Broadband Internet Service in Rural and Urban Pennsylvania:

A Common Wealth or Digital Divide?

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Broadband Internet Service in Rural and Urban Pennsylvania: A Common Wealth or Digital Divide?

A report by
Dr. Amy K. Glasmeier and Lawrence E. Wood
EMS Environment Institute
Pennsylvania State University

Project members
Lee Carpenter and Andrew N. Kleit,
EMS Environment Institute, Pennsylvania State University
and Sharon Strover, University of Texas

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For more information, contact the Center for Rural Pennsylvania, 200 North Third St., Suite 600, Harrisburg, PA 17101, telephone (717) 787-9555, fax (717) 772-3587, email: info@ruralpa.org.

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CHAPTER I . INTRODUCTION

Since the early 1990s, the Internet has grown in use and importance as an information, entertainment, and business medium. While only a decade ago many people had not even heard of the Internet, today they go online and do so at broadband speeds. A broadband connection allows Internet users to employ advanced applications that are otherwise unavailable or ineffective through a dial-up connection. As broadband increases in importance, it is fundamental to assess how its availability may vary, specifically in relation to issues such as income, race, and geographic location. For rural areas in particular, the availability of broadband can be especially important to improving education, healthcare, and business opportunities.

Rural broadband availability is particularly significant in Pennsylvania, where close to a quarter of the state's population live in rural areas.[1] The focus of this Center for Rural Pennsylvania sponsored research project was to assess the availability of broadband services in rural areas of the state. The report examines the extent to which telephone Digital Subscriber Line (DSL) and broadband cable modem services are deployed throughout rural Pennsylvania and compares this deployment with that in the state's more urban areas. DSL and cable modem services are the most widely used and economically viable broadband options for many residential and small business users. As this report demonstrates, many of Pennsylvania's rural residents had limited or no access to these services at the time the data was compiled.

THE GROWTH AND IMPORTANCE OF THE INTERNET AND BROADBAND

For most Americans and many people around the world, computer use has become a part of everyday life. Approximately three-quarters of the United States' population currently uses the Internet on a somewhat frequent basis, and Internet use is growing at the rate of 2 million new users each month.[2] While email remains the primary application for most residential users of the Internet, people are increasingly going online for product and service information, to make purchases, and for health and medical information. Furthermore, with the Internet's ability to provide up-to-the-minute information, the American population is relying on the Internet more and more as a source for news and entertainment, at the expense of television and other information media. In fact, studies indicate dramatic increases in Internet use during major national and worldwide events.[3] As an information and entertainment medium, the Internet is in many ways unmatched, and while many residential users still use a dial-up service to connect to the Internet, many applications are unavailable or too slow without broadband speeds. Like the use of the Internet more generally, the use of broadband services is growing significantly.

As the Internet has increased in importance for the residential user, it has become essential for many institutional and business users, and business demand for broadband is increasing. Business users often depend on the Internet for communication, accessing and transferring information and data, advertising, sales, and purchases. Businesses that wish to transfer large amounts of data effectively are especially dependent upon broadband rather than dial-up services. Having a particularly reliable broadband connection is essential for businesses that could lose thousands of dollars or more in sales if their Internet service is down for even a few hours. Last year, E-commerce sales in the United States were estimated at $45 billion, and E-commerce has been steadily increasing as a percent of total sales for American businesses over the past few years.[4]

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[1] Rural residents as reported in the 2000 Census. In this analysis, broadband availability is assessed for residents living in three types of geographic areas: metropolitan, non-metropolitan urban, and non-metropolitan rural. Appendix B more fully explains these designations.

[2] According to Greenspan (2002) in September 2002, 72 percent of the U.S. population had used the Internet at least once within the previous 30 days. Growth rate available at http://cyberatlas.internet.com.

[3] U.S. Department of Commerce (2002), Cyber Atlas Staff (2003), and CyberAtlas Staff and Mark Berniker (2003).

[4] Cox (2003).

WHAT IS "BROADBAND"?

The Federal Telecommunication Standards Committee notes that the term "has many meanings depending upon application," while the International Telecommunication Union defines broadband as "the capacity to transmit large quantities of electronic signals (including data, video, text, and voice) rapidly."[1] Others assign specific speeds to the meaning of broadband with some specifying broadband speeds as 2Mbps or greater, which is somewhat high by most standards.[2] Still others have assigned exceptionally slow speeds, at least in the modern era of telecommunications, to their definition of broadband, defining downstream access of 256 Kbps and upstream access of 64 Kbps as broadband service.[3] In any event, and typically regardless of speeds offered, cable modem, DSL, wireless, and satellite Internet technologies have become synonymous with the term broadband in technical reports as well as in the language used by policymakers, researchers, the media, telecommunications providers, and consumers.[4] DSL, cable modem, satellite, and wireless technologies, even if not meeting the speeds of some technical definitions of broadband, are the broadband systems of service being widely deployed and used in Pennsylvania and throughout America and much of the world.

Speed of broadband service often depends on that being offered by a provider, which in turn can depend on the type of infrastructure that provider uses to offer the service, or even the provider's perception of what speeds will be demanded by potential users. Cable modem and DSL providers in Pennsylvania, in metropolitan and in more rural areas, often offer different packages with various speeds of service ranging from 128 Kbps to 2 Mbps and higher. Slower speeds have lower costs while higher speeds, including highly advanced services, have higher costs. Furthermore, in places where providers do not offer packages with speeds required by some business users, they can often provide exceptionally fast broadband connections on a case-by-case basis as demand warrants.

In short, the various technologies discussed in this analysis typically allow users to connect to the Internet at 5–10 times the speed, if not a few hundred times the speed, of a dial-up connection. As the providers of such service are not always quick to point out, however, speeds and reliability can often vary. Furthermore, many of the typical, lowest-cost broadband packages available, not only in Pennsylvania but throughout the United States, offer speeds not much faster than dial-up speeds and, thus, do not allow for the use of many interactive applications that would otherwise be available through the Internet, including real-time applications such as videoconferencing. For that reason, it is potentially inaccurate or at least misleading to refer to DSL or cable modem technologies across the board as being broadband technologies. In many respects, the term broadband could be under far more scrutiny by policymakers, the media, researchers, and even consumers, and what has become the common understanding of the term may be playing into the hands of some providers, who are often only offering speeds of service simply somewhat faster than a dial-up connection at a price that many consumers can hardly afford to pay.

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[1] See http://glossary.its.bldrdoc.gov and http://www.itu.int/home/index.html.

[2] Dodd (2002); Goleniewski (2002).

[3] Report cited in FCC (2002) titled "The Development of Broadband Access in OECD Countries" published by the Office of Economic Cooperation and Development, Directorate for Science, Technology and Industry, Committee for Information, Computer and Communications Policy, Working Party on Telecommunications and Information Service Policies.

[4] See other reports cited in this research. For technical reports, see FCC (2002); Governor's Office of Appalachia (2002); Maryland Technology Development Corporation (2002); Texas House of Representatives Committee on State Affairs (2002). For media reference see Young and Grant (2003) and Hansell (2003). Note also the prevalence of advertisements offering DSL, cable modem, and satellite as broadband services.

Small businesses rely heavily on the two main broadband services discussed in this report.[5] Though businesses have used broadband Internet connections for over a decade, demand has more than doubled over the past few years, and this growth is reflective of increased demand for broadband by small businesses.[6] For schools, medical facilities, governments, libraries, and other institutions, broadband services are also of clear importance. For example, broadband can facilitate distance-learning opportunities for schools, is essential to the accurate delivery of medical images, and improves Internet access at local libraries. But while the use of broadband services has increased dramatically over the past few years, a "digital divide" remains between urban and rural America in terms of the deployment of these services.

THE DIGITAL DIVIDE AND RURAL AMERICA

The term digital divide acquired widespread use in the late 1990s with reports of a growing disparity throughout much of American society in terms of access to computers and the Internet.[7] The division between technological "haves" and "have-nots" is related to urban-rural location, income, race, education, and other demographic factors. While recent reports indicate that these gaps are narrowing, some disparities remain.[8] And while use is one aspect of the digital divide equation, another key issue is availability, particularly of advanced telecommunications services such as broadband. Over the past year reports in states throughout the country have focused on the availability of broadband services.[9] These reports have typically indicated that broadband is widely available in urban areas but less so in rural areas though the disparity in broadband service availability between urban and rural America seems to be narrowing.[10] In many respects, this narrowing is due to such services already having been deployed in metropolitan markets for a number of years and providers only recently having begun to offer broadband to rural areas.

Furthermore, many rural areas that have broadband service may have only one provider, compared to typically quite a few providers in large urban areas. Since competition for broadband is especially important considering that quality, costs, and speeds of service can vary dramatically, having little or no choice in broadband providers can cause users to settle for inferior service.[11] For example, a provider may offer only a relatively slow speed or may provide only residential but not business-class broadband packages. Also, some providers set limits on monthly data transfer amounts, while others have especially poor customer support.[12] Cable providers often do not have their infrastructures deployed to all of the homes and businesses in a given community. And estimates indicate that in some areas where telephone providers are offering DSL services, as much as 20 percent of homes cannot access such services due to various technical problems.[13] For business users especially, using a second provider as a backup can be essential.

Rural Americans are using the Internet at the same rate as their urban counterparts.[14] And since broadband access can offer a host of opportunities to rural individuals, businesses, and institutions, no or limited broadband availability can leave many individuals and even entire communities behind. The overall market for broadband services among American businesses is especially strong, and rural businesses and, hence, rural economies may have the most to gain from broadband availability. Moreover, the presence of advanced telecommunications infrastructures has become a decisive factor in business location deci-

[5] Small businesses may not be able to afford higher cost broadband services such as T-1 lines. The survey of businesses in rural Pennsylvania showed that a substantial number of small businesses were using DSL and cable modem broadband services.
[6] Estimates from FCC (2002) indicated an approximate doubling of business broadband use between 1999 and 2001.
[7] National Telecommunications and Information Administration (NTIA), third *Falling Through the Net*, July 1999.
[8] FCC (2002), U.S. Department of Commerce (2002).
[9] FCC (2002); Governor's Office of Appalachia (2002); Maryland Technology Development Corporation (2002); Texas House of Representatives Committee on State Affairs (2002).
[10] FCC (2002).
[11] See Appendix A for a sample of the variation in types and costs of broadband services in Pennsylvania.
[12] See http://www.dslreports.com.
[13] Pinkham Group (2001); Young and Grant (2003).
[14] U.S. Department of Commerce (2002).

sions over the past few years and is therefore essential to attracting new businesses and industries to rural areas.[15] Broadband services also have significant potential for spurring entrepreneurial activity and supporting telecommuters working in rural areas.[16]

Though some businesses require a dedicated and exceptionally fast telecommunications connection such as a T-1 line, these services can cost $1,000 or more per month in rural areas. In metropolitan areas such services often range from $400–$500 per month. For rural business users who cannot afford the costs of a T-1 line, DSL or cable modem service can be the best and most affordable broadband option by providing sufficient speeds at little cost. In short, DSL and cable modem services are an excellent medium between a T-1 line and a dial-up Internet connection. Even low-end DSL and cable modem services can offer more than sufficient speeds to business users, often for only $40–$50 per month. Some business-class DSL and cable modem services actually exceed the speeds of a T-1 line, yet cost in the range of only $100–$200 per month. For many rural schools, medical facilities, governments, libraries, and other institutions, DSL or cable modem services may be the most viable, cost-effective technologies as well.

