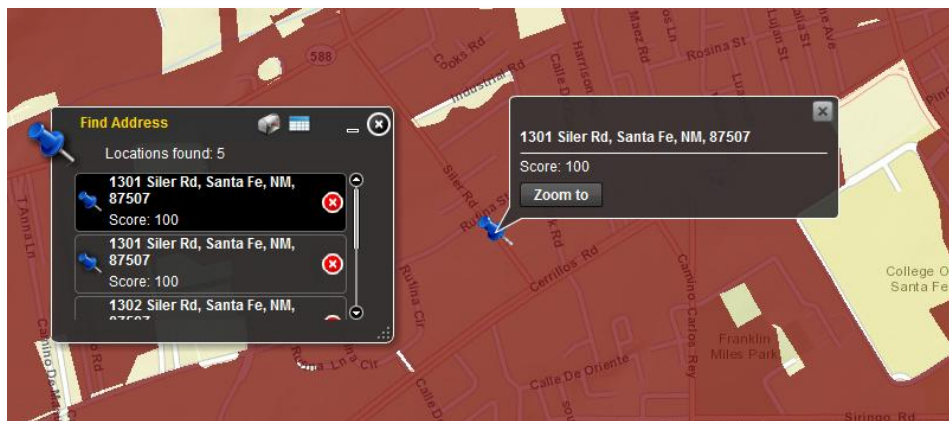


Figure 6: 'Find Address' Results with Cable Coverage

And, users can map broadband-provider footprints to learn about broadband services available to a community (Figure 7).

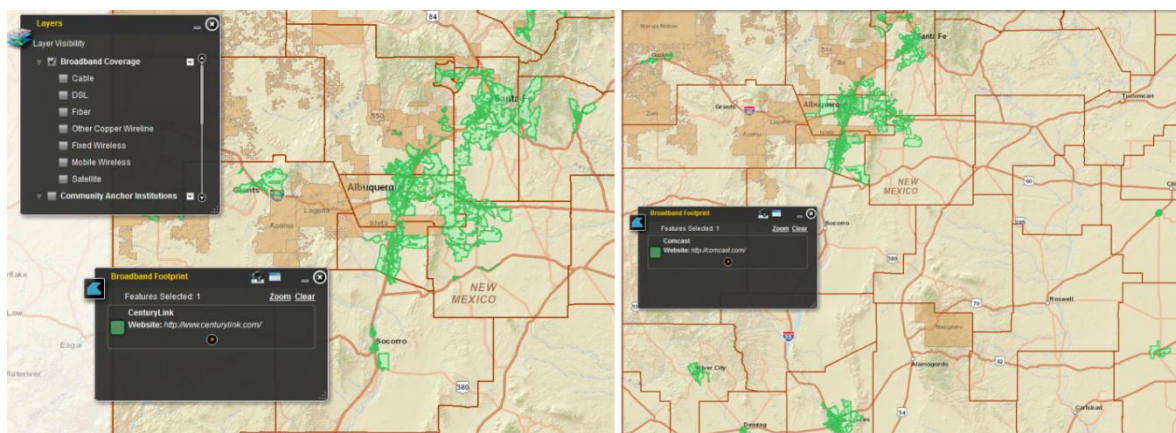


Figure 7: Broadband Footprint for CenturyLink (left); Broadband Footprint for Comcast (right)

Selecting the “Community Anchor Institutions” (CAIs) layer will populate the map view with icons representing public schools (K-12), higher education, libraries, medical/healthcare institutions, fire stations, law enforcement facilities, government agencies, and non-government community resources. A user can then click on a specific mapped icon for details about that building—including the entity’s name and address, as well as its type of broadband technology. (Figure 8)

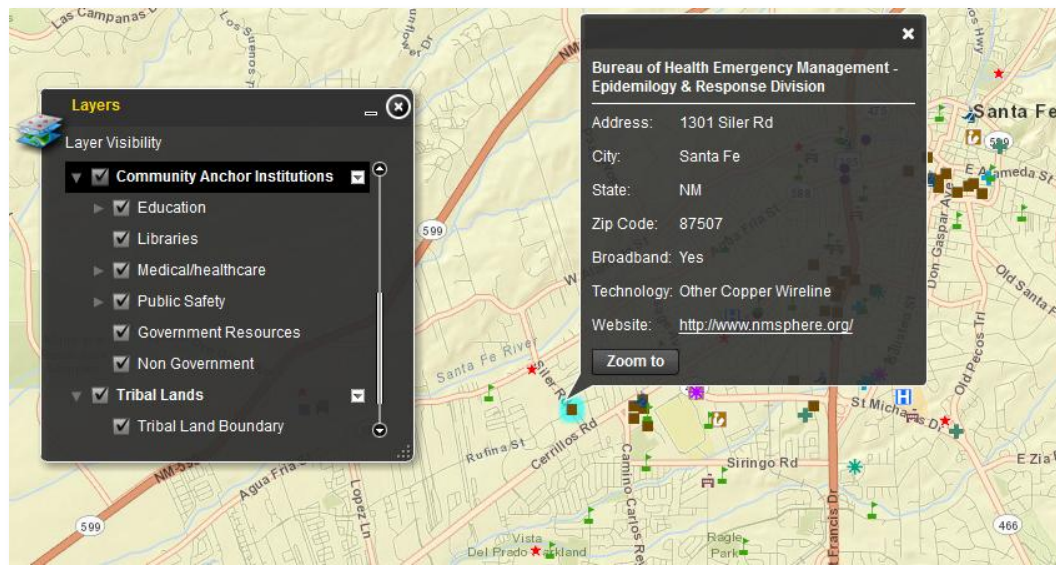


Figure 8: NMBB Map: Community Anchor Institutions (CAIs), with CAI Selected

Not all of these information fields are available for every CAI on the NMBB Map, but community anchor institutions can easily submit information about their facilities—and, in the process, improve the NMBB Map—through the Community Anchor Site Assessment (CASA) crowdsourcing application (Figure 9). The CASA application (<http://nmdbbmapping.org/bbcrowd/>), which appears and functions very much like the NMBB Map itself, solicits information about institutions that already appear on the map, as well as about new institutions.

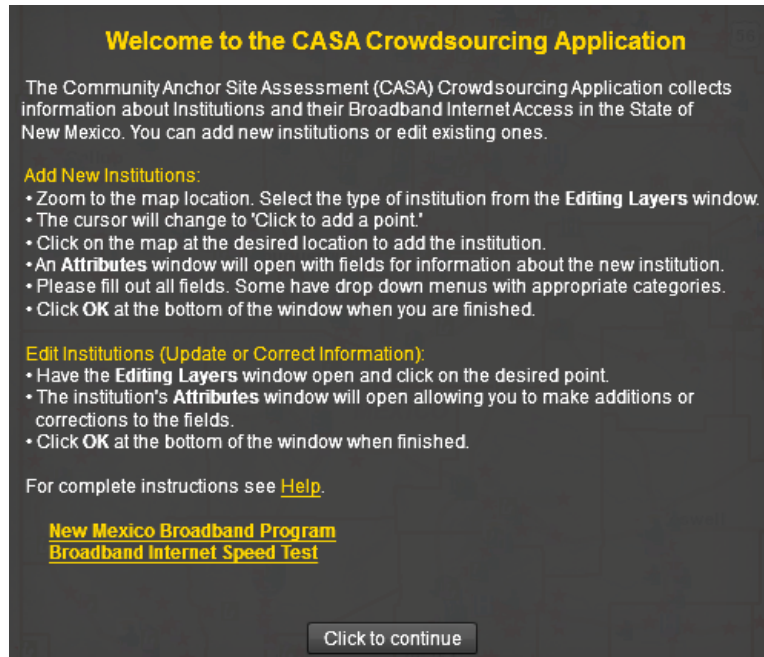


Figure 9: NMBB Crowdsourcing Application—Community Anchor Site Assessment (CASA)

Another way in which the public can improve the NMBB Map while doing their own research is through the broadband speed test (identified by a stopwatch icon in the map's toolbar; see Figure 10).



Figure 10: NMBB Map—Link to Broadband Speed Test

When users run the broadband speed test, which opens in a new browser window (Figure 11), the data about their connection speeds are recorded; with enough data points, the state can better validate the speeds reported by Internet Service Providers.

Earth Data Analysis Center
University of New Mexico

Facility Name

Residential

Street Address

Apt/Ste

City *

ZIP *

Internet Provider Name

Type of Technology

Unknown

Begin Test

OOKLA

Figure 11: New Mexico Broadband Mapping Program Speed Test

Because of the federal reporting standards that govern its data collection, the NMBB Map is limited in a number of ways.

- First, the map tracks availability only down to the Census block level—which, in rural New Mexico, can represent a large area; if any location in that block can be served, the entire block will be shown as served—even though most of the residents do not actually have access. The availability of infrastructure within a Census block does, however, offer a guide to the community in terms of what service provider might be well positioned to expand access to nearby residences or businesses.
- The map relies heavily on self-reporting by the commercial carriers—all of which use different methodologies to quantify their service levels.
- The map does not distinguish between residential broadband and connectivity that is adequate for institutions, government, and businesses. Small businesses often need higher capacity broadband than residential users. And, even if broadband is shown on the NMBB Map as available to the residential market, it may not be available to the small business market (and vice versa).

That being said, the NMBB Map is an invaluable tool for communities seeking to explore their local broadband supply.

NMBB State- and County-Level Maps

Following every reporting cycle, the NMBB Program aggregates the map data in state- and county-level reports that are available on the DoIT website

(http://www.doit.state.nm.us/broadband/map_statewide.shtml and http://www.doit.state.nm.us/broadband/map_county_availability.shtml).

NM County-Level Maps

The *NM Broadband Map Gallery: County Focus Maps & Statistics* page

(http://www.doit.state.nm.us/broadband/map_county_availability.shtml) contains documents that illustrate broadband coverage in New Mexico by county. The maps portray broadband availability and those technologies (DSL, cable, wireless, fiber, etc.) that provide access. Each document consists of two pages: the first is multi-layered and the second provides statistics and demographic data. Documents are available as PDF files for download and browser viewing. (Figure 12)

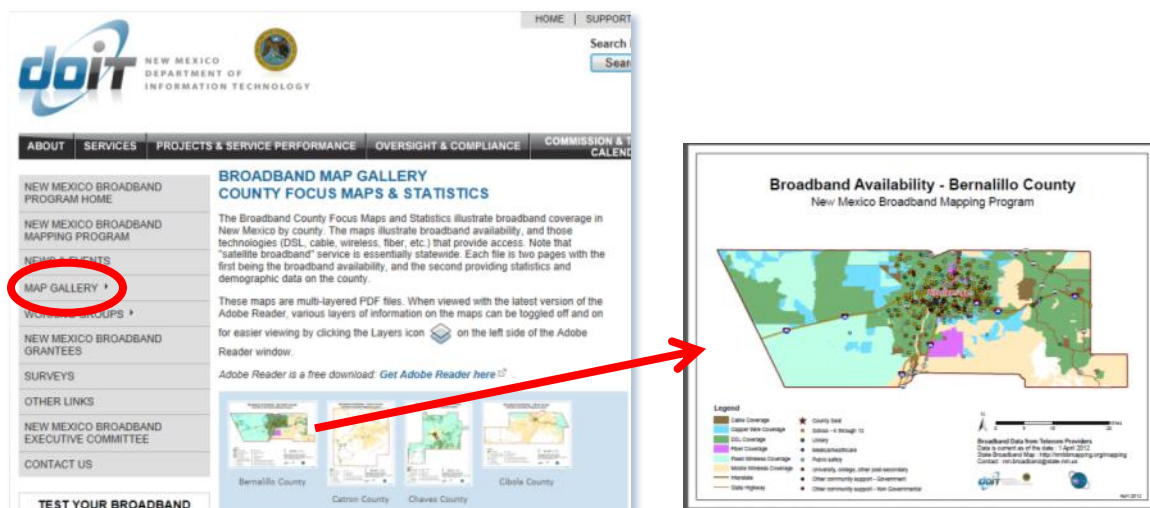


Figure 12: NM Broadband County Maps

NM State-Level Maps

The *NM Broadband Map Gallery: Statewide Maps* page

(http://www.doit.state.nm.us/broadband/map_statewide.shtml) contains documents that depict broadband availability, community anchor institution, and demographic information for the state, in addition to other relevant maps. These map documents are provided as multi-layered PDF files for download and browser viewing. Layers can be toggled on or off. (Figures 13 and 14)

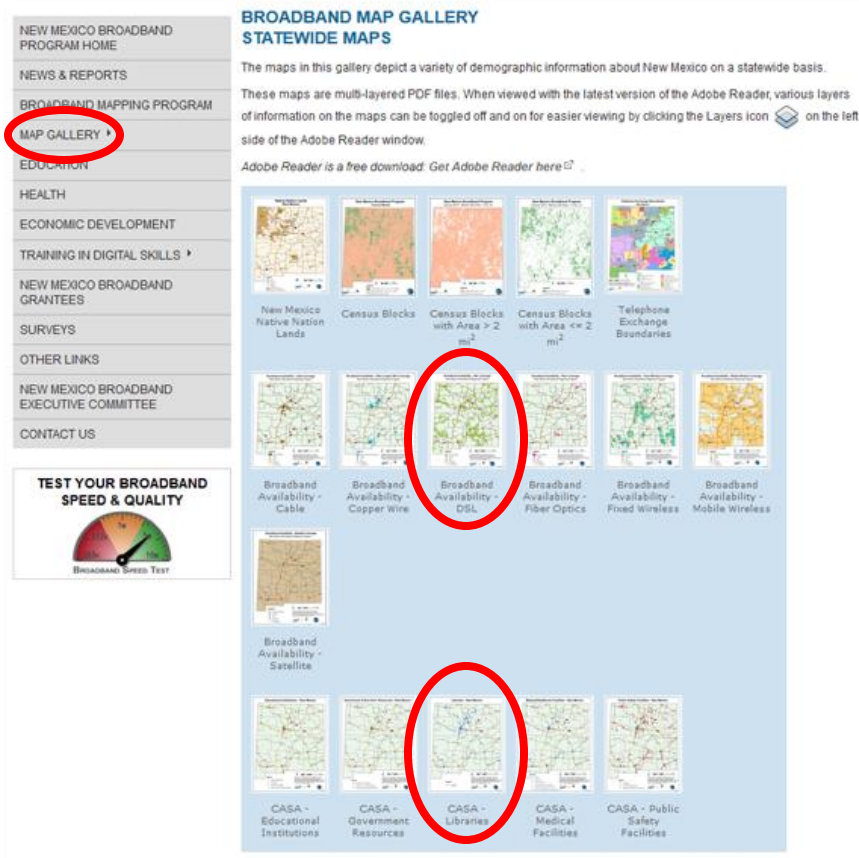


Figure 13 NM Broadband Map Gallery: Statewide Maps

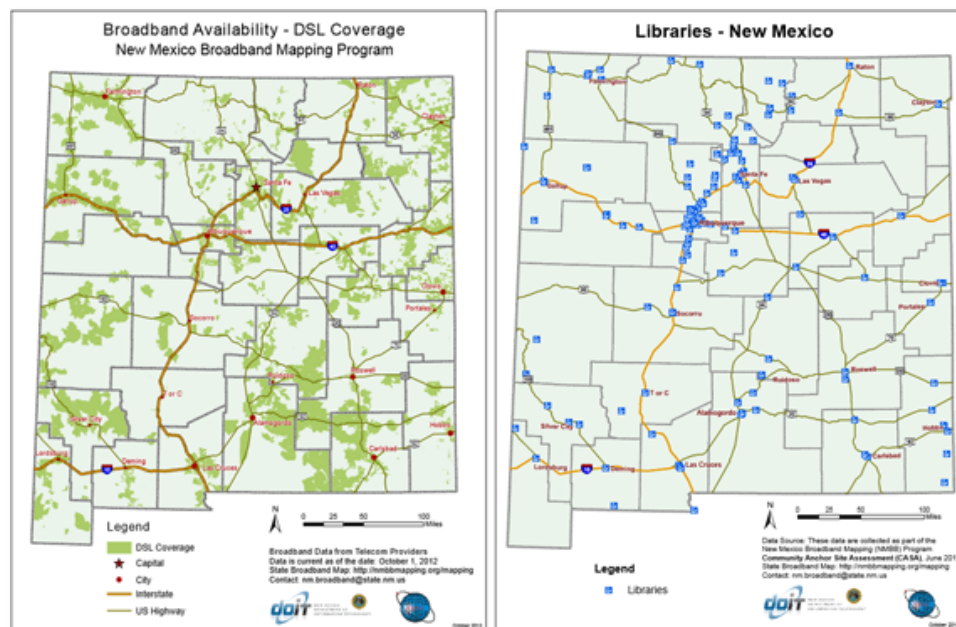


Figure 14 NM Broadband Statewide Maps: DSL Coverage (left); Community Anchor Institutions—Libraries (right)

National Broadband Map

The New Mexico Broadband Map data are provided by the state to the federal government every six months, on the same cycle as the NMBB Map updates; the data inform the National Broadband Map (NBM; <http://www.broadbandmap.gov>), the federal government's primary source of statistics regarding broadband availability nationwide.¹

The NBM is a great achievement and represents the first time that the United States has attempted to collect these data in one central location in order, ideally, to provide a picture of true broadband availability nationwide. It is important to note, however, that data are displayed differently on the New Mexico and National Broadband Maps. The NBM displays wireline technology coverages using Census blocks that are less than two square miles in area; for the blocks that are greater than two square miles in area, road segments are mapped. These road segments are buffered with a 500-foot radius to create polygons, or areas. Whereas, the NMBB Map displays broadband wireline coverages using Census blocks, regardless of size of area. For wireless technologies, NBM and NMBB display coverages in the same manner.

The NBM website allows users to search and compare data in a variety of ways. Enter an address to view broadband providers for the Census block that contains the address (Find Broadband); generate summary statistics for broadband availability or rank a given area for a specific attribute (Analyze the Data); or map broadband availability by technology type (Explore the Maps). (Figure 15)




Figure 15: National Broadband Map Website

The NBM website also allows you to access summary data for the state as a whole (Figure 16), or for other geographies (e.g., congressional district, native lands, city, county). And you can export data in a number of file formats for further analysis or mapping.

¹ The NBM is a collaborative effort among the Federal Communications Commission and the Department of Commerce's National Telecommunications and Information Administration (NTIA). NTIA is also the agency that oversees the \$7.2 billion in Broadband Technology Opportunities Program (BTOP) stimulus grants authorized under the American Recovery and Reinvestment Act of 2009.

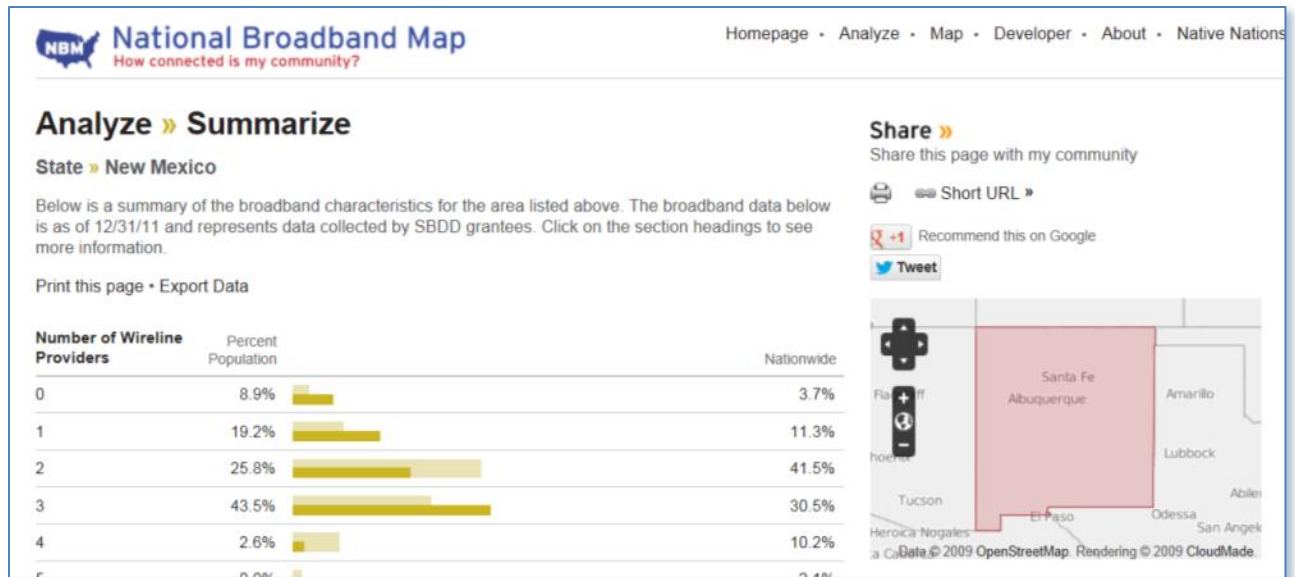


Figure 16: Example of NBM Search Results for the State of New Mexico

Figure 17 shows part of the summary for San Ildefonso, a native nation within New Mexico's borders.

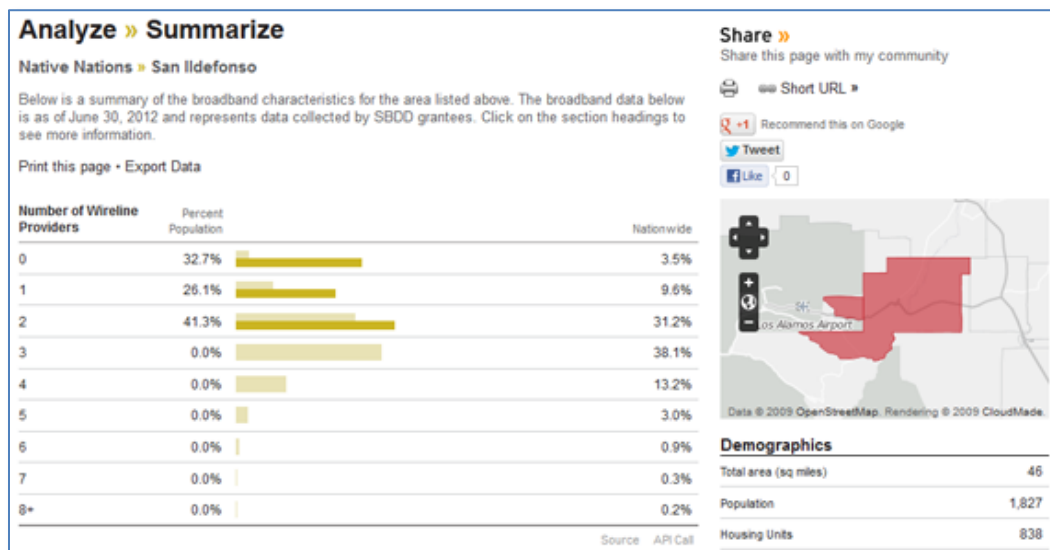


Figure 17 NBM Analyze > Summarize: Native Nations > San Ildefonso

The NBM data include a list of all reported service providers in a given geography, which leads to the next level of research into your local broadband supply: determining what service providers are active in your community.

Sources of Broadband Supply

There are a number of different kinds of commercial broadband carriers in New Mexico, and many of them provide detailed information about their services on their websites. Often, you can use an individual address in your community to pinpoint the availability of broadband from a given company

(see Figure 18). Indeed, this strategy is likely to give you more granular data than the National Broadband Map, whose database is less granular than the broadband providers' own internal databases.

The screenshot shows the MegaPath website. The header reads "Covad is now MegaPath – Offering broadband access, VoIP and Security". Below this, a paragraph states: "MegaPath is the largest privately-held, end-to-end facilities based provider of Data, VoIP, and Security services in the U.S. Whether your business has one location, multiple offices, or virtual teams, you can rely on MegaPath for affordable, reliable and scalable networking. MegaPath offers a broad selection of business-class Internet connectivity with robust SLAs and speeds from 1.5 Mbps to 45 Mbps." Below the text is a section titled "SEE OUR MOST POPULAR OPTIONS. CALL US FOR OTHER SERVICES AND PRICING." which contains three service cards: "Business T1" (Guaranteed lowest price on MegaPath's T1, Robust SLA with 99.99% guaranteed uptime, Mission-critical performance), "2x2 Mb Ethernet" (Increased bandwidth at a lower cost per MB, 99.99% guaranteed uptime SLA, Mission-critical performance), and "Dedicated ADSL" (Dedicated, scalable, affordable DSL, 99.5% uptime guarantee available, Cost-effective, low price). To the right is a "Check For Service" form with fields for Address, City, State (dropdown menu showing NM), Postal Code, and Phone. There are radio buttons for "Home/Home Office" (selected) and "Business", and a red "Get Results" button.

Figure 18: Service Provider Website with Search Function

When we discuss service providers, we are often referring to “last-mile” providers, or the companies that will connect an individual home or business to the Internet. At a high level, these last-mile services providers can be categorized as follows:

- **Incumbent wireline providers.** These include the large incumbents, such as the phone company (e.g., CenturyLink) and cable companies. Local incumbents may also include small local phone companies or local coops, which are smaller and more locally and regionally focused than the large national carriers. Getting information about incumbent services can be difficult because the big providers, in particular, consider these data proprietary.
- **Business-focused wireline providers.** At the higher end of the market are companies that focus largely or completely on high-capacity connections for small and large businesses.
- **Competitive wireline providers.** These are companies on the smaller side who are attempting to compete with the incumbents.

Similar in nature to the wireline last-mile providers are wireless technologies:

- **Satellite providers.** Popular in rural areas where wireline infrastructure is particularly limited, these providers can sell service to virtually any resident or business.
- **Mobile (cellular) providers.** Again, the NBM provides basic data, and on the providers' sites you can often plug in an address to determine whether service is available. Mobile service areas are often challenging to define in less densely populated areas, however. The same holds true where there is challenging terrain (e.g., canyons, mountains) because it is hard to reliably propagate wireless signals there.

In contrast to last-mile providers are “middle-mile” networks, which, as their name implies, operate the infrastructure necessary to connect the last-mile providers to the Internet backbone. The large phone and cable companies are all middle-mile providers in the sense that they bring their long-haul capacity into and around New Mexico. There are also small middle-mile networks, especially those funded by the

Broadband Technology Opportunities Program (BTOP), such as REDI Net in north central New Mexico. Smaller middle-mile networks typically do not sell services directly to residents or business customers, and they often have limited “footprints” or service areas.

Checklist

To help you document your community’s current providers and services, use Table 1 on the following page to record information you are able to gather about current providers of broadband services (e.g., data, video and telecommunications) to consumers, businesses, and governmental agencies in your area. The checklist below includes sample questions of the type that should guide your discussions (Figure 19).

- What services do you currently offer
- What are the costs for those current services?
- What services do you expect to provide in the near future?
- Do you plan to expand your service footprint?

Figure 19: Types of Information to Gather to Measure Supply

Table 1: Broadband Supply Matrix

Provider	Broadband Type	Residential service packages?	Business service packages?	Notes

Broadband Demand

Given the state of broadband services nationwide, it is safe to say that the demand for broadband across most of New Mexico is not being met. In our experience, there is a gap between broadband supply and demand in almost every community across the United States. This is not because of any nefarious plot or ill intent by any entity; rather, it is because the high capital cost for constructing broadband infrastructure and the relatively low associated revenue for broadband services (particularly in areas of low population density) mean that there is limited return on investment. So we find almost universally greater demand for broadband than there is supply.

The question, then, is: How great is the gap in your community and where should local resources and efforts be applied to reduce the gap?

While assessing broadband supply is a “simple” matter of researching the NBM and identifying local providers, the process of assessing broadband demand in a community is typically much more nuanced and involved. Quantifying broadband demand to a degree sufficient for planning an infrastructure project will require informal conversations, in-person interviews, stakeholder meetings, public sessions, surveys, and other data-gathering techniques.

If you have access to a comprehensive list of local businesses’ e-mail addresses (from the chamber of commerce or economic development group, for example), you could use an online tool such as Survey Monkey as a cost-effective alternative to mailing surveys. In our experience, online surveys tend to be more reliable and useful for business surveys than for residential surveys.

Sources of Broadband Demand

To begin with, you will need to understand the demand among a number of different types of broadband users. These include:

- Government, including general government operations and public safety
- Institutional, including K-12 schools, colleges, libraries, health care providers
- Commercial and industrial
- Small business
- Residential
- Public wireless (outdoor, fixed indoor)

Assessing business and residential demand is challenging and will frequently require extensive mail or telephone surveys. These can be costly and time-consuming, particularly if they are to result in statistically significant data. One shortcut to getting a sense of residential and small business demand is to talk to staff within the relevant local government offices who field calls from potential consumers who are unable to locate the broadband services they seek. This might be the cable franchising authority, an economic development authority, or an IT department. In almost any community there is a relatively steady stream of calls, complaints, and requests for help from small business and residential consumers who hope that their government will be able to help them identify (or incent the availability of) a type of service that they cannot currently obtain.

For purposes of broadband planning, governmental and institutional facilities are sometimes collectively referred to as “community anchor institutions” (CAI) or community anchor sites. Because these entities are often among the biggest buyers of broadband services in a community, the process of discussions among CAIs can give you a very good sense of the demand in your community—not just now, but how it is likely to grow over time. These organizations typically have a firm grasp of their current broadband use (i.e., capacity, service levels, cost), and routinely project how much capacity they will need to meet future growth plans.

On the other side of the equation, too, CAIs are also often likely to be the driving force behind a middle-mile infrastructure investment in your community; because the potential revenue relative to the cost of construction is far better for connecting a single CAI than for a residential neighborhood, private sector providers are likely to be more attracted to these big customers. Thus, it will likely be more efficient and productive for you to focus, at least initially, on governmental and institutional broadband demand.

(As discussed earlier in this chapter, the New Mexico Broadband Map includes many, but not all, of the state’s CAIs.)

Questions to Ask

Depending on where you are in your broadband planning, your evaluation of community broadband needs can be basic (e.g., identifying what groups need more broadband access) or complex (e.g., projecting capacity needs based on data such as projected population growth, anticipated business growth, and industry concentrations). As a starting point, you should:

- Meet with representatives of key entities that you believe would be potential users of expanded broadband access, including the business community, schools, medical centers, tourist destinations, and large organizations
- Meet with incumbent and potential wireline or wireless providers to discuss their existing offerings, future plans (to the extent that they will share that information) and interest in offering services in the community
- Hold discussion groups with citizens and representatives of various potential user groups to better understand their perspectives on existing broadband alternatives and desire for expanded broadband access in the future

Your local or regional chamber of commerce is an important stakeholder, and a good resource for getting a sense of small business needs; broadband is frequently a high priority area for chambers nationwide.

Checklist

To help you document your community’s current demand for broadband (and, ultimately, to quantify the aggregate demand among all users), Table 2 on the following page will enable you to record information about users and their bandwidth needs, as well as notes on any factors that will have an impact on their future broadband needs. The checklist below includes sample questions of the type that should guide your discussions (Figure 20).

- What types of connectivity and broadband services do the stakeholders currently use?
- What limitations do the stakeholders see in their current broadband situations?
- How aware are respondents of current high-speed options?
- What are their expectations for current and future high-speed needs?
- What applications do the stakeholders currently use and plan to use in the future?

Figure 20: Types of Questions to Ask to Measure Demand

Table 2: Broadband Demand Matrix

User	Current bandwidth	Future bandwidth needs	Notes

Chapter 2: Identifying and Collaborating with Existing Broadband Providers

While the incumbent cable and telephone providers are easy enough to identify, many local governments are unfamiliar with the full range of entities that are capable of delivering services, possibly in partnership with the community. This chapter explains what private providers may be potential partners for your project and how to identify and contact them. The list of potential providers includes community non-profits, national non-profits, incumbent cable and telephone operators, entrepreneurial local and regional service providers, and others.

Who Are the Industry Players?

The broadband industry can generally be divided in two major ways: Between wireline and wireless services; and between incumbent providers that are older, larger, and more well-established, and competitive or entrepreneurial providers, which tend to be newer, smaller, and perhaps less traditional in their business practices. We thus have four general categories of industry players: Wireline incumbents, wireline competitors, wireless incumbents, and wireless competitors.

Wireline Incumbents

Wireline incumbents are phone and cable companies that operate both last-mile (to the home or business networks) and middle-mile infrastructure. They therefore provide services to end-users as well as middle-mile and long-haul capacity which connects their last-mile holdings to larger networks, and ultimately to the Internet backbone and thereby to the world. Phone companies generally have larger footprints in rural, low-density areas, while cable tends to dominate wireline service in denser population centers.

Phone companies have long held license to operate phone networks in public rights-of way. Particularly in rural areas, incumbent phone companies, regardless of size, are the most likely entities to have extensive middle-mile and last-mile infrastructure, and to be the most important providers of traditional voice services to homes and business. For many communities throughout the country, including large parts of New Mexico, phone lines are the only existing wireline network infrastructure built to homes and businesses. In rural areas, these incumbents are often also the only major broadband providers, usually via digital subscriber line (DSL) networks that ride the incumbents' old copper phone lines.

In your area, this category may include big providers such as Century Link and, in more rural areas, smaller incumbent carriers referred to as "rural telcos," such as Plateau Telecommunications, Inc. and Tularosa Basin Telecommunications, Inc.

Unlike in rural areas, the role of cable providers in the broadband market mostly occupies densely populated communities. This is particularly true in big cities, but also in small towns with dense population centers. Cable incumbents have almost no footprint outside of these areas, but within those towns and cities, the cable infrastructure is very likely the most capable, robust, high-bandwidth network option.

Major incumbent cable providers in New Mexico include Cable One, Comcast, Time Warner Cable, Baja Broadband, and US Cable.

Wireline Competitors

Dominant as the incumbents are nationwide with regard to wireline infrastructure, there is nevertheless a competitive and growing set of entrepreneurial wireline broadband companies. This segment presents important opportunities for local collaboration, in part because smaller, newer companies are often more interested in innovative partnerships than long-established companies with long-standing business models.

New Mexico is fortunate in that there is considerable competitive creativity on this side of the industry. The range of potential partners includes companies like CityNet in Albuquerque, an innovative partner using the City's sewer system to build a fiber-to-the-premises (FTTP) network—the first project of its kind in the country. Among the competitors are also local electric coops and utilities that have diversified (or are considering diversifying) into the communications business, and are slowly but steadily building new communications capabilities.

In addition, there exists a range of both new and established competitive players who were recipients of American Recovery and Reinvestment Act (ARRA) grants or loans, and are already offering, or are about to start offering, a range of communications products in the middle mile or last mile. New Mexico recipients of these BTOP² (U.S. Department of Commerce) and Broadband Initiatives Program (BIP)³ (U.S. Department of Agriculture) funds include the Kit Carson Rural Electric Coop, ENMR Plateau Telephone Cooperative, Inc., La Jicarita Rural Telephone Cooperative, Peñasco Valley Telephone Cooperative, Inc., and the Baca Valley Telephone Company, Inc.

Wireless Incumbents

The incumbent wireless providers are the national mobile carriers that dominate the industry. They include AT&T Wireless, Sprint, T-Mobile, Verizon Wireless, and U.S. Cellular. AT&T and Verizon are the biggest providers in this field; the others are quite a bit smaller on a national basis, but still important players, and potential partners. These providers will be found to different degrees in New Mexico, and those that do not have extensive network infrastructure of their own will have roaming agreements with the other companies (under which a user of the first company's services will be able to roam without additional cost to the network of the incumbents that are present in that area). Significantly, however, a wireless broadband phone that usually receives high-end broadband services (for example, so-called 4G service) may, when roaming, receive significantly less capacity.

The major mobile broadband incumbents in New Mexico are Verizon Wireless, AT&T Wireless, Sprint, T-Mobile, and Cricket. Verizon and T-Mobile carry 4G services, though T-Mobile's 4G service is an HSPA+ service rather than the faster LTE service.

² Broadband Technology Opportunities Program

³ Broadband Initiatives Program

Wireless Competitors

On the competitive side of the wireless industry, more modestly sized companies—some based in New Mexico—offer either wireless mobile service or fixed wireless. Fixed wireless, like land-line service, delivers broadband capacity to a particular location rather than a mobile device, and can be an important broadband solution in rural areas where wireline construction is cost-prohibitive.

Wireless providers in New Mexico include: Agave Broadband LLC; Higher-Speed Internet, LLC; Leaco Rural Telephone Cooperative, Inc.; PVT Networks, Inc.; Sacred Wind Communications, Inc.; Southwestern Wireless; Tularosa Basin Telephone Company, Inc.; and Kit Carson Electric Cooperative. (Another provider, Plateau Telecommunications, Inc., sold its wireless assets to Verizon Wireless in October 2012.)⁴

In many communities, there are one or two very small, local Internet service providers (ISP), frequently offering wireless service in unlicensed spectrum such as Wi-Fi, that have survived industry consolidation and the unfortunate situation of big provider dominance of the broadband industry. You may find that there are local entrepreneurs in your community who are defying the odds in the broadband market—and can serve as potential partners for your project.

This leads to our next topic: How do you identify, locate and contact these potential partners?

Engaging with Industry Players

Your most important source for information on local providers is the extensive work the State of New Mexico has done to collect and maintain a comprehensive provider database, and to map the availability of broadband by technology and provider in communities throughout the state. Chapter 1 above provides a description of how to navigate the New Mexico Broadband Map (NMBB), and we recommend you begin with a survey of the map to identify some of the providers that have infrastructure in or near your community—and therefore might be interested partners. Unfortunately, some providers have declined to provide data to the state, so the map may not be as comprehensive as we would like. It is an excellent starting point, however, and the most important effort to date to determine what providers are in New Mexico, where they are, and how they operate. In addition, the state's database of providers is available online; this database includes a comprehensive list of providers known to the state that own facilities and/or provide services in New Mexico, and their respective contact information.⁵

Another important means of identifying and contacting providers is through data your local government likely already has. Your permitting or public works department is a potential source of information on who has applied for permits to build in what areas, and current work that may be occurring even now. If those providers are required to obtain a license or franchise in your community to use rights-of-way or other publicly held spaces, then the agency within your local government that provides and oversees those credentials will also have information, including contact information, regarding existing (and perhaps potential) providers in and around your community. As discussed above in the introduction,

⁴ "Verizon Wireless Completes Purchase of Southeastern New Mexico Rural Market," News Release, Verizon Wireless, October 16, 2012. <http://news.verizonwireless.com/news/2012/10/pr2012-10-16e.html>

⁵ See: "Participating Internet Service Providers," New Mexico Department of Information Technology, <http://www.doit.state.nm.us/broadband/isps.shtml>

organizing your community and bringing the right people to the table should ideally include all of these agencies (permitting, public works, franchising agency), both because these agencies are important stakeholders for your project, and because they hold this kind of important information—contacts and relationships—with your potential private partners.

Engaging with Alternative Potential Partners

The range of potential broadband partners is not limited to entities already in or exploring the broadband industry. Broadband is a civic activity—a matter of community and economic development. We strongly encourage you to explore relationships with non-traditional entities that may be your logical partners, because of their missions' alignment with yours.

In some rural communities, local governments have partnered with community non-profits whose missions are focused on providing otherwise inaccessible services that are fundamental to education and economic well-being for some members of the community.

In one case, for example, a community non-profit took on a fixed wireless broadband program in partnership with the county government—because the delivery of broadband to enable education, health care, and home-based business was entirely in keeping with its other efforts in building affordable housing, providing Head Start educational services, and providing life-line telephone services to the rural elderly.

In another case, a community media center deployed free Wi-Fi in a low-income, unserved town in partnership with the local government because providing access to broadband was the next step in its mission of making technology available to people in the community who could not afford costly equipment.

We encourage you to explore, with entities in your community that are likely already partners in other areas of your local government, whether broadband development is important to their service mission. Clearly, this category of potential private partners would approach broadband with a very different set of purposes than private providers, who are in the profit-making realm. It is important not to discount the non-profit sector, however, because it can potentially fill broadband gaps that may be neglected under the business models of the for-profit providers.

Chapter 3: Understanding the True Availability of Broadband in Your Community

In Chapter 1, we outlined the state’s impressive work aggregating data about broadband supply and discussed how to navigate the data via the New Mexico Broadband Map. Here, we recommend two mapping strategies at the local level to determine the true availability of existing broadband in your community:

- First, we recommend gathering technical data through field analysis and testing.
- Second, we recommend gathering more qualitative information through engagement with community members, key stakeholders, and other partners.

We make these recommendations with the caveat that you should exercise a degree of moderation in these data gathering efforts. Comprehensively and scientifically mapping all of the fiber, coaxial, and copper cable network throughout your community is extremely costly, for example, so unless your resources are very abundant, we do not recommend it. (There are other methods of data collection that may be both less costly and more useful.) Consider your budgetary and labor resources from the outset so that you do not exhaust them gathering too much data. If you are a rural community, in particular, you already know that your community has a broadband supply gap. In other words, gather the geographic data you can, but keep the scope of the work proportional to the other efforts you will need to undertake in the future. By taking a conservative approach with your budget, volunteer hours, and other valuable resources, you will have more of each for future stages of this process.

Mapping Based on Technical Data Collection

There is a considerable amount of work you can do in the field to try to determine the location of infrastructure and the quality of services throughout your community. However, aerial wires are not always easy to distinguish—and it is not always clear who owns them. In many communities, too, lines are buried.

Before you attempt to gather any hard data, there are several assumptions you can safely make about broadband technology locations. In the case of cable modem broadband service, you should expect to find service mostly in and near population centers, and mostly in residential areas. For DSL, the availability of service depends on proximity to a provider’s central office. Finally, mobile broadband access depends on both proximity to cellular antennas and terrain (because topography can have a big impact on the uniformity of coverage from a given antenna).

Cable TV Broadband

Cable broadband service is typically only available in cities and towns with sufficient population density to support the operator’s business model. If you are a jurisdiction of a reasonable size, such as Silver City, Hobbs, Carlsbad, or Farmington, you likely have cable infrastructure. In sparsely populated rural areas, you likely do not.

Cable providers operate under an agreement with a local franchising authority designated by the local government. Their service footprint is delineated by the agreement. If a municipality is the franchising authority, you can expect to find service throughout much of that municipality.

However, while franchising agreements require a certain standard of service, they often require the provider to build only to areas surpassing a certain population density. In many parts of the country, franchise agreements have not obligated cable companies to build out to communities with fewer than 20 homes per square mile, or to areas that are not contiguous with the rest of the cable system. This is a very important point to take into account as you study supply. Initial impressions may indicate that an entire jurisdiction has cable broadband service, when in fact portions of the community are not served due to low population density in those areas. In virtually all communities throughout the country, cable service is, to some extent, marked by a patchwork of gaps of this kind. To ascertain an accurately granular picture, it is vital that you know the terms of your community's franchising agreement, which is likely codified by city ordinance. The franchising authority will have answers to these questions.

Given this knowledge, you can then look in specific areas of concern to you (e.g., where you suspect cable may or may not exist), through on-the-ground observation. How can you identify wireline broadband infrastructure? Utility poles that carry cable plant typically will include a cable amplifier or other distinctive types of cable TV infrastructure (Figure 21).



Figure 21: Utility Pole with Cable Amplifier

If you do not observe these in your area of interest, you may wish to investigate the local availability of cable supply further. In particular, if the area in question is densely populated enough to be covered by

the local franchise agreement, the provider may not be compliant with its obligations. If you suspect this is the case in your community, you should contact the franchising authority and request that they investigate and, if necessary, enforce the agreement.

DSL Supply

In sparsely populated areas, DSL is often the only wireline broadband service available. DSL infrastructure does not require a new build-out to the premises, because it runs over the copper telephone lines that exist nationwide. In the case of DSL supply, then, the main issue is not population density, but proximity to provider infrastructure.

DSL signals are routed through phone lines via a provider's central office; your state government will know the locations of these central offices. DSL providers may also have installed DSL cabinets, which extend the distance of service by another 15,000 to 18,000 feet, so it is important to determine if and where these cabinets exist. The farther the user is from the central office or cabinet, the weaker and less reliable the DSL signal will be. The signal ceases to be viable outside of a distance of 15,000 to 18,000 feet (Figure 22).

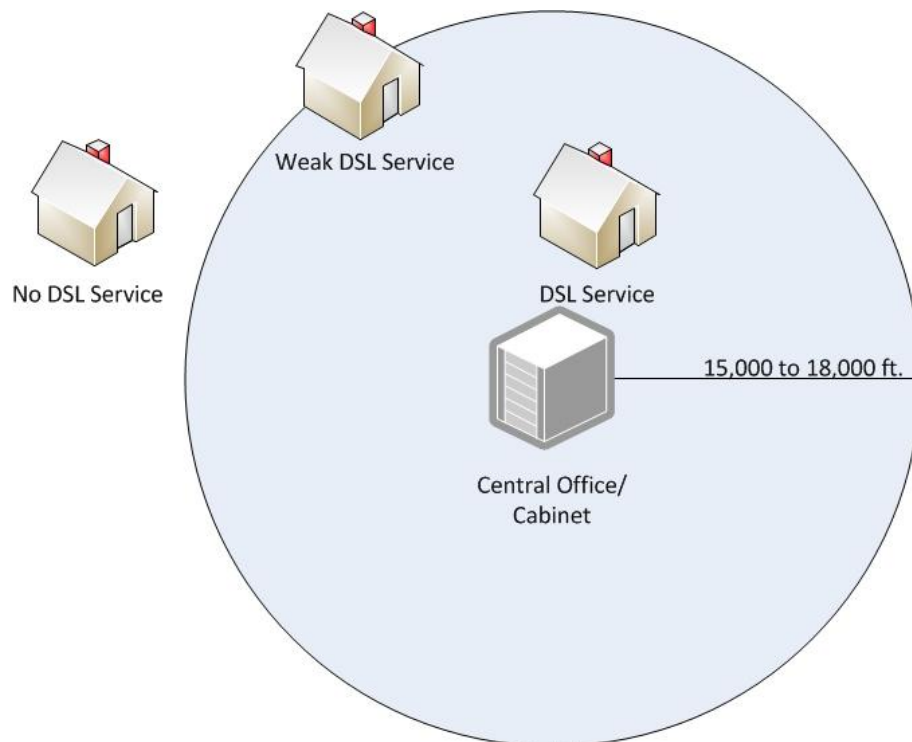


Figure 22: DSL Service Diagram

Even within this range, signal strength varies greatly, and service is not guaranteed; a DSL provider will have a finite number of circuits at a given central office, and potential new subscribers may find that the provider has no capacity available.

Fiber Optics

Fiber optic technology is used for 1) fiber-to-the-premises (FTTP) broadband service, 2) the backbone portions of DSL and cable TV networks, 3) long-distance intercity or interstate links, and 4) high-volume connections for commercial and institutional customers.

Some communities (including Clovis) are served by small local FTTP providers, which provide high-speed data, video, and voice services. If your community receives these services, you are probably aware of them. FTTP is usually concentrated in more built-up areas and new housing or business developments.

If long-haul or backbone fiber optics pass near or through your community, there may be options for using those fiber optics as part of a solution to extend broadband to your area. Utility poles that carry fiber optic cables often have banjo-shaped storage loops in the cables (Figure 23). They may also have tags identifying their owners. Underground fiber may have manholes and markers identifying their owner and providing contact information (primarily as a warning to others who may dig near the fiber.) The owner will be able to inform you what options may exist for obtaining access to the fiber or obtaining services.

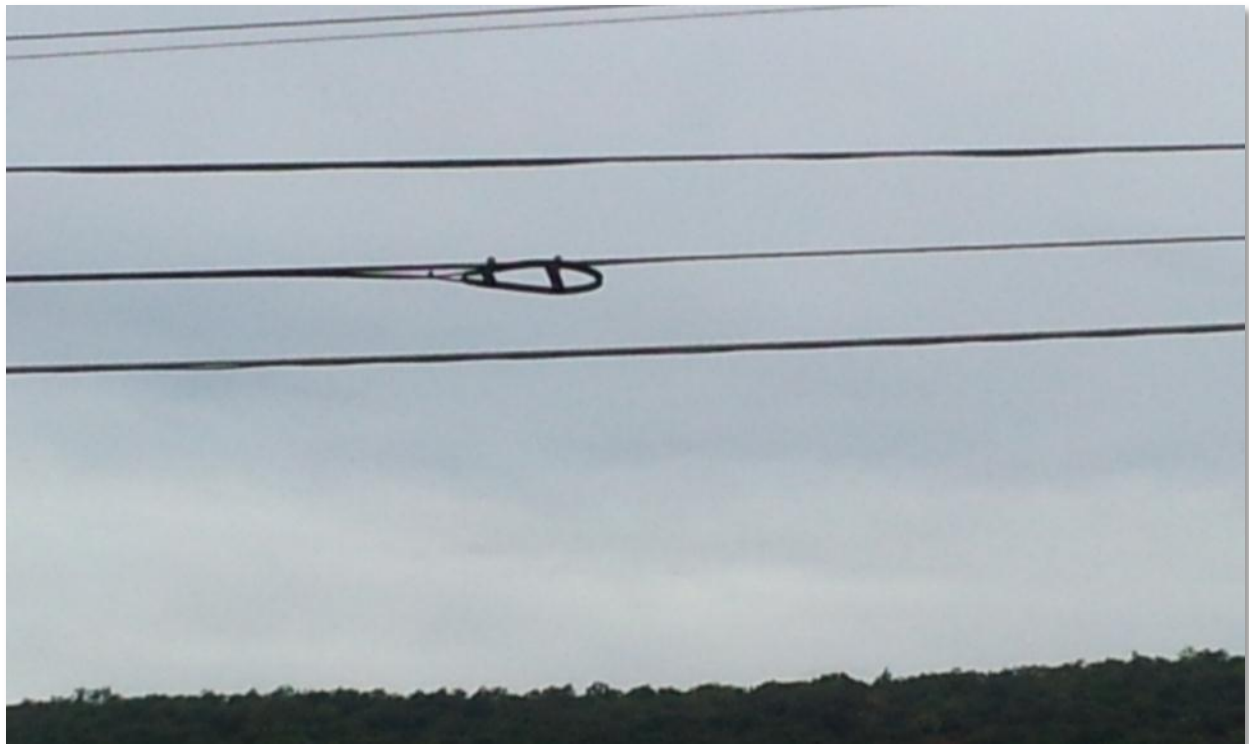


Figure 23: Aerial Fiber Optic Cable with Storage Loop

Mobile Supply (4G and 3G)

Mobile broadband service is available across greater areas than wireline service, but coverage varies a great deal. Important factors include the locations of wireless towers, the physical topography of the area, and what generation of service the incumbent providers offer.

We recommend gathering data on mobile broadband coverage through on-the-ground testing. In addition to locating towers and antennas attached to sites such as water towers, testing for mobile connections and speeds can be done with relatively little equipment.

We recommend using a laptop with a robust processor and, ideally, without much software installed on it. The computer need not be top of the line; however, you do not want unnecessary programs running in the background that may slow it down, nor do you want its internal processes or lack of available memory to affect the broadband tests. Make sure the battery life on the computer is sufficient for the entire day's work, or that you have the ability to recharge it in the field. (An inexpensive alternator can convert a car charger to an AC outlet.)

For the wireless hardware itself, we recommend ideally using external Wi-Fi hotspot devices, one for each wireless provider you are testing. It is possible to use a smartphone with a "hotspot" function, but these devices have many other processes running on them, and may provide poorer performance as a hotspot as a result.

On the software side, we advise using at least two platforms to gather data. Reliable testing platforms include clients provided by Measurement Lab (measurementlab.net), DSL Reports (dslreports.com), and the Federal Communications Commission's Consumer Broadband Test (which also includes a link to MLAB; broadband.gov).

Before you begin, run tests in a known area of good service to ensure the hardware and software is working well, and record your findings as a control.

We recommend starting by spacing your test locations by 0.5 mile. If you encounter an area where service drops, or an area of particular concern to you, you can increase the number of tests you conduct over a given distance. You may test at each driveway you pass, for example.

If you have the capability, we advise using interactive software to test the quality of the broadband connection as well. Online video puts significant demands on your connection, and is a good way to differentiate areas where signals are strong and weak. To start, from a known reliable wireline broadband connection, view a one-way video from a site such as a subscription streaming video service. (You may also use non-subscription sites such as YouTube, but their videos may contain more buffering.)

In addition, we recommend testing a two-way video platform such as Jabber or Skype to test both directions of data transfer. This requires a webcam, preferably internal to the laptop to avoid any complications with an additional external device. The person on the other end of the video exchange should ideally be on a fast wireline connection to make sure that network connection has no chance of being the limiting factor. There are typically functions within video software that indicate delay or loss of data, and these are useful metrics, along with a qualitative test of the picture and sound quality.

To conserve budget, rather than purchasing new hardware and service from each broadband provider you wish to test, it may be advantageous to coordinate with other communities, agencies, or the state to find existing hardware and account access you may be able to use or borrow. Departments throughout your government, other jurisdictions, or possibly the non-profit community may have existing subscription hotspots or services you can borrow.

Mapping Based on Reporting by Key Stakeholders and Other Partners

The second strategy we recommend for local broadband mapping is to gather as much information as you can directly from others in your community. Every person and organization in your community, including business stakeholders, government agencies, non-profits, and individual residents, is a potential source of information on broadband supply. We recommend enhancing your picture of broadband availability with anecdotal and qualitative data from these sources.

As we have mentioned before, your local government is probably getting calls from residents who want more service options. Community interest organizations like the local Chamber of Commerce are probably hearing the same thing. Other associations, representing homeowners or businesses, or even governments (e.g., a Municipal League), may have information on specific user groups and some idea of the issues faced by their members.

You can continually be collecting these data to identify gaps with respect to all services. For instance, anecdotal discussions can help you identify areas where there is purportedly cable (i.e., according to a provider) but, in reality, lack of residential density means that it has not been built. The same may be true of areas where DSL is advertised, but never available in reality.

Finally, some segments of the commercial community are likely to have especially specific knowledge of broadband supply. Realtors, in particular, are likely to know the relevant issues in some of your neighborhoods, because broadband access is a significant consideration in the commercial real estate market.

Chapter 4: Broadband Technologies

This chapter provides a high-level primer on wireline and wireless broadband technologies. Given their long-term importance, we pay particular attention to fiber-to-the-premises (FTTP) networks and advanced wireless broadband (4G). For each of the technologies discussed here, we provide an overview of the advantages and disadvantages, and discuss their abilities to support both evolving communications requirements and consumer expectations—because, as we have noted earlier, broadband is a tool; the technology that a community chooses to deliver broadband will depend on its unique situation.

Wireline Technology

The majority of homes and businesses nationwide are connected via wireline communications—which, as the name suggests, means that a physical “wire” connects a user’s home or business to the network. The role of the wireline connection has evolved to provide users’ most intensive needs—high-definition television, telecommuting applications, telemedicine, gaming, data backup, digital media storage and transport, and “cloud” applications.

The wireline component is also typically the highest-speed portion of a communications network that includes a wireless/mobile component; in that type of network, wireline communications provide the backbone between key network locations and the interface with the wireless network (i.e., the base stations or cell sites).

There are three primary modes of wireline communications:

- 1) Fiber-to-the-premises (FTTP), adopted by Verizon in some markets,
- 2) Hybrid fiber-coaxial (HFC), used by cable operators, and
- 3) Digital subscriber line (DSL) used by incumbent providers over their copper telephone lines.

Fiber-to-the-Premises (FTTP)

Since the early 1990s, telecommunications and broadband operators have deployed wireline networks consisting of their legacy infrastructures (copper or coaxial), and the core, backbone, and long-haul components using fiber optic technology. Over that time the providers have expanded the fiber component from the core, to reach closer to the home and business.

Fiber-to-the-premises (FTTP) provides the greatest capacity, reliability, and flexibility of all wireline solutions and is therefore the state-of-the-art wireline transport technology. Fiber itself provides a broad communications spectrum and has a theoretical capacity of hundreds of Gbps per fiber with off-the-shelf equipment; even low-priced equipment can provide 1 Gbps.

Because it contains no metal components, fiber is not susceptible to interference from outside signals or to corrosion. Fiber installed 20 years ago is not physically or technologically obsolete.

Fiber optic equipment generally has a range of 12 miles with standard passive optical network (PON) electronics⁶ and almost 50 miles with higher-powered electronics.⁷ The range eliminates the need for electronics or powering in the middle of most networks, reducing the network's required staffing and maintenance and improving availability during storms or mass power outages.⁸ Fiber can be continuously upgraded simply by replacing or upgrading the network electronics at the ends.

Figure 24 illustrates a sample FTTP network, demonstrating how high levels of capacity and reliability are brought directly to the premises. Figure 25 illustrates at a higher level of detail how an FTTP network provides connectivity without a technical bottleneck to the Internet or other service providers, and can also provide a flexible, high-speed backbone for wireless services.

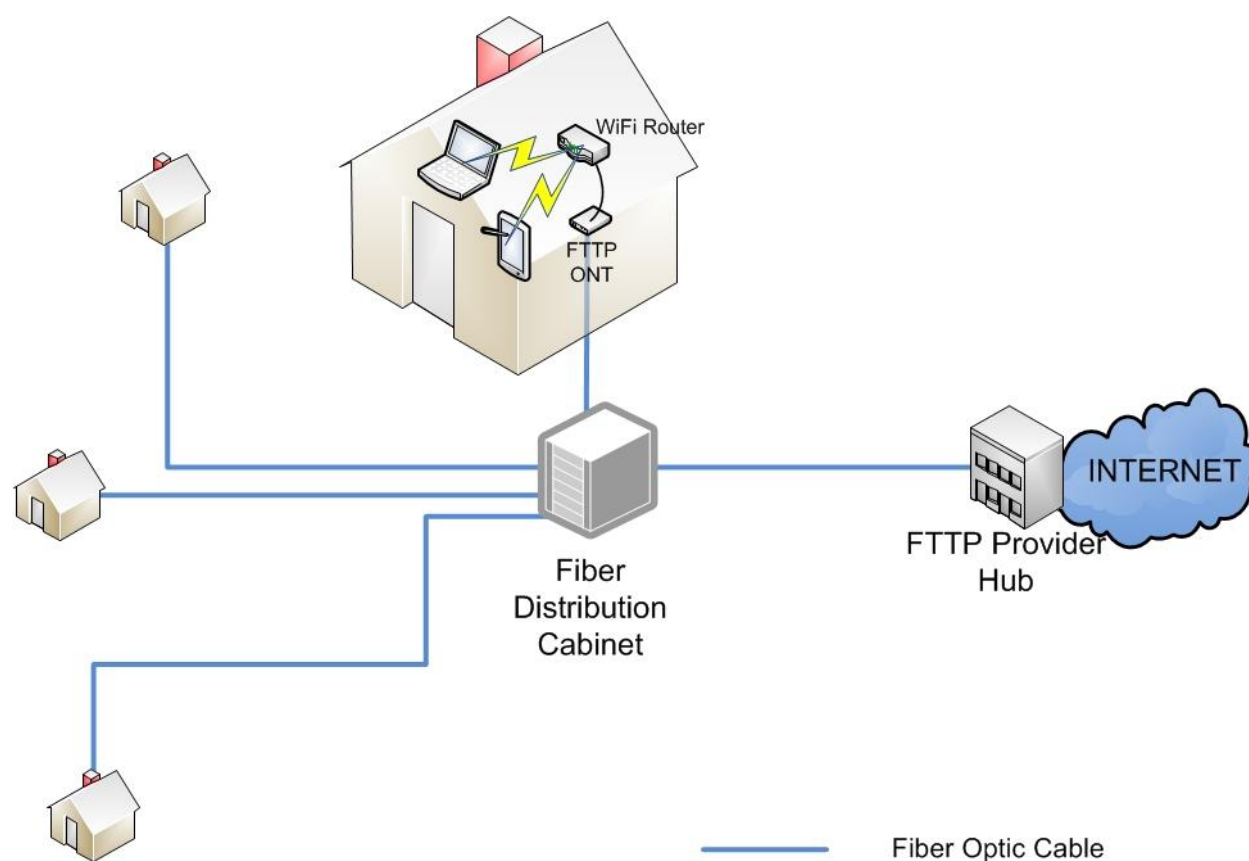


Figure 24: Sample FTTP Network

⁶ ITU-T Recommendation G.984.2 Gigabit-capable Passive Optical Networks (GPON): Physical Media Dependent (PMD) layer spec., p. 10, Table 2a, <http://www.itu.int/rec/T-REC-G.984.2-200303-I/en> (accessed August 30, 2012).