Social and economic problems confronting many rural communities can include high rates of out-migration, inadequate healthcare, limited educational opportunities, and economies that may be overly dependent on one or two industries. While broadband services are certainly not the entire solution to these problems, broadband availability is interrelated with these issues. And while many rural communities are already at a social and economic disadvantage when compared to urban and metropolitan areas, insufficient telecommunications technologies can place them at an even greater disadvantage as a lack of connectivity may intensify existing social and economic problems. Business, healthcare, and educational opportunities all stand to be compromised in areas without adequate telecommunications services. In sum, broadband offers an important means for bridging the urban-rural digital divide both now and in the foreseeable future. To achieve this goal will require a regulatory environment that sets as its goal universal access to telecommunications services and the active role of government in the provision of adequate broadband services.

The remainder of this report is composed of four sections focusing in turn on explaining the Internet, supply and demand of broadband services, and policy recommendations for more universal availability. This next chapter is a description of the overall architecture of the Internet from the Internet backbone down to the last mile. The focus is on last mile technologies with particular emphasis on the providers of these services in Pennsylvania. Chapter III assesses the availability of these services in the state's rural versus other areas. It also covers the extent to which there is competition for these services in such areas and characteristics of cable and telephone providers that are and are not providing broadband services. Chapter IV is a demand analysis of broadband services in the nation and in Pennsylvania. This section further assesses broadband use by businesses in rural parts of the state. Policy recommendations are found in Chapter V.

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[15] Based on conversations with regional planners, including planners in Pennsylvania. Documentation of this relationship is often anecdotal. See Korsching, Hipple, and Abbott 2000; Parker 2001; and Lentz and Oden 2001.

[16] Conversations with telecommunications providers in the state indicated that the growing trend in telecommuting is more evident in suburban metro areas of the state, but rural providers were also seeing growth in their service areas. Detailed research on relationships between telecommunications infrastructures and telecommuting is limited. Therefore, the understanding of such relationships must rely largely on anecdotal evidence.

CHAPTER II. THE INTERNET: FROM THE BACKBONE TO THE LAST MILE

Though diagrams often depict the Internet as an amorphous cloud, in actuality, it is highly structured and consists of the Internet backbone, middle mile infrastructures, and last mile facilities. For information to travel the Internet from user to user, it goes from one user over what is commonly referred to as the last mile, through middle mile facilities, and then to the backbone where the process is then reversed––middle mile to last mile—before the information reaches its final destination. Thus, the backbone is the long haul network while middle mile facilities connect a local Internet service provider (ISP), such as a telephone or cable company, to the backbone, and the last mile is what connects the user to the local provider.

The Internet is probably best understood as a network of networks that function and interact interchangeably, effectively working as a single, seamless system. While backbone, middle mile, and last mile facilities all interconnect, there are various interconnections within each of these levels as well. For example, the backbone consists of a variety of relatively small, medium, and large networks operated by a number of different providers. These networks interconnect throughout the country and world, typically in metropolitan areas. There are similar interconnections within middle mile and last mile facilities as well. Thus, though any given backbone, middle mile, or last mile network functions autonomously, it depends upon a variety of other autonomously operated networks at various geographic scales during the process of sending and receiving information.

This report focuses on last mile providers and services, which are the crucial factor in determining whether or not rural areas have broadband connections to the Internet. Moreover, this analysis particularly emphasizes cable and telephone last mile providers, as their services account for more than 95 percent of all broadband services in the United States at this time.[17]

THE INTERNET BACKBONE

The history of the Internet can be traced to the late 1960s, when the Department of Defense's Advanced Research Projects Agency began developing a national backbone network that, over time and after considerable modifications, has become known as the Internet. The Department of Defense's initial goals for developing this network related to Cold War security concerns and to allowing members of government and university researchers to share information electronically. In 1987, oversight of this original network was shifted to the National Science Foundation, which contracted a private company to operate and manage the infrastructure. Along with this initial government network, and especially beginning in the 1980s, grew an increasing number of privately owned backbone networks, as companies such as MCI and AT&T began offering advanced, dedicated telecommunications connections to corporate clients who were interested in having such connections between corporate offices in various parts of the country. By the mid-1990s, a number of backbone networks were in place primarily interconnecting in the nation's largest metropolitan areas.

THE INTERNET IS PROBABLY BEST UNDERSTOOD AS A NETWORK OF NETWORKS THAT FUNCTION AND INTERACT INTERCHANGEABLY, EFFECTIVELY WORKING AS A SINGLE, SEAMLESS SYSTEM.

Over the past few years the backbone network has extended to include second-tier metropolitan markets. Today, more than 40 companies operate individual networks that are part of what is broadly understood to be the Internet backbone.[18] Numerous backbone providers, including Comcast, Sprint, AT&T, Regional Bell Operating Companies (RBOCs) such as Verizon, and others, have infra-

[17] Estimates of this percentage vary. See FCC (2002); Greenspan (2003), and http://www.yankeegroup.com.
[18] This figure is an estimate. See http://www.boardwatch.com.

structures throughout various parts of the country and world. These individual companies each have long haul and regional backbone networks that, individually and taken together, have the ability to transfer immense amounts of information over exceptionally long distances. These backbone networks, even when considered in terms of a single provider, are vast. AT&T, for example, has a core backbone network that consists of more than 73,000 miles of fiber optic cable with extensive amounts of fiber further connecting to this core.[19] Backbone networks have become so vast, in fact, that current bandwidth availability at the backbone level actually exceeds current needs, and costs for using these long haul networks have declined enormously over the past few years.[20] On the other hand, bottlenecks connecting to these backbone infrastructures can occur in middle mile facilities.

THE MIDDLE MILE

For a local Internet provider, connecting last mile facilities to the Internet backbone typically requires the use of middle mile facilities. These facilities are often the fiber networks that connect the larger telephone companies' central and tandem offices and larger cable company regional networks. Thus, large cable and telephone providers often transport Internet data to the backbone entirely over their own middle mile facilities. Conversely, smaller providers typically must lease middle mile connections from these larger carriers. Almost every small Internet provider in the state, whether cable, telephone, wireless, or even dial-up, relies on a connection from middle mile providers (such as Sprint, Verizon, Cable and Wireless, or AT&T) or a mix of providers to connect their local facilities to the Internet backbone. In some instances, even the large cable and telephone companies lease middle mile facilities from their counterparts.

Costs for middle mile services are almost invariably higher in rural than in urban areas. Affordable middle mile connections are particularly important to small providers in rural areas, but these connections can be high cost if their last mile facilities are far from a point of connection to the Internet backbone.[21] Small providers usually lease a T-1 line or a number of T-1 lines to connect their last mile facilities to the Internet backbone. Because the costs for T-1 lines are distance sensitive, they can be significantly higher in rural than in metropolitan areas. Though middle mile costs often do not impact the prices paid by the eventual end-users of the Internet in rural areas, they do affect the costs of providing these services for the local, last mile providers themselves and can contribute to a small provider's unwillingness to provide broadband in the first place.

The expense of leasing multiple T-1 lines can result in local providers limiting the number of middle mile lines, which can affect service quality. For example, insufficient capacity of middle mile connections may limit the speeds at which local users can connect to the Internet. Restricting middle mile capacity may also lead the provider to limit broadband speeds offered to users or cause the provider to place monthly limits on data transfers for individual users to keep the overall use of service in line with the provider's middle mile capacities. But leasing facilities from two or more providers can be essential to the reliability of broadband service, as this "redundant" connection is necessary when one middle mile service temporarily goes down.

In short, however, middle mile facilities and, more especially, the Internet backbone are not the key factors in determining whether broadband services are available to rural users. The most important factor relates to a local provider's willingness to offer these services and the capacity and quality of any given last mile infrastructure over which these services are provided.

LAST MILE PROVIDERS IN PENNSYLVANIA

Last mile technologies include DSL service, cable modem service, and more infrequently wireless or satellite service. This report focuses on the cable industry and telephone providers of DSL because cable modem service is the most widely used broadband Internet service in the United Stated today, and DSL accounts for the majority of the remaining broadband services.[22]

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[19] http://www.att.com.
[20] ISP-Planet Staff (2002).
[21] Smetannikov (2003).
[22] U.S. Department of Commerce (2002).

THE CABLE INDUSTRY

Cable television service began in Pennsylvania in the 1950s largely in rural areas where adequate television reception was not available via conventional rooftop antennas. Cable providers in Pennsylvania grew tremendously throughout the 1960s and 1970s, with small, "mom and pop" companies serving various communities. Though approximately 50–60 of these smaller operations still remain, particularly in some of the more rural areas, most have been bought-out by larger companies. Currently a few major and often national cable providers, such as Comcast and Adelphia, account for the majority of cable TV services in the state. Thus, while the cable industry in Pennsylvania, from the privately held mom and pops to community-owned operations to large providers, is probably as diversified as the cable industry anywhere else in the country, the majority of cable TV service in Pennsylvania comes from a relatively few providers. In fact, while there are as many as 100 cable providers in the state today, only 15 or so account for more than 90 percent of the state's cable television services. Many of the smaller, rural cable companies provide service to only 1,000 to 2,000 households or fewer.

On a nationwide basis, cable companies are the largest providers of broadband Internet services in the United States today. The cable industry's relative dominance in market share of broadband is reflective of its earlier start than telephone providers and of having the infrastructure in place to provide broadband to a greater number of households than the telephone industry. Furthermore, in the mid-1990s, competition related to the advent of satellite television and the perceived threat of the telephone industry positioning itself to enter the television market spurred a number of cable companies to aggressively upgrade their networks. Though the aim of these upgrades was largely to increase the quality and range of television services, these upgrades have also resulted in many cable companies' ability to provide broadband Internet services. With the growth in demand for such services over the past few years, these upgrades have been in many ways a lucrative windfall.