⁷ Cisco Small Form-Factor Pluggable Modules for Gigabit Ethernet, http://www.cisco.com/en/US/prod/collateral/modules/ps5455/ps6577/product_data_sheet0900aecd8033f885.pdf (accessed August 30, 2012).

⁸ Powering is required at the central office facility (usually equipped with long-running generators) and at the user premises (requiring the user to have backup power, such as a battery or a home generator). In contrast, hybrid fiber-coaxial networks have power supplies in each neighborhood with a few hours of battery backup. Once the batteries are depleted, the cable operator must place a generator at each power supply location.

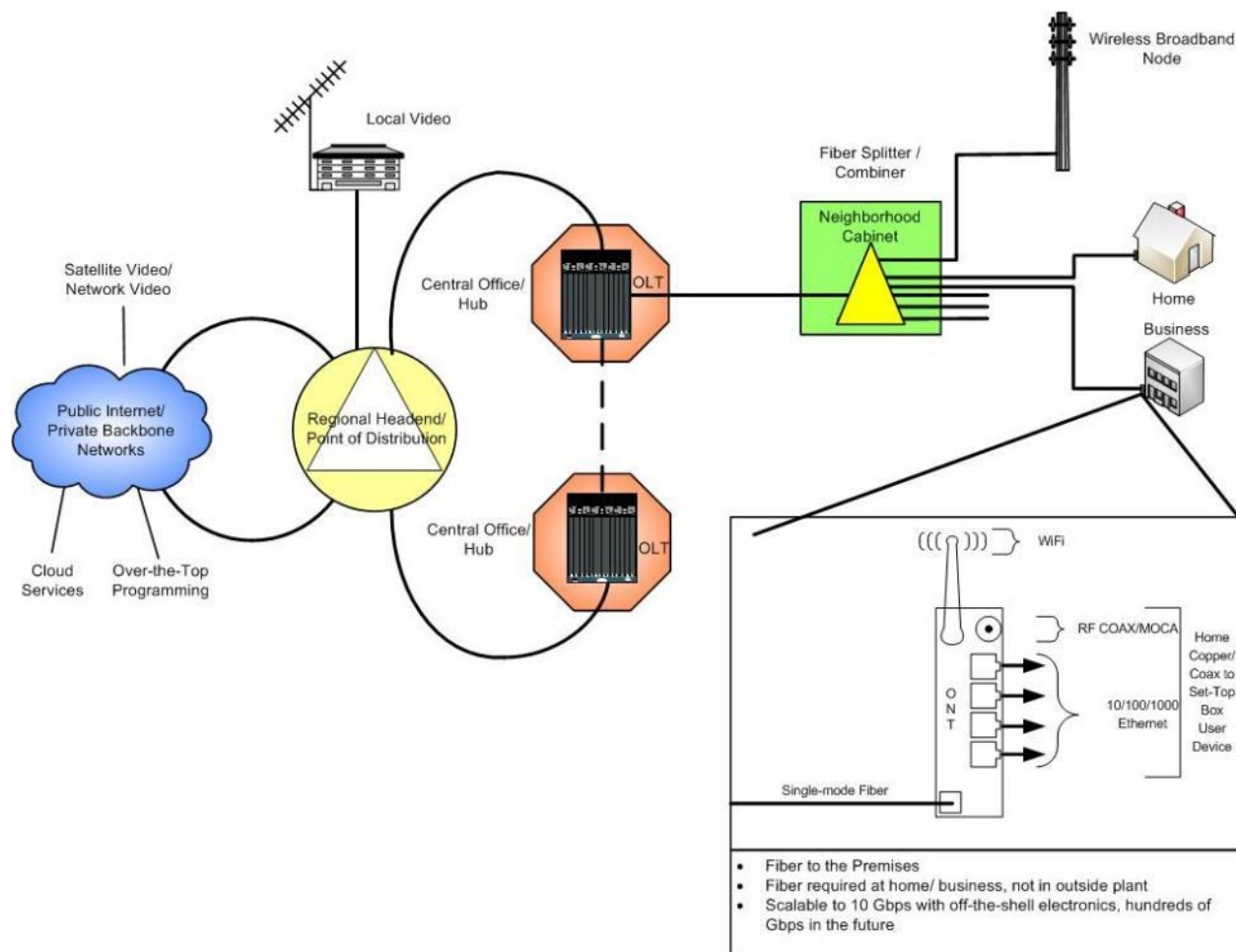


Figure 25: Sample FTTP Network (Detailed)

By the late 2000s, Verizon began constructing fiber optics all the way to homes and businesses in selected markets nationwide. This technology now reaches more than 15 million customers under the brand name FiOS.⁹ In other parts of the United States, municipal operators and telephone cooperatives have also constructed FTTP networks. Internationally, FTTP is increasingly common, sometimes initiated by private sector companies, sometimes initiated or mandated by governments.

Verizon is providing data, video, and voice services with a maximum offered speed of 300 Mbps download, 65 Mbps upload.¹⁰ However, the fiber in the Verizon FTTP network could scale to significantly higher speeds. With the Gigabit Passive Optical Network (GPON) electronics Verizon is currently deploying, each 36-user segment of the network shares 2.4 Gbps of downstream capacity and 1.2 Gbps of upstream capacity; assuming 50 percent penetration, this can provide a 133 Mbps average

⁹ Previously the only premises to receive fiber optics were those receiving the highest-speed business services, such as DS3 (45 Mbps) or greater symmetrical services.

¹⁰ "More than twice as fast as anything you've ever seen*," Verizon, http://offer.verizon.com/search?urlp.sem_adgr_id=1026_48627&urlp.google_ad_key=8178916593&google_kw_mt=e&google_kw_sid=1026_11474091&sem_kw_id=1026_46066&se=g&adc_visit=40aea437-1ebd-4cbc-9a59-6457de4f3aec&adc_visitor=1f1accb8-f507-4db7-8d80-e6b4695bd215m (accessed September 4, 2012).

committed speed per user and 66 Mbps upstream—with burst capacity significantly higher. The next generation upgrade is 10G GPON technology (10 Gbps downstream, 2.4 Gbps upstream), which is under test by Verizon and deployed for trial users in the Singapore OpenNet.¹¹ When required by customer demand, the operator can activate the 10G GPON on the same fiber as the current GPON, requiring no new outside plant electronics and creating no disruption on the existing network.

Although Verizon offers the fastest mass-deployed service in some U.S. communities, it is—as Google’s fiber project in Kansas City illustrates—moving considerably more slowly than the FTTP technology permits. Hong Kong Broadband Network (HKBN) and the electric utility’s network in Chattanooga, Tennessee are also offering 1 Gbps using FTTP technology.¹² Verizon representatives have stated in private meetings that the company anticipates offering 1 Gbps service by 2017.¹³

Hybrid Fiber–Coaxial (HFC)

Cable operators have extended fiber optics progressively closer to their subscribers’ premises but have generally stopped at nodes about one mile from the premises, using coaxial cable for the last mile. Thus, their networks are a hybrid of fiber and coaxial infrastructure. Comcast, for example, typically only constructs fiber optics to the premises of businesses that subscribe to Metro Ethernet and other advanced services (i.e., generally faster than 50 Mbps).

Cable operators have discussed constructing fiber optics to the premises, starting with new greenfield developments, but so far have generally not done so. They have typically opted instead to install new coaxial cables to new users, even though the construction cost to new premises is approximately the same.

The current leading cable technology for broadband, known as Data over Cable System Interface Specification version 3.0 (DOCSIS 3.0), makes it possible for cable operators to increase capacity relative to earlier cable technologies by bonding multiple channels together. The DOCSIS 3.0 standard requires that cable modems bond at least four channels, for connection speeds of up to 200 Mbps downstream and 108 Mbps upstream (assuming use of four channels in each direction). A cable operator can carry more capacity by bonding more channels.

Theoretically, there is significant room for upgrading the speeds in a cable system, especially if there is access to high-speed fiber optic backbone. For example, Virgin Mobile is offering 1.5 Gbps service in Britain over a cable network, presumably by bonding more than 30 channels.¹⁴ It is critical to note that

¹¹ Other fiber technologies include WDM PON, which assigns separate wavelengths of light to separate users (a deployment is currently underway in South Korea), and point-to-point fiber networks, such as the Citynet in Amsterdam, with individual users each receiving separate dedicated fibers.

¹² HKBN bb1000 description, http://www.hkbn.net/2010/eng/en_service1_1a5.html, HKBN pricing from \$27 Gigabit At Hong Kong Broadband, <http://www.dslprime.com/fiber-news/175-d/2878-27-gigabit-at-hong-kong-broadband> (accessed August 30, 2011); Your Gig is Here, <http://www.chattanoogagig.com> (accessed August 30, 2011); Chattanooga pricing at approximately \$350, <https://epbfi.com/you-pick/#/fi-tv-essential&fi-speed-internet-30> (accessed August 30, 2011).

¹³ As recounted by Joanne Hovis, President, CTC

¹⁴ Speed is claimed in advertising but no independent verification is available. Also, there is no description of the burst vs. guaranteed speed or the symmetry (upstream/downstream) of the service. See, for example: Beach,

these are peak speeds, and that the capacity is shared by all customers on a particular segment of coaxial cable; this is typically hundreds of homes or businesses. Speeds decrease during bandwidth “rush hours” when more users simultaneously use greater amounts of data. For example, residential bandwidth use typically goes up a great deal during evening hours when more people use streaming video services and other large data applications.

Figure 26 illustrates sample DOCSIS 3.0 network architecture.

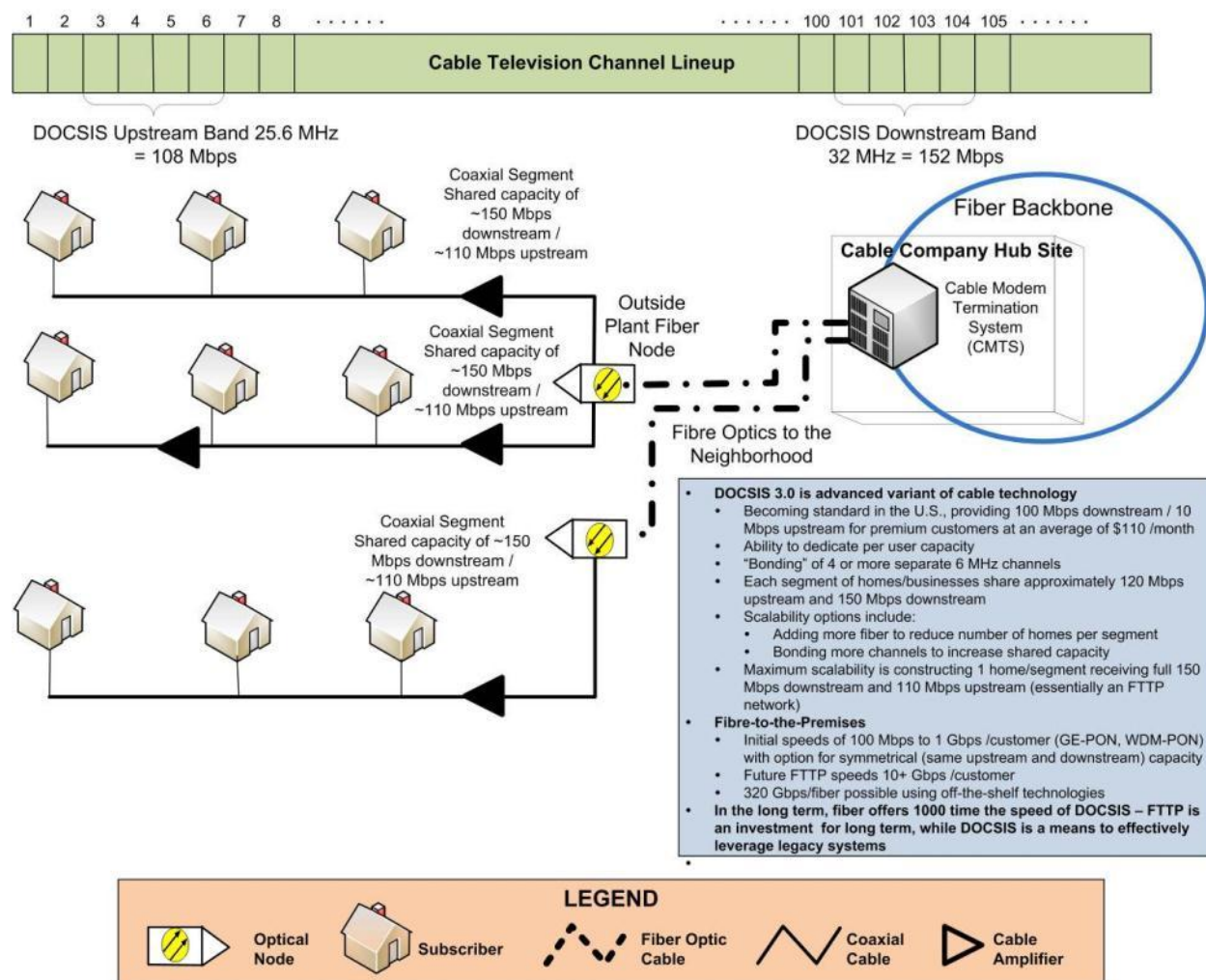


Figure 26: Sample DOCSIS 3.0 Network

Ultimately, the maximum speed over an HFC network is limited by the physics of the cable plant; although an HFC network has fiber within certain portions of the network, the coaxial connection to the customer is generally limited to less than 1 GHz of usable spectrum in total. By comparison, the capacity of fiber optic cable is orders of magnitude greater and is limited, for all intents and purposes, only by the

Jamie, “Virgin Media trials 1.5 Gbps speeds using DOCSIS 3.0,” telecoms.com, Sept. 14, 2011.
<http://www.telecoms.com/32896/virgin-media-trials-1-5-gbps-speeds-using-docsis-3-0/> (accessed Sept. 4, 2012).

electronic equipment connected to it—allowing for virtually limitless scalability into the future by simply upgrading the network electronics.

Thus, while DOCSIS 3.0 is more than adequate for the high-speed demands of most residential customers in the current market, it will not have the same longevity as fiber-to-the-premises, which is basically immune from obsolescence.

Digital Subscriber Lines (DSL)

Copper “twisted-pair” telephone lines remain the main wireline communications medium globally, and considerable effort has gone into extending the capabilities and capacity of these lines. Digital subscriber line (DSL) technology expands the capacity of twisted-pair copper lines to provide higher-speed service.

Retail providers selling DSL services on copper lines deliver a maximum speed that depends on the proximity of the central office or cabinet to the customer premises.¹⁵ The available speed varies on a case-by-case basis, depending on the above factors. Usually a DSL customer needs to be within three or four miles of a central office or cabinet. That central office must also have enough capacity to deliver service to a new customer; in some densely populated areas, a central office might not be able to provision service to a new customer, even if that customer is within the necessary distance of the facility.

In the United States, the most advanced widely available DSL platform is the U-verse network deployed by AT&T in its service areas. U-verse constructs fiber to cabinets within approximately one-half mile of the home and uses the copper wires for the subscriber connection.¹⁶ The maximum offered data speed of U-verse is 24 Mbps, with additional capacity for video traffic.¹⁷ Video and voice are provided in Internet Protocol (IP) format, requiring IP set-top converters for all voice and video services.

Wireless Technology

With the improvement of the quality and speed of wireless communications, the public has become accustomed to using Internet services with wireless technologies, either on a communications link managed by a wireless service provider (i.e., a cellular data plan), on local infrastructure typically managed at a home or business (i.e., a Wi-Fi hotspot), or through a mixture of those two approaches, in which an entity such as a service provider, municipality, landlord, or homeowners association operates a hotspot-oriented infrastructure.

It is critical to understand that wireless communications is limited and will always provide less capability and flexibility than the wireline technologies available at a given moment in time. Wireless is limited by over-the-air spectrum (i.e., the “channels” used for the signals), by range, and by line-of-sight. When an individual views images or videos on a device such as an iPad or a wireless Roku set-top converter, the

¹⁵ The performance and maximum capacity of DSL on a copper telephone line depends on the frequency response of the individual line, which in turn depends on the condition and length of the line.

¹⁶ AT&T's U-verse dissected, <http://adslm.dohrenburg.net/uverse/> (accessed September 2, 2012).

¹⁷ AT&T U-verse High Speed Internet, <http://www.att.com/u-verse/explore/internet-landing.jsp?fbid=regRwrVqL4d> (accessed September 2, 2012).

communications link has traveled through a fiber optic backhaul connection to a service provider's base station (or to a home FTTP optical network terminal, cable modem, or DSL modem). From that point the signal travels either over a service provider network with careful signal and capacity modeling,¹⁸ or from a hotspot located only a short distance from the user (and usually only serving the users in that premises).

That said, wireless technologies continue to improve and provide many of the services that homes and businesses need. Even if it is not, strictly speaking, a "third pipe" of fully competitive broadband to the home (after telephone and cable connections), it provides much of the value of one of those connections, and is currently the only one that follows users away from their homes or businesses.

As the U.S. Department of Commerce noted in a recent report on competitiveness, wireless broadband—like wired broadband—is a platform for innovation and economic growth:

"Broadband also can be provided wirelessly, and the rapid growth of mobile communications clearly shows how important this technology has become to the American way of life. Wireless broadband, like wired broadband, has the potential to transform many different areas of the American economy by providing a platform for new innovation. The spread of wireless broadband will increase the rate of growth in per capita income and will spur economic activity through new business investment. There is the potential for many new high-quality jobs to be created, both directly through investments in wireless infrastructure, and indirectly through as yet unanticipated applications, services and more rapid innovation enabled by advanced wireless platforms. Although these effects are difficult to quantify precisely, evidence from the economics literature suggests that they are likely to be substantial. Areas where innovations using wireless technologies are likely to have significant effects include consumer products and services; products to enhance business productivity, including business process re-engineering; health care, through products like patient-physician video conferencing, personal handheld biosensors to generate diagnostic information, and remote transmission of diagnostic information and images; education; and public safety, where a nationwide interoperable wireless broadband network for public safety will ensure that first-responders have real-time access to critical information in an emergency."¹⁹

Available Services

For some residents, even those who receive wireline service to their homes or businesses, their primary contact with the Internet is through their smartphone or wireless-equipped tablet or laptop computer. This connection can be made either through a mobile broadband data plan or through a Wi-Fi hotspot that is fed by a wireline connection.

¹⁸ Despite the dedicated spectrum (channel capacity), detailed engineering, and continuous upgrades in technology, wireless providers face significant challenges meeting the demand of users with laptop/tablet and smartphone devices, and have implemented bandwidth limits and other measures to control and ration usage.

¹⁹ "U.S. Competitiveness and Innovation Capacity," *Infrastructure for the 21st Century*, U.S. Department of Commerce (2011), p. 5-8 to 5-10.

Mobile Broadband

Nationwide, wireless providers operate a mixture of third-generation (3G) and emerging fourth-generation (4G) technologies. The service providers typically sell devices (cellular telephones, smartphones, air cards, tablet computers) bundled with 3G or 4G services. Typically devices are not transferrable from carrier to carrier, because they are “locked” into the carrier by software and/or because differences in the technologies used by the carriers limits compatibility of the devices (discussed below). Therefore, the purchase of a device is a de facto commitment to a particular service provider, as long as the owner uses the device.

The typical performance of 2G, 3G, and 4G wireless technologies is illustrated in Table 3 below.

Table 3: Typical Performance for Advertised 2G/3G/4G Services

Applications	Technology (Download/Upload Service Speeds) ²⁰		
	2G/2.5G–EDGE/GPRS, 1xRTT (128 Kbps–300 Kbps/ 70 Kbps–100 Kbps)	3G–EVDO Rev A, HSPA+ (600 Kbps–1.5 Mbps/500 Kbps–1.2 Mbps)	4G – WiMAX/LTE (1.5 Mbps–6 Mbps/500 Kbps–1.2 Mbps)
Simple text e-mails without attachments (50 KB)	Good (2 seconds)	Good (1 second)	Good (1 second)
Web browsing	Good	Good	Good
E-mail with large attachments or graphics (500 KB)	OK (14 seconds)	Good (3 seconds)	Good (1 second)
Play MP3 music files (5 MB)	Bad (134 seconds)	OK (27 seconds)	Good (7 seconds)
Play video files (100 MB for a typical 10-min. YouTube video)	Bad (45 minutes)	OK (9 minutes)	Good (3 minutes)
Maps and GPS for smartphones	Bad	OK	Good
Internet for home	Bad	OK	Good

The strict definition of 4G from the International Telecommunications Union (ITU) was originally limited to networks capable of peak speeds of 100 Mbps to 1+ Gbps depending on the user environment;²¹ according to that definition, 4G technologies²² are not yet deployed.

²⁰ These data assume a single user. For downloading small files up to 50 KB, it assumes that less than 5 seconds is good, 5-10 seconds is OK, and more than 10 seconds is bad. For downloading large files up to 500 KB, it assumes that less than 5 seconds is good, 5-15 seconds is OK, and more than 25 seconds is bad. For playing music, it assumes that less than 30 seconds is good, 30-60 seconds is OK, and more than 100 seconds is bad. For playing videos, it assumes that less than 5 minutes is good, 5-15 minutes is OK, and more than 15 minutes is bad.

In practice, a number of existing technologies (e.g., LTE, WiMAX) are called 4G and represent a speed increase over 3G technologies as well as a difference of architecture—more like a data cloud than a cellular telephone network overlaid with data services. Furthermore, a transition technology called HSPA+, an outgrowth of 3G GSM technology previously considered a 3G or 3.5G technology with less capability than LTE or WiMAX, has been marketed as “4G” by AT&T and T-Mobile, so the definition of 4G is now fairly diluted. The ITU and other expert groups have more or less accepted this.²³

Wi-Fi

Wi-Fi is a wireless technology that operates over unlicensed spectrum frequencies. It is commonly used in homes and offices for wireless local area networks, allowing a wireline Internet connection to be available to any device within range of a wireless router installed in the building.

Wi-Fi is also used by public and private organizations to provide broadband access to the public at a low or no charge. Some cities have developed public Wi-Fi access points for their downtown areas, and many businesses offer Wi-Fi to customers at no additional charge. Some mobile devices, such as a version of Apple’s iPad tablet, contain no other means of connecting to the Internet whatsoever; these Wi-Fi-only mobile devices would not be viable products were it not for a significant and growing public Wi-Fi supply.

Wi-Fi’s broadcast range is relatively low; it typically serves only to extend a wireline connection within a building or limited area. Nevertheless, it is the way many people connect to the Internet, and provides an easy way for businesses and others to provide access to a large number of people without concern for licenses, permits, or complicated network maintenance.

TV White Spaces

An emerging wireless technology is “TV white spaces” (TVWS) networking, which can cover longer distances than a Wi-Fi signal and deliver connectivity at a level higher than available mobile services. (Users would get typical download speeds of 3 Mbps and typical upload speeds of 1 Mbps.) TVWS base station equipment is also inexpensive relative to 3G, WiMAX and LTE technologies typically used in licensed spectrum.

“TV white spaces” are the unused buffer zone separating stations on the broadcast spectrum; the Federal Communications Commission (FCC) has made that portion of the spectrum available for unlicensed use because, with improvements and efficiencies in broadcast technology, the white space is no longer needed by the broadcasters to fully broadcast their signals. Even in urban areas where the broadcast spectrum is congested, there are white spaces available for other uses (Figure 27).

²¹ “Development of IMT-Advanced: The SMaRT approach,” Stephen M. Blust, International Telecommunication Union, <http://www.itu.int/itunews/manager/display.asp?lang=en&year=2008&issue=10&ipage=39&ext=html> (accessed September 2, 2012).

²² Such as LTE Advanced under development.

²³ “ITU softens on the definition of 4G mobile,” *NetworkWorld*, December 17, 2010, <http://www.networkworld.com/news/2010/121710-itu-softens-on-the-definition.html> (accessed September 2, 2012).

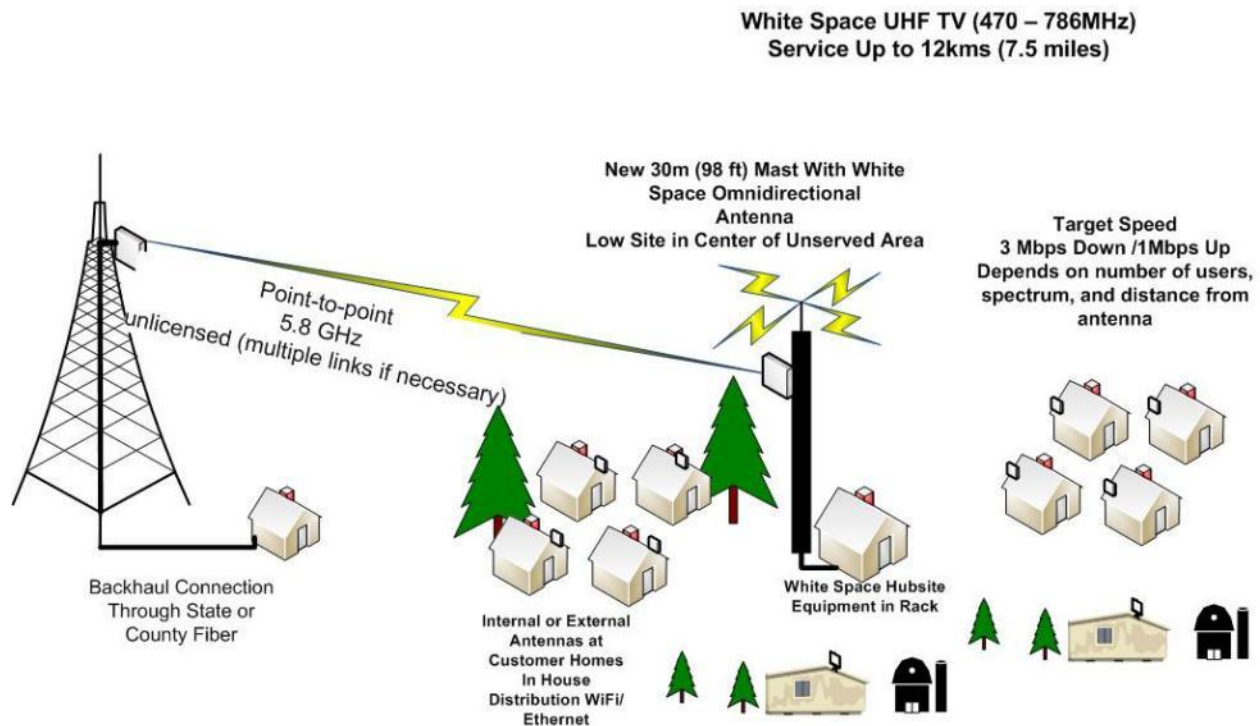


Figure 27: TV White Spaces Network Diagram

Content producers and the equipment manufacturing industry, led by Google and Microsoft, had lobbied the FCC for six to eight years to have the white spaces made available as open, unlicensed spectrum, with the expectation that there would be the same kind of growth and development of use of that spectrum as there was in the unlicensed spectrum that Wi-Fi utilizes.

They targeted this spectrum not just because the white space was available, but because it has excellent propagation characteristics—including indoors. It is able to penetrate physical obstructions that cannot be penetrated by the spectrum used for traditional Wi-Fi—from exterior building walls to broad-leaf trees and, in a limited way, larger physical obstructions such as hills.

An additional reason that TVWS technology may be desirable is the cost of carrier wireless services (e.g., AT&T, T-Mobile, Verizon Wireless, and so on). These services are expensive on a monthly basis, and become even more costly if users have prepaid or non-contract usage or exceed their monthly data allowances (i.e., data caps)—meaning that heavy users (especially home-based businesses) are essentially unable to use mobile broadband connections as their primary broadband connection.

That said, TVWS is in its infancy. The FCC only approved the strategy in the past few years and formalized the rules that will make it possible in the past year. So although there has been a lot of research and development, the earliest deployments will be by pioneers. In addition to the potential technical disadvantages of being an early adopter, launching a TVWS network has some financial disadvantages, as well: There has not yet been widespread adoption, so manufacturers have not yet realized economies of scale. There are few sources of equipment, and prices are not as low as they will be when scale has been achieved (as in the Wi-Fi market).

Limitations

In addition to the limited range of Wi-Fi and TVWS networks, mobile wireless broadband has technological limitations relative to wireline. These include:

- 1) *Lower speeds.* At their peaks, today's newest wireless technologies, WiMAX and LTE, provide only about one-tenth the speed available from FTTP and cable modems. In coming years LTE Advanced may be capable of offering Gbps speeds with optimum spectrum and a dense build-out of antennas—but even this will be shared with the users in a particular geographic area and can be surpassed by more advanced versions of wireline technologies (with Gbps speeds already provided by some FTTP providers today).
- 2) *More asymmetrical capacity, with uploads limited in speed.* As a result it is more difficult to share large files (e.g., video, data backup) over a wireless service, because these will take too long to transfer; it is also less feasible to use video conferencing or any other two-way real-time application that requires high bandwidth.
- 3) *Stricter bandwidth caps.* Most service providers limit usage more strictly than wireline services. Though wireless service providers may be able to increase these caps as their technologies improve, it is not clear whether the providers will keep ahead of demand. A *Washington Post* article about Apple's iPad with 4G connectivity highlights the issue: "Users quickly are discovering the new iPad gobbles data from cellular networks at a monstrous rate. Some find their monthly allotment can be eaten up after watching a two-hour movie. That has left consumers with a dilemma: Pay up for more data or hold back on using the device's best features."²⁴
- 4) *Limitations on applications.* For example, users of smartphones and some tablet computers are limited to approved applications by service providers or device manufacturers. Apple limits the applications that can operate on its iPhone and iPad devices. Although Android is an open platform, Verizon Wireless blocks uploads of video from Android wireless devices on its networks by disabling the feature unless the user is on a private Wi-Fi network. The FCC has reiterated that wireless providers have almost unlimited latitude to manage usage on their networks, in effect applying network neutrality rules only to wired networks; service providers can therefore expand their "management" of applications beyond the devices they provide to blocking or slowing applications from users with aircard-equipped PCs or home networks. The 3GPP protocols underlying LTE and subsequent technologies are designed to enable service providers to manage capacity based on application type (i.e., to prioritize particular types of traffic and make others lower priority).

Broadband Applications and Bandwidth Demands

Broadband is not an end in itself. The value of broadband is in its ability to reliably and consistently deliver applications—from Internet content, e-mail, and distance learning to telehealth and e-commerce. Broadband applications also include telecommuting, videoconferencing, data backup, Voice over Internet Protocol (VoIP), distance learning, security cameras, and remote access.

²⁴ Cecilia Kang, "New iPad users slowed by expensive 4G network rates," *Washington Post*, March 22, 2012. http://www.washingtonpost.com/business/economy/new-ipad-users-slowed-by-expensive-4g-network-rates/2012/03/22/gIQRXLXYUS_story.html?hpid=z2 (accessed September 2, 2012).

Broadband must provide the needed applications to and from users, whether they are individual citizens, public school buildings, businesses, or some other organization. Higher-quality broadband means more flexibility in using and adding applications, and applications running better and more reliably. Therefore, a suitable broadband connection requires taking into account all of the presently used applications, all of the users using them, and all of the applications that users might need in the future. The service should also be scalable, in the event that a user group outgrows the connection.

Broadband is important to residential users, but an occasional outage, while frustrating, is acceptable. Some organizations, on the other hand, could not operate if they could not connect, or if customers or suppliers could not reach them. While websites and e-commerce are typically “hosted” away from the business at a data center, many other applications must connect to the business. For those businesses, having both primary and backup connections is an option, as is a service-level agreement (SLA) with a provider, guaranteeing a particular level of performance, with penalties for nonperformance.

For both businesses and citizens, applications can run radically differently if high-capacity, high-quality broadband is available for a reasonable cost. Given suitable assumptions, entire classes of applications—server access, videoconferencing, video upload, server backup, telecommuting, and distance learning, for example—require more than 5 Mbps downstream. These applications are not currently supported by satellite, and hence will require other broadband services. The applications can be supported by higher-speed DSL services and higher-end cable services if those services are available.

This is more of an issue for businesses; 5 Mbps DSL services require the appropriate proximity to a phone central office, and therefore might not be available at a business location, even if the phone company has lines to the business. Cable may adequately support the applications, but again, cable might not be present at the business location. And these speed requirements assume a single user; as more users are added, the suitability of DSL and cable modem services quickly declines. Cable services from the smaller providers in smaller markets also become significantly more expensive above 5 Mbps—typically more than \$100 per month. In other words, even businesses with some broadband availability will face availability and cost barriers that may slow or stop their use of broadband applications.

Table 4 below describes the performance of common broadband applications, given a particular broadband service speed.²⁵ This table defines performance needs from today’s perspective. The demand for higher-capacity connections will continue to rise—as, for example, more users (citizens and small businesses alike) explore public or private “cloud computing” services, which support and deliver hosted applications and storage over the Internet. Unlike traditional hosting services, cloud computing requires no special equipment beyond Internet access and a personal computer, and many companies are aggressively marketing cloud-based services for personal and business use.

²⁵ The table assumes a single user. For downloading small files up to 1 MB, download time less than 10 seconds is good, 10 to 15 seconds is fair, and more than 15 seconds is not acceptable. For uploading videos of 1 GB, upload time less than 30 minutes is good, 30 to 90 minutes is fair, and more than 90 minutes is not acceptable. For downloading high-definition videos (2 GB), download time less than 10 minutes is good, 10 to 15 minutes is fair, and more than 15 minutes is not acceptable. For applications such as videoconferencing and remote server access, no concurrent usage of the same application by the same user. Server back-up will normally occur during off-peak times (10 p.m. to 6 a.m.). For telemedicine files up to 160 MB, download time of less than 30 seconds is good, 30 to 60 seconds is fair, and more than 60 seconds is unacceptable.

Table 4: Performance of Applications over Various Broadband Speeds

Applications	56 Kbps/ 56 Kbps (Dial-up, maximum speed)	256 Kbps/ 256 Kbps (DSL)	768 Kbps/ 384 Kbps (DSL; Satellite; 3G Wireless)	1 Mbps/ 384 Kbps (DSL; Satellite 3G/4G Wireless)	3 Mbps/ 768 Kbps (DSL; Satellite; 4G Wireless)	7 Mbps/ 768 Kbps (DSL; Cable; 4G Wireless)	10 Mbps/ 1 Mbps (DSL; Cable; Fiber; 4G Wireless)	15 Mbps/ 2 Mbps (DSL; Cable; Fiber)	20 Mbps/ 2 Mbps (Cable; Fiber)	50 Mbps/ 10 Mbps (Cable; Fiber)	100 Mbps/ 10 Mbps (Fiber)	1 Gbps/ 100 Mbps (Fiber)
Simple text e-mail without attachments (50 KB)	OK (8 sec.)	Good (2 sec.)	Good (1 sec.)	Good (1 sec.)	Good (1 sec.)	Good (1 sec.)	Good (1 sec.)	Good (1 sec.)	Good (1 sec.)	Good (1 sec.)	Good (1 sec.)	Good (1 sec.)
Receive e-mail with medium attachments or graphics (500 KB)	Bad (72 sec.)	OK (16 sec.)	Good (6 sec.)	Good (4 sec.)	Good (2 sec.)	Good (1 sec.)	Good (1 sec.)	Good (1 sec.)	Good (1 sec.)	Good (1 sec.)	Good (1 sec.)	Good (1 sec.)
Download small files (e.g., a fifty-page text document with limited graphics) (1 MB)	Bad (3 min.)	OK (32 sec.)	OK (11 sec.)	Good (8 sec.)	Good (3 sec.)	Good (2 sec.)	Good (1 sec.)	Good (1 sec.)	Good (1 sec.)	Good (1 sec.)	Good (1 sec.)	Good (1 sec.)
Download large files (e.g., new software or a large program update) (500 MB)	Bad (20 hr.)	Bad (5 hr.)	Bad (87 min.)	Bad (67 min.)	OK (23 min.)	OK (10 min.)	Good (7 min.)	Good (5 min.)	Good (4 sec.)	Good (80 sec.)	Good (40 sec.)	Good (1 sec.)
Download high-definition (HD) video (5 GB)	Bad (9 days)	Bad (44 hr.)	Bad (15 hr.)	Bad (12 hr.)	Bad (4 hr.)	Bad (96 min.)	Bad (67 min.)	Bad (45 min.)	OK (34 min.)	Good (14 min.)	Good (7 min.)	Good (40 sec.)
Upload videos, presentations (1 GB)	Bad (40 hr.)	Bad (9 hr.)	Bad (6 hr.)	Bad (6 hr.)	Bad (3 hr.)	Bad (3 hr.)	Bad (134 min.)	OK (67 min.)	OK (67 min.)	Good (14 min.)	Good (14 min.)	Good (80 sec.)
Daily incremental backup, up to 20 GB	Bad (> 1 day)	Bad (> 1 day)	Bad (> 1 day)	Bad (> 1 day)	Bad (> 1 day)	Bad (> 1 day)	Bad (> 1 day)	Bad (23 hr.)	Bad (23 hr.)	OK (5 hr.)	OK (5 hr.)	Good (27 min.)

Applications	56 Kbps/ 56 Kbps (Dial-up, maximum speed)	256 Kbps/ 256 Kbps (DSL)	768 Kbps/ 384 Kbps (DSL; Satellite; 3G Wireless)	1 Mbps/ 384 Kbps (DSL; Satellite 3G/4G Wireless)	3 Mbps/ 768 Kbps (DSL; Satellite; 4G Wireless)	7 Mbps/ 768 Kbps (DSL; Cable; 4G Wireless)	10 Mbps/ 1 Mbps (DSL; Cable; Fiber; 4G Wireless)	15 Mbps/ 2 Mbps (DSL; Cable; Fiber)	20 Mbps/ 2 Mbps (Cable; Fiber)	50 Mbps/ 10 Mbps (Cable; Fiber)	100 Mbps/ 10 Mbps (Fiber)	1 Gbps/ 100 Mbps (Fiber)
Telemedicine (e.g., radiological images such as mammograms) (160 MB download)	Bad (7 hr.)	Bad (84 min.)	Bad (28 min.)	Bad (22 min.)	Bad (8 min.)	Bad (4 min.)	Bad (3 min.)	Bad (86 sec.)	Bad (64 sec.)	Good (26 sec.)	Good (13 sec.)	Good (2 sec.)
Web browsing	Bad	Bad	OK	OK	Good	Good	Good	Good	Good	Good	Good	Good
Interactive online applications (trading, e-business, online meeting presentation, document sharing, gaming)	Bad	Bad	Bad	OK	OK	Good	Good	Good	Good	Good	Good	Good
Videoconferencing streaming at 384 Kbps (desktop/single user)	Bad	Bad	Bad	Bad	OK	OK	OK	Good	Good	Good	Good	Good
Telecommuting/Remote server access using VPN client	Bad	Bad	Bad	Bad	Bad	Bad	OK	OK	OK	Good	Good	Good
Multi-point videoconferencing streaming at 768 Kbps for a group of five to six	Bad	Bad	Bad	Bad	Bad	Bad	Bad	Bad	Bad	Good	Good	Good
Stream HD video (3 – 5 Mbps)	Bad	Bad	Bad	Bad	Bad	OK	OK	Good	Good	Good	Good	Good
Distance learning	Bad	Bad	Bad	Bad	Bad	Bad	Bad	OK	OK	Good	Good	Good

Chapter 5: Public-Private Partnerships

This section of the guidebook surveys a range of factors to be analyzed as a community considers entering into a public-private partnership to develop a broadband network. The variety of public-private partnership models reflects the diversity of interests, goals, and resources among the many communities seeking to build high-speed networks for their citizens.

At the outset, it is important to acknowledge that every infrastructure project involves, in some sense, both public and private participation. In traditional business models used by incumbent providers, infrastructure still must be built in public rights-of-way and on publicly owned or regulated utility poles. In public ownership models, private entities are hired to build, operate, or maintain the network (or some combination of the three). So in a sense, every infrastructure project is both a public and private endeavor. Therefore, even in models where infrastructure is owned, operated, and maintained by a county, tribe, or municipality, the private sector will benefit.

Looking specifically at public-private partnerships for broadband infrastructure projects where capital and/or operational costs are shared, the advantage of public-private partnerships is that they enable communities to share risk and cost with private partners. For businesses, by assuming some of the risk, they can have a share in the return on investment. Sharing the risks and benefits of a project allows communities to pursue projects that may otherwise be unattainable. It is a formidable challenge for a local jurisdiction to conduct a costly build-out to unserved areas, and the same can be true for private providers. A public-private partnership can help control and share costs for all parties.

Public-private partnership broadband models are relatively new. The dynamic we see today of municipal hybrid fiber-coax networks and FTTP networks is about 15 years old. During that time, about 80 municipal networks have emerged across the country. The trend accelerated in the late 1990s and early 2000s. The business models are still in their early phases of development. We therefore do not have a great deal of data, particularly with respect to FTTP, on the relative success of many of these arrangements.

It is very important for a community to look at a full range of options if it plans to enter the broadband market. For many communities, a public-private partnership can be of great benefit; for others, there may be other models that are superior. There is no one-size-fits-all approach.

To evaluate the options, there are three primary issues that any community should consider:

1. **Risk**—the costs associated with developing and running the network balanced against the revenue it generates,
2. **Reward**—the successful implementation of the policy goals of the project), and
3. **Control**—who owns the network and decides how it operates.

Not surprisingly, these three metrics contain tradeoffs among themselves. Achieving all three—minimum risk, maximum reward, and the desired level of control—is highly difficult. Officials should consider carefully what components of these three items are the most important to them, and be prepared to make sacrifices where appropriate.

A community can attain reward and control relatively easily if it is willing to take on all of the risk. Giving up some of the risk will likely also result in giving up some control of the project. However, it is possible to spread the risk and control without sacrificing much of the reward. This relates directly to the policy goals of the project, which the community should decide at the outset.

Risk

Every community will define risk differently, but most often when we use the term “risk” we refer to financial commitments. Some communities have no tolerance for financial risk at all, and others can afford to spend significant resources for a potential long-term payoff. If a community has a financial stake in the network being built, it may need to have strong assurances that it will be able to make that money back, or that the network will pay for itself over time, or will service its own debt from bonds.

There are non-financial risks as well, including the risk of not being able to achieve the stated policy goals. You can reduce financial risk if you have a good private partner, but without the right arrangement, you may risk losing out on the goals that caused you to enter into the agreement in the first place. Issues such as open access, guaranteed competition, pricing, universal service, and service to public institutions are potential goals that may not be realistic without taking a financial risk.

Finally, where lack of broadband is an issue, communities should seriously consider that it is also a risk to do nothing. Entering into a costly infrastructure project with or without private partners is certainly a risk, but so is the prospect of local citizens and businesses not having high-speed Internet, and the benefits (e.g., a means to maximize economic potential) that such access provides.

Reward

As is true with risk, probably the most common measurement of success is financial. However, with due consideration to financial goals and constraints, we can also measure success based on specific policy goals such as enabling economic development; facilitating the education process among teacher, students, and parents; and enabling new kinds of telehealth applications. After all, enabling these kinds of applications are generally the reasons for public sector involvement in broadband planning to begin with. It would be unusual for a municipality, county, or tribe to enter the broadband market simply to generate income like a private company.

These and other benefits that tend to drive communities to engage in fiber network builds might encourage communities to consider a different kind of reward analysis. Qualitative goals can be more difficult to evaluate than financial ones, but they should not be ignored.

Control

A community may or may not wish to control its own network. In some instances, it is beneficial for a municipality, county, or tribe to become the Internet service provider itself, and to sell services over the fiber it has built. In other instances, the community has no interest in this level of control, so long as it can guarantee that a private partner is meeting the community’s policy goals. The community will want to ensure that prices, service options, access, and other consumer variables enable their goals to be

met, and that the service reaches the intended population. This does not necessarily mean that the municipality, county, or tribe needs to control the service themselves.

A community seeking partners should therefore: Figure out the specific goals of the project; determine what kind of control these goals require; and seriously evaluate its risk tolerance. This analysis will help decide what kinds of public-private partnership models may be beneficial.

Examples

Below are a few examples of communities that have entered into public-private partnerships. These cases illustrate different balances among risk, reward, and control to meet the needs of their communities and their policy goals.

ENMR-Plateau

The Estancia Valley Economic Development Association is a multijurisdictional organization in New Mexico whose members are working together on regional broadband improvements. As an economic development association, they seek to stimulate growth throughout the underserved eastern region of the state through broadband development, but do not seek to own or operate their own network. The association's members identified the kinds of infrastructure likely to make the most difference in serving the region's communities, and sought a private partner on that basis.

Their partner of choice was ENMR-Plateau, a local telephone cooperative.²⁶ The association supported ENMR-Plateau on a grant application to build middle-mile fiber; the cooperative ended up winning two rounds of grants to serve eastern New Mexico and parts of western Texas.

In this case, the public economic development entity acted as the catalyst for broadband development through its support of a private cooperative effort. Identifying infrastructure goals for the region at the outset and identifying an existing private partner allowed them to accomplish their goals without taking any risk themselves.

Farmington, New Mexico

Farmington is a city in northwest New Mexico with a municipal electric utility, the Farmington Electric Utility System. The city already has about 80 miles of fiber in its possession. Currently, the utility is the only user of this fiber, but the city is exploring expanding the use of the fiber to provide service to residents and businesses. Using private consultants, the city evaluated various models for broadband service.

²⁶ At the time this partnership was formed, the ENMR-Plateau telecom cooperative held its own wireless assets. On October 16, 2012, Verizon Wireless announced it had completed the purchase of the cooperative's wireless assets. ENMR-Plateau wireless subscribers will be transitioned to Verizon Wireless service. The wireline infrastructure was not affected, and remains under cooperative ownership.

Source: Verizon Wireless News Center, October 16, 2012.
<http://news.verizonwireless.com/news/2012/10/pr2012-10-16e.html>

The consultants determined that leasing the municipal fiber to existing ISPs was the best option for Farmington; they also considered the option of the city offering a “triple play” service itself, but found that such an offering would require a \$100 million capital investment. Furthermore, the consultants warned of further risk, in the form of significant pushback from incumbent ISPs, should the city opt for a public broadband offering.

The partnership model therefore is public ownership and private operation. The city can offer use of the fiber at a low cost basis, and guarantee an open access network. It stands to benefit financially, both from leasing the fiber and from the economic development benefits of greater broadband in the community.

Amsterdam

The city of Amsterdam entered into a public-private partnership a number of years ago with a local bank and a local group of housing cooperatives that own much of the residential real estate in the city. They have arranged a fiber build that will be partially municipally funded.

By not funding the entire build, the city gave up a certain amount of control—and with no ownership interest, it certainly gave up a lot of potential long-term reward, assuming the network makes money. However, the city was able to secure the two things it really wanted. First, it ensured that the build-out will be universal; it was important to the city that all neighborhoods are served, not just the wealthy areas, as is often the case under traditional broadband business models. Second, the city guaranteed open access.

The city was not concerned about owning the network itself, so long as these goals were being met. It also spread out the responsibilities of the network among its various partners, so that one set of entities held ownership of the fiber, a different set handled operations, and yet another handled service. In this way, the city guaranteed its policy outcomes and minimized its own risk.

Google Fiber

The Google Fiber project in Kansas City, Missouri and Kansas City, Kansas has gained national attention. Essentially, Google has taken on the build itself; the company will both own and operate the fiber network. The cities have little control in that regard, but also have close to no risk. The cities are providing some benefits to the company to help bring down costs, but they will also get a massive infusion of economic development benefits. These come not only from the network itself, which could cost about \$2 billion, but also in all of the long-term economic development benefits discussed above.

Sandy, Oregon

The City of Sandy has partnered with a private provider that will finance and build an FTTP network throughout the community. The provider will also maintain the network, which is a considerable ongoing operating cost. In return, the community will guarantee the provider a certain level of revenue for 10 years. The city will be the Internet service provider in this case. The minimum level of return it is guaranteeing to the private partner is within reasonable expectations for the expected revenues from the network.

The city is taking risk; if this level is not met, the City will cover the difference. This arrangement gives the private provider a guaranteed income stream for 10 years, and the community does not have to come up with the upfront capital cost of building the network; however, as the ISP, the city maintains control over specific business decisions, such as the types of data products offered, bandwidth options, and pricing. The city has shared the risk and the reward, but maintained control of what is important to them.

Joint-Funded Fiber Build-Out

In one community (which we cannot name due to ongoing negotiations), there are significant areas that are entirely unserved by broadband. For people who want their children to have access to educational resources and for people who want to run home-based businesses, this is a huge problem. The local government is forming an arrangement with a private provider, under which both sides will fund 50 percent of a network build. The community does not care about owning or operating the network, and does not want to place any restrictions on its use. The community simply wants broadband in the local market. Its rationale is that the initial subsidy amount is relatively modest compared with the economic benefits of enabling a large number of people to run home-based businesses, and the subsequent improvement of the tax base.

Chapter 6: Broadband Funding Mechanisms

The natural extension of a discussion of broadband network partnerships and business models is a discussion of project funding mechanisms. This chapter presents strategies that local governments can take to identify funding sources for community broadband projects, including federal E-rate subsidies, the U.S. Department of Agriculture's Rural Utilities Service (RUS) loan and grant programs, other federal grant programs, and other current and potential funding sources.

A detailed overview of current federal funding opportunities is included in Appendix A.

Overview

As of this writing in fall 2012, it is not a particularly good time to be looking for broadband grant funding, either public or private. For a range of reasons—including virtual paralysis in Congress and the challenging economic environment—resources are particularly low at the moment.

Programs that existed just two years ago do not now. The broadband funding in the American Recovery and Reinvestment Act of 2009—the Broadband Technology Opportunities Program (BTOP) and the Broadband Initiatives Program (BIP)—were very much one-time programs, and there appears to be no appetite in Congress right now to reauthorize comparable programs.

In addition, the rather challenging political atmosphere in Washington and the upcoming election mean that very little legislation—particularly on the appropriations side—has been successful. In fact, all federal spending is being met with levels of suspicion that is unprecedented in our experience. In addition, with respect to foundations, grant sources are much lighter than they were just a few years ago, largely because of the deterioration of the economy and foundation endowments.

That said, there are still steps that local governments and public-private partnerships can take to be prepared for opportunities as they arise. For example, local government staff can subscribe to alerts of upcoming funding deadlines through www.grants.gov. And, if a local government has grant-writing capabilities, it should consider applying widely when opportunities present themselves. Many grant opportunities are something of a longshot—but the same was true of the BTOP funding, and that longshot paid off for many New Mexico communities.

We also recommend that interested communities closely monitor progress on the reauthorization of the Farm Bill (i.e., the Food, Conservation, and Energy Act of 2008).²⁷ The Farm Bill has traditionally been a vehicle by which rural broadband program are funded; it is likely to continue to be so, after the one-time shift to the ARRA. We have reason to hope that future iterations of the Farm Bill will include significant broadband funding, and that the current lack of such is a temporary sign of the times that will, presumably, change.

To help focus your future efforts in identifying funding options, we researched relevant federal funding opportunities; we highlight in this section your most likely near-term funding opportunities.

²⁷ "Farm Bill Resources," Economic Research Service, U.S. Department of Agriculture. <http://www.ers.usda.gov/farm-bill-resources.aspx> (accessed October 10, 2012).

First, there are two relatively modest but very attractive grant opportunities: The Community Connect program and the Distance Learning and Telemedicine program. Both are important opportunities, and both are highly competitive—but we feel they are worth dedication of resources because they are weighted on the grant side, rather than focused on loans, which would be much more costly.

Second, we include here details about the Universal Service Fund, which represents an ongoing source of funding for rural telecommunications infrastructure, and which has seen recent changes that could have an effect on broadband availability in many communities.

Finally, we note the availability of rural broadband loans—and the shortcomings of the existing program.

Community Connect Program Grants

The Community Connect Grant program²⁸ is a modest-sized, but significant, grant program for local and tribal government that focuses on targeted deployment to completely unserved, very low income areas. The program is administered by the Rural Utilities Service (RUS) of the U.S. Department of Agriculture. Local USDA representatives have told us that RUS is constantly seeking interested and capable grant recipients for this program in New Mexico and welcomes applications from New Mexico communities.

Priority is given to areas demonstrating “economic necessity.” The application process is rigorous and competitive (with awards given to only 10 percent of applicants) and once awarded, program requirements are demanding (e.g., requiring last-mile service for all households in the service area).

Awards can be given to both public and private entities; eligible applicants include local governments and community nonprofits.

The grants carry a 15 percent match requirement that can be met with in-kind contributions; awards range considerably in size from \$50,000 to \$1 million. When the next grant window opens (likely this coming spring), it is likely to close 60 days later.

Community Connect funds approximately 15 projects annually (from an application pool of 150). Eligible projects must offer basic broadband transmission service to both residential and business customers within the proposed service area. Examples of eligible projects include deploying broadband transmission service to critical community facilities, rural residents, and rural businesses; constructing, acquiring or expanding a community center (but only 5 percent of grant or \$100,000 can be used for this purpose); or building broadband infrastructure and establishing a community center with at least 10 computer access points, which offer free public access to broadband for two years.

While Community Connect has a fairly broad mission, funding is geographically limited to a single community with a population less than 20,000 that does not currently have Broadband Transmission Service (as determined by the FCC National Broadband Map). Grants cannot duplicate any existing broadband services, nor can applicants charge for services to any critical community facilities for at least two years from the grant award.

²⁸ “About Community Connect Grants,” Rural Development, U.S. Department of Agriculture. http://www.rurdev.usda.gov/utp_commconnect.html (accessed October 10, 2012).

To prepare the most competitive Community Connect grant application possible, we would recommend that a jurisdiction chart an area within its unserved footprint, then target the lowest income portions of that area.

Distance Learning and Telemedicine Program Grants

The Distance Learning and Telemedicine (DLT)²⁹ program has historically provided both grants and loans, but appropriations have been limited to grants in recent years. Grants of \$50,000 to \$500,000 are given for equipment, rather than broadband facilities or service; however, this may provide a good way for New Mexico communities to leverage a new broadband network (e.g., by helping finance video conferencing systems and medical units). As such, this could be a good supplement to other funding options.

Funds can be awarded to both public and private entities (including corporations or partnerships, tribes, state or local units of government, consortia, and private for-profit or not-for-profit corporations), assuming they provide the requisite services.

Grantees must provide education or medical care via telecommunications. Eligible entities must either directly operate a rural community facility or deliver distance learning or telemedicine services to entities that operate a rural community facility or to residents of rural areas. Among the grant scoring categories are innovativeness, benefits and needs (including economic need), and availability of matching funds.

Universal Service Fund

The Universal Service Fund, a creation of the Telecommunications Act of 1996, has traditionally been, along with RUS loans, the most significant source of telecommunications funding for rural America. There are four key programs within Universal Service,³⁰ all of which are of note to many local and tribal governments in New Mexico.

Lifeline Program

The Lifeline program for low-income citizens has traditionally included two key programs: Lifeline and Link Up, which subsidize the telephone service and initial connection charges, respectively, for low-income Americans.³¹

In brief summary, Lifeline has provided low-income households with a \$9.25 per month subsidy on phone service, so long as they were purchasing service from participating telecommunications carriers. In the past year, Lifeline has been modestly reformed by the FCC. For purposes of this guidebook, the most significant change has been that the \$9.25 subsidy can now be applied to bundled phone and Internet service, and is no longer limited to standalone phone service. While this change seems very

²⁹ "About the DLT Program," Rural Development, U.S. Department of Agriculture.
http://www.rurdev.usda.gov/utp_dlt.html (accessed October 10, 2012).

³⁰ "Universal Service," Federal Communications Commission.
http://transition.fcc.gov/wcb/tapd/universal_service/welcome.html (accessed October 10, 2012).

³¹ "Lifeline Program for Low-Income Consumers," FCC Encyclopedia, Federal Communications Commission.
<http://www.fcc.gov/lifeline> (accessed October 10, 2012).

modest, it is actually quite significant. The enabling legislation itself appears to be the barrier to allowing the subsidy to be used for standalone Internet service—hence the importance of the ability to bundle phone and Internet and still realize the benefit of the subsidy.

This program as it currently stands will not have implications for build-out of broadband facilities in many communities—but the availability of the subsidy is information that we think is worth including in any educational materials that local jurisdictions prepare for outreach to their residents.

The other significant aspect of Lifeline/Link Up reform is contained in a pending proceeding at the FCC, which has the potential to reallocate some of the Lifeline funding to libraries and possibly other public and nonprofit entities. Specifically, in a Further Notice of Proposed Rulemaking, the Commission asks for comments on the prospects of allocating some of the Lifeline reform savings to funding digital literacy efforts. Such allocation of funding would enable those entities to undertake digital literacy training. The Commission’s focus has been on potentially using the E-rate mechanism to enable libraries to purchase digital literacy training services. There is a possibility that the program will be defined more broadly to make public entities such as local government, or non-profits, eligible for funding for such programs. This could be of real importance in low-income and less connected communities.

There is no way to predict at this stage how the proceeding will be resolved; as of the fall of 2012, the comment period is closed but the FCC has not yet made any announcement.

Separately, however, the FCC selected Leaco Rural Telephone Cooperative, in the southeastern portion of the state, as one of the organizations that will pilot broadband adoption strategies through Lifeline.³²

High Cost and Connect America Funds

The Universal Service High-Cost program,³³ which has been the largest part of the Universal Service Fund (well in excess of \$4 billion per year on an ongoing basis), has traditionally funded eligible telecommunications carriers (ETCs) to build and operate telecommunications (telephone) facilities in rural unserved areas. This program has been famously complex and inefficient. The FCC undertook to reform the program over the past year, to mixed reviews.

For purposes of the broadband future of New Mexico’s local communities, the most significant change to note is that a part of the High Cost fund will be gradually transitioned over time into a new program, the Connect America Fund,³⁴ which will subsidize the construction of broadband (data) facilities, rather than exclusively telephone services as in the past. Over time, the shift from telephone to data service will accelerate, assuming that the FCC’s current strategy is not changed.

The key points for New Mexico’s jurisdictions are that, first, only ETCs are able to leverage this funding. This is a private sector funding opportunity, and there is a right of first refusal by the incumbent

³² “Lifeline Reforms Save Over \$210 Million; 14 Broadband Pilots Launched,” News Release, Federal Communications Commission, December 19, 2012. <http://www.fcc.gov/document/lifeline-reforms-save-over-210-million-14-broadband-pilots-launched> (accessed December 20, 2012).

³³ “Universal Service Program for High Cost Areas,” Federal Communications Commission. http://transition.fcc.gov/wcb/tapd/universal_service/highcost.html (accessed October 10, 2012).

³⁴ “Connect America Fund (CAF),” Federal Communications Commission. <http://www.fcc.gov/encyclopedia/connecting-america> (accessed October 10, 2012).

telecommunications carriers in the community. As a result, this is really an opportunity for incumbents to build to the unserved parts of the state.

This program is also truly limited to the unserved parts of the state; at least as conceived by the FCC in the regulations, the fund will not pay for competitive facilities—it will only serve areas that are entirely unserved by broadband.

Because this and other changes in the High Cost program create certain financial threats or challenges for existing High Cost-funded telecommunications carriers, the program is, not surprisingly, subject to extensive litigation, and it currently is difficult to project when there will be clarity about the program's future. With time, we believe that the new Connect America program may be a long-term partial solution for parts of the state.

Schools and Libraries (E-rate) Program

The Schools and Libraries Universal Service program—typically referred to as the E-rate program—subsidizes the provision of broadband and telecommunications services to eligible K-12 schools and public libraries.³⁵ It also covers such entities as Head Start programs, which is significant in many communities across the state.