Though competition from outside the industry has done much to spur aggressive upgrades by cable providers, competition within the cable industry itself is largely nonexistent. Thus, most communities, especially those in rural areas, have only one cable provider from which to choose. If a cable company is not providing cable modem service in any given area, prospective broadband users must hope that another telecommunications provider, such as a telephone company, is offering broadband services. The reason for the lack of competition in the cable industry is two-fold. First, if a cable company decides to compete with an incumbent cable provider in any given city or community, it must carry out an "overbuild." This means that the company must deploy, for the most part, its own infrastructure to provide cable TV service. Overbuilds are obviously expensive, which is likely the biggest reason that cable companies do not move in and compete with existing providers, especially considering that the local market for cable service has typically been saturated. Another reason is the "unwritten rule" in the cable television industry that cable companies will not compete with each other for service.[23] For these two reasons, cable overbuilding has occurred in only a few areas of the United States. The rare cases where it has happened have largely been in major cities, whereas in rural areas of the nation and of Pennsylvania, overbuilding is largely nonexistent. Thus, most of the cable franchises in the country are geographically separated with operating lines often being municipal boundaries.

Cable television companies were initially concerned with providing information, particularly television service, in one direction: from the provider to the customer, so that is the way they originally built-out their systems. However, with the advent of video on demand, other advanced television services, Internet telephony, and broadband Internet, cable providers have increasingly sought to make their systems capable of providing not only a downstream feed to the user but an upstream feed from the user to the provider as well. More than simply having two-way capabilities, however, increasing the MHz capacity of a cable system and deploying extensive

[23] Based on conversations with various cable providers in the state and with contractors involved with the cable industry.

amounts of fiber optics throughout a cable network (the two typically go hand-in-hand) can be essential if a cable company wishes to effectively deploy many of the advanced television and broadband services currently on the market. A particular benefit of increasing and improving system capacity is that cable providers can then offer a much wider range of services, from an increased number of channels to broadband Internet to perhaps even Internet telephony. Due to the increased demand for broadband over the past few years, some providers are looking to upgrade their systems primarily so that they can offer broadband Internet services.

With the various services that cable companies can provide, upgrading cable infrastructures can range from the relatively straightforward to the more elaborate, and is largely dependent upon the range and quality of services a company wishes to offer. Generally speaking, cable providers must address a few infrastructure issues if they are to provide broadband Internet service. Deploying two-way, return-path amplifiers throughout a local cable system infrastructure is one key, and many older systems have only one-way amplifiers in place.[24] It is also necessary to have a Cable Modem Termination System (CMTS) in place at the headend, which is a cable company's equivalent of a telephone company's central office.[25] Though many larger cable companies have their own middle mile and even backbone networks in place, other cable companies must connect to and, therefore consider the costs of, middle mile facilities out of the headend.

Though not essential for providing broadband service, many companies also deploy fiber optic cable when upgrading their cable systems. Many larger providers that already have considerable amounts of fiber optic cable within their infrastructures are in the process of further deploying such cable throughout their systems. Thus, while at one time all cable company infrastructures relied strictly on coaxial cable, cable systems are now largely a mix of coaxial cable and fiber optic lines, though the final connection between a cable company's infrastructure and the end-user is almost invariably coaxial cable. In general, increased amounts of fiber in a cable system increase the ability to provide more and better quality services. Furthermore, fiber can be essential to providing quality and high-capacity services over long distances, and makes economic sense for many providers as costs of deploying fiber have been decreasing over the past few years, making it comparable to the costs of deploying coaxial cable. This is especially economical if coaxial lines are old and need to be upgraded anyway. The most advanced cable architectures, often those found in metropolitan but not rural areas, have extensive fiber networks with relatively limited amounts of coaxial cable connecting users to these networks.

In the end, the provision of cable modem service often comes down to whether a cable system or a particular company has two-way amplifiers in place, though upgrades at the headend and middle mile connections to the backbone are necessary, too. But upgrading a system generally involves relying on a range of technologies, especially fiber optic networks, to increase system MHz capacities. For small providers, the costs of upgrading a system to allow for cable modem services can be as low as $50,000. For larger, metropolitan providers, however, especially those looking to provide services such as Internet telephony, the costs of infrastructure upgrades for a system can be in the tens of millions of dollars. Finally, large and small providers alike can have a range of advanced and less advanced infrastructures in place, not only serving different areas but even within the same relatively small service area. Thus, cable modem service may be available to those living in a small rural town but not to those living on the outskirts of the town though they have service from the "same" cable system.

THE TELEPHONE INDUSTRY- DSL

As is the case with cable companies, the telephone company landscape in Pennsylvania is especially

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[24] Amplifiers intensify the cable signal from the provider to the user, and return-path amplifiers allow for this process from the user to the provider. Cable signals need to be amplified more or less every few thousand feet to retain their integrity.

[25] A CMTS processes Internet information being sent to and from the user. Also, some providers are now finding ways around implementing a CMTS within their headends, as they are connecting to the CMTS of other Internet Service Providers elsewhere. This is seemingly a fairly new phenomenon.

diverse. At the same time, telephone service, especially local telephone service, is dominated by one major provider—Verizon. Verizon is considered an Incumbent Local Exchange Carrier (ILEC), meaning that prior to the Federal Telecommunications Act of 1996 it was the only provider of local, residential telephone service in areas where it offered such service. In contrast to ILECs, Competitive Local Exchange Carriers (CLECs) compete with ILECs for local service. Though there were some elements of competition within the telephone industry beginning in the early 1980s, especially for the provision of long distance service to businesses in metropolitan markets, the Telecommunications Act of 1996 was designed to inject even more competition into the industry, particularly among local and long-distance providers. While some competition has developed over the past few years, in many rural areas of the state such competition has been limited. This is especially the case in terms of DSL services - CLECs provide such services in some of Pennsylvania's metropolitan markets but provide virtually no DSL services in rural areas of the state. Thus, where DSL service is available in the state's rural areas, it is being provided by an ILEC.[26]

The Pennsylvania ILEC landscape is similar to that of states throughout much of the nation. In other words, one of the original Regional Bell Operating Companies provides the majority of local telephone service; a second tier of providers, many of whom operate in other states as well, serves a large portion of the state; and a relatively large number of independent providers that often have extensive coverage areas serves only a small number of customers due to the especially rural nature of their service areas.

DSL technologies were first developed in 1989. Although it was originally thought that the main application of DSL would be for video services, demand for DSL has largely grown in relation to broadband Internet access. Telephone companies, in general, began introducing DSL services to their customers in the late 1990s largely in reaction to the deployment of broadband services by cable companies that had begun a few years earlier.[27] Types of DSL services range in terms of speeds and of upstream and downstream capabilities. Examples include Asynchronous DSL (ADSL) and Synchronous DSL (SDSL). ADSL offers faster downstream than upstream speeds, while SDSL offers the same upstream as downstream speeds. SDSL services are particularly suited to advanced applications, such as videoconferencing, that require a high-capacity upstream path.

The main requirement for providing DSL is a Digital Subscriber Line Access Multiplexer (DSLAM), a piece of equipment typically housed in a telephone company's central office. DSL is a particularly cost-effective technology for providers and users in that, by segregating data or video traffic from voice traffic, it allows for voice, data, and video services to be run over the existing copper wire already deployed to homes and businesses. Thus, an advantage for the telephone companies is that, aside from the costs of the DSLAM, the company is for the most part leveraging existing infrastructure to provide DSL broadband Internet access.

However, there are limitations to providing DSL service with the primary problem being that DSL is a distance sensitive technology. Users beyond 18,000 feet (about 3 miles) from a central office DSLAM are typically unable to effectively receive DSL service due to distance-related copper wire signal degradation. Though telephone company central offices are scattered throughout much of the state, in rural areas these offices are often located in small towns. Thus, some remote rural residents and those living in small towns without a telephone company central office may be as far as 15 to 20 miles from central office facilities.[28] Moreover, local loops do not always run in a straight line path to the user, so even those living within the 18,000 foot threshold may have copper loops from the central office that are much

[26] FCC (2002) indicated that CLECs accounted for approximately 7 percent of DSL services in the United States. The metropolitan nature of CLEC broadband availability based on http://www.cedmagazine.com and on interviews with cable and telephone providers in the state, where it was found that no CLECs were competitively offering DSL services in non-metropolitan rural areas of Pennsylvania (though they may offer such services in a few rural areas of the state). There are CLECs providing DSL in metropolitan areas of Pennsylvania.

[27] Dodd (2002) and Young and Grant (2003).

[28] Based on calculations using a GIS, telephone central office and central office boundary data.

longer. Finally, DSL is also distance-sensitive in that customers farther from the central office—in the range of 12,000 to 18,000 feet—may be unable to obtain the same speeds of service as more proximate users, even when using and paying for the "same" service.

The quality of copper local loops can also compromise service, particularly if the copper wire is relatively old or the condition is otherwise poor. Another issue that can hinder the provision of DSL services is, ironically, technologies that have been deployed to improve the quality of voice transmission, particularly loading coils and bridge taps. In all, estimates indicate that as many as 20 percent of those living and working within 18,000 feet from a central office may be unable to receive quality DSL services due to these types of technical limitations.[29]

On the other hand, technologies and the providers are overcoming these distance and technical limitations. Some providers deploy remote DSLAMs, which can often provide the same levels of service as DSLAMs that are located within a central office or integrate remote DSL technologies into their basic telephone network infrastructures. Also, DSL technologies are improving as "second-generation" DSLAMs can provide equivalent speeds to all customers within a range of approximately 26,000 feet from the central office.

In summary, distance, the condition of copper local loops, and other hindrances can all affect the availability and quality of DSL services, though some providers are overcoming these limitations. Furthermore, costs of deploying DSL technologies are falling. Individual DSLAMs now cost in the range of $30,000 to $40,000, which is close to half the price of a couple of years ago. Remote DSLAMs can be less than $10,000. However, for many providers, particularly those with poor quality infrastructure in certain areas, there are other costs to consider, like removing bridge taps or loading coils or replacing poor quality lines. In general, though, continual improvements in DSL technologies are allowing phone providers to offer increasingly faster and higher quality DSL services.

While DSL and cable modem services are currently the primary means for connecting to the Internet at broadband speeds, satellite and wireless technologies can be viable options. At present, satellite technology cannot provide the speeds or quality of service required by some users, while wireless broadband services have thus far only been deployed in a few rural areas.[30] Nonetheless, these technologies could be key for providing broadband services to rural areas in the future, and they could inject further competition into local broadband markets. Though there are some limitations to these technologies at this time, the satellite and wireless broadband industries are constantly improving their technologies.

WIRELESS BROADBAND

A wireless broadband connection to the Internet is perhaps the best alternative to DSL and cable modem services. However, the FCC estimates that less than 1 percent of all broadband connections in the United States are currently through a wireless service.[31] At the same time, at least in the United States as a whole and especially in metropolitan areas, the availability of wireless broadband service is growing rapidly and offers tremendous potential for underserved rural areas.