Under this program, a range of providers can compete to provide services to schools and libraries. Through a structured program administered by the Universal Service Administrative Company (USAC), schools and libraries post their requests for proposals (RFP) and select the best bid, then cooperatively with the service provider apply to USAC for the subsidy amount. The funding flows directly from USAC to the provider.

Because of reforms to the E-rate program that were undertaken by the FCC in 2010 and implemented in 2011, public and non-profit entities now qualify as eligible providers. Thus, this program is potentially of significant importance to local and tribal governments in the state; as the operator of a public-sector anchor institution fiber network, for example, a public-private partnership could potentially serve schools and libraries that are eligible for the subsidy. At the very least, such a partnership would have the opportunity to compete to provide the best possible, most cost-effective services to subsidy-eligible entities. The program also provides for subsidy of construction of some fiber to schools and libraries, which could present an opportunity to expand the reach of public interest fiber across the state.

Rural Health Care Program

The last component of the Universal Service Fund is the Rural Health Care program, which partially funds telecommunications services for rural health care providers.³⁶

In addition to the primary rural program, a Rural Health Care Pilot Program has helped 200 selected hospitals and groups of healthcare providers nationwide pay for telecommunications network

³⁵ "E-Rate – Schools & Libraries USF Program," FCC Encyclopedia, Federal Communications Commission. <http://www.fcc.gov/encyclopedia/e-rate-schools-libraries-usf-program> (accessed October 10, 2012).

³⁶ "Rural Health Care Program," Federal Communications Commission. <http://transition.fcc.gov/wcb/tapd/ruralhealth/welcome.html> (accessed October 10, 2012).

construction and upgrades. The Pilot Program has been criticized, however, for its failure to get money to recipients in a timely manner.

This program may evolve into the Health Infrastructure Program. Potential recipients under the forthcoming program include acute-care facilities that provide services traditionally provided at hospitals, such as skilled-nursing facilities and renal dialysis centers and facilities and administrative offices and data centers that do not share the same building as the clinical offices of a health-care provider but that perform support functions critical for the provision of health care.

Although this program could theoretically provide 85 percent of the construction costs of new regional or statewide networks to serve public and non-profit health care providers in areas of the state where broadband is unavailable or insufficient, it is not a viable short-term funding option because the Health Infrastructure Program has not yet been launched. (The Notice of Proposed Rulemaking was published in July 2010, but the program has not yet been adopted by the FCC.) Funding would come from the Universal Service Fund (i.e., surcharges on telephone bills), rather than Congressional appropriations. As such, funding will be stable once launched.

RUS Broadband Loan Program

The other most extensive, long-term funding of rural broadband and telecommunications facilities construction has been the Rural Utilities Service (RUS) rural broadband loan program, which is funded through the Farm Bill and administered through the RUS.³⁷

The program has financed, at competitive rates, broadband networks in rural areas throughout the United States. It gets a range of different kinds of reviews. The interest rates are generally considered to be extremely competitive, but the programs are quite famously very labor- and paperwork intensive.

Both public and private sector entities are eligible for the program. However, if a given jurisdiction were to undertake strategies requiring extensive financing, it is not clear to us that these loans would be more advantageous than public bonds, especially given that there is no grant component.

We recommend that communities assessing their broadband options take a look at RUS loan opportunities and compare them to alternative loan structures.

³⁷ "RUS Telecommunications Programs," Utilities, Rural Development, U.S. Department of Agriculture. <http://www.rurdev.usda.gov/RUSTelecomPrograms.html> (accessed October 10, 2012).

Chapter 7: Benefits On and Off the Balance Sheet

As with any significant public investment, a broadband initiative requires detailed financial analysis and a calculation of the potential return on investment. Financial considerations are obviously critical for any significant infrastructure investment. However, cash flow may not be your prime metric for evaluating the feasibility or the importance of a broadband infrastructure program. In fact, we believe that local governments should consider defining their success metrics more broadly and include the “benefits beyond the balance sheet”—the intangible societal rewards that broadband offers the community as a whole and might deliver to individual citizens.

This chapter provides a general discussion of a range of direct and indirect benefits that may inform a robust public discussion of a community broadband initiative. These benefits—which, in general, can be split between middle-mile and last-mile infrastructure—include costs savings and revenue streams, as well as economic development, positive environmental impacts, and improved educational outcomes.

Direct Benefits of Middle-Mile Networks

There are dollars-and-cents ways to model some of the potential benefits of a proposed middle-mile network. This analysis comprises at least two elements. First, there are the existing and future costs that a governmental network can help the operator avoid (i.e., by replacing services for which the government previously paid third parties). Second, there are the potential revenues that a network can bring to the community—especially given new E-rate regulations that make governmental networks eligible for subsidy in serving schools and libraries. Together, these two sides of the equation can add up to significant dollars—and potentially to sufficient amounts to justify financing the necessary construction. A multiplier effect for money that stays in a local community may swing the calculation even further.

Capitalizing on Cost Savings—Current and Future

Government entities of all sizes are major consumers of connectivity services, to support internal operations, public safety functions, and a range of other applications. Typically, government facilities lease circuits from a phone company or similar provider, and for that privilege they pay rates that sometimes represent many hundreds if not thousands of percent profit for the phone companies. Worse, the circuits are usually relatively low-bandwidth connections, because the retail costs of very high bandwidth services make those connections simply unaffordable.

A government fiber optic network that links all of the governmental operations eliminates the jurisdiction’s ongoing cost of leasing circuits, which represents an easily quantifiable present value on the financial statement. These are as close to “guaranteed” line items as possible: Build the network and you will shave this amount from your accounts payable.

In fact, because a government fiber network can deliver far higher-capacity connectivity than the jurisdiction had previously leased, the value is even greater than the simple cost-avoidance measure. When you own your own network, for example, you can accomplish gigabit speeds among and between the facilities on your network using inexpensive, off-the-shelf equipment—and you will incur no cost for

bandwidth because the traffic is “on network” (i.e. on your Intranet, not going out to the Internet). You can also deliver Internet connections to these facilities at much lower per-unit cost, because you can aggregate the needs of all your departments to more cost-effectively purchase commodity bandwidth. This is particularly true if you are able to develop a partnership that benefits the wholesaler from which you are buying.

The cost savings generated by a government network will grow over time, too. The very lowest estimates would value that growth in lockstep with the expected inflation of retail service prices. But in reality, the government network will deliver even more value because it can inexpensively scale to meet the jurisdiction’s future needs for more capacity (which are likely to grow exponentially) and connectivity to additional sites—which would be financially impossible using leased circuits.

Whether creating a business case for a new network or developing budget projections for the status quo, it is incredibly important for communities to understand how greatly their governmental bandwidth needs will grow. Capacity requirements for government operations have grown exponentially over the past 15 years, and there is nothing to suggest that the pace of growth will abate over the next 15 years. In addition, most governmental operations and community anchors are already overtaxed in terms of their broadband capacity—meaning that they already require much more bandwidth today, let alone tomorrow. (In practical terms, that means that absent a government-owned network, governments will continue to be unable to deliver the capacity they need to adequately support their internal operations and those of community anchors—and that they will lack the bandwidth to undertake all kinds of future innovations, even if they have the necessary hardware, software, and ideas.)

With a government-owned fiber network, the cost to scale up to meet needs like this is far lower than if you are buying circuits from someone else—not just because they have a profit motive, but because they may not have the infrastructure where you need it. If the phone company has only low-speed twisted-pair copper in your footprint, the only way to get the capacity you need is to pay them to build fiber to you—and then to pay them to deliver services over the fiber you just financed for them. Viewed in that light, a government-owned network becomes even more compelling.

Creating Revenue Streams

Like a toll road waiting for traffic, a government-owned and operated fiber optic network represents a potential source of revenue for the community. Projected cash flow generated by a government-owned network is not as certain as the avoided costs, but prudent business modeling can include scenarios ranging from best-case to worst; this is just one of many factors to consider in building the business case.

There are, in fact, three potential revenue streams in a fiber network; two are fairly traditional, and one is both new and potentially very lucrative.

Dark or Lit Fiber to Community Anchors

The first revenue stream is a well-established aspect of network operations: Providing either dark fiber or lit services for non-governmental institutions. This model hews very closely to the service delivered to governmental operations—but instead of helping the government avoid its own costs, it creates a

revenue stream for the operator. By providing reasonably priced fiber to qualified non-profit and community organizations and facilities, the network operator also supports the needs of anchor institutions—which in turn support the citizens.

To understand the magnitude of revenue that a government fiber network can earn from this source, it is helpful to understand what types of facilities can be connected and what level of service they need.

Community anchor institutions are places where members of the community go for the kinds of services that support and sustain them, and where services like broadband Internet access (and the applications supported by broadband) are aggregated and made available to them. A government fiber network connection is a natural fit at these facilities.

Broadly defined, these anchors include government buildings, community colleges, schools, libraries, municipal utility facilities, and other public facilities such as community media centers, key non-profits, hospitals, clinics, community centers, senior centers, and public housing.

Community anchor institutions are big buyers of connectivity among and between each other, and to the Internet. Some of them, such as libraries, colleges, and media centers, often provide Internet access and broadband applications to residents who lack home broadband service. And like government operations, community anchor institutions have seen—and are likely to continue to see—their bandwidth needs grow exponentially.

Middle-Mile Capacity

The second potential revenue stream derives from providing middle-mile capacity to private sector operators. This is a more speculative income source, but a growing body of evidence indicates that it is feasible given the proper market conditions. (A formal Request for Information process would easily enough establish a sense of just how feasible those market conditions are in a given community.)

The funding rules for the federal Broadband Technology Opportunities Program (BTOP), in fact, made this market an implicit requirement: Grant recipients were required to commit to nondiscriminatory, open access policies that make access available to third-party service providers.

The reasoning behind this approach is straightforward: By making middle-mile capacity available where it does not otherwise exist, and at very reasonable cost, you are reducing the barriers to investment for entrepreneurial companies (and non-profits) that want to build last-mile capacity. Those companies' lease arrangements would not only lead to really meaningful revenues, but would also stimulate private investment and the extension of broadband service to members of the community that otherwise would not have it, or who would not have the benefits of competition. As with the lit and dark fiber services to non-governmental anchors, then, selling middle-mile capacity has both a financial and societal impact.

Because many of the BTOP infrastructure grants incorporate this business model, significant data will emerge over the next few years as to the scope of the ROI of this model. Preliminary indications from many of these projects are very good. In both metropolitan and rural areas, BTOP awardees are engaged in negotiations with last-mile providers who seek access to the new middle-mile fiber that will make it possible for them to affordably reach areas for last-mile service.

E-Rate Subsidies

Another very significant potential revenue stream enabled by a government-owned fiber network is one that hinges on a September 2010 Federal Communications Commission (FCC) order. In that decision, the FCC for the first time made non-regulated non-profit and public networks eligible for the E-rate subsidy under the Universal Service Fund.

This is by no means a free lunch for network operators; the requirements for becoming an E-rate provider, including participation in a competitive procurement process and extensive paperwork, are necessarily strict. But there are simply enormous positive financial implications for governments that choose to become E-rate providers. Serving schools and libraries means realizing the benefits of E-rate subsidies that can range as high as 90 percent depending on the level of poverty in your community.

If your schools and libraries were to complete the competitive process and award your network a contract—meaning that your network provided the best service at the best price—you would have the confidence of guaranteed revenues that are independent of the fiscal position of your local government. Depending on how much E-rate subsidy you qualify for, the bulk of the funding could come from sources other than your government. This funding could go a long way toward covering your operating costs, and possibly even some of the cost of servicing the debt that you undertake to build the network. In other words, the E-rate subsidy could help to make your network more self-sustaining and less dependent on government or other external funding.

The Multiplier Effect

Both in terms of avoiding costs and increasing revenues, government-owned networks deliver one additional benefit: They keep money in your community. Whereas circuits leased from a large national provider require the delivery of a big monthly check to a potentially far-away corporate entity, monthly fees paid to a government-owned network stay in the community—to be spent on other government services, and to be multiplied when locally employed network employees go out to eat or spend money at other local businesses.

This is true of E-rate subsidies, too. The schools and libraries that benefit from E-rate never touch the actual money that subsidizes their connectivity—it usually goes directly from USAC, the administrator of the program, to the phone or cable company that provides services. So if your schools and libraries have been utilizing E-rate through a provider that is headquartered in New York or Houston or some other city far from you, the benefit of the flow of money in your community never happens—it goes directly to that other city. When the E-rate subsidy becomes a revenue source for your own locally owned and operated network, however, that money comes into your community. That has benefits for the bottom line of your network and your government operations, and also has an extended impact based on a multiplier effect. You get the benefit of the dollar itself, but also the dollar being spent over and over in your community.

Norwood Light Broadband, the municipal fiber network operator in Norwood, Massachusetts, makes that point directly to its potential customers. Visitors to the town's "Entering Norwood" website see the value proposition spelled out for them:

“Do you own a house or business in Norwood? Do you have children that go to school in Norwood? Your money will do a lot more good keeping it in town instead of lining the pockets of multi-billion dollar conglomerates like Verizon & Comcast. When you write out a check to the Town of Norwood, your money stays in town working for you.”³⁸

Indirect Benefits of Last-Mile Networks

Indirect benefits are often the primary reason that governments build broadband infrastructure. Local governments are in the business of providing education for their young people, job training for their unemployed, and so on; broadband is just the latest, and newly essential, tool to enable those public goals. Thus, when a government entity builds a middle-mile infrastructure to its schools and to enable private sector last-mile development—or when the government builds its own last-mile network—it is fulfilling what it sees as a basic need of its citizens.

In broad strokes, these indirect benefits might include accelerating economic development, enhancing health care quality, narrowing the digital divide, providing enhanced educational opportunities to schoolchildren, enabling job search and placement opportunities at public computer centers, and helping isolated senior citizens make virtual social connections. Some of these benefits are explored in greater detail below.

Economic Development

As challenging as broadband deployment can be, its importance is even greater. A significant body of economic literature, dating to the late 1990s, has demonstrated the clear link between the economic well-being of rural communities and even low-speed broadband. Dating from the very first of these studies, which was conducted by Carnegie Mellon University and MIT, the link has been clear.³⁹

As new broadband platforms emerge, the same link has been apparent. As William Lehr at the Massachusetts Institute of Technology summarized in a recent paper on broadband, “...a growing body of empirical evidence attests to the significant contribution of broadband to economic growth, productivity improvements, and job creation.”⁴⁰

And fortunately for rural areas that lack sufficient wireline infrastructure but may see upgrades in wireless broadband facilities, the link between wireless broadband and economic development has also been established. As the U.S. Department of Commerce noted in a recent report on competitiveness, wireless broadband—like wired broadband— “has the potential to transform many different areas of the American economy by providing a platform for new innovation.”

³⁸ “Norwood Light Broadband: ‘For the People, by the People,’” Entering Norwood website. <http://www.enteringnorwood.com> (accessed Oct. 22, 2012).

³⁹ Gillett, Sharon E., et al., “Measuring the Economic Impact of Broadband Deployment,” National Technical Assistance, Training, Research, and Evaluation Project #99-07-13829, February 28, 2006. http://cfp.mit.edu/publications/CFP_Papers/Measuring_bb_econ_impact-final.pdf (accessed Oct. 22, 2012).

⁴⁰ Lehr, William, “Anchor Institutions Help Secure Broadband’s Promise,” Massachusetts Institute of Technology (2012). Page 6.

The report notes that as broadband spreads, it is likely to bring with it increases in income and new business investment, and new, high-quality jobs. These jobs are likely to be created directly—through investments in infrastructure—as well as “indirectly through as yet unanticipated applications, services and more rapid innovation enabled by advanced wireless platforms.”

The report also summarizes the existing economic scholarship linking broadband and economic development and concludes that, although it is difficult to quantify the economic effects of broadband, such effects “are likely to be substantial.”⁴¹

What has not been established, and is still quite controversial, is whether *more* last-mile broadband (i.e., high-data-rate fiber-to-the-premises, or FTTP) has a greater impact on economic development than do earlier-generation broadband technologies that deliver lower speeds, such as DSL and cable modem service. There is an ongoing debate in this regard, and what analyses do exist tend to be on a case study or qualitative, rather than a quantitative, basis. For example:

- A 2005 case study of Lake County, Florida, for example, noted the benefits of the county’s municipal network: “Our econometric model shows that Lake County has experienced approximately 100% greater growth in economic activity—a doubling—relative to comparable Florida counties since making its municipal broadband network generally available to businesses and municipal institutions in the county. Our findings are consistent with other analyses that postulate that broadband infrastructure can be a significant contributor to economic growth. Our results suggest that efforts to restrict municipal broadband investment could deny communities an important tool in promoting economic development.”⁴²
- A 2010 report by the Public Policy Institute of California looked at the issue on a national scale, and found a correlation—though not causality: “Using broadband data from the Federal Communications Commission and economic data from several government and proprietary sources, we examine broadband availability and economic activity throughout the nation between 1999 and 2006. Our analysis indicates a positive relationship between broadband expansion and economic growth. This relationship is stronger in industries that rely more on information technology and in areas with lower population densities. Although the evidence leans in the direction of a causal relationship, the data and methods do not definitively indicate that broadband caused this economic growth.”⁴³
- Most recently, a conference on “Broadband and Economic Development”—which brought together speakers such as the former director of the FCC’s National Broadband Plan and the chairman of the Fiber to the Home Council—explored the topic from a variety of angles: “Economic development comes in many flavors, some that produce more and better jobs than others. Our second panel, including economists and economic development experts, will explore

⁴¹ “U.S. Competitiveness and Innovation Capacity,” *Infrastructure for the 21st Century*, U.S. Department of Commerce (2011), p. 5-8 to 5-10.

⁴² Ford, George S. and Thomas M. Koutsy, “Broadband and Economic Development: A Municipal Case Study from Florida,” *Applied Economic Studies*, April 2005. <http://www.aestudies.com/library/econdev.pdf> (accessed Oct. 22, 2012).

⁴³ Jed Kolko, “Does Broadband Boost Economic Development?” Public Policy Institute of California, January 2010. http://www.ppica.org/content/pubs/report/R_110JKR.pdf (accessed Oct. 22, 2012)

the many sides of economic development. They will define it, discuss how it is measured and compared, note success factors and barriers to success, and outline potential areas of special opportunity.”⁴⁴

Significantly, the debate about the economic impact of FTTP is largely a U.S. debate. The importance of FTTP to future economic development and competitiveness is taken as a given in much of Europe and the developed nations of Asia—most of which have made public investments in FTTP that, on average, are hundreds of times larger than the public broadband investments made by the United States through the 2009 Recovery Act broadband programs.⁴⁵

Environmental Impacts

Though there are no quantifiable direct environmental benefits to be derived from a last-mile broadband network (e.g., selling carbon credits), the potential indirect benefits of such connectivity are significant. For example, reduced automobile travel related to increased telecommuting and teleconferencing, among other sources, could lead to a significant annual reduction of CO₂ emissions. And where a broadband network supports Smart Grid initiatives, there is potential for reduced consumer energy consumption.

Telecommuting

Dependable, high-speed Internet access greatly improves the ability to work from home, or telework. This is often touted as the “most transformative”⁴⁶ and “biggest environmental benefit”⁴⁷ of FTTP. Indeed, telework confers a wide array of primary and secondary emissions benefits, which may provide significant cost savings to a community and its residents by reducing vehicle-operating expenses, the amount of time spent traveling, road repairs, and traffic congestion. In addition, by decreasing miles driven and gasoline burned, telecommuting benefits the environment and reduces greenhouse gases (GHG) by lowering auto emissions. Where telework occurs full time, it can reduce demand for constructing office space and related electricity use.⁴⁸

⁴⁴ “Broadband and Economic Development,” Broadband Properties Summit 2011, April 28, 2011. <http://www.bbpmag.com/2011s/11economic-sessions.php> (accessed Oct. 22, 2012).

⁴⁵ Nationwide FTTP construction projects are near completion or underway in Australia, China, Malaysia, New Zealand, Singapore, South Korea, and other Asian nations. More localized investments have been made in significant parts of western Europe. And the European Union and its members have undertaken significant regulatory change designed to spur FTTP investment by the private sector.

⁴⁶ Stephen Ezell *et al.*, “The Need for Speed: The Importance of Next Generation Broadband Networks,” Information Technology and Innovation Foundation, March 2009. 15. <http://www.itif.org/files/2009-needforspeed.pdf>.

⁴⁷ Steven S. Ross and Masha Zager, “Fiber to the Home Is Green Technology,” Broadband Properties, Jan/ Feb 2009, at 30 http://www.bbpmag.com/2009issues/jan09/BBP_JanFeb09_CoverStory.pdf.

⁴⁸ “Broadband Services: Economic and Environmental Benefits.” 20. (Reporting a \$25 million reduction in national real estate costs.)

Indeed, the American Consumer Institute estimates that doubling the number of full-time teleworkers (to 20 percent) could reduce national GHG emissions by almost 600 million tons over the next 10 years due to reduced auto use, business energy conservation, and reduced office construction.⁴⁹

“Universal, affordable, and robust broadband” is a “necessary prerequisite” for telework.⁵⁰ In market research conducted by CTC in San Francisco, for example, 67 percent of respondents reported that they needed higher speeds than cable modem to telework and 70 percent of respondents indicated that they would telework more if they had sufficient broadband speed. Other studies support this finding. Indeed, fiber networks have quadrupled the amount of time employees spend working from their homes.⁵¹

Teleconferencing

Broadband infrastructure facilitates teleconferencing, enhancing telework performance and allowing companies to grow without having to build new offices or shuttle between them. Video arraignment could also allow face-to-face interaction between a judge and prisoners in jail, without expending time and money to transport a prisoner to the courthouse.

The potential environmental benefits of teleconferencing are dramatic. In fact, videoconferencing uses 500 times less energy than a 1,000 km (621 mile) business flight. Nationally, emissions could be reduced by nearly 200 million tons if only 10 percent of airline travel were replaced by teleconferencing over the next 10 years.⁵² These reductions also confer significant economic benefits. GlaxoSmithKline reports that its corporate travel costs declined by 20 percent after it installed a telepresence system. As with telework, teleconference potential could not be realized without a reliable, high-speed broadband connection.

Smart Grid

By allowing two-way communication and the transmission of real-time information between consumers and utilities, Smart Grid technologies operating over a fiber optic network enable utilities to better manage the power grid as an integrated system and adjust supply to changing demand. At the same time, the technologies allow end-users to make more informed decisions about energy consumption. This is particularly effective where prices vary depending upon demand.

The potential benefits of such a Smart Grid approach are dramatically illustrated in a case study of 112 homes in the Olympic Peninsula, west of Seattle. Participating houses were given a digital thermostat

⁴⁹ “Broadband Services: Economic and Environmental Benefits,” 25-26. *See also* Jonathan Rintels, “An Action Plan for America: Using Technology and Innovation to Address Our Nation’s Critical Challenges,” The Benton Foundation, 2008. 24. http://www.benton.org/initiatives/broadband_benefits/action_plan; Consumer Electronics Association, “The Energy and Greenhouse Gas Emissions Impact of Telecommuting and e-Commerce,” July 2007. 8, 29. http://www.ce.org/Energy_and_Greenhouse_Gas_Emissions_Impact_CEA_July_2007.pdf. (Reporting average daily energy savings from telework of 16-23 kWh/ teleworker, assuming a “typical” vehicle with 21 miles per gallon and a 24 mile round-trip commute.)

⁵⁰ Jonathan Rintels, “An Action Plan for America: Using Technology and Innovation to Address Our Nation’s Critical Challenges,” The Benton Foundation, Nov 2008. 24. http://www.benton.org/initiatives/broadband_benefits/action_plan.

⁵¹ “The Need for Speed: The Importance of Next Generation Broadband Networks.” *See also* Irene Berlinsky, “Working at Play, Playing at Work: The Rise of the Prosumer,” IDCLink, January 15, 2009.

⁵² Fuhr and Pociask. 40

and a computer controller for their water heaters and clothes dryers. Residents used an Internet website to set their favorite home temperature and pre-determine an allowed variance from that temperature. On average, participating houses reduced their electric bills by 10 percent, with some participants reporting even greater savings. The environmental benefits of this approach are enormous. For example, the Pacific Northwest National Laboratory reports that, over a 20-year period, this simple technology could save \$70 billion on spending for power plants and infrastructure, and avoid the need to build the equivalent of 30 large coal-fired plants.

Although fiber is not specifically mentioned as an enabling technology for most Smart Grid applications, fiber is a critical, growing component of facilitating customer and distribution automation/Smart Grid technologies. Fiber is essential for robust and secure backhaul communication to distribution substations, data concentrators, and other demarcation points.

Educational Outcomes

The multi-billion-dollar federal Broadband Technology Opportunities Program (BTOP) was predicated on the benefit of connecting community anchor institutions (CAIs), including K-12 schools and community colleges, to high-capacity broadband networks. The recent E-rate program changes (described above) also reflect the federal government's belief in the ability of broadband to improve educational outcomes.

As a recent State Educational Technology Directors Association (SETDA) report noted, "Given that bandwidth availability determines which online content, applications, and functionality students and educators will be able to use effectively in the classroom, additional bandwidth will be required in many, if not most, K-12 districts in this country in the coming years."⁵³

Broadband enables students and their teachers to connect to the world outside their classrooms—to conduct research, access instructional applications, view multimedia content, or interact with instructors or peers in other schools. And like business or governmental users, educational users gain potentially more benefit from more robust connections. (See "Broadband Applications and Bandwidth Demands" in Chapter 4.)

The potential applications for broadband are varied. Interactive whiteboards are growing in popularity. By connecting these interactive displays to a computer and projector, teachers can operate software loaded on the computer, including Internet browsers. Users can also digitally capture notes written on the whiteboard, control the computer through the whiteboard, translate cursive writing to text, and, in some systems, connect to an audience response system, whereby students can remotely respond to questions and generate a graphic depiction of responses on the whiteboard. The interactive whiteboard industry is growing rapidly. A survey of British schools found that 98 percent of secondary and 100

⁵³ Fox, C., Waters, J., Fletcher, G., & Levin, D. (2012). The Broadband Imperative: Recommendations to Address K-12 Education Infrastructure Needs. Washington, DC: State Educational Technology Directors Association (SETDA). http://www.shlb.org/ckfinder/userfiles/files/The_Broadband_Imperative%20-%20SETDA%20-%20May%202012.pdf (accessed Oct. 23, 2012).

percent of primary schools had interactive whiteboards by 2007.⁵⁴ These devices are now viewed as “standard equipment” in schools and are likely to be in “nearly every” U.S. school by 2013.⁵⁵

American schools are also increasingly embracing one-to-one computer programs (also known as “ubiquitous computing”), whereby each student and teacher has one Internet-connected wireless computing device for use both in the classroom and at home. A 2006 survey found that 31 percent of superintendents are implementing ubiquitous computing in at least one grade, up from an historical average of 4 percent. Moreover, over 75 percent of superintendents recognized the potential benefits of one-to-one computing, agreeing with the statement that “ubiquitous technology can reduce the time, distance, and cost of delivering information directly to students and that teachers can spend substantially more one-on-one time with each student and personalize the education experience to each student’s needs.”⁵⁶

By 2007, 78.7 percent of U.S. school districts reported moderate to significant improvement in one-to-one computing programs,⁵⁷ with potentially significant benefits for student learning. A 2006 report by America’s Digital Schools found that one-to-one computing programs correlated with increased student retention and attendance, improved writing skills, and reduced disciplinary problems.⁵⁸ As Michael Davino, Superintendent of Schools in Springfield, New Jersey explains, “[a] wireless laptop program provides up-to-date information, access to virtual experiences, instant feedback, individualized attention for all learning styles, student independence, and constant practice. And it’s highly adaptable to individual, small group, or whole class instruction.”⁵⁹

Many schools are using the Internet to expand course offerings. For instance, in Greenville, South Carolina, students are enrolling in an online Latin course taught by a teacher at another district school. Elsewhere, students can use the Internet to take higher level or better-quality courses than those available at their home schools.⁶⁰ The Greaves Group has found that many schools are even offering core courses over the Internet, with vocational technology (91 percent) leading, followed by science (78 percent) and social studies (76 percent). Online learning is often used for advanced-placement courses, including art and music (38 percent), math (35 percent), and science (31 percent), which may not have sufficient student enrollment to support a live course.⁶¹

The Internet helps break down the walls of the classroom, allowing students to participate in virtual fieldtrips and better visualize their lessons. Students are going online and “touring the Smithsonian National Air and Space Museum, experiencing a tribal dance in Africa, or scouring the depths of the

⁵⁴ Becta, “Harnessing Technology Schools Survey 2007: Analysis and Findings,” July 2008.

http://partners.becta.org.uk/upload-dir/downloads/page_documents/research/ht_schools_survey07_key_findings.pdf.

⁵⁵ Meris Stansbury, “Researchers Identify Key Ed-Tech Trends,” eSchool News, Mar 30, 2009

<http://www.eschoolnews.com/news/top-news/index.cfm?print&i=53795&page=1>.

⁵⁶ “America’s Digital Schools 2006: A Five-Year Forecast, 2006,” The Greaves Group and The Hayes Connection. 15, 18. <http://www.ads2006.net/ads2006/pdf/ADS2006KF.pdf>.

⁵⁷ Stansbury.

⁵⁸ “America’s Digital Schools 2006: A Five-Year Forecast, 2006.” 15.

⁵⁹ “America’s Digital Schools 2006: A Five-Year Forecast, 2006.” 18.

⁶⁰ Rintels. 21.

⁶¹ “America’s Digital Schools 2006: A Five-Year Forecast, 2006.” 19.

Pacific Ocean in a submarine.” Users are exploring the digital archives at the Library of Congress and collaborating with students, professors and government officials in other states and around the world.⁶²

Outside school, online learning allows workers to “overcome the barriers of time and distance” by providing access to continuing education and professional training at the convenience of the individual users.⁶³ E-learning has also helped corporations reduce costs for employee training by avoiding direct travel expenses and lost productivity during travel.

Research by the International Society for Technology in Education (ISTE) and the Consortium for School Networking confirms that these applications have meaningful results. In particular, technology has:

- Led to measurable improvements in school performance (as measured on the Adequate Yearly Progress Tests under the No Child Left Behind Act of 2001).
- Improved attendance, decreased dropout rates, increased graduation rates, and allowed increased parental involvement.
- Improved school efficiency and productivity.
- Helped teachers satisfy professional requirements by helping develop lesson plans and providing continuing education opportunities.
- Enhanced students’ problem-solving and independent-thinking skills.
- Enabled schools to meet the needs of special education children.
- Increased equity and access in education by creating learning opportunities for geographically isolated students.
- Improved workforce skills.⁶⁴

Case studies bear out these benefits. For instance, elementary school students in the “Enhancing Missouri’s Instructional Networked Teaching Strategies” (eMINTS) program consistently scored higher on standardized achievement tests than students who did not have access to the same technology. Participants’ classrooms are equipped with a teacher’s desktop computer and laptop computer, a scanner, a color printer, a digital camera, an interactive white board, a digital projector, and one computer for every two students. In New York, middle and high school students enrolled in the “Points of View media project” used Webcams to access museums and historical collections, streaming video and video conferencing, and primary documents to explore the Theodore Roosevelt era. Seventy-five percent of program participants reported that they learned more than they would have from a traditional class.⁶⁵

Healthcare Outcomes and Expenses

Broadband technology can improve healthcare outcomes and dramatically reduce a range of healthcare expenses by providing the tools to remotely monitor patients, allow collaboration between medical

⁶² Rintel. 21.

⁶³ Rintel. 21.

⁶⁴ “Why Technology in Schools?” Ed Tech Action Network.
www.edtechactionnetwork.org/technology_schools.html.

⁶⁵ “Ed Tech and Student Achievement,” Ed Tech Action Network.
http://www.edtechactionnetwork.org/student_achieve.html.

professionals, facilitate the transfer of medical data and images, and increase access to emergency services in remote areas.⁶⁶ By one estimate, these services can lead to savings of \$165 billion per year.⁶⁷ “Always-on broadband” is “essential” for some of these applications and greatly improves others that “depend on uninterrupted real-time transmission.”⁶⁸

Medical Information

Broadband allows users to access medical information online, avoiding costly trips to medical professionals. Approximately 20,000 health-related websites provide information to the more than three-quarters of online Americans who access medical information over the Internet.⁶⁹ More than 10 percent of broadband users use the Internet for this purpose on a given day.⁷⁰ Broadband users can also avoid scheduling (and driving) to multiple appointments by using the Internet to get a second opinion based on their medical records or by exchanging e-mails with their doctors. Notably, Kaiser Permanente reduced appointments with primary care physicians by 7 percent to 10 percent by allowing its enrollees to e-mail questions to their doctor through a secure messaging system.⁷¹ Thirty-seven percent of Kentucky broadband users report that access to online information has saved them an average of 4.2 unnecessary trips for medical care in a single year.⁷²

Remote Monitoring

Telehealth holds particular promise for remote monitoring of chronic conditions. Nearly half of Americans (45 percent or 130 million people) suffer from at least one chronic condition, such as arthritis, asthma, cancer, depression, diabetes, heart disease, and obesity. Combined, treatment of these conditions accounts for 75 percent of healthcare spending—\$1.5 trillion annually.⁷³ Despite this enormous expense, most Americans with chronic conditions suffer from inadequate treatment. For instance, according to the National Center for Policy Analysis, less than one-fourth of patients with high blood pressure control it adequately. Twenty percent of patients with Type-1 diabetes fail to see a

⁶⁶ Pam Belluck, “With Telemedicine as Bridge, No Hospital Is an Island,” *New York Times*, Oct. 8, 2012. http://www.nytimes.com/2012/10/09/health/nantucket-hospital-uses-telemedicine-as-bridge-to-mainland.html?pagewanted=1&_r=1&nl=health&emc=edit_hh_20121009 (accessed Oct. 10, 2012). See also Rintels. 15. (Broadband can “revolutionize medical treatment”). See also Carlton Doty, “Delivering Care Anytime, Anywhere; Telehealth Alters the Medical Ecosystem.” Forrester Research for the California Healthcare Foundation, Nov 2008. See also “Benefits of Telemedicine,” Telemedicine Association of Oregon, Jan 16, 2004. <http://www.ortcc.org/PDF/BenefitsofTelemedicine.pdf>.

⁶⁷ Rintels. 15.

⁶⁸ Alexander H. Vo, “The Telehealth Promise: Better Health Care and Cost Savings for the 21st Century,” University of Texas Medical Branch, May 2008. 13.

⁶⁹ Devon Herrick, “Convenient Care and Telemedicine,” National Center for Policy Analysis, NCPA Policy Report No. 305 (ISBN #1-56808-179-0), Nov 2007. 14. http://www.heartland.org/custom/semod_policybot/pdf/22678.pdf. See also Rintels.

⁷⁰ Rintels. (“On an average day, one in nine of those with a broadband connection uses it to research online medical information.”)

⁷¹ Herrick. 14.

⁷² Ross and Zager. 31.

⁷³ Partnership to Fight Chronic Disease, 2008 Almanac of Chronic Disease. 7. http://www.fightchronicdisease.org/pdfs/PFCD_FINAL_PRINT.pdf. (Foreword by Richard Carmona, 17th U.S. Surgeon General.)

doctor annually, with 40 percent of diabetics failing to regularly monitor their blood sugar level or receive recommended annual retinal exams.⁷⁴

Through remote monitoring, tens of millions of Americans can manage and address their chronic illnesses at dramatically lower cost. In fact, both the Benton Foundation and the University of Texas estimate that remote monitoring could lower hospital, drug, and out-patient costs by 30 percent, reducing the length of hospital stays from 14.8 days to 10.9 days, office visits by 10 percent, home visits by 65 percent, emergency room visits by 40 percent, and hospital admissions by 63 percent.⁷⁵

Remote-monitoring applications are incredibly varied. Patients with chronic obstructive pulmonary disease can improve lung function with the use of an inhaler and monitor airflow to and from their lungs with a spirometer, lowering hospital readmissions to 49 percent as compared to 67 percent for patients lacking home monitoring. Similarly, remote monitoring of a group of congestive heart failure patients in one study cut re-hospitalizations in half over a six-month period.⁷⁶ Diabetics in Pennsylvania using home-monitoring systems for their glucose levels were able to reduce hospitalization costs by more than 60 percent from a control group with traditional in-person nurse visits.⁷⁷ The Veterans Administration reports similar savings from its home-monitoring system, which has reduced emergency room visits by 40 percent and hospital admissions by 63 percent.⁷⁸ Remote monitoring holds particular promise for the elderly, by allowing them to defer or avoid institutionalization, thereby enhancing quality of life and reducing medical costs.

Lowered Transportation Costs

Broadband can also reduce transportation costs between medical facilities by allowing doctors to remotely monitor patients and collaborate with one another. As the Center for Information Technology Leadership (“CITL”) notes, widespread adoption of telehealth technologies can “bring the collective wisdom of the entire healthcare system to any patient, anywhere, any time,” allowing “quantum leaps in the efficiency of the healthcare system.”⁷⁹ These efficiency gains are accompanied by dramatic cost savings.

In fact, CITL estimates that telehealth technologies can prevent:

- 39 percent (850,000) of transports between emergency departments, with an annual savings of \$537 million.

⁷⁴ Herrick. 8.

⁷⁵ Rintels. 16.

⁷⁶ Herrick. 16. *See also* Rintels. 16. (Discussing a New York case study that reduced health care costs for home-bound patients with congestive heart failure to cut overall health care costs by 41 percent).

⁷⁷ Rintels, 15.

⁷⁸ Neal Neuberger, “Advancing Healthcare Through Broadband: Opening Up a World of Possibilities,” Internet Innovation Alliance, 2007. Date of Access: July 28, 2009. <http://internetinnovation.org/factbook/entry/small-pilot-projects/>.

⁷⁹ Caitlin M. Cusack, et al., “The Value of Provider-to-Provider Telehealth Technologies,” Center for Information Technology Leadership, November 2007, at 4 (available online at http://www.citl.org/pdf/CITL_Telehealth_Report.pdf).

- 43 percent (40,000) of transports from correctional facilities to emergency departments and 79 percent (543,000) of transports from correctional facilities to physician office visits, with an annual savings of \$280 million.
- 14 percent (387,000) of transports from nursing facilities to emergency departments and 68 percent (6.87 million) of transports from nursing facilities to physician office visits, with an annual savings of \$806 million.⁸⁰

It should be noted that the costs and benefits associated with avoided medical transport are not necessarily borne by the same people. The underlying costs of installing the telehealth technology are borne by the physician office or hospital. Savings associated with avoided transports because of this technology, however, accrue to the payer, which (with the exception of correctional institutions), is likely the patient, the state, or insurance provider. Moreover, these savings will only accrue if both institutions (e.g., the correctional facility and hospital) have adequate bandwidth.

Enhanced Medical Access for Rural Residents

There has been a great deal of research on the potential benefits of broadband for rural medical care. Notably, the Federal Communications Commission (FCC) has already authorized over \$400 million to 25 states to use telemedicine networks to provide medical care to rural areas.⁸¹ This allows rural doctors to provide timely medical care while avoiding costly—and potentially risky—transfers to urban hospitals. In Georgia, for instance, telemedicine allows doctors at academic centers to participate remotely in the examination of patients at rural hospitals, cutting transports by 60 percent to 80 percent.⁸² This program enables doctors at the Medical College of Georgia’s neurology department to use videoconferencing to examine, diagnose, and treat stroke patients at 10 rural hospitals.⁸³ Broadband also improves the quality of medical care in rural areas by providing access to in-service training without requiring costly participation in distant conferences.⁸⁴

Improved Medical Efficiencies

Broadband can help cut costs by improving efficiency in a number of ways. In hospitals, remote monitoring with high-resolution video allows a single doctor to simultaneously observe and treat multiple patients. The American Consumer Institute reports that this application reduced ICU deaths by

⁸⁰ Cusack, et al. at 2-3; *See also* Jonathan Rintels, “An Action Plan for America: Using Technology and Innovation to Address Our Nation’s Critical Challenges,” The Benton Foundation, Nov 2008, at 16 (adopting CITL’s analysis) (available online at http://www.benton.org/initiatives/broadband_benefits/action_plan); Alexander H. Vo, “The Telehealth Promise: Better Health Care and Cost Savings for the 21st Century,” University of Texas Medical Branch, May 2008, at 2. It should be noted that Cusack et al.’s analysis was funded by the AT&T Foundation, among others. As such, the authors may have applied somewhat generous assumptions about telehealth potential and savings. As indicated here, the Cusack analysis has been embraced by others and forms the basis of our analysis below.

⁸¹ Robert LaRose *et. al.*, “Closing the Rural Broadband Gap,” Department of Telecommunication, Information Studies, and Media, Michigan State University, Nov 30, 2008. <https://www.msu.edu/~larose/ruralbb/>.

⁸² Dr. Jay Sanders, President and CEO, the Global Telemedicine Group and Professor of Medicine (Adjunct) at Johns Hopkins School of Medicine (cited in the Broadband Factbook).

<http://internetinnovation.org/factbook/entry/application-of-telemedicine-to-rural-healthcare/>.

⁸³ Rintels. 16.

⁸⁴ Fuhr and Pociask. 39.

50 percent at Johns Hopkins.⁸⁵ The potential benefits of telemedicine outside a single institution are even greater. Because the current medical system is fragmented, doctors seldom have comprehensive information about a patient's medical history, leading to costly and invasive duplicate procedures. This disjointed system means that "[p]atients may be treated at multiple locations by multiple doctors who keep multiple paper records and fill out multiple paper forms seeking reimbursement from multiple insurance carriers."⁸⁶ By creating a universal repository for medical records, caregivers can coordinate treatment, easily provide second opinions, streamline billing, and avoid duplicative procedures. Online access to medical records could help doctors avoid such inefficiencies, with savings totaling \$81 billion annually—or \$670 per household.⁸⁷ Of course, these savings will require a significant up-front investment from medical professionals who will have to upload medical histories and transition to electronic record keeping.

⁸⁵ Fuhr and Pociask. 37.

⁸⁶ Rintels. 17.

⁸⁷ Rintels, 18. (Citing Rand Health, "Extrapolating Evidence of Health Information Technology Savings," 2005 Public Medical Research Data from the National Health Expenditure Data, HHS and "Upgrade America's Health Care System: Pass Health IT Legislation Now," Business Roundtable, April 2, 2008).

Chapter 8: Risks of Broadband Initiatives

Understanding the risks inherent in pursuing a community broadband initiative is essential to a successful outcome. This chapter briefly introduces a range of potential risk factors that project stakeholders should consider as part of their planning process.

Political, Legislative, and Legal Risk

The political, legislative and legal risks of attempting to deploy any communications infrastructure with a public component—regardless of the model—are significant.

Political risk has been shown to be particularly large for very big investment projects like the construction of communications infrastructure across a town, county, or state. This is because such projects are especially visible and sometimes involve the use of public funds or public debt—which can make the project a lightning rod for opposition among competing elected officials or interest groups. Moreover, these projects are prone to controversy because of potential cost overruns, schedule delays, and benefit shortfalls.

Legislative risk is, in general, similar to political risk, though legislative risk refers to the risk of loss due to a change in law according to due process in a particular jurisdiction. Legislative risk can increase as the result of legislators' preexisting viewpoints, and through the persuasive lobbying efforts of competing interest groups and organizations.

Legal risk is the risk from uncertainty due to legal actions or uncertainty in the applicability or interpretation of contracts, laws, or regulations. In other words, will the partnership that is building a broadband project be sued by an incumbent provider? Or will local or state laws or regulations be interpreted in such a way that the project may not proceed?

Historically, efforts to deploy competing fiber-to-the-premises networks with some element of public ownership or financing have attracted significant local incumbent opposition. This opposition has manifested itself through efforts to sway local policymakers to vote against the venture, by forcing public referendums, and by leveraging the influence of incumbent trade associations to introduce new or amended legislation to block the effort.

Interestingly, opposition to a local broadband effort may rise in proportion to the level of service a network proposes to offer. A middle-mile project, for example, might attract only local opposition and attention; a fiber-to-the-premises (FTTP) model, on the other hand, might attract the attention of the entire national communications industry and related industries. That is because publicly financing a high-capacity FTTP infrastructure would be perceived as a direct challenge to the interests of numerous players supported by the current market structure.

Marketplace, Operational, and Financial Risk

The key to ensuring a project's long-term sustainability is the ability to contain its marketplace, operational, and financial risks.

Market or competitive risk is the risk of withstanding the likely responses of a competitor through a planned technology improvement, invention, acquisition, price reduction, or similar action. In simple terms, this is the risk that a new broadband project—like any new business venture—will not be able to attract enough customers or earn enough revenue to continue operating.

Operational risk is the risk of loss resulting from inadequate or failed internal processes, people and systems, or from external events. There are other risks that are potential consequences of operational risk events. For example, reputational risk (damage to an organization through loss of its reputation or standing) can arise as a consequence of operational failures—as well as from other events.

Being aware of this risk may lead the planners of a community broadband project to favor an approach that brings all aspects of network operations in house—or the awareness of this risk may have exactly the opposite effect. A public entity with extensive network operations experience may want to handle network operations with internal staff and processes; one that does not have that type of institutional experience, or that does not have adequate staff resources to take on additional tasks, might decide that the better approach would be to contract for services with the private sector. A public–private partnership could lead to a similar splitting of responsibilities.

Tied in with these other risks is financial risk—the risk that a broadband enterprise will not have adequate cash flow to meet its financial obligations. This risk goes hand-in-hand with market/competitive risks—though a broadband network that attracts plenty of customers might still run into financial trouble if, for example, it has cost overruns in its construction.

Chapter 9: Community Engagement Case Studies

As this report has stated time and time again, there exists a wide range of potential options for enhancing broadband deployment in a community. Because most local community broadband initiatives and public-private partnerships are in their initial, formative stages, there are not one or even a few models that stand out or provide foolproof guidance for community broadband planning. A successful strategy in your community will likely arise from the unique circumstances of needs and assets your community has; we cannot overstate the importance of leveraging your existing skills, internal capacity, local organizations, and community leaders as you seek to expand your broadband future.

That said, we provide below two case studies of successful local and regional broadband plans that offer, if not foolproof models, at least illustrations of how some communities have worked their way through many of the processes described in this guidebook to achieve successful and important outcomes.

Carroll County, Maryland

Carroll County, Maryland is a largely rural county that sits just outside the Baltimore metropolitan area. The County has some areas that can be considered remote outer suburbs of Baltimore; however, there are no highways or major routes to Carroll County. As a result, the County has remained rural and has not seen significant development that might have arisen had there been a major traffic artery connecting it to Baltimore, or even to Washington, D.C. some 45 miles south.

The County has a well-respected public school system, a vibrant community college, and a private college (McDaniel College) as well as a number of municipal population centers, the largest of which is the City of Westminster.

Background

Communications infrastructure in Carroll County is limited. Comcast serves the municipal population centers with cable modem service; Verizon provides DSL service in parts of the County, also mainly concentrated in the population centers. The rural areas that comprise the majority of the County, however, do not have wired service options. And while mobile wireless broadband exists in much of the County, coverage is spotty and unreliable, as in many rural areas. Unlike the dense metropolitan areas closer to Baltimore and Washington, D.C., Carroll County has not seen Verizon FiOS (fiber-to-the-home) build-out, putting it at even further disadvantage to those nearby metropolitan areas for the development of businesses, jobs, and residential housing.

More than 10 years ago, a range of municipal and County officials, private citizens, and public sector IT staff came together to begin work on incrementally expanding the availability of broadband in the County. Senior IT staff from the public school system, community college, and public library system worked with the Carroll County Department of Economic Development, as well as with the cable regulatory commission and representatives of a number of municipalities, to devise a strategy for modest public investment in middle-mile fiber infrastructure. As envisioned, the fiber would serve four

key public entities: County government, schools, libraries, and the community college. This middle-mile fiber could also potentially be leveraged in the future to enable private sector last-mile deployment.

The result of these efforts was the creation of the Carroll County Public Network (CCPN), which provided cost-effective bandwidth to all four of the above groups of public institutions, and gave the County a major selling point for attracting businesses. The CCPN itself provided all of the benefits of affordable broadband discussed in this report, (closing the economic digital divide, stimulating economic development, enhancing educational opportunities), and also put the County in an excellent position to take advantage of future broadband initiatives at the state level, and encourage further development at the local level. It has proven to be an asset both to institutional networking in the County and to providing access to the outside Internet for a largely underserved community.

Maximizing Benefits

After the passage of the 2009 Recovery Act, the State of Maryland received about \$115 million in federal grants to implement a statewide network build-out. Carroll County's share of fiber expansion was assigned to the Inter-County Broadband Network (ICBN), a sub-recipient of the grant managed by a separate jurisdiction. Like CCPN, the goal of ICBN is to connect community anchor institutions, such as schools, libraries, and hospitals, and to provide additional fiber assets for the community. Because Carroll County already had an existing broadband network plan in place, it was ahead of many other jurisdictions both in existing infrastructure and strategic planning; the County could therefore take advantage of ICBN to connect other sites and expand its middle-mile fiber even more. The CCPN put the County in an extremely good position to make the most of the federally funded project.

The success of CCPN is also enabling broadband investment at the municipal level. Just as the County was able to maximize the value of its assets when state and federal participation became available, the City of Westminster is now pursuing a public last-mile network using the CCPN infrastructure.

Westminster, the county seat and home to numerous community anchor institutions including McDaniel College, is laying the groundwork for a fiber-to-the-home network plan under which the City would build the fiber network and would contract with one or more private partners to provide services over the City's infrastructure. This collaborative effort, when built, will bring state-of-the-art technology and world-class bandwidth to an area that has not seen commercial fiber investment. The County's proactive efforts in building a community network has therefore enabled further development and investment at the state and local levels.

Finally, the CCPN provides a way for competitive Internet retailers to help bring broadband to the underserved rural residents of the County. Though municipal last-mile fiber models are not practical in sparsely populated rural areas, the middle-mile fiber can nevertheless be used as backhaul for a wireless broadband service. Freedom Wireless Broadband, a local Internet service provider, sells Internet service from a connected fiber backbone over wireless frequency. The service is targeted in designated areas where the company has installed access nodes that relay the signal to end users as WiFi signal. This kind of targeted multi-point wireless network allows residents who do not live in the population centers to nevertheless have some use of the middle-mile wireline bandwidth, despite not having a wireline connection themselves.

The case of Carroll County illustrates that simply by having fiber assets in its possession, a community attracts further development. Having existing fiber infrastructure and an existing network plan enabled the County to leverage ICBN's state and federal resources to maximize their gains; on a smaller scale, the County's early investment in fiber is also enabling its largest municipality to explore fiber-to-the-home technology that would not otherwise be possible. Thus, the CCPN has effectively brought together municipal, County, state, and private resources to achieve the common goal of increased access to broadband and closing the digital divide in Carroll County.

Portland, Oregon

Compared to the private sector, local government can more efficiently and effectively build and operate fiber to key public community anchor institutions like K–12 schools. That's because local governments have the requisite operational capabilities, and their motivation is solely on providing high-capacity broadband at low prices. With no profit motive, local government can deliver much more bandwidth at much lower prices than the private sector is willing or able to provide.

Portland, Oregon's fiber optic Integrated Regional Network Enterprise ("IRNE") is a case in point. A telecommunications network designed to carry all of the voice, video and data communications traffic for the City, public schools, and other strategic partners, IRNE features a high-capacity, highly reliable design that costs less and offers more than conventional telecommunications services available in the region.

History

Before the advent of IRNE, the City spent over \$8 million annually on private telephone services to serve roughly 7,000 telephone extensions. The City also had a limited data communications budget that provided T-1 services at major city buildings (like the 911 Center) but only 56 Kbps Frame Relay services at most other locations. The City's limited budget prevented it from providing high-speed broadband service to public schools and most other public buildings.

In response to these growing needs and limited resources, the City launched IRNE in 2002 as a shared communications backbone. IRNE leverages funds, expertise and infrastructure—and circumvents the exorbitant rates by private telecom companies for phone lines and high-speed Internet connections.

IRNE was financed through the City's franchising authority over the rights-of-way for telecommunications and public utilities. The City required any telecommunications carrier who wanted to place conduit in City streets for their network to build additional conduit for the City as a condition of receiving a franchise and permit. Such construction was credited as partial payment for use of the City's rights-of-way. The incremental cost of this construction was minimal, particularly when compared to the potential cost of providing the capacity as a stand-alone project at a future date. Such simultaneous construction thus worked to benefit both parties.

Portland later designed a fiber plan that would take advantage of these conduit resources and create a wide-area network for use by the City. This is particularly evident in the Institutional Net ("I-Net"), which relies on fiber that is owned and maintained by Comcast but extends to IRNE. In this way, the I-Net allows circuits to originate on one network and terminate on another, in effect extending the reach of

both networks. The I-Net provides high-speed transmission services to 17 public organizations, including eight school districts (all of the County's K-12 institutions, totaling 272 sites), a regional educational service district, four local governments, the county libraries (17 sites), two community colleges (at eight sites), the Housing Authority of Portland, the State of Oregon and one large, non-profit, social service organization.

The I-Net produces these wide-ranging public benefits at a fraction of the cost of leased services. The City also realizes significant cost savings by using the same staff to support both networks (i.e., IRNE and I-Net). In particular, the dual management of both networks preserves resources that would otherwise have to be invested in technicians, tools, and fiber equipment.

Today, the \$14 million system links K-12 schools and other educational entities, regional transportation and public safety agencies, municipal offices, and government agencies outside the City to a network of fiber-optic cable that carries City phone calls, enterprise data, utility monitoring (SCADA), and Internet traffic.

Benefits

Portland created IRNE as a low-cost fiber optic network to reduce the City's telecommunications' expenses and to boost economic development. It has saved local governments and public schools in the Portland region millions of dollars in networking costs as compared to leased alternatives. It has also saved money by preventing redundancy in network development and the related duplication of investment between various government entities. In fact, the City of Portland has eliminated 90 percent of the leased data circuits that were in place at the time of construction. The City has used some of these savings to lease data circuits in previously under-served areas, expanding connectivity to areas that were not previously cost-effective. This was done in a cost-neutral financial package where no new money was necessary.

At the same time, IRNE has dramatically increased speed. The City formerly leased circuits for low-density uses (e.g., fire stations) with a 56 Kbps Frame-Relay service connection. Today, these facilities have a dedicated T-1 connection. Overall, the City estimates that IRNE has increased bandwidth per site an average of 500% with no increase in monthly cost.

Partners

IRNE serves as a network for government and education institutions in the region. It provides service to City of Portland governmental entities and provides optional services to other governmental jurisdictions, including K-12 and higher education institutions with a need to interconnect with local government and each other. IRNE links the State Office Building, Portland Public Schools, the Multnomah Educational Service District, and Metro to a central location where high-speed connections may be made to any Internet service provider. Today, over 400 schools, libraries, fire stations, police precincts and other small and large public sector locations receive low-cost, high-speed, reliable broadband voice, video and data from the IRNE. Partners include BTS (Portland's Bureau of Technology Services), Portland Public Schools, Portland State University, Multnomah County, Multnomah Education Service District, and Portland Community College.

Viability

Although it required a considerable (\$14 million) infrastructure investment, the costs per participating organization are low, given the large number of partners that benefit from the network. By sharing the network among a larger number of public sector users, average costs are lowered and savings accrue not only to the City, but also to other public entities using the network. Moreover, IRNE streamlines costs by leveraging federal transportation dollars and initiatives along with cable and telecommunications provider assets.

Network Efficiencies

IRNE is an engineering collaboration among public sector agencies leveraging multiple sources of funds and telecommunications plans to form a well-engineered, well-executed network architecture and service operation. This collaboration has led to dramatic network efficiencies.

Efficiencies are also realized through demand aggregation. Absent IRNE, the school districts and other beneficiaries would have had to independently acquire the necessary data circuits. IRNE has allowed the City to aggregate demand by using the same infrastructure and negotiating on behalf of each of these entities. Thus, IRNE satisfies the demand of a wide range of beneficiaries through a single network.

Future Plans

Portland is in the process of overlaying a 10 Gbps ring that will connect major City locations to increase non-SONET bandwidth, and in doing so, free up existing SONET bandwidth for additional high-availability services. The City is also expanding its partnerships within its fiber cooperative (Cooperative Telecommunications Infrastructure Consortium, “CTIC”) to include additional counties in Oregon. Portland is also exploring the possibility of interconnecting its fiber networks with several partners in Washington (Washington Department of Transportation, Clark County, and the City of Vancouver) to enable further benefit for public safety agency cooperation.

Sandy, Oregon

Located between Portland’s metropolitan sprawl, 25 miles to the west, and Mt. Hood National Forest to the east, the city of Sandy, Oregon has about 9,600 residents. As the center of a mostly rural portion of Clackamas County, Sandy is developing into previously uninhabited areas with new housing and commercial buildings.

Sandy holds a number of distinctions in terms of broadband: It has operated a wireless broadband network through a municipal utility (SandyNet) for nine years; its City Council recently passed an innovative ordinance to accelerate construction of residential broadband infrastructure; and it currently is developing a fiber-to-the premises (FTTP) network with a private partner.

The level of broadband service available to Sandy’s residents and businesses is possible because of a progressive municipal government, an innovative public–private partnership, and ongoing public support of broadband as a City service.

Municipal Wireless Broadband

Since 2003, the City of Sandy has offered wireless broadband service to residential customers—and given citizens an option other than dial-up-service. Since 2008, the City has offered fiber or dedicated wireless service to business customers. Both the residential and business services benefit from the City’s agreement with Clackamas County, which gives SandyNet extensive backhaul to the Internet.

As the City website notes, “SandyNet is the Internet Service Provider owned by the people of Sandy and operated as a public service by the City of Sandy.” The website also notes that, “As a non-profit utility, SandyNet operates on a break-even basis, and all savings are passed onto the customers.”⁸⁸

Residential fixed WiFi service with speeds up to 5 Mbps currently costs \$19.95 per month within the City limits; residents are also responsible for a \$100 installation fee. In the rural communities outside of the City, wireless service up to 5 Mbps is available as the terrain allows at \$39.95 per month with the same \$100 installation fee.

Business customers within the City limits can take advantage of fiber infrastructure the City has installed down the Highway 26 corridor; fiber connections with speeds up to 1 Gbps (1,000 Mbps) are available, as are dedicated wireless (up to 30 Mbps) and WiFi (5 Mbps) service.

Accelerating the Development of Infrastructure

The City Council passed an ordinance in 2011 requiring developers to put fiber conduit all the way into any new home, just as they must install water, sewer, and storm drainage.⁸⁹ The ordinance, which passed unanimously, is designed to cost-effectively enable the expansion of broadband to all new buildings.

City Council Member Jeremy Pietzold, who chairs the seven-member SandyNet Advisory Board appointed by the City Council, noted that his only regret about the new conduit ordinance is that the City did not have the foresight to pass it 10 years ago—which would have better positioned Sandy for future broadband development.

Sandy’s ordinance, which is similar to one in place in the City of Loma Linda, California, is well suited to a fast-growing community. In a densely populated, fully built-up community, the results would likely be far more modest. In addition, an ordinance that places this obligation on developers is likely to garner more support when it clearly aligns with a local government’s stated goal of expanding its broadband infrastructure.

Meeting the Future with Fiber

After extensive feasibility analysis and study, the City Council and City Manager recently announced an agreement with a private company—i3 America—to build an open-access fiber-to-the-premises (FTTP)

⁸⁸ “SandyNet: The City of Sandy’s connected community,” City of Sandy website.

http://www.ci.sandy.or.us/index.asp?Type=B_BASIC&SEC={3226EC2F-8CCB-4208-88D8-4AC6C99FA6D2} (accessed December 3, 2012).