Wireless broadband infrastructure involves a radio transmitter/receiver that "connects" the user with the provider's central antenna, often through intermediate antennas. The provider then links to the Internet using more traditional middle mile facilities such as a T-1 line or a bundle of T-1 lines. Thus, wireless Internet providers can build-out their infrastructures incrementally, with the initial infrastructure placed at the provider's central location, intermediate antennas often positioned on towers or building rooftops within a community, and then individual antennas provided to each residential or business user. This incremental build-out process allows wireless providers to avoid the large investment costs of having to build a more traditional landline system, such as cable or telephone companies must do. Once wireless services are established within an area, the provider can supply

[29] Pinkham Group (2001).
[30] Based on discussions with providers, including wireless providers.
[31] FCC (2002).

antennas and, hence, service to individual users as demand warrants.

There are several types of wireless broadband services, and the characteristics of these services all vary somewhat in terms of speed and quality, means of deployment, and potential technical limitations. A key issue that differentiates the types of wireless services is whether they are provided over licensed or unlicensed spectrums. The use of licensed spectrums requires a license from the FCC. These licenses are costly, so it is mainly exceptionally large telecommunications providers that have purchased and own the rights to these spectrums. Wireless spectrum licenses are for specifically defined, geographically bounded areas, which are often large and include urban and rural areas. Providers are not required by their licensing agreements to provide service throughout their entire service areas, and broadband wireless through licensed spectrums are typically highly localized and often not offered to the more rural parts of service territories. As a result, wireless broadband over licensed spectrums is not being widely deployed at this time in Pennsylvania or the rest of the country.[32] Furthermore, two leading providers in this arena went bankrupt in 2001. Therefore, the best opportunity for growth in wireless broadband, especially in rural areas, seems to be through unlicensed spectrums. However, because these spectrums are not licensed by the FCC, providers are not protected from interference with these spectrums. Nevertheless, broadband provision through unlicensed spectrum allows for exceptionally fast connections to the Internet that can rival if not exceed many of the cable modem and DSL services currently available. Moreover, in optimal conditions and terrain, broadband over unlicensed spectrum can function up to a range of 15 miles.

As is the case with other broadband technologies, there are technical limitations to deploying wireless broadband services. Wireless Internet connections can be a problem due to line of site issues related to trees, buildings, and mountains or to rain, which can lower the quality of the service. Furthermore, there can be problems with users tapping into each others' Internet connections, which could be a privacy issue. These technical issues may not be resolved for a few years. Nevertheless, there are perhaps 15 to 20 independent Internet Service Providers (ISPs) currently offering wireless services in non-metropolitan areas of Pennsylvania, a trend that has developed especially over the past couple of years.[33] These providers have prices that are comparable to DSL and cable modem prices and speeds that are even faster than those many cable and DSL providers can offer. It seems likely that many areas will have to depend upon ISPs not affiliated with cable or telephone providers if they are to have a wireless broadband option. Providing new wireless broadband will require financial resources for initial investments as well as technical expertise to adequately offer such services, prospects that may favor larger ISPs or other incumbent telecommunications providers. At the same time, an advantage of offering wireless broadband service is that virtually any new or established telecommunications provider can begin offering this service to a community without having to confront substantial regulatory or financial obstacles.

SATELLITE

A high-speed satellite Internet connection is available virtually anywhere in the United States, making satellite a viable choice for many rural users.[34] However, satellite Internet connections cannot offer the same speeds as other broadband services and, therefore, may be insufficient for the needs of many Internet users, especially business users. In fact, the upstream speeds of satellite "broadband" connections are often only equivalent to the speeds of dial-up Internet services.[35] However, satellite has a great advantage over wireless and especially over cable and DSL broadband connections in that it requires no infrastructure build-outs.

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[32] None of the providers interviewed offered wireless broadband over licensed spectrums in Pennsylvania.
[33] Based on discussions with providers, including wireless providers.
[34] See http://www.directv.com/ and http://www.starband.com and Sukow (2001).
[35] Information about speeds available at http://www.directv.com/ and http://www.starband.com.

The satellite Internet providers already have their infrastructure in place, and for the user an Internet connection begins simply with the purchase of a satellite dish. But as is the case with wireless broadband, satellite use for Internet connections is currently low, accounting for approximately 1 percent of total broadband Internet users in the United States.[36]

Quality of service and technical issues currently limit satellite technology's effectiveness in providing broadband services.[37] A satellite Internet connection requires the user's satellite dish to have an unobstructed view of the southern sky. Though this is not a problem for most users, in some rural areas of the state mountains or trees could obstruct this view. Rain and snow can also interfere with satellite Internet services, creating reliability concerns. Furthermore, due to satellite delay, some real-time Internet applications may not be particularly effective using a satellite connection. Though costs of monthly service are comparable but slightly higher than the typical costs of DSL and cable modem services, the initial costs of purchasing a satellite dish—in the range of a few hundred dollars—could be prohibitive for some users. Furthermore, professional installation costs for a satellite system are often around $200, though users can install their own systems.[38]

Despite these limitations, satellite is serving the needs of at least some Internet users at this time. And in the future, this technology may also serve as a viable means to connect to the Internet at relatively fast speeds. As is the case with all of the last mile technologies discussed in this report, satellite technologies are improving, and satellite providers may find themselves in an increasingly better position than cable, telephone, and wireless providers to offer last mile broadband service to a number of remote, rural customers. There are currently two major providers of satellite Internet service in the nation, and at least one small satellite ISP in the state. The service area of this provider includes a relatively large number of rural residents.

In sum, all of the types of last mile providers discussed above have limitations. But providers can overcome some obstacles by getting creative. A few providers interviewed for this study were working together through methods such as sharing infrastructures. Some were considering this cooperation over particularly long distances, such as by having a last mile provider in one part of the state use the "headend" facility of a provider in another part of the state. As technologies continue to develop and if last miles providers are willing to work together, there are a number of arrangements that could develop over time.

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[36] FCC (2002).
[37] Based on business interviews. In general, these users were less satisfied than those using DSL and cable modem connections.
[38] See http://www.directv.com/ and http://www.starband.com.

CHAPTER III. ANALYSIS OF BROADBAND SUPPLY IN PENNSYLVANIA

This chapter examines the extent to which cable and telephone providers are deploying broadband services throughout Pennsylvania and considers the degree to which there is an urban-rural digital divide in the provision of broadband telecommunications services. Broadband service availability is assessed at three geographic levels: metropolitan areas, non-metropolitan urban areas, and non-metropolitan rural areas. Definitions of these areas and a detailed methodology are included in Appendix B. Aside from geographic differences, this analysis also examines how the supply of broadband varies by socioeconomic characteristics including race, income and age, and by type and size of service provider.

DATA COLLECTION AND ANALYSIS

With the deployment of broadband services increasing at a rapid rate, the only way to thoroughly understand the nature of Internet availability at any point in time is through detailed discussions with the providers themselves. The analysis for this report is based on interviews with members of the telecommunications industry in Pennsylvania, ranging from the cable, telephone, and other ISPs to companies that implement telecommunications infrastructures for such providers. These interviews provided detailed information about broadband service availability from each of the providers. Furthermore, these conversations included discussions of broadband demand, telecommunications infrastructure issues, regulatory matters and concerns, and competition.

Research on telecommunications infrastructure can become dated rather quickly. For example, some of the interviewed providers that were not providing broadband services had plans to begin doing so within the next year, while others that were providing broadband in only parts of their service areas were in the process of continually rolling out broadband to areas they were not yet serving. Precise monitoring of the availability of broadband services in rural areas of the state even in the relatively near future will require a detailed examination as has been conducted here. This report represents the most extensive analysis of rural broadband availability in Pennsylvania at this time, and it is the most detailed analysis that has been conducted to date in terms of broadband availability and the urban-rural digital divide in the state.

Provider interviews took place by phone largely over the course of three months, from October to December 2002. Companies were interviewed for approximately 45 minutes to an hour. The information gathered in the interviews has enabled a detailed understanding of where within their service territories each provider is currently providing broadband. Cable companies provided information about service availability at the county subdivision level, including cities, townships, and boroughs. Data were collected from 45 of the approximately 90 cable providers in the state, including all of the state's major cable providers for at least some of their service territories. The data gathered from the cable providers permitted an assessment of cable modem availability for more than 60 percent of the state's population, including more than 60 percent of the state's non-metropolitan rural population.

For telephone companies, data were collected by ILEC (Incumbent Local Exchange Carrier) central office location, of which there are more than 800 in the state. Providers were further questioned about the extent to which they were using remote technologies to deploy DSL services to areas significantly beyond their central offices. In total, 21 of the state's 26 ILECs provided information about their entire service areas; five ILECs declined to participate in this analysis. Use of the ILEC data enabled a detailed assessment of the extent to which the majority of the state's population has access to DSL services, including more than 50 percent of the state's non-metropolitan rural population.

Lack of participation by certain providers was based primarily on concerns about the nature of the data and the degree to which it was deemed to be proprietary. To facilitate the data collection process, it was agreed that information about individual providers in this analysis would not be disclosed. While

ONE FINDING IS ESPECIALLY CLEAR: THERE IS A DIGITAL DIVIDE BETWEEN URBAN AND RURAL AREAS OF THE STATE IN TERMS OF THE PROVISION OF BROADBAND SERVICES. IF ANYTHING, THIS DIVIDE IS MORE ACUTE THAN WHAT IS INDICATED IN THE RESULTS OF THIS RESEARCH.

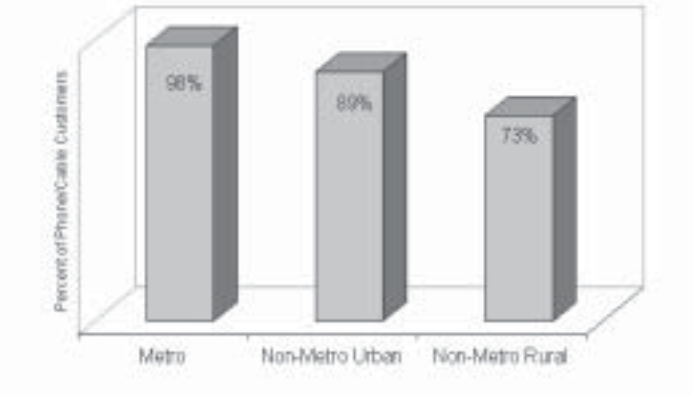
other less current and less reliable data about the provision of broadband services are available elsewhere, the researchers felt that sacrificing the ability to identify particular providers for the sake of reliable and current data was an essential and acceptable trade-off.

Finally, due to various technical issues related to conducting an analysis of this type, this research likely over represents broadband availability, especially in the state's rural areas. This potential for overrepresentation, however, should not dramatically affect the understanding of analysis results. One finding is especially clear: there is a digital divide between urban and rural areas of the state in terms of the provision of broadband services. If anything, this divide is more acute than what is indicated in the results of this research.

BROADBAND AVAILABILITY BY CABLE AND TELEPHONE PROVIDERS

As indicated in Figure 1, broadband Internet access is available to 98 percent of Pennsylvania's metropolitan population but is less available in non-metropolitan areas.[39] Eighty-nine percent of the non-metropolitan urban population and 73 percent of the non-metropolitan rural population have broadband services in their areas. Thus, there is clearly a rural/urban digital divide in broadband service availability.

Figure 1: Broadband Availability by Location



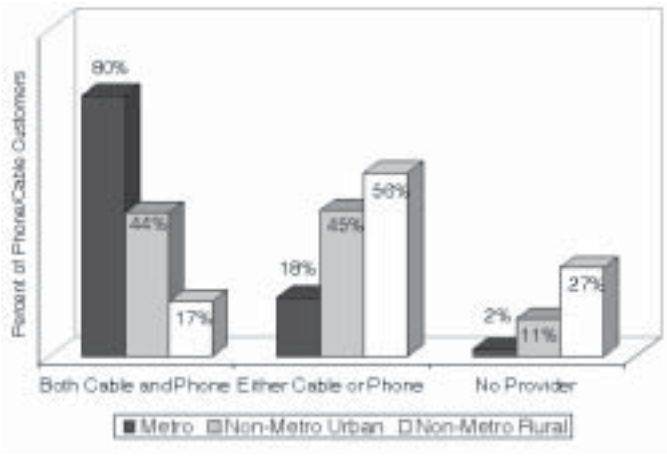
Although there is a high degree of broadband availability throughout much of the state, there is a clear disparity in provider type options serving metropolitan and non-metropolitan areas as indicated in Figure 2. Approximately 80 percent of metropolitan residents have broadband available from a cable and a telephone provider. This can be an underestimation of the total number of providers as, in some metropolitan areas of the state, a number of CLECs offer broadband services. On the other hand, about 44 percent of the state's non-metropolitan urban population has broadband available from both a cable and a telephone provider. This limited choice in providers can pose problems for some business users, especially if the services offered by the only provider are unreliable or inadequate for user needs. In non-metropolitan rural areas, choice for broadband services is even more limited with only 17 percent of the population having a choice between cable modem and DSL for broadband services.

This figure refers only to areas where the researchers contacted one cable company and the ILEC telephone provider. In some instances, especially in metropolitan areas, there may have been additional providers such as another cable company or a CLEC.

DSL is currently available to 79 percent of phone customers. However, as indicated in Figure 3, provision of DSL services is far more likely in metropolitan areas, as 83 percent of the state's metropolitan residents have DSL available, but only 62 percent and 21 percent of the non-metropolitan urban and rural residents have access to such services. There is less differentiation in cable modem service, which is available to 95 percent, 71 percent,

[39] The data presented in this section refer to the customer base of cable and phone providers interviewed, not necessarily the entire population. The terms "population" or "residents" are used to reflect this group since coverage by such companies is nearly universal.

Figure 2: Broadband Provider Options by Location



and 63 percent of the state's metropolitan, non-metropolitan urban, and non-metropolitan rural customers, respectively.

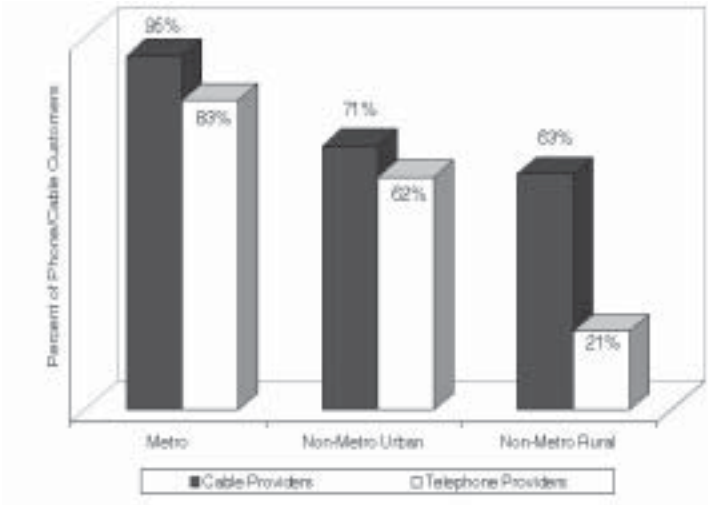
The next factor affecting availability is provider size. Cable companies are classified as small, medium, or large providers, while telephone companies are either small or large. The small cable providers are mainly rural and serve approximately 6,000 households or less. They include about half of all of the cable providers in this analysis. The medium cable companies serve a mix of metropolitan and rural areas and provide service to approximately 20,000–60,000 households. These include approximately 25 percent of the cable companies in this analysis. The remaining cable companies serve a range of metropolitan and rural households and serve at least 100,000 households.[40]

Small telephone providers consist of independent telephone companies that operate exclusively in Pennsylvania and service approximately 5,000 access lines or less and of small, independent companies that have a limited service area outside of the state and provide a small number of access lines to neighboring areas within Pennsylvania. Large providers have approximately 70,000 access lines or more in Pennsylvania or are owned and operated by a company outside of Pennsylvania and serve a relatively large number of access lines on a nationwide basis. A total of 17 telephone companies met the criteria for being small, while four companies were designated as large.

Table 1: Distribution of Cable and Telephone Companies by Size

	Small	Medium	Large
Cable	50%	25%	25%
Telephone	81%	N.A.	19%

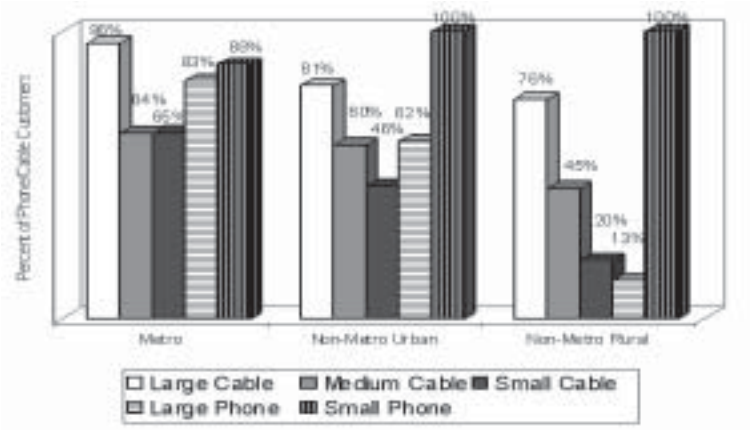
Figure 3: Broadband Availability by Location and Provider Type



In summary, the companies in this analysis can be understood as follows: 1) large cable companies that serve a mix of metropolitan and non-metropolitan homes and businesses and have cable services throughout much of Pennsylvania and the rest of the nation; 2) medium cable companies that serve a mix of metropolitan and non-metropolitan areas but primarily operate in Pennsylvania; 3) small cable companies that operate almost entirely in Pennsylvania and in the state's rural areas and serve relatively few households and businesses; 4) large telephone companies that serve a large number of access lines in Pennsylvania or have extensive operations outside of the state; and 5) small telephone companies that serve a mix of metropolitan and non-metropolitan urban and rural areas and typically operate only in Pennsylvania serving a few thousand customers.

[40] Numbers of households served are approximations. The largest "small" provider served about 11,000 households, while the smallest "medium" provider served approximately 17,000 households.

Figure 4: Broadband Availability by Location and Provider Size



As indicated in Figure 4, large cable companies are more likely to provide cable modem services than are their smaller counterparts in any type of service area, offering such service to 96 percent of their customers in metropolitan areas, 81 percent of those in non-metropolitan urban areas, and 76 percent of those in non-metropolitan rural areas. Medium and small cable providers are offering broadband services to only 45 percent and 20 percent of their non-metropolitan rural customers, respectively. Large and small telephone companies demonstrate an opposite pattern of service provision.

Overall, small telephone companies followed by large cable providers are clearly the leaders in providing broadband services in rural areas of the state. The small cable operations and the large telephone companies, on the other hand, are far less likely to offer broadband services in their rural areas. Moreover, there is a significant drop-off for the large telephone companies in terms of DSL provision between metropolitan areas and non-metropolitan rural areas. In sum, if rural residents or businesses have broadband access, they are usually served by either a small telephone company or a large cable provider and may have a choice of service if they are served by both. However, companies vary and some large telephone providers are deploying broadband at a much greater rate in rural areas than are others, and some small cable providers are providing cable modem service throughout their entire service areas.

SOCIO-ECONOMIC CHARACTERISTICS ASSOCIATED WITH BROADBAND AVAILABILITY

Literature on the digital divide asserts that factors such as race, income, and age could relate to the deployment of broadband services.[41] Three sets of statistical models, for all providers and for cable and telephone providers individually, were created to clarify the extent to which these factors are associated with deployment of broadband in Pennsylvania. Furthermore, the relationships were assessed at the metropolitan, non-metropolitan urban, and non-metropolitan rural levels.

The results of the models indicate that population density is the most important factor for total providers in metropolitan and in non-metropolitan areas. In other words, metropolitan and non-metropolitan urban areas are more likely to have these services than rural areas without significant population concentrations. Race and age are not important factors. For cable modem providers, while population density is important, income also plays a discernable role in the deployment of broadband. Race and age are again not important factors.

For telephone providers, the most important factor is unquestionably population density. In the models for metropolitan areas, there was a negative association between percent white population and the provision of DSL. This negative association may be explained by the much larger percentage of non-whites in metropolitan urban areas and the fact that companies have already deployed DSL in most of their central offices in such areas. The less densely populated areas tend to have largely white populations. In some of these areas, the telephone companies have not yet fully deployed DSL services. This may be for a variety of reasons including population density and the fact that many of the existing telephone infrastructures in these areas are ill equipped to handle DSL services. With growing demand for DSL in suburban areas, many telephone companies have

[41] Many of these factors are associated more with use than with availability. See U.S. Department of Commerce (1999), U.S. Department of Commerce (2002), and FCC (2002).

made changes to these infrastructures to allow for DSL services. Age and income are not important factors in the telephone model.

The provider interviews reinforced the findings of the models. Telephone providers were more likely to indicate that lack of deployment in certain areas was due to low population density, while some cable providers suggested that income demographics were also a factor. In some respects, cable companies may have more of an opportunity than telephone companies to consider issues such as income when deploying broadband services. Cable companies can build-out or improve their infrastructures differentially by deploying fiber optic cable to one part of a community and not to another. On the other hand, when telephone providers put the infrastructure in a central office, services are largely available to anyone living within an 18,000-foot radius of that central office.