⁸⁹ “Ordinance 2011-05 - Municipal Broadband Facilities in New Subdivisions,” Sandy City Council Minutes, June 6, 2011. http://sandy.granicus.com/MediaPlayer.php?view_id=2&clip_id=357&meta_id=16562%C2%90 (accessed December 2, 2012).

network throughout the City.⁹⁰ Under the terms of the public–private partnership, i3 will finance, construct, and maintain the network. And while i3 will own the network, the City will have the option to purchase it after 10 years.⁹¹

The City will be the Internet service provider, expanding the SandyNet brand to include SandyNet Fiber service.⁹² It expects to offer symmetrical 100 Mbps residential service for \$39.95 per month, or Gigabit service (1,000 Mbps) for \$99.95 monthly.

The decision to construct an FTTP network—which is expected to be complete by early 2014, and which will route fiber through the City’s sewer pipes⁹³—was based in part on the strong demand for SandyNet WiFi service. Just as demand for broadband nationwide has increased in virtual lock-step with the availability of more bandwidth-intensive applications, the City’s residents and businesses have expressed an increasing need for higher-capacity broadband.

The City’s decision to pursue FTTP is also a logical extension of its years of offering wireless broadband; the City government has long viewed broadband as an essential service—so upgrading that service for its citizens is a natural next step.

The City’s residents are solidly behind the FTTP initiative, too—reportedly responding in very positive terms to a City survey, and clamoring for their neighborhoods to be chosen as the site of an earlier FTTP pilot program in a City-sponsored “Why Wait for Google?” contest.⁹⁴

Construction Financing

In return for the private entity’s capital investment in the FTTP network, the City committed to a guaranteed level of revenue for 10 years. The minimum level of return the City is guaranteeing to its private partner is within reasonable expectations for the expected revenues from the network. That said, the city is taking risk; if this level is not met, the City will have to cover the difference.

This risk-sharing arrangement means that the private partner gets a guaranteed income stream for 10 years, while the community does not have to come up with the upfront capital cost of building the network; however, as the ISP, the City maintains control over specific business decisions, such as the types of data products offered, bandwidth options, and pricing. The City has shared the risk and the reward, but maintained control of what is important to them.

⁹⁰ “Sandy launches initiative for fiber internet service to all homes and businesses,” press release, i3, Sept. 19, 2012. <http://www.i3-america.com/news/sandy-launches-initiative-fiber-internet-service-all-homes-and-businesses/> (accessed December 2, 2012).

⁹¹ “Oregon’s SandyNet to Use Sewers for Fiber Deployment,” *Community Broadband Networks*, website, Sept. 20, 2012. <http://www.muninetworks.org/content/oregons-sandynet-use-sewers-fiber-deployment> (accessed December 2, 2012).

⁹² SandyNet Fiber, website. <http://www.sandynetfiber.com/> (accessed December 2, 2012).

⁹³ “Sandy launches initiative for fiber internet service to all homes and businesses.”

⁹⁴ Emily Fuggetta, “Sandy’s city-run Internet will deliver high speed at low cost,” *The Oregonian*, July 16, 2011. http://www.oregonlive.com/clackamascounty/index.ssf/2011/07/sandy_fiber_internet_project_t.html (accessed December 2, 2012). See also: “Fiber-to-the-Home Project,” City of Sandy website. http://cityofsandy.com/index.asp?Type=B_BASIC&SEC={7278745B-B2DF-4B0A-BEB9-AACE986F1C12} (accessed December 2, 2012).

Appendix A: Funding Opportunities

While America's Recovery and Reinvestment Act (ARRA) provided a tremendous boost to broadband funding, these grants have been allocated and many expire in the near term. Fortunately, there are a number of alternative ongoing federal programs that could help finance broadband expansion in some counties. The nature of support varies widely, with some programs providing low-interest loans and others providing grants or tax credits. In some instances, support has declined significantly in recent years as the federal budget has tightened. Some programs are narrowly tailored to specific types of investments (e.g., educational or healthcare), while other programs have broad mandates that can be used to support virtually any broadband improvements.

This compendium provides background on some of the most promising broadband funding opportunities. (We recommend subscribing for alerts of upcoming funding deadlines through www.grants.gov.) The programs include:

- Department of Agriculture – Expansion of 911 Access; Telecommunications Loan Program
- Department of Agriculture – RUS – Rural Broadband Loan Program (through Farm Bill)
- Department of Agriculture – RUS – Community-Oriented Connectivity Broadband Grant Program (“Community Connect”)
- Department of Agriculture – RUS – Public Television Digital Transition Grants
- Department of Agriculture – RUS – Telecommunications Infrastructure Loans
- FEMA – Homeland Security Grant Program (HSGP)
 - *State Homeland Security Program (SHSP)*
 - *Urban Areas Security Initiative (UASI)*
- FEMA – Interoperable Emergency Communications Grant Program (IECGP)
- FCC- Rural Health Care Pilot Program (now transitioning to Health Infrastructure Program)
- FCC – Universal Service Administrative Company (USAC) (through Universal Service Fund)
 - *Rural Healthcare Fund*
 - *E-Rate Program – USF Schools and Libraries Program*
 - *FCC – Universal Service Fund, Connect America Fund*

Department of Agriculture, Rural Utilities Service (RUS)

Telecommunications Loan Program

Expansion of 911 Access

USDA cautions that this program is limited to loans to provide 911 service. Areas with existing 911 capability will not be prioritized.

ENTITIES FUNDED: The program can provide loans to any entity eligible to borrow from the Rural Utility Service, including state or local governments, tribes and emergency communications equipment providers (if the state is prohibited from acquiring debt). Agency staff indicate, however, that awards are given to telephone companies (which may provide broadband service), though the County could theoretically receive an award to distribute.

NATURE OF AWARD: Loan

FY 2011 RESOURCES: The program has not yet been finalized; however, USDA staff note that (as a loan program) it is not subject to appropriations.

TYPICAL AWARD SIZE: Loan (either cost of money (currently 3.75%) or 4% loan). “Typical” award size is unknown (pending finalization of the rule).

COST-SHARE REQUIREMENT: N/A (loan)

APPLICABLE DEADLINES: Comments on the rule were due 11/14/2011. The rule should be finalized in early 2012; however, there are not yet application deadlines.

PROGRAM MISSION: The program is intended to “provide[] rural first responders with the tools they need to maintain mission-critical voice and broadband service during times of emergency or during natural disasters.” The new rule explicitly codifies the Secretary of Agriculture’s authority to make loans in five areas of eligibility to expand or improve 911 access and integrated emergency-communications systems in rural areas for the Telecommunications Loan Program.

PROJECTS FUNDED: The program appears to have broad application to emergency-communication improvements. For instance, it could provide support for projects that help responders precisely locate rural wireless 911 calls, contact 911 via text message, or send emergency responders photos or videos of crime scenes or accidents. The new regulation would also give the Rural Utility Service the ability to finance wireless upgrades for public safety and security. USDA staff, however, report that the program is fairly narrowly tailored to 911 and could not extend to construction of a broadband system, despite arguable benefits for emergency communications.

RESTRICTIONS: The loan program is limited to “rural areas” (defined as an area that is not located within a city with a population greater than 20,000 or an urban area contiguous to city with a population greater than 50,000) (7 CFR 1735(2)). Awards are made based on existing emergency communications capability (7 CFR 1735.12). Awards are also limited to providing 911 service (though could extend to upgrading 911 to digital service).

KEY LINKS:

- Federal Register Notice (http://www.ofr.gov/OFRUpload/OFRData/2011-23152_PI.pdf)

PROGRAM CONTACT:

- David Villano (202-720-9554 or david.villano@wdc.usda.gov)
- Kenrick (“Rick”) Gordon is the RUS Field Representative. He is happy to provide additional information regarding all USDA programs. (Kenrick.gordon@wdc.usda.gov; 717-761-3280)

Department of Agriculture, Rural Utilities Service (RUS)

Rural Broadband Loan Program (through the Farm Bill)

This seems to be the RUS program with the greatest promise for many counties. The application process is not onerous and there is some flexibility in what loans can cover.

ENTITIES FUNDED: Entities eligible to receive loans include corporations, limited liability companies, cooperative or mutual organizations, Indian tribes, and state or local government. Individuals or partnerships are not eligible.

NATURE OF AWARD: Awards are in the form of Treasury-rate loans, 4% loans, and loan guarantees. Loans are for the term of the life of the facility (thus, 18-20 years for standard-wire broadband). Money is dispersed as construction is completed, with monthly advances against the following month's contract. Once awarded, funding covers capitol costs and can retroactively cover pre-application expenses (e.g., project design); however, applicants must take a "leap of faith" in preparing these details during the application process.

FY 2011 RESOURCES: The Obama Administration's FY2011 budget proposal requested (and P.L. 112-10 appropriated) a \$22.32 million loan subsidy to support a loan level of \$400 million for the Rural Broadband Access Loan and Loan Guarantee Program. Funding seems somewhat uncertain for 2012, however. Resources had not yet been appropriated when the Notice of Solicitation of Applications (NOSA) was published, though USDA anticipated \$700 million in available resources at that time. USDA intended to carry over \$300 million in prior year funding to FY2012 and anticipated an additional \$100-300 million in new lending authority. Despite this, the Department of Defense and Full-Year Continuing Appropriations Act, 2011 (P.L. 112-10) rescinded all available unobligated budget authority from past years. In June 2011, the House of Representatives passed an amendment, which would provide a \$6 million loan subsidy (thereby providing \$100 million in lending authority). The program is currently authorized through FY2012 (and is likely up for reauthorization in the 2012 Farm Bill).

TYPICAL GRANT AWARD: Congress approves an annual appropriation (loan subsidy) and a specific loan level (lending authority) for the program. To date, the Rural Broadband Loan Program has provided \$1.8 billion in awards across 2,800 communities. Awards range from \$100,000 (minimum) to \$100 million (maximum), with an average award of \$640,000. (See 76 Fed. Reg. 13771 for details on previous awards.)

COST-SHARE REQUIREMENT: N/A (loan)

APPLICABLE DEADLINES: USDA announced a modified program on March 14, 2011, with applications due summer 2011. Three awards were announced on September 1, 2011. The FY2012 timeline is unclear, though the Agency processes applications year-round (i.e., applications can be submitted at any time). If Congress approves a Continuing Resolution at the current lending level, USDA will be able to award

“carry-over” funds (totaling \$300 million) in 2012. Applications are likewise “carried over.” Thus, if a proposal is not funded, the application will remain in the application pool for the next funding cycle.

PROGRAM MISSION: The Rural Broadband Loan Program has a broad mission. It is designed “[t]o provide loans for funding, on a technology neutral basis, for the costs of construction, improvement, and acquisition of facilities and equipment to provide broadband service to eligible rural communities.”

PROJECTS FUNDED: The program funds costs of construction, improvement, and acquisition of facilities and equipment to provide broadband service to eligible rural areas. Thus, loans are not limited by anticipated end uses.

RESTRICTIONS: Loans are limited to eligible rural communities (i.e., an area with less than 20,000 inhabitants and not adjacent to an urbanized area with more than 50,000 inhabitants). An eligible service area must be completely contained within a rural area, at least 25 percent of the households in the area must be underserved, no part of the service area can have more than three incumbent service providers (note that an area may have two competing broadband service providers), and no part of the funded service area can overlap with the service area of current RUS borrowers and grantees or be included in a pending application before RUS. It is likely that portions of a county would qualify, although the county may not qualify in its entirety. Incumbent service providers are broadband providers that RUS identifies as directly providing broadband service to at least five percent of the households within a service area.

OTHER REQUIREMENTS: Applicants must complete build-out within three years, demonstrate ability to provide the service at the Agency’s “broadband lending speed” (5Mbps up and down), and demonstrate an equity position of at least 10 percent of the loan amount. (76 Fed Reg 13779) Note that awards are only partially based on project design, but pay particular attention to the business plan and *pro forma*. Thus, applicants must invest resources preparing these supporting documents. Loans are given to those projects that demonstrate the greatest likelihood of repayment (as demonstrated by the business plan). RUS will give greatest priority to applicants that propose to offer broadband to the greatest proportion of households that have no incumbent service provider.

KEY LINKS:

- General background: www.rurdev.usda.gov/utp_farmbill.html (including application materials) and <http://edocket.access.gpo.gov/2011/pdf/2011-5615.pdf>
- Application guide: <http://www.rurdev.usda.gov/supportdocuments/Broadband%20Application%20Guide%203.14.11.pdf>
- NOSA: <http://edocket.access.gpo.gov/2011/pdf/2011-5611.pdf> (NB: awards have already been committed)
- Farm Bill loan program brochure: http://www.rurdev.usda.gov/supportdocuments/BBLoanProgramBrochure_8-11.pdf

- Presentation on the Broadband Loan Program:
<http://www.rurdev.usda.gov/supportdocuments/FarmBillRegulationPresentation.pdf>
- CRS Report on RUS Programs: <http://www.nationalaglawcenter.org/assets/crs/RL33816.pdf>

AGENCY CONTACT:

- Ken Kuchno (202-690-4673); Kenneth.kuchno@wdc.usda.gov
- Kenrick (“Rick”) Gordon is the RUS Field Representative. He is happy to provide additional information regarding all USDA programs. (Kenrick.gordon@wdc.usda.gov; 717-761-3280)

Department of Agriculture, Rural Utilities Service (RUS)

Community-Oriented Connectivity Broadband Grant Program (“Community Connect”)

Community Connect grants are generally not a good fit for communities in this region, as priority is given to areas demonstrating “economic necessity” (which tends to favor the south). The application process is rigorous and competitive (with awards given to only 10% of applicants) and once awarded, program requirements are demanding (e.g., requiring last-mile service for all households in the service area). Awards are fairly modest, and would be limited to a discrete community within a county.

ENTITIES FUNDED: Awards can be given to both public and private entities. Eligible applicants for broadband grants include incorporated organizations, Indian tribes or tribal organizations, state or local units of government, or cooperatives, private corporations, and limited liability companies organized on a for profit or not-for-profit basis. Individuals or partnerships are not eligible.

NATURE OF AWARD: Grant with modest (15%) match requirement.

FY 2011 RESOURCES: The Obama Administration’s FY2011 budget proposal requested \$17.976 million for the Community Connect Grant Program. For FY2011, P.L. 112-10 appropriated \$13.4 million to Community Connect Grants. Funding is provided through annual appropriations in the Distance Learning and Telemedicine account within the Department of Agriculture appropriations bill. The program is funded at about \$15 million annually.

TYPICAL GRANT AWARD: Awards range considerably in size, though all are fairly modest (ranging from \$50,000 to \$1 million).

COST-SHARE REQUIREMENT: Applicants must make a matching contribution of at least 15 percent of the total award. This match can be made with “in kind” contributions, but cannot be made with federal funds.

APPLICABLE DEADLINES: FY 2011 awards were announced Sept. 30, 2011 (with a May 3, 2011 application deadline). The FY 2012 grant cycle remains unknown absent appropriations, although funding is anticipated. Applications could be solicited as early as February 2012 (though Ken Kuchno notes that this is unlikely) and a November 10, 2011 email from Senior Loan Specialist Janet Malaki confirms that the program is not yet accepting 2012 applications. Conversations with program staff confirm that there is a 60-day application window (typically in the spring) with awards given in September. Updates on application deadlines are available through www.grants.gov.

PROGRAM MISSION: Community Connect has a broad program mission of helping “rural residents tap into the enormous potential of the Internet.”

PROJECTS FUNDED: Community Connect funds approximately 15 projects annually (from an application pool of 150). Eligible projects must offer basic broadband transmission service to both residential and business customers within the proposed Service area. Examples of eligible projects include deploying broadband transmission service to critical community facilities, rural residents, and rural businesses; constructing, acquiring or expanding a community center (but only 5% of grant or \$100,000 can be used for this purpose); or building broadband infrastructure and establishing a community center with at least 10 computer access points, which offer free public access to broadband for two years.

RESTRICTIONS: While Community Connect has a fairly broad mission, funding is geographically limited to a single community with a population less than 20,000 that does not currently have Broadband Transmission Service (as determined by the FCC National Broadband Map). Grants cannot duplicate any existing broadband services, nor can applicants charge for services to any critical community facilities for at least two years from the grant award. Priority is given to areas that demonstrate “economic necessity.” The grant process is very selective, with awards given to only 10 percent of applicants.

OTHER REQUIREMENTS: Grant requirements are fairly onerous, as recipients must agree to provide last-mile services throughout the entire service area (i.e., “basic transmission service to residential and business customers”).

KEY LINKS:

- Basic background: http://www.rurdev.usda.gov/utp_commconnect.html
- Application Guide: <http://www.rurdev.usda.gov/SupportDocuments/CC2011AppGuide3-10-11.pdf>
- CRS Report on RUS Programs: <http://www.nationalaglawcenter.org/assets/crs/RL33816.pdf>

AGENCY CONTACT:

- Long Chen and Janet Malaki (202-690-4673) (community.connect@wdc.usda.gov)
- Kenneth Kuchno (202-690-4673)
- Kenrick (“Rick”) Gordon is the RUS Field Representative. He is happy to provide additional information regarding all USDA programs. (Kenrick.gordon@wdc.usda.gov; 717-761-3280)

Department of Agriculture, Rural Utilities Service (RUS)
Delta Health Care Services Grants

This program is limited to the Mississippi Delta region and thus cannot benefit New Mexico jurisdictions.

Department of Agriculture, Rural Utilities Service (RUS)

Distance Learning and Telemedicine (DLT)

While the program has historically provided both grants and loans, appropriations have been limited to grants in recent years. Grants are given for equipment, rather than broadband service; however, this may provide a good way for a county to leverage a new broadband network (e.g., by helping finance video conferencing systems and home medical units). As such, this could be a good supplement to other funding options. Applicants have a fairly high likelihood (50%) of receiving an award.

ENTITIES FUNDED: Funds can be awarded to both public and private entities (including corporations or partnerships, tribes, state or local units of government, consortia, and private for-profit or not-for-profit corporations), assuming they provide the requisite services. Individuals are not eligible. Grantees must provide education and medical care via telecommunications. Eligible entities must either directly operate a rural community facility or deliver distance learning or telemedicine services to entities that operate a rural community facility or to residents of rural areas.

NATURE OF AWARD: While DLT historically provided both grants and loans, recent appropriations have been limited to grants (no loan applications were accepted in FY2011).

FY 2011 RESOURCES: Funding has declined in recent years (and been eliminated for DLT loans). The program provided \$30 million in FY2010, \$25 million in FY2011, and less funding is anticipated in FY2012.

TYPICAL GRANT AWARD: Grant awards range from \$50,000 (minimum) to \$500,000 (maximum). Roughly 50 percent of applicants are awarded grants.

COST-SHARE REQUIREMENT: The grant program requires a 15 percent match. Such matches may be made through “in kind” contributions, but cannot be made with federal funds. Applications that provide a greater contribution may be scored more favorably.

APPLICABLE DEADLINES: The grant period opens between February and June. USDA published a Notice of Solicitation of Applications (NOSA) in February 2011, prior to passage of a final Appropriations Act to ensure sufficient time to prepare and review applications. Applications were due by April 25, 2011. Thus, applications may be solicited before funding is secure.

PROGRAM MISSION: Grants are available for projects that “meet the educational and health care needs of rural America.”

PROJECTS FUNDED: Grants can be used for equipment, but not broadband service. Eligible projects vary and can include capital assets (e.g., interactive video equipment, data terminal equipment, inside wiring, etc.), instructional programming that is a capital asset, technical assistance and instruction. Loans have

historically been awarded for projects that establish links between teachers and students or medical professionals in the same facility, site development of buildings, construction or purchase of land, acquisition of telecommunications transmission facilities, or distance learning broadcasting. Grants can provide operating costs for the first two years of a program. Note that although there is nominally a loan program “on the books,” Congress has not provided appropriations in recent years. Grants are made for projects where the benefit is primarily delivered to end users that are not at the same location as the source of the education or health-care service.

RESTRICTIONS: Demonstration projects are not eligible for DLT funds. Projects must be in a rural area as defined by 7 CFR 1703.126(a)(2) (available online at <http://cfr.vlex.com/vid/1703-126-criteria-scoring-grant-applications-19918213>). Eligible projects must receive at least 20 (or 45) points using these criteria.

KEY LINKS:

- Basic background: http://www.rurdev.usda.gov/UTP_DLT.html
- Notice of Solicitation of Applications (NOSA) (76 Fed. Reg. 10321 (Feb. 24, 2011)) (<http://www.gpo.gov/fdsys/pkg/FR-2011-02-24/html/2011-4137.htm>)

AGENCY CONTACT:

- Sam Morgan (202-205-3733 or sam.morgan@wdc.usda.gov)
- Gary Allan (202-720-0665 or gary.allan@wdc.usda.gov)
- General information (202-720-1051 or dlinfo@wdc.usda.gov).
- Kenrick (“Rick”) Gordon is the RUS Field Representative. He is happy to provide additional information regarding all USDA programs. (Kenrick.gordon@wdc.usda.gov; 717-761-3280)

Department of Agriculture, Rural Utilities Service (RUS)

Public Television Digital Transition Grants

The Public Television Digital Transition program is fairly limited, as the award does not provide ongoing operational expenses and is restricted to rural areas without public television.

ENTITIES FUNDED: USDA provides grants to public television stations which serve rural areas. A public television station is a non-commercial, educational television broadcast station. Individuals are not eligible.

NATURE OF AWARD: Awards are given as a 100 percent grant.

FY 2011 RESOURCES: Approximately \$4.5 million was available for public television grants in 2011.

TYPICAL GRANT AWARD: Awards can be as high as \$750,000. There is not a set minimum level.

COST-SHARE REQUIREMENT: There is no matching requirement.

APPLICABLE DEADLINES: Applications are due annually on July 25. In 2011, the Notice of Funding Availability was published on June 10. Grant deadlines can be tracked via www.grants.gov.

PROGRAM MISSION: Public Television Digital Transition Grants are intended to “[a]ssist Public Television Stations serving substantial rural populations in transitioning to digital broadcast television transmission.”

PROJECTS FUNDED: Funds can be used to acquire, lease, and/ or install facilities and software needed for the digital transition, including digital transmitters and power upgrades of existing Digital Television (“DTV”) equipment.

RESTRICTIONS: Grants are limited to stations serving rural areas (i.e., any area of the US not included within the boundaries of any incorporated or unincorporated city, village, or borough having a population in excess of 20,000). Grants are nonrenewable and cannot cover a station’s ongoing operational expenses.

KEY LINKS:

- FY2011 NOFA: <http://www.gpo.gov/fdsys/pkg/FR-2011-06-10/pdf/2011-14367.pdf>
- General Resources: http://www.rurdev.usda.gov/UTP_DTVResources.html

AGENCY CONTACT:

- Gary Allan, Chief, Advanced Services Division (202-690-4493)

- Kenrick (“Rick”) Gordon is the RUS Field Representative. He is happy to provide additional information regarding all USDA programs. (Kenrick.gordon@wdc.usda.gov; 717-761-3280)

Department of Agriculture, Rural Utilities Service (RUS)

Telecommunications Infrastructure Loans

USDA provides loans to support broadband in rural communities. Loans are limited to telephone companies serving rural areas within cities of fewer than 5,000 inhabitants. Other, more generous grants and subsidies may be available.

ENTITIES FUNDED: The Department of Agriculture provides Telecommunications Infrastructure Loans to entities providing telephone service in rural areas; public bodies providing telephone service in rural areas as of 1949; cooperative, nonprofit, limited dividend or mutual associations. All borrowers must be incorporated or a limited liability company.

NATURE OF AWARD: All awards are in the form of low-interest loans and include: cost-of-money loans (interest rate fluctuated between 2.9 and 5% for a 20-year term in 2005-2008), guaranteed loans (interest rates are Treasury rate plus 1/8%; historically between .15 and 4.2%), and hardship loans (5% interest).

FY 2011 RESOURCES: It is unclear how much funding is available in any given year, though \$13 billion has been lent since the program's inception.

TYPICAL AWARD: \$50,000 is the minimum loan award. The maximum is unclear, though Triangle Telecom has received \$136 million to date.

COST-SHARE REQUIREMENT: N/A (loan)

APPLICABLE DEADLINES: Applications can be submitted year-round.

PROGRAM MISSION: The Telecommunications Infrastructure program makes "long-term direct and guaranteed loans to ... finance[e] the improvement, expansion, construction, acquisition, and operation of telephone lines, facilities, or systems to furnish and improve Telecommunications service in rural areas." The loans are intended to provide advanced telecommunications networks for rural areas, especially broadband networks designed to accommodate distance learning, telework and telemedicine.

PROJECTS FUNDED: Loans can be used to finance telecommunications in rural areas for improvements, expansions, construction, acquisitions and refinancing.

RESTRICTIONS: Loans are limited to rural areas, narrowly defined as areas within a city of fewer than 5,000 inhabitants.

KEY LINKS:

- General information: http://www.rurdev.usda.gov/utp_infrastructure.html

- Brochure: <http://www.rurdev.usda.gov/supportdocuments/telecomloansflyerfactsheet.pdf>
- Regulations: http://www.rurdev.usda.gov/supportdocuments/7_cfr_part_1735.pdf

AGENCY CONTACT:

- Kenrick (“Rick”) Gordon is the RUS Field Representative. He is happy to provide additional information regarding all USDA programs. (Kenrick.gordon@wdc.usda.gov; 717-761-3280)

FEMA – Homeland Security Grant Program (HSGP)

The Homeland Security Grant Program supports five interconnected grants (totaling \$1.3 billion in FY2011) that are intended to enhance national preparedness capabilities.⁹⁵ Of these, the State Homeland Security Program (“SHSP”) holds the greatest promise, though it is not likely to be a substantial funding source (as grants are allocated to counties based on population and appropriations have declined dramatically in recent years).

State Homeland Security Program (SHSP)

ENTITIES FUNDED: The SHSP provides funding to all 50 states.

NATURE OF AWARD: Grant

FY 2011 RESOURCES: While funding remains substantial, it has declined considerably in recent years. Funding in fiscal year 2011 (\$526,874,100) was 50% of funding the previous year – and is expected to be reduced by 340% in 2012.

TYPICAL GRANT AWARD: Grants are allocated to individual counties using a population-driven formula.

COST-SHARE REQUIREMENT: None

APPLICABLE DEADLINES: Varies

PROGRAM MISSION: SHSP is intended to support the implementation of State Homeland Security Strategies to address the identified planning, organization, equipment, training and exercise needs at the state and local levels to prevent, protect against, respond to, and recover from acts of terrorism and other catastrophic events.

PROJECTS FUNDED: SHSP provided awards to three priority funding areas in FY2011: (1) Advancing “whole community” security and emergency management, (2) building prevention and protection capabilities (e.g., “If you See Something Say Something”), and (3) maturation and enhancement of state and major urban areas fusion centers. Broadband deployment could be supported under the first of these funding priorities.

⁹⁵ The five grant programs include: the State Homeland Security Program (SHSP), Urban Areas Security Initiative (UASI), Operation Stonegarden (OPSG), Metropolitan Medical Response Grants (MMRS), and the Citizen Corps Program (CCP). Only the first two are described herein.

RESTRICTIONS: States must spend at least 25% of SHSP funds toward law-enforcement, terrorism-prevention-oriented planning, organization, training, exercise, and equipment activities. Broadband deployment could satisfy these requirements.

KEY LINKS:

- Summary of all HSGP programs: <http://www.fema.gov/government/grant/hsgp/>
- Guidance document addressing all HSGP programs:
http://www.fema.gov/pdf/government/grant/2011/fy11_hsgp_kit.pdf
- HSGP fact sheet: http://www.fema.gov/pdf/government/grant/2011/fy11_hsgp_faq.pdf

AGENCY CONTACT:

- Gary Harrity (gharrity@mema.state.md.us)

Urban Areas Security Initiative (UASI)

The Urban Areas Security Initiative is limited to 31 designated “high-threat, high-density urban areas” throughout the United States. As such, it does not provide funding for many areas.

FEMA – Interoperable Emergency Communications Grant Program (IECGP)

The Interoperable Emergency Communications Grant Program (IECGP) appears to support broadband deployment; however, the program is no longer funded.

FEMA – Emergency Management Performance Grants (EMPG)

Emergency Management Performance Grants appear to extend to broadband deployment. Because allocations are population-based, this is unlikely to be a substantial funding source for some counties. Nonetheless, this may be an option worth exploring with the state Emergency Management Agency.

ENTITIES FUNDED: FEMA awards Emergency Management Performance Grants (EMPG) directly to all 50 states. A single state application is accepted from the State Administrative Agency (SAA) or the State's Emergency Management Agency (EMA) on behalf of state and local emergency management agencies.

NATURE OF AWARD: Grant

FY 2011 RESOURCES: \$330 million was awarded nationwide in both FY2011 and FY2010, with distribution based on population.

TYPICAL GRANT AWARD: Grants are distributed based on population.

COST-SHARE REQUIREMENT: The EMPG Program has a 50% Federal and 50% State cost-match requirement. The state match can be made with in-kind contributions, but cannot be filled with other federal funds.

APPLICABLE DEADLINES: FY2011 applications were due June 20, 2011.

PROGRAM MISSION: Emergency Management Performance Grants are given to intra- and inter-state emergency management systems that encourage partnerships across all levels of government and with non-governmental organizations. "The FY 2010 EMPG Program assists state and local governments in enhancing and sustaining all-hazards emergency management capabilities."

PROJECTS FUNDED: Note that FEMA's guidance and application kit identifies broadband as an eligible project: "Emergency communications activities include the purchase of Interoperable Communications Equipment and technologies such as voice-over-internet protocol bridging or gateway devices, or equipment to support the build-out of wireless broadband networks in the 700 MHz public safety band under the Federal Communications Commission Waiver Order."

RESTRICTIONS: Grants must be expended during a 24-month period of performance.

KEY LINKS:

- Fact sheet: <http://www.fema.gov/pdf/government/grant/empg.pdf>
- Guidance and application kit:
http://www.fema.gov/pdf/government/grant/2011/fy11_empg_kit.pdf

AGENCY CONTACT:

- Gary Harrity (gharrity@mema.state.md.us)

Federal Communications Commission

FCC – Universal Service Fund, Connect America Fund

The new Connect America Fund (CAF) may provide a funding opportunity to support broadband; however, FCC staff is concerned that public entities are unlikely to receive funding directly (as funds are likely to go to price-cap carriers). To receive an award, a State or county would need to be designated an Eligible Telecommunications Carrier. To qualify, a county would have to be deemed unserved (i.e., no providers offering broadband at speeds of 3 Mbps down/ 768 Kbps up).