Relationships between broadband services, provider types, and various socio-economic characteristics are included in Table 2. Overall, areas without broadband are older, less educated, poorer, and have fewer non-whites. There is greater variation in income by cable modem services than by DSL availability. Per capita income is almost $2,000 lower in areas where cable modem service is not available than in areas where it is. There also is a greater percent of non-white population, higher poverty rates, a higher elderly population, and lower levels of educational attainment where cable modem service is not provided than in areas where it is. Somewhat contrasting disparities exist with respect to DSL. This fact is likely due to distance-related qualities associated with the technology since, once deployed, DSL service is available to a wide radius of users. In metropolitan urban areas especially, the range of socio-economic characteristics among persons within 18,000 feet of a central office can be quite notable.

SUMMARY AND INTERPRETATION OF FINDINGS

Broadband services are available in most metropolitan areas, many non-metropolitan urban areas, and to a lesser extent in non-metropolitan rural areas of the state. The most important factor associated with broadband service availability is population density, though factors such as income, especially for cable modem providers, appear to play a role as well. Investing in the infrastructure necessary to provide broadband services in densely populated areas offers cable and telephone providers a much greater return on their investment than it does in less densely settled areas. For phone companies, the main investment decision regarding DSL provision typically relates to whether or not they will do so from any given central office. This and other research has indicated that telephone companies, especially the larger providers up to this point in time, almost invariably made DSL

Table 2: Population Characteristics of Areas by Broadband Availability

Areas with →	Broadband	No Broadband	Cable Modem	No Cable Modem	DSL	No DSL
Non-White Population	5.4%	1.1%	1.3%	3.1%	7.6%	1.4%
Population 65 and Older	15.6%	15.8%	14.9%	16.1%	15.1%	14.9%
Population with College Degree	16.1%	10.2%	15.2%	11.6%	16.4%	13.5%
Per Capita Income	$18,393	$16,074	$18,053	$16,132	$18,594	$17,915
Poverty Rate	8.5%	10.1%	8.2%	10.5%	9.0%	7.7%

Note: Median percentages. Broadband availability from at least one provider.
Socio-economic Data Source: U.S. Census Bureau, 2000 Decennial Census

investment decisions based upon population density in a given central office location.[42]

As opposed to telephone companies, cable providers can single out areas within a larger service area where they will deploy infrastructures not only to provide broadband but also advanced television services, such as high-definition television and video on demand. Deploying advanced infrastructures that include large amounts of fiber optic cable in high-income rather than in low-income areas makes economic sense for cable companies as it is assumed that high-income users can afford and therefore will purchase the advanced television and broadband services that such infrastructures can provide.

LARGE PROVIDERS

To further understand the patterns of broadband deployment throughout the state, it is important to consider the variation in large and small company behavior. Broadband deployment activities of large companies are particularly pertinent because they are by far the largest providers of their respective services in all areas of Pennsylvania. Large cable companies provide broadband services with greater frequency, especially in rural areas, than do their telephone company counterparts. This mirrors national trends.[43] At a national level, some large cable companies are offering cable modem service to close to 100 percent of their cable television customers, and some of the larger providers in Pennsylvania indicated that they were doing the same.[44]

The extensive level of broadband provision by large cable companies is a reaction to competitive pressures, local government regulation, and market opportunities. First, infrastructure build-outs in reaction to satellite competition and potential competition from the telephone industry for television services caused a number of large cable companies to significantly upgrade their infrastructures in the mid-1990s. These upgrades were done to offer a wider range of television services, especially unique services such as high-definition television and video on demand, that would provide a competitive advantage vis a vis satellite companies. Infrastructure upgrades during the 1990s left the cable companies well poised to begin offering broadband services when the demand for broadband first developed and started to grow. In total, large cable companies in the United States spent as much as $60 billion upgrading their systems in the 1990s.[45] Though most cable providers still see satellite as their biggest competitor, the ability to offer telephone services allows cable providers, especially in some metropolitan areas of the state, to compete for the provision of telecommunications services as well.

In the early and mid-1990s, some local governments required large cable companies to develop two-way ready cable systems (for reasons unrelated to broadband) in return for local cable franchise rights. After these extensive upgrades, many of the infrastructures of the state's major cable providers now allow them to offer broadband services. Still, some of the larger companies' "stand-alone" systems in rural areas are less sophisticated. In some instances, large cable companies have not yet upgraded certain cable systems, often those recently acquired from a small rural provider. Hence, return-on-investment related issues will likely be the most important factor determining whether the large companies upgrade these systems in the near future.

In contrast, large telephone companies faced very different threats of competition. This variation may help account for why large telephone companies have deployed broadband services more slowly and to a lesser extent in rural areas than have their cable counterparts. In many instances, especially in rural areas, large telephone companies must now make larger investments than cable companies if they wish to provide broadband to users, especially if copper lines need to be replaced or conditioned to effectively provide the service.

Less extensive upgrades by some of the larger providers are due to a number of issues. For example, prior to 1996, ILECs faced limited to no

[42] Pinkham (2001).
[43] FCC (2002).
[44] See Hansell (2003) and http://www.point-topic.com. Also based on provider interviews.
[45] Young and Grant (2003).

competition in their areas of operation. Thus, many large providers had little incentive to upgrade their infrastructures, especially in rural areas. With the advent of the Telecommunications Act of 1996, ILECs were required to allow competitors to have access to their telecommunications networks. In consequence, major providers throughout much of the country indicated that this change provided a disincentive to upgrade their infrastructures.[46] Also, since virtually all of the initial users of the Internet used dial-up services, demand for second phone lines increased dramatically in the short run, making the Internet profitable for local telephone providers even without offering broadband access. Finally, over the past few years, competition in the telephone industry has related more to wireless telephone services. With many people starting to use such services for long distance calls and some users abandoning their local calling service and relying solely upon wireless telephone service, it is likely that large providers are finding little incentive to upgrade their landline infrastructures, especially in rural areas.[47] Most large and small landline telephone providers see wireless services as their biggest competitor.

Nonetheless, many of the large telephone companies in Pennsylvania have deployed the infrastructure necessary to provide DSL throughout most of their metropolitan service areas and are in the process of continually deploying infrastructure in rural areas of the state. At the same time, the extent to which large providers are deploying DSL services in rural areas varies dramatically. In some instances, such providers have installed DSLAMs and remote DSLAMs in rural areas and are therefore serving a wide range of non-metropolitan urban and rural customers. In other instances, large providers have installed only central office and not remote DSLAMs, meaning that customers farther than 18,000 feet from the central office do not have access to DSL services. In still other instances, large providers have not installed DSLAMs in their non-metropolitan service areas and are therefore not offering DSL services in such areas. Nonetheless, large telephone company deployment of DSL has increased in some rural areas over the past year. And some large providers, having already deployed DSL in their metropolitan markets, have indicated plans to increasingly deploy central office and remote DSLAMs in some of their more rural service territories within the next year. According to some companies, these areas will be the main focus of the next phase for rolling out DSL. However, some telephone providers do not believe that current demand for DSL in more remote rural areas justifies the capital investment. This perspective could limit the deployment of DSL in some rural areas of Pennsylvania in the future.

SMALL PROVIDERS

Considering the size of their service areas, small, independently owned telephone companies have some of the most sophisticated telecommunications infrastructures in Pennsylvania. As supported in other research, small telephone companies throughout the United States often aggressively deploy relatively advanced infrastructures.[48] In addition, a survey of small providers nationwide indicates that Pennsylvania's small ILECs are ahead of similar ILECs in many other states.[49] Many of Pennsylvania's smaller ILECs offer broadband to virtually their entire service territories, while others offer such service to 85 to 95 percent of their customers and have plans to expand to their remaining customers within the next year or so. Only one small telephone company interviewed was not providing DSL service, though this company claimed that it was going to do so within a few months. Many of the small telephone companies started offering DSL over the past year and were using central office and remote DSLAMs to extend broadband service throughout a large extent of their service areas.

The advanced nature of some of the smaller telephone system infrastructures reflects the prevailing belief among small providers that extensive upgrades are needed to remain competitive. Main-

[46] See recent FCC proceedings on the matter of unbundling, available at http://www.fcc.gov. Similar interpretation is offered by telephone providers in the state.
[47] The large telephone providers did not acknowledge this in interviews, though others within the telecommunications industry offered such an interpretation.
[48] See NECA (2001), Pinkham (2001), and Schadelbauer (2002)
[49] See NECA (2001).

taining this competitiveness, however, also means that a few of these providers have moved quite aggressively into the provision of other telecommunications services, especially cable TV. Furthermore, unlike some of the large ILECs in the state, many of the smaller ILECs are currently exempted from having to open their networks to CLECs. However, most of the smaller providers suggest that they would have upgraded their infrastructures even if it were not for this "rural exemption." It also seemed certain at the time of this research that the request for an extension of this exemption was not going to be granted by the Pennsylvania Public Utility Commission. A few small providers noted that the regulatory agreements of Chapter 30 had played into their provision of DSL, though all but one of those that were currently providing service suggested that they would be providing such services even without the Chapter 30 agreement. The company that was not yet offering DSL suggested that the primary reason it would be doing so in the future was its Chapter 30 obligations.

Finally, another reason for offering DSL and upgrading systems was that a number of small telephone providers feel a responsibility to provide a high-quality service to their customers. Many of these companies operate in one or a few small towns, have been serving these local communities for as long as 100 years, and know many members of the local communities they serve. So, in many respects, small telephone companies are the top providers of broadband services in the state, though their service areas account for only a very small part of overall ILEC territory.

In contrast to telephone companies, less than half of the small cable companies in this analysis are providing broadband services. Furthermore, some of those cable companies providing broadband offer it in only part of their service areas. In general, the larger cable companies' infrastructures are better equipped to offer cable modem service. High-capacity cable systems in the state are found almost entirely among the larger providers. While the large cable companies often have extensive amounts of fiber optic cable deployed throughout their infrastructures, only a few of the small rural providers have such infrastructures in place. Without thorough system upgrades, many of the small cable companies will be unable to handle more advanced television and Internet applications either now or in the future. Nonetheless, many smaller cable providers are looking to upgrade their systems, primarily in reaction to the growth in demand for broadband. And many of the small providers that have upgraded their systems did so, often over the past year or two, primarily for the provision of broadband service. The reasons for these upgrades or for the desire to upgrade, then, are largely in contrast to the reasons that the larger cable providers were upgrading their infrastructures a few years ago, and are indicative of the growing demand for broadband services.

In general, the smallest cable providers are not providing broadband services. A relatively clear threshold of cable TV households served differentiates whether a small cable company provides broadband services. Companies serving in the range of 3,000 or fewer households typically are not providing broadband, while all of the small companies serving more than 3,000 homes are. Many of the small companies not providing cable modem service at present claim that it would involve a complete rebuild of their systems. These providers are facing a number of financial obstacles to providing broadband service, including upgrading their infrastructures to become two-way capable, installing a CMTS, and leasing middle mile facilities, which can be expensive in remote rural areas. Some providers suggest that they would have to change over 100 amplifiers. Major infrastructure upgrades required to serve only a few thousand households are indicative of the low population densities of the areas in which some of these small providers are offering cable television service. This low population density is a clear reason that small cable providers feel it would be too costly to upgrade their systems. To a lesser degree, perception of low demand for broadband services or more advanced television services is another reason that small cable providers are not upgrading their infrastructures.

Many of the especially small providers interested in upgrading their systems for the provision of cable modem service claim that they are having or would have a difficult time obtaining financing to begin making the necessary upgrades. Barriers are seen to be the current economic climate and the current state

of affairs of the cable industry. Thus, with the difficulty in gaining financing and without a guarantee of a return on the investment, many of these providers may not upgrade their systems in the near future. Furthermore, a clear pattern in the cable industry has been that small providers who hope to sell their operations tend to postpone upgrades prior to exiting the market. In fact, the interviews for this study identified some small providers looking to sell their companies at this time. In sum, the experience is mixed for small cable providers. Some have no intention of upgrading their systems in the near future while others are looking for ways to do so. On the other hand, some of the small cable providers, like their telephone counterparts, are offering broadband services throughout their entire service territories.

In conclusion, many small communities and some of the most rural areas of Pennsylvania are currently receiving broadband services. Others are not. The provision of these services relates to a range of issues, especially population density and the type of cable and telephone providers serving the area. In short, if a small rural town is served by a large cable provider or a small telephone company, the chances are fairly high that broadband services will be available. On the other hand, if the town is served by a large telephone company or a small cable company, the opposite is likely true. Aside from the issue of broadband availability, there is the issue of quality of service in rural areas. With limited competition in such areas, if the quality of service from a provider is poor, users may have no choice but to settle for that inferior broadband service.

CHAPTER IV. DEMAND FOR BROADBAND SERVICES

While broadband supply is clearly an important factor in the use of broadband services, another key part of the equation is demand. The demand for broadband services is potentially related to a number of issues including the demographics and economy of an area, price, how well a broadband provider markets its product, the length of time broadband has been available in the area, and user familiarity with broadband capabilities. Though broadband is available throughout much of the United States, the current "take rates" for these services—meaning the use of broadband services where they are actually available—are somewhat low, at least among residential users. The rapid deployment of broadband services over the past few years has meant that DSL, cable modem, or both services are currently available to about 80 percent of the nation's population. However, the national take rate for broadband is only between 10 and 20 percent and can vary dramatically by geographic location.[50] It is important to note that take rates are not necessarily reflective of business demand for broadband since potential residential users greatly outnumber potential business users due to the far greater number of households than businesses.

Although take rates are not high, broadband demand is growing dramatically. Some broadband providers experienced more than double-digit growth in their subscriber bases during 2002, and many providers in Pennsylvania indicated that they are unable to keep up with the demand for services at this time.[51] Overall take rates for DSL providers in the state average 7 percent, ranging from a low of 3 percent to a high of 11 percent, while for cable providers take rates are currently averaging 10 percent, with rates for individual providers as low as 2 percent and as high as 20 percent.[52] Furthermore, many of these providers are offering services where there are competitive providers, so actual overall take rates in some areas are somewhat greater than as indicted by each individual provider.

Higher take rates for cable providers are due in part to length of time in the market relative to telephone companies. Many of the phone companies in Pennsylvania did not begin offering DSL until the past year or two, while many cable companies have been offering cable modem services since the mid- to late-1990s. Furthermore, some providers indicate vast differences in take rates in different parts of their service areas. Relatively large providers, who offer broadband services in rural, suburban, and large urban markets typically suggest that their highest take rates are in their suburban and urban markets, with those rates being as high as 30 percent. In general, broadband providers in Pennsylvania indicated higher take rates in urban than in rural areas, though a few rural providers indicated that between 10 and 20 percent of their rural customers are currently using their broadband services.

THE COSTS AND BENEFITS OF BROADBAND SERVICE

The two most important factors contributing to the demand for broadband, especially among residential users, are benefits, or utility, and costs of service, and these two factors are highly interrelated. For many consumers, the benefits of having a broadband connection do not warrant the costs, which are relatively high. National take rate figures indicate that 80 to 90 percent of Internet consumers are opting for a dial-up rather than a broadband connection. It is still the case that many consumers have never used anything faster than a dial-up connection to the Internet and therefore cannot compare the benefits of a faster connection. Costs for dial-up services are typically as low as $10 to $20 per month, while the costs for low-end broadband services are often about

[50] FCC (2002) and U.S. Department of Commerce (2001). Take rate estimates often vary because some companies are unwilling to provide information about the number of broadband users they have.
[51] See Fusco (2002). Pennsylvania information gathered through interviews with providers.
[52] Based on information from 10 telephone providers and 16 cable providers in the state. Other providers did not know their current take rates, and still other providers were not willing to disclose this information.

$40 to $50. A recent national survey indicates that only about 12 percent of consumers nationwide are willing to pay $40 per month for broadband services. More than 30 percent would be interested in broadband services at a cost of $25 per month, which is only slightly higher than some dial-up services.[53] It is also important to note that the monthly costs of even dial-up services are prohibitive for some low-income consumers. Some ISPs in Pennsylvania indicated that they had numerous customers in both urban and rural areas who were unable to continue making payments of $20 per month dial-up service.[54] In addition, business class services can be in the range of $200 per month, which may be too expensive for some small business users.

The difference between broadband and dial-up costs is an important factor in determining broadband demand for those that primarily use the Internet to access email, which remains the main use of the Internet.[55] For many users, the slow speeds of a dial-up connection may be an annoyance, but the benefits of having a higher-speed connection to primarily access email may not warrant the costs of broadband service. However, conversations with providers revealed that those who regularly use the Internet for applications, such as gaming or working from home, that require higher speeds than a dial-up connection are often willing to pay for broadband at current prices.

It may also be the case that exceptional growth in demand for broadband in the future will relate to increased use of television services, such as high-definition television or video on demand, which require a broadband connection to the home. With many telephone and cable providers now offering Internet, telephone, and television services to their customers through broadband connections, the lines between Internet use and demand for broadband services are becoming increasingly blurred. In some instances users already have one broadband line to the home that offers Internet, telephone, and television services.

In short, it seems possible that in the future, various technologies, applications, and consumer expectations could increase consumer demand for advanced telecommunications connections, such that consumers may be willing to pay reasonable costs for such services. At current speeds offered by many providers, however, a broadband connection for many residential users means little more than freeing up the phone line and connecting to the Internet at somewhat faster than dial-up speeds. For such service, consumers are often unwilling to pay high prices. On the other hand, one clear issue for residential users related to dial-up service is, in fact, tying up the phone line. Based on conversations with broadband providers, it is clear that consumers are willing to pay at least slightly more than dial-up costs for an "always-on" Internet connection that does not interfere with incoming and outgoing phone calls.

It is also important to remember that it has been only a relatively few years since providers have made broadband services more widely available to many consumers. Evidence suggests that as consumers become more aware of the availability and benefits of such services, the market will begin moving beyond its current stage resulting in more widespread use of broadband. Some of the state's metropolitan broadband providers indicate that they have moved into their second tier of customers, and in some of their service areas, take rates are in the range of 30 percent and are projected to reach 40 percent or more over the next few years. According to some providers, this second tier of demand seems to be related to the desire for a service that is at least somewhat faster than a dial-up connection and that frees up the phone line. In metropolitan areas of the state, some providers indicate that many of their residential broadband users have become familiar with the speeds of such connections through their place of employment. These users therefore are interested in having a broadband connection at home as well. These trends offer an indication that as user familiarity with broadband services grows, demand grows as well.

Providers are attempting to find ways to make broadband more appealing and affordable to their customers. Nationally, providers are increasingly offering bundled packages of combinations of televi-

[53] Strategis group in FCC (2002). See also Macklin (2003).
[54] Based on conversations with ISPs in the state that were offering dial-up services.
[55] Greenspan (2002); U.S. Department of Commerce (2002).

ALMOST ALL OF THE BUSINESSES IN THE SURVEY THAT WERE CURRENTLY USING THE INTERNET SAW THE INTERNET BECOMING INCREASINGLY IMPORTANT FOR THEIR BUSINESSES.

sion, telephone, and broadband Internet services at lower costs than consumers would pay for each separately. Such packaging is causing broadband Internet take rates to grow quite dramatically for some providers.[56] Another trend is lowering broadband prices along with lowering speeds of service. A few providers in Pennsylvania that recently did this indicated that their take rates increased dramatically. These trends demonstrate that cost, perhaps even more than speed, is important in determining take rates for broadband.

In conclusion, the demand for broadband is growing but the market is adjusting in terms of speeds and costs with a trend being for providers to lower their costs and speeds of service. This trend speaks to utility as users, especially residential users, do not at this time demand Internet speeds that are exceptionally fast, but instead want something that is simply faster than dial-up services. At the same time, telecommunications providers may not be offering the benefits and related price that the market is willing to bear. Considering the monopolistic nature of the cable and telephone industries, it could be that consumers should demand higher broadband speeds at lower costs from their providers.

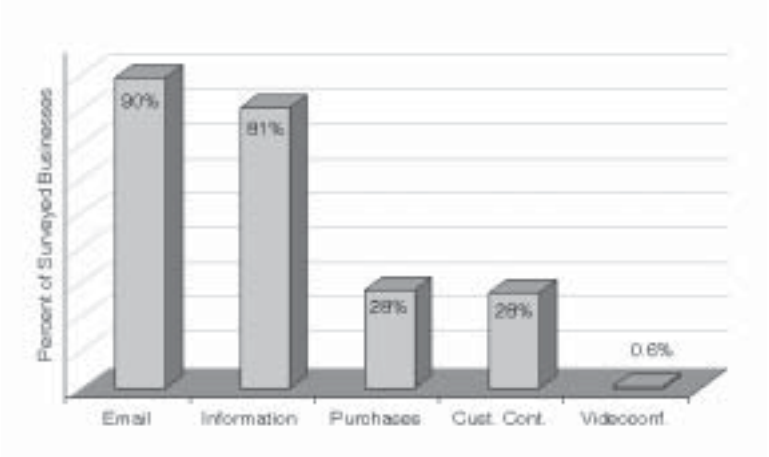
SURVEY OF BUSINESS INTERNET USE

While residential demand for broadband remains somewhat low at this time, business demand is notably higher and should continue to grow in the future.[57] At the same time, only limited research relates to business use of the Internet, especially in rural areas, and information about the extent to which rural businesses are using broadband connections and the reasons for using the Internet more generally is largely unavailable. Thus, in a pilot study conducted in relation to this research, businesses in rural counties of Pennsylvania were surveyed about their use of the Internet including the extent to which they are using broadband services.[58] This survey was conducted in spring 2002 to provide insight into the principal motivation of this report. Therefore, results presented below should be understood strictly as part of a pilot study and not related to the contractual agreement for this research. Data collection methods were somewhat less rigorous than those followed in the collection of broadband supply information.