ENTITIES FUNDED: Funding is limited to “Eligible Telecommunications Carriers” (ETCs), which can include price-cap carriers and rate-of-return companies. However, a government entity could theoretically qualify as an ETC and provision its own network. Thus, there is nothing that prohibits the state from accessing CAF money, though it would have to be designated an ETC to do so. The FCC never contemplated a state-level entity competing in the process. In most states, designation of the ETC would be made by the state PUC.

ETCs can include both price-cap companies and rate-of-return companies. Price-cap carriers include about 20 larger companies (e.g., AT&T, Frontier, Verizon). Rate-of-return companies are reimbursed based on actual cost, rather than a cost model, but might not exist in a county.

NATURE OF AWARD: The CAF provides subsidies in unserved (presumably – but not necessarily – rural) areas. These subsidies are based on the cost of providing service.

FY 2011 RESOURCES: The CAF is funded at \$24.5-billion over five years (and will have an average annual budget of \$4.5-billion), with initial awards granted in the first quarter of 2013. This budget includes a \$300 million nationwide award as one-time support for mobile voice and broadband services in unserved areas and \$100 million nationwide for “alternative technology” (e.g., satellite) in remote areas. Note that these funds are in addition to other FCC Universal Service Fund programs. Thus, CAF does not impact funding for other USF programs (e.g., E-Rate and Rural Healthcare). The CAF is the program formerly known as the “high-cost” program.

Currently, wireless carriers (e.g., US Cellular) in high-cost areas are reimbursed (through the USF) based on the amount of money provided to wireline incumbents to serve the same area. This approach is inappropriate, however, because wireline and wireless providers use different network architecture (and thus have different costs). This approach to wireless carriers will be phased out in 2013 and replaced with a reverse auction for the cost of providing ongoing wireless support through the CAF.

TYPICAL GRANT AWARD: Awards are determined using “incentive-based, market-driven policies, including competitive bidding.” Actual award amounts are location-specific, but cannot exceed \$3,000 per line in a single area. The maximum award value is based on the actual cost (“cost model”) of serving a particular area (taking into account terrain, population density, and other factors). The FCC would then offer that

money to Eligible Telecommunications Carriers (generally designated by the state PUC) to serve these areas. If the incumbent carrier declines to extend coverage, the FCC would hold a reverse auction to determine who could serve the area at the lowest cost. Eligible Telecommunications Carriers would thus compete to provide service at the lowest cost.

COST-SHARE REQUIREMENT: There is no cost-share requirement.

APPLICABLE DEADLINES: This is a new program with a model and competitive bidding mechanism to be adopted by December 2012 and awards to be distributed in 2013 through 2017. As such, there is not yet an application deadline.

PROGRAM MISSION: The Connect America Fund is intended “to extend broadband infrastructure to the millions of Americans who currently have no access to broadband.” The FCC has announced a goal of expanding high-speed Internet access to over 7 million Americans living in rural areas over six years.

PROJECTS FUNDED: While the program is not yet off the ground, the Notice of Proposed Rulemaking indicates that grants will be awarded to projects that “(1) preserve and advance universal availability of voice service; (2) ensure universal availability of modern networks capable of providing voice and broadband service to homes, businesses, and community anchor institutions [within the threshold of support]; (3) ensure universal availability of modern networks capable of providing advanced mobile voice and broadband service; (4) ensure that rates for broadband services and rates for voice services are reasonably comparable in all regions of the nation; and (5) minimize the universal service contribution burden on consumers and businesses.” There will also be at least \$100 million set aside annually for a “remote areas fund” to support alternative technology platforms (e.g., satellite and unlicensed wireless services). Funding under the CAF extends to any technology, as long as it meets minimum-service requirements (i.e., 4 Mbps downstream and 1 Mbps upstream). Nonetheless, fiber is generally most cost-effective. ETCs must provide to every entity that falls within the established threshold level of support in the unserved area.

RESTRICTIONS: The CAF is limited to unserved areas where there would not be deployment absent federal support. Thus, CAF areas are high-cost areas to serve. Funding is not necessarily limited to rural areas; however, unserved areas are likely to be rural. An area is considered served if at least one provider offers broadband at speeds of 3 Mbps down/ 768 Kbps up.

Funding is limited to price-cap carriers that deploy broadband to their customers. Broadband is defined to include services with speeds of at least 4 Mbps downstream and 1 Mbps upstream. Such speeds are deemed necessary to support “robust, scalable broadband” that is needed to enable the use of “common applications such as distance learning, remote health monitoring, VoIP, two-way high-quality video conferencing, Web browsing, and email.” Grants are not available in areas where unsubsidized competitors are already providing broadband that satisfies this definition.

To qualify, an ETC must deliver broadband at the requisite speed (4 *Mbps* downstream and 1 Mbps upstream), impose no limitations on access, charge reasonable rates, and satisfy build-out obligations.

OTHER REQUIREMENTS: Eligible carriers must commit to interim build-out requirements in three years and final requirements in five years.

KEY LINKS:

- FCC Press Release announcing NPRM:
http://transition.fcc.gov/Daily_Releases/Daily_Business/2011/db1027/DOC-310695A1.pdf

AGENCY CONTACTS:

- Patrick Halley, Legal Advisor (Patrick.Halley@fcc.gov or 202-418-7550)

FCC – Universal Service Fund, Rural Health Care Program

While the Rural Health Care Program doesn't support comprehensive broadband deployment, this funding may provide useful resources. This program typically has surplus resources, so funding should be available. The one caveat is that funding is provided based on the differential between urban and rural rates for telecommunications. While a county may be eligible in its entirety, funding levels may be low if local telecommunications service rates are comparable to urban rates elsewhere in the state. Sample urban rates can be found at <http://usac.org/rhc/tools/rhcdb/UrbanRates/search.asp>

ENTITIES FUNDED: Funding is limited to non-profit and public entities (e.g., rural health clinics, nonprofit hospitals, teaching hospitals, and community mental health centers and can include the county or state). Funding does not extend to private physician offices or clinics, long-term care facilities, substance abuse treatment facilities, emergency medical service facilities, home health agencies, blood banks or community centers). A full list of eligible providers is available at <http://www.usac.org/res/documents/rhc/pdf/RHC-Welcome-Packet.pdf> (click on "eligibility" in table of contents).

NATURE OF AWARD: The Rural Health Care Program provides a subsidy to eligible institutions for telecommunications and Internet services.

FY 2011 RESOURCES: Funding is stable as resources are not subject to appropriations. The program was authorized in the 1996 Telecommunications Act and FCC and is funded through the Universal Service Fund. The Rural Health Care Program anticipates it will disperse \$92 million in 2010, with up to \$400 million available annually. Note that this program is distinct from and unaffected by the Connected Areas Fund (CAF).

TYPICAL GRANT AWARD: Savings vary, but eligible facilities save an average of 65% on telecommunications services and all applicants receive a straight 25% discount on their Internet bill.

COST-SHARE REQUIREMENT: There is not technically a cost-share, though eligible facilities will have to pay the remaining portion of their bills.

APPLICABLE DEADLINES: The fund-year application window typically opens in March or April. Eligible health care providers must file a FCC Form 465 documenting their needs (the form will be posted on the RHC website to allow service providers to bid for services. The applying health care providers must wait at least 28 days from the date of the posting before entering into services, sign a services agreement, and have services installed prior to July 1 of each year to receive a full 12 months of funding. The application timeline is available online here:

<http://usac.org/res/documents/rhc/pdf/Training/Primary%20Program%20Timeline.pdf>

PROGRAM MISSION: The Rural Health Care Program is intended to reduce the disparity in cost between rural and urban telecommunications and Internet services used for the provision of health care at eligible facilities.

PROJECTS FUNDED: The Rural Health Care Program funds monthly recurring costs of telecommunications and Internet services at eligible facilities. It does not extend to infrastructure.

RESTRICTIONS: Facilities must be located in rural areas. See the county's status on the Rural Healthcare page (<http://usac.org/rhc/tools/rhcdb/Rural/2005/search.asp>).

KEY LINKS:

- General background: http://www.usac.org/_res/documents/rhc/pdf/RHC-Welcome-Packet.pdf

AGENCY CONTACT:

- Chin Yoo (chin.yoo@fcc.gov) and Linda Oliver (linda.oliver@fcc.gov)
- Paloma Costa handles outreach on behalf of the Universal Services Administrative Company (USAC)'s Rural Health Care Program (pcosta@usac.org; 202-772-6274)

FCC – Universal Service Administrative Company (USAC), E-Rate Program – USF Schools and Libraries Program (“E-Rate”)

The E-Rate program provides funding to the state or county to provide internet connectivity to low-income schools, libraries and rural healthcare institutions where it may otherwise be cost-prohibitive to provide service.

ENTITIES FUNDED: Funding is not limited to price-cap carriers, but is provided to eligible schools, school districts and libraries (either individually or as part of a consortium). Funds are distributed to both public and private schools, as long as they provide primary or secondary education, operate as a non-profit business, and do not have an endowment exceeding \$50 million. Eligible libraries must be eligible for assistance from a state library administrative agency under the 1996 Library Services and Technology Act. Generally, libraries are eligible if their budget is separate from a school and they do not operate as a for-profit business. Determine whether a county has filed a Form 470 to initiate the application process by searching the website (submitted forms can be searched by year and zip code at: http://www.slforms.universalservice.org/Form470Expert/Search_FundYear_Select.aspx).

NATURE OF AWARD: Funding is provided through the Universal Service Fund in the form of a subsidy on the eligible facility’s telecommunications expenses. The size of the subsidy varies, as elaborated below and may cover both Internet service and infrastructure.

FY 2011 RESOURCES: Funding is stable as resources are not subject to appropriations. The Universal Service Fund was authorized in the 1996 Telecommunications Act and was just increased to \$2.25-billion annually (and is intended to increase at the rate of inflation). Note that the E-Rate program is a distinct program from the Connect America Fund; as such, resources are unaffected by the CAF. Resources for any given library are determined based on poverty levels in the relevant school district.

TYPICAL GRANT AWARD: E-Rate provides a discount on eligible services, with the size of the discount (ranging from 20%-90%) dependent on the level of poverty and the urban/rural status of the population served. The funding level can be determined from the matrix available on the E-Rate website (<http://www.usac.org/sl/applicants/step05/discount-matrix.aspx>). The primary measure for determining Schools and Libraries support discounts is the percentage of students eligible for free and reduced lunches under the National School Lunch Program (NSLP), calculated by individual school. For instance, if 70 percent of the students at the relevant school are eligible for NSLP, E-Rate will reimburse 80 percent of the costs for eligible services.

COST-SHARE REQUIREMENT: There is not technically a cost-share, though eligible facilities will have to pay the remaining portion of their bills.

APPLICABLE DEADLINES: The application process begins in October and continues throughout the year. The second stage (Form 471 application) filing window for Funding Year 2012 opened on Monday, January 9, 2012 and will close at 11:59 pm EDT on Tuesday, March 20, 2012. A flowchart depicting the general

process (without dates) is available at http://www.usac.org/_res/documents/sl/pdf/application-process-flow-chart.pdf.

PROGRAM MISSION: The program is intended to reduce the disparity between rural and urban broadband services. The Schools and Libraries Program of the Universal Service Fund (“E-Rate”) makes discounts available to eligible schools and libraries for telecommunication services, Internet access, and internal connections. The program is intended to ensure that schools and libraries have access to affordable telecommunications and information services.

PROJECTS FUNDED: The Schools and Libraries Program is designed to support connectivity - the conduit or pipeline for communications using telecommunications services and/or the Internet. Funding is requested from providers under four categories of service: telecommunications services, Internet access, internal connections, and basic maintenance of internal connections. E-Rate provides for ATM, Centrex, DSL, email, Ethernet, fiber, fractional T1, frame relay, internet access charges, ISDN, mileage-related charges, monthly internet access charges, MPLS, NRS, OC-1 or OC-3, redundant circuit, satellite service, telephone service, T1, T3 or DS3. The Fund extends to equipment (e.g., fiber) and access. Priority is given to the physical infrastructure (“Priority 1”) over internal connections (“Priority 2”) (although funds are also available for the latter). The E-Rate helpline notes that eligible applicants are virtually assured funding to assist with Priority 1 projects.

RESTRICTIONS: Facilities need not be located in rural areas, though funding levels will increase based on poverty and rural status.

KEY LINKS:

- To submit questions about the program: <http://www.usac.org/about/tools/contact-us.aspx>
- <http://www.usac.org/sl/>
- http://www.usac.org/_res/documents/sl/pdf/E-rate-Overview.pdf
- Eligible service list (a comprehensive – 55 page – document with descriptions of all qualifying services): http://www.usac.org/_res/documents/sl/pdf/ESL_archive/EligibleServicesList-2012.pdf
- Training sessions are provided to potential applications in the fall (<http://www.usac.org/sl/about/training-sessions/training-2011/fall/presentations.aspx#presentations> for schedule and links).

AGENCY CONTACT:

- The E-Rate helpline is extremely helpful. Contact 1-888-203-8100 with questions.
- Gina Spade (gina.spade@fcc.gov)

FCC - Universal Service Fund - Rural Health Care Pilot Program (now transitioning to Health Infrastructure Program)

Although this program could theoretically provide 85% of the construction costs of new regional or statewide networks to serve public and non-profit health care providers in areas of the country where broadband is unavailable or insufficient, it is not a viable short-term funding option because the Health Infrastructure Program has not yet been launched and grantees were selected for its predecessor in 2007. The Pilot Program was criticized for its failure to get money to recipients in a timely manner. The Notice of Proposed Rulemaking was published in July 2010, but the program has not yet been adopted by the FCC.

ENTITIES FUNDED: The Rural Health Care Pilot Program has helped 200 selected hospitals and groups of healthcare providers pay for telecommunications network upgrades. Potential recipients under the forthcoming program include acute-care facilities that provide services traditionally provided at hospitals, such as skilled-nursing facilities and renal dialysis centers and facilities and administrative offices and data centers that do not share the same building as the clinical offices of a health-care provider but that perform support functions critical for the provision of health care.

NATURE OF AWARD: Grant/ Subsidy to reduce the cost of service in rural areas

FY 2011 RESOURCES: It does not appear that there are any FY2011 resources as the FCC issued a Notice of Proposed Rulemaking (July 2010) announcing the forthcoming Health Infrastructure Program, but has not yet launched it. Funding would come from the Universal Service Fund (i.e., surcharges on telephone bills), rather than Congressional appropriations. As such, funding will be stable once launched.

TYPICAL GRANT AWARD: Unknown, though subsidies under the pilot program covered up to 85 percent of rural health care costs, with an annual budget of \$400 million, annually. Demand is consistently lower than this budget, however (with only \$90 million expended in 2010). The NPRM announces that the forthcoming program would support up to 85 percent of the construction costs of new regional or statewide networks to serve public and non-profit health care providers in areas of the country where broadband is unavailable or insufficient. The program would also subsidize 50 percent of the monthly recurring costs for access to broadband services for eligible public or non-profit rural health-care providers. These funds are distinct from – and unaffected by – the new Connect America Fund.

COST-SHARE REQUIREMENT: There is not technically a cost-share, though eligible facilities will have to pay the remaining portion of their bills.

APPLICABLE DEADLINES: N/A, as the program is not soliciting new participants and the Health Infrastructure Program has not yet been adopted by the FCC. Correspondence in early 2012 with FCC staff indicates that they do not have a projected timeline for adoption.

PROJECTS FUNDED: The pilot program was a traditional telecommunications program and did not extend to broadband. The Rural Healthcare Program Provides for ATM, Centrex, DSL, e-mail, Ethernet, fiber, fractional T1, frame relay, internet access charges, ISDN, mileage-related charges, monthly internet access charges, MPLS, NRS, OC-1 or OC-3, redundant circuit, satellite service, telephone service, T1, T3 or DS3. The program would provide support for the construction of state or regional broadband health care networks that can, for example, connect rural and urban health-care providers; facilitate the transmission of real-time video, pictures, and graphics; bridge the silos that presently isolate relevant patient data; and make communications resources more robust and resilient. Broadband infrastructure projects could include either new facilities or upgrades to existing facilities. In addition, funding could be used to support up to 85 percent of the cost of connecting health-care networks to Internet2 or National LambdaRail (NLR), both of which are non-profit, nationwide backbone providers.

RESTRICTIONS: Providers receiving resources from the current Telecommunications Program (to subsidize rates paid by rural health care providers for telecommunications services to eliminate the rural/urban price difference for such services within each state) would not be eligible to receive support under this program for the same service. Health care providers that did not receive funding under the current Rural Health Care pilot program could apply, assuming that they met the general eligibility criteria for the program. Funding is limited to rural areas.

OTHER REQUIREMENTS: There were apparently complaints about FCC's failure to distribute funds from the Pilot Program quickly enough. The hope is that this permanent substitute will be more efficient.

KEY LINKS:

- General background: <http://www.fcc.gov/encyclopedia/rural-health-care-pilot-program#faqNPRM>

AGENCY CONTACT:

- Chin Yoo (chin.yoo@fcc.gov)
- Linda Oliver (linda.oliver@fcc.gov)
- Ernesto Beckford (202-418-1523)

U.S. Treasury– New Markets Tax Credit

The New Markets Tax Credit may provide a source of revenue for broadband investments; however, to qualify, a county must identify a Community Development Entity with a primary mission of benefiting low-income households. Moreover, projects must be aimed at low-income communities (defined below). Even if a county can identify a qualifying CDE and a low-income community, the credits are very competitive and only offset 39 percent of project investment over seven years. Notably, while broadband is consistent with the program mission, no broadband projects appear to have received funding in 2010. The government has expressed an interest in shifting the focus away from real estate, however, which may make broadband projects more desirable going forward.

ENTITIES FUNDED: Permits individual and corporate taxpayers to receive a credit against federal income taxes for making Qualified Equity Investments (QEI) in Community Development Entities (CDEs). Allocatees are nonprofits, government entities, and others who provide subsidized financing, whose primary mission is to benefit low-income households. Thus, the state could be an allocatee and pass on the value of the credit to broadband developers. Awards are given to CDEs, who serves as “an intermediary vehicle for the provision of loans, investments, or financial counseling in Low-Income Communities.” Efforts are made to “ensure that a proportional amount of investments would be made in rural communities,” with 19 percent of 2010 awards invested in rural markets. That same year, 48.5 percent of awards were given to non-profits, 28.3 percent were given to certified Community Development Financial Institutions, and 16.2 percent were given to government-controlled entities (total of 59.6% to these categories). Other awards were given to real-estate development companies and financial institutions. In 2010, 42 percent of awards went to national service areas, whereas only 21 percent went to local markets.

NATURE OF AWARD: The program provides a tax credit to qualifying CDEs (e.g., those offering preferential rates and terms to low-income communities).

FY 2011 RESOURCES: Since the program’s inception (in 2000), there have been 594 awards totaling \$29.5 billion in tax credit allocation authority. \$3.5 billion was available in 2011, with authorization (through Section 733 of the Tax Relief, Unemployment Insurance Reauthorization and Job Creation Act of 2010) provided through 2016 (though allocations vary annually).

TYPICAL GRANT AWARD: The NMTC offsets 39% of an investment over a seven-year credit period. Under IRC §45D(a)(2), the applicable percentage is five percent for the first three credit allowance dates and six percent for the last four credit allowance dates. Thus, if a CDE receives a \$2 million NMTC allocation, the entity can claim a NMTC equal to 39 percent of \$2 million (or \$780,000). In essence, an investor in the NMTC program gets 39 cents in tax credits during the seven-year credit period for every dollar invested and designated as a QEI. Through 2010, there have been 8 NMTC allocation rounds. The average (and median) award is \$35 million (with awards ranging from \$10 to 77 million). In 2010, 99 CDEs out of a pool of 250 applicants were awarded. They received \$3.5 billion in allocations (thus \$1.36-billion in tax credits – \$3.5b*.39). This represents about 13 percent of applicants, as applications representing \$26.6-

billion were submitted. Thus, the process is fairly competitive (with requests up by 14 percent from 2009-2010). Allocations have ranged from \$2 to 5-billion since the program's inception.

COST-SHARE REQUIREMENT: There is not technically a cost-share, though the tax credit merely offsets expenses (so recipients are still responsible for 61 percent of project costs).

APPLICABLE DEADLINES: The funding window for new applicants is initiated with a Notice of Allocation Authority in the Federal Register (published last in May 31, 2011) and collected for several months (in 2011, applications were accepted until July 27). The credit then applies for a 7-year cycle, which begins on the date the Qualifying Equity Investment is initially made. Notably, the Department of the Treasury's Community Development Financial Institutions Fund (CDFI) is soliciting comments on the NMTC program (78 Fed. Reg. 68841 (Nov. 7, 2011) with a comment deadline of 2/6/12, available online at: <http://www.federalregister.gov/articles/2011/11/07/2011-28687/new-markets-tax-credit-program>). The Notice solicits comment on ways to increase program effectiveness (and to "promote greater investment in non-real estate businesses"). The Notice raises specific questions about census tract eligibility, treatment of certain businesses, community accountability, transaction costs, evaluation of financial products, and use of other subsidized financing in conjunction with the NMTC; however, it may provide a venue to flag the need to benefit broadband, given Treasury's shifting focus from real estate.

PROGRAM MISSION: The NMTC provides tax incentives to induce private sector, market-driven investments in businesses and real-estate developments in economically distressed communities.

PROJECTS FUNDED: Examples of expected projects include financing small businesses, improving community facilities such as daycare centers, and increasing home-ownership opportunities. Note that, no awards were given to broadband projects in 2010 (as reflected in this collection of 2010 recipient profiles: <http://www.cdfifund.gov/docs/2010/nmtc/2010NMTCProgramAllocateeProfiles.pdf>).

RESTRICTIONS: The NMTC is only given to projects that benefit "a low-income community" (LIC), defined as any population census tract where the poverty rate for such tract is at least 20 percent or in the case of a tract not located within a metropolitan area, median family income for such tract does not exceed 80 percent of statewide median family income, or in the case of a tract located within a metropolitan area, the median family income for such tract does not exceed 80 percent of the greater of statewide median family income or the metropolitan area median family income. At least 85 percent of the investment must be made in a low-income community.

KEY LINKS:

- Application: <http://www.cdfifund.gov/docs/certification/CDE/CDEcertificationApplication.pdf>
- Background information (from IRS): <http://www.irs.gov/pub/irs-utl/atgnmtc.pdf>
- Recipient profiles: <http://www.cdfifund.gov/docs/2010/nmtc/2010NMTCProgramAllocateeProfiles.pdf>

Appendix B: Broadband Definitions

Broadband refers to a high-speed, always-on connection to the Internet, providing two-way data transmission.

Types of Transmission Technology

Wireline Services

Cable Modem service enables high-speed Internet access using the same cable television infrastructure, including coaxial cables, that delivers cable TV programming. Users can access the Internet without disrupting cable TV service.

- **Cable Modem – DOCSIS 3.0** refers to Data over Cable Service Interface Specifications (DOCSIS). It is the current technological standard for cable modems and offers faster broadband service than older standards.
- **Cable Modem – Other** refers to cable modems that use versions of Data over Cable Service Interface Specifications (DOCSIS) other than the current standard, DOCSIS 3.0.

Digital Subscriber Line (DSL) is a technology that provides Internet access by transmitting data over traditional copper telephone lines to homes and businesses. Users are able to connect to the high-speed Internet via a modem without disrupting their telephone service.

- **Asymmetric xDSL** used primarily by residential consumers, typically provides faster download speed for receiving data than upstream speed for sending data. This means that it may be faster to download webpages, data, or media than it would be to upload this information.
- **Symmetric xDSL** used primarily by businesses, provides equal speed for sending and receiving data. This technology allows moving large data files among various users and between multiple sources.

Electric Power Line, referred to as "Broadband over Power Lines," provides broadband by using the power lines connected to a consumer's residence. Consumers must use special modems provided by the power company in order to access broadband Internet services.

Optical Carrier–Fiber to the End User refers to a fiber-optic-based broadband network. Fiber has the capacity to transmit data at speeds surpassing any other broadband technology.

Other Copper Wireline is a technology other than DSL that uses phone lines to transmit data. Examples include T-1 and ISDN lines.

Wireless Services

Satellite is another form of wireless broadband technology provided through the satellites. This technology is useful for serving remote or sparsely populated areas. Obtaining satellite broadband may be more costly and involved than obtaining DSL or cable modem.

Terrestrial Fixed Wireless technology enables wireless broadband service to a specific geographic location using a spectrum that is shared among Internet service providers. This wireless service includes

WiFi (WLAN – Wireless Local Area Network) and other, similar technologies, e.g., WiMAX and other proprietary wireless systems.

Terrestrial Mobile Wireless technology enables wireless broadband services in a specific geographic location using a spectrum that is dedicated to an Internet service provider and targeted for mobile use by consumers within the area. This wireless service is generally offered by cellular phone providers, and includes technologies such as LTE, mobile WiMAX, CDMA2000 (EVDO), and UMTS (HSPA).

Download and Upload Speeds

Broadband speed refers to the amount of data that a user can download or upload per second. The only difference between downloading and uploading data is the direction of data transfer between the user and the server. Speeds are generally measured in kilobits per second (Kbps), megabits per second (Mbps), or gigabits per second (Gbps).

- **Download Speed** is the speed at which your Internet connection downloads data to your computer from the server.
- **Upload Speed** is the speed at which your Internet connection uploads data from your computer to the server.

The speeds advertised by Internet Service Providers (ISPs) provide information about the configuration settings of network equipment such as cable, DSL, or Routers. These speeds give an indication of the maximum or peak data rates that a customer may experience. Advertised speeds might differ from the actual speeds received by the user, depending on a number of factors that may include your computer, network congestion due to other users, the location of your home or business, etc. Better speeds can be obtained when network congestion is low, in the non-peak hours of Internet traffic.

Underserved and Unserved Areas

Underserved area means a Last Mile or Middle Mile service area that meets at least one of the following factors.

- (i) No more than 50 percent of the households in the Last Mile or Middle Mile service area have access to facilities-based, terrestrial broadband service at greater than the minimum broadband transmission speed (set forth in the definition of broadband above).
- (ii) No fixed or mobile terrestrial broadband service provider advertises to residential end users broadband transmission speeds of at least three megabits per second (Mbps) downstream in the Last Mile or Middle Mile service area.
- (iii) The rate of terrestrial broadband subscribership for the Last Mile or Middle Mile service area is 40 percent of households or less.

Unserved area means a Last Mile or Middle Mile service area where at least 90 percent of the households lack access to facilities-based, terrestrial broadband service, either fixed or mobile, at the minimum broadband transmission speed (set forth in the definition of broadband, above). A household has access to broadband service if the household readily can subscribe to that service upon request.

Satellite broadband service availability and subscribership rates are not considered for the purpose of determining whether an area is underserved or unserved.

Middle Mile and Last Mile

Last Mile refers to the final leg of the telecommunications networks delivering communications connectivity to retail customers—the part that actually reaches the customer; the infrastructure at the neighborhood level.

Middle Mile is the segment of a telecommunications network that links a network operator's core network to the local network plant that provides access to the local loop, or in the case of cable television operators, the local cable modem termination system. Middle mile facilities provide connections between the network backbone and last-mile connection.

Appendix C: Abbreviations and Acronyms

3G	third generation of mobile telecommunications technology
3GPP	3rd generation Partnership Project
4G	fourth generation of mobile telecommunications technology
ARRA	American Recovery and Reinvestment Act
b	bit
B	byte
BB	broadband
BIP	Broadband Initiatives Program
BTOP	Broadband Technology Opportunities Program
CAI	Community Anchor Institution
CASA	Community Anchor Site Assessment
DoIT	[NM] Department of Information Technology
DOCSIS 3.0	Data over Cable System Interface Specification version 3.0
DSL	Digital Subscriber Line
EVDO	Enhanced Voice-Data Optimized or Enhanced Voice-Data Only
FCC	Federal Communications Commission
ft	foot
FTP	File Transfer Protocol
FTTP	fiber-to-the-premises
G	giga-; 10^9
GB	gigabyte
Gbps	gigabits per second
GHz	gigahertz
GIS	Geographic Information Systems
GPON	Gigabit Passive Optical Network
HFC	hybrid fiber-coaxial
HSPA+	Evolved High-Speed Packet Access
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
Hz	Hertz
ID	[unique] identifier
IP	Internet Protocol
ISP	Internet Service Provider
IT	information technology
ITU	International Telecommunications Union
K-12	kindergarten through twelfth grade
k, K	kilo-; 10^3 ['k' is the correct symbol; however, 'K' is commonly used in technology texts]
KB	kilobyte

kpbs	kilobits per second
LTE	Long-Term Evolution; marketed as 4G LTE
M	mega-; 10^6
MB	megabyte
Mbps	megabits per second
MHz	megahertz
MLAB	Measurement Lab
NBM	[NTIA] National Broadband Map
NDA	Non-Disclosure Agreement
NGO	Non-governmental Organization
NM	New Mexico, State of New Mexico
NMBB	New Mexico Broadband
NMBBP	New Mexico Broadband Program
NM DoIT	New Mexico Department of Information Technology
NPRM	Notice of Proposed Rulemaking
NTIA	National Telecommunications and Information Administration
PDF, pdf	[Adobe] Portable Document Format and file extension
PON	Passive Optical Network
RUS	[U.S. Department of Agriculture] Rural Utilities Service
SBI	State Broadband Initiative
SFTP	Secure File Transfer Protocol
SLA	service-level agreement
sq mi	square mile(s)
TVWS	TV white spaces [wireless technology]
TXT, txt	text file extension
UMTS	Universal Mobile Telecommunications System
U.S., US	United States [of America]
USAC	Universal Service Administrative Company
VoIP	Voice over Internet Protocol
VPN	virtual private network
Web	World Wide Web
Wi-Fi	wireless technology; wireless local area network; originally, a play on Hi-Fi (high fidelity)
WiMAX	Worldwide Interoperability for Microwave Access