The survey included 195 businesses in rural counties, 85 percent of which were using the Internet. There was a tremendous range in the types of businesses surveyed, a sample of which includes: real estate agencies; accountants; law firms; motels, hotels, and bed and breakfasts; automotive repair shops; a metal manufacturer; a florist; a bakery; a jeweler; and a golf driving range. About 90 percent of the businesses surveyed were service-oriented, which is reflective of the types of businesses generally found in rural areas. Most of the businesses had only a few employees. The median number was 6.5, and close to two-thirds had 10 employees or fewer.

The survey involved a fixed set of questions, which largely allowed for open-ended rather than forced-

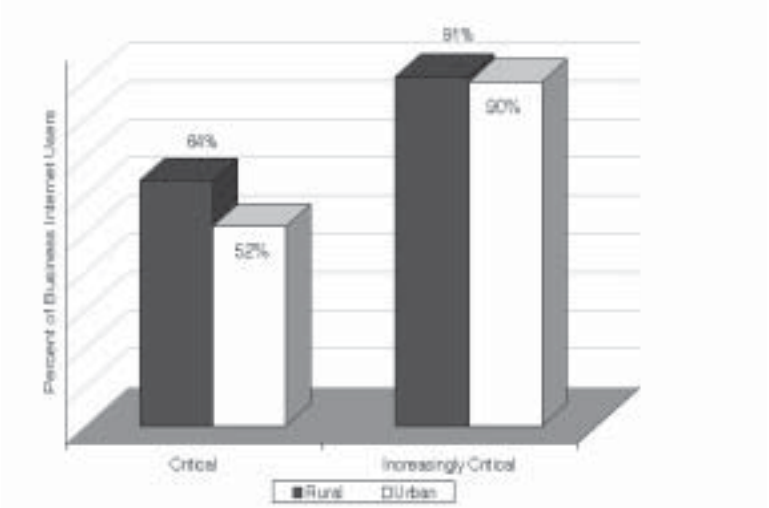
Figure 5: Primary Business Internet Applications



[56] Greenspan (2003).
[57] FCC (2002).
[58] Rural counties per the Center for Rural Pennsylvania definition at the time. See appendix D for details.

choice responses. Questions focused on the types of Internet applications that are important to rural businesses and the extent to which Internet use is critical for these businesses. Questions also sought to determine the extent to which businesses were using a broadband connection and the type of broadband provider they used to obtain this connection. Details about the research methodology and survey design and implementation are found in Appendix C.

Figure 6: Critical Nature of Internet Use to Businesses



The results of the survey indicate that more than 80 percent of businesses in predominantly rural counties are using the Internet for at least some purpose and that overall use of the Internet in urban and rural areas of these counties is essentially equivalent. As opposed to a couple of years ago, users do not have a problem accessing the Internet through dial-up services for a reasonable price, though slightly more than 25 percent of the dial-up Internet users did express a concern with the reliability of their service. As little as a couple of years ago, many Internet users in rural counties could not access the Internet without making a long-distance phone call, but times have changed. In the survey, only one business user indicated the inability to access the Internet without a long-distance call. Based on conversations with people in the telecommunications industry and in conducting research on it, it was understood that nearly everyone in the state has access to the Internet at least through a dial-up connection that does not require a long-distance phone call.

Although Internet access is relatively universal, a broadband connection is not. Approximately 33 percent of the businesses in this analysis use a broadband connection, including 19 percent of the rural users and 42 percent of the urban users. Most are satisfied with their current broadband service. Use of cable modem and DSL for broadband access are fairly evenly distributed among the business users in this analysis, and these providers account for approximately two-thirds of all broadband connections. Higher capacity lines, such as T-1 lines, account for most of the remaining broadband connections, while slightly less than 10 percent of users rely on a satellite connection and no users indicated using a wireless connection. Though most of the broadband users did not cite reliability of their service as a problem, there was a relatively high incidence of this problem for those using satellite service.

In general, whether through a dial-up or broadband connection, it is clear from the survey that many business users are increasingly relying upon the Internet to conduct business. As indicated in Figure 5, while email is the most common primary Internet application for business users in rural counties, the Internet is also an important means for these businesses to acquire or exchange information, with more than 80 percent indicating such a primary application. Moreover, 28 percent use it for purchases, and 28 percent for customer contacts.

Furthermore, nearly 60 percent of Internet users thought that its use was critical to their business. Within the rural counties in which the survey respondents are located, businesses were coded into rural and urban areas. As indicated in Figure 6, approximately two-thirds of the rural users and slightly more than half of the urban users said that the Internet is critical to their business. In some respects, the difference in critical nature between urban and rural users may indicate that accessing the Internet is

especially critical to remote rural users. Almost all of the businesses in the survey that were currently using the Internet saw the Internet becoming increasingly important for their businesses. Moreover, close to half of the non-users of the Internet who were surveyed saw a potential need for the Internet in the future.

While broadband and dial-up users are generally satisfied with their services, slightly more than 5 percent of the business users indicated that the inability to secure a better Internet connection had hurt their business. In sum, the results of this research give a clear indication that many businesses in rural counties of Pennsylvania are relying upon the Internet. Many of these users see the Internet as critical to their business, and it is clear that many rely upon the Internet to acquire and exchange information. Furthermore, many rural businesses are using a broadband connection to the Internet, indicating relatively high demand for broadband services among these users. Considering that such services are not available in some rural areas of the state and that quality of service may be an issue in areas where there is only one broadband provider, the results of this pilot study indicate that business demand for broadband is sufficiently high in rural areas to warrant bringing high quality, reasonably priced services to these areas.

CHAPTER V. CONCLUSIONS AND POLICY RECOMMENDATIONS

CONCLUSIONS

This research suggests that much of Pennsylvania has access to broadband Internet service. However, availability varies between metropolitan and non-metropolitan areas of the state not only for overall deployment but also in the choice of providers. Telecommunications technologies are in a constant state of change. This technological flux tends to favor urban and metropolitan areas, which continue to have more advanced services than their rural counterparts.

Some countries have more widespread deployment of broadband services at relatively lower prices than currently found throughout most of the United States. In many areas of the United States, broadband services are completely inadequate, which comes at a cost to health, education, and business opportunities. Also, low-income members of American society are generally unable to afford a broadband connection.

Proactive policy steps can be taken to ensure that rural areas have access to broadband and an array of high-quality broadband services both now and in the future. These steps involve not only assessing and further supporting the supply of broadband services, but evaluating and encouraging the demand for such services as well. Furthermore, policy makers must unambiguously define the concept of "universal access" to broadband services, while at the same time maintaining enough flexibility in such a designation to allow for adaptability in their oversight of inherently changing and dynamic technologies. Defining "universal access" is a genuinely difficult task, but without such definitions and the flexibility to adapt to the changing nature of broadband services and availability, policy makers will find it difficult to act effectively to promote technology diffusion and consumer uptake.

At present, various state-level government agencies in Pennsylvania are currently involved, to differing degrees, in monitoring, evaluating, or promoting the use of broadband. These agencies include the Department of Education, the Public Utility Commission, and the Office of Information Technology. As was done in other states, policy makers can adopt various roles and initiatives to help ensure that all areas of Pennsylvania have access to high-quality and affordable broadband service. Proactive involvement on the part of state legislatures or governor's offices has often been crucial to supporting state-level broadband initiatives elsewhere.

Aside from state agencies, a number of associations in Pennsylvania could potentially participate or increasingly participate in efforts to promote broadband deployment, including the Pennsylvania Economic Development Association, the Pennsylvania Telephone Association, and the Pennsylvania Cable and Telecommunications Association. Assuring that all citizens of the commonwealth have access to affordable and high-quality broadband service will require that the telecommunications providers themselves work closely with the state, either alone or through more systematic efforts via their respective associations. In short, various entities are already involved, at least to some extent, in the realm of either evaluating or attempting to assure the deployment of broadband services. These efforts should become better coordinated, more systematic, and focused.

At the federal level, a variety of agencies support broadband deployment efforts. These agencies include, among others, the Department of Education, the Department of Commerce's National Telecommunications and Information Administration, and the Department of Agriculture's Rural Utilities Service.

In Pennsylvania in particular, there is a need for aggressive action to make sure that all areas of the state are receiving broadband services and exceptional standards of such service. The state could also ensure that Pennsylvanians are actively using the Internet to its fullest advantages. For those lacking service due to cost, the state could experiment with selective subsidies to reach the goal of Internet access for all. By capitalizing on many of the advanced infrastructures that are already in place throughout the state and encouraging the continued deployment of such infrastructures, Pennsylvania has an opportunity to emerge as a leader in terms of broadband and telecommunications service availability.

The following policy suggestions should be encour-

aged in conjunction with an evaluation of the activities of such state-level agencies currently engaged in efforts related to the deployment of advanced telecommunications services. An accounting and coordination of such activity could bolster the efficient and successful implementation of the recommendations provided below.

RECOMMENDATIONS

1. Establish the parameters of "universal access" but keep them flexible.

The state should define its policy intentions of universal access, accounting for issues such as variations in competition and different levels of service found particularly in the state's rural areas. In short, regulation of a particular technology is less advisable than regulating in terms of speed, cost, and quality of service.

In a regulatory environment at both the federal and state levels that ostensibly advocates universal access to telecommunications services, the notion of "universal access" is poorly defined. Considering the range and quality of broadband services available and some of the geographic limitations related to the provision of broadband services to especially remote, rural areas, an ambiguous notion of universal access can result in a broad range of interpretations of what such access might entail. In terms of telephone services, for example, universal access can seem relatively clear. But in the constantly changing environment of broadband services, where speeds, quality of service, and consumer expectations about such service can vary dramatically in the short term and may significantly change in the relatively long term, defining universal access can be especially difficult. The lack of detail to guide the principle of universal access limits the state's ability for policy intervention and innovation.

The future of broadband is uncertain due to the changing nature of telecommunications technologies and demand for such technologies - the growth in broadband deployment and demand over the past few years is nothing like many industry analysts would have suspected five years ago, and the last five years will likely be nothing like the next. Policy makers must be concerned with speeds, costs, and quality of service and must understand that it is not the type of technology that is important, but the deployment of effective and quality broadband services that is the key issue regarding universal access. In addition, policy must be flexible enough to adapt to changing broadband technologies and the changing needs of users as new technologies become available.

2. Monitor the supply of broadband services in Pennsylvania.

The state should implement a coordinated, systematic, and ongoing monitoring process including assessment and evaluation of broadband service availability and the infrastructures being used to provide broadband services from the regional level to last mile service.

Currently, policy makers' role in facilitating the deployment of quality broadband services is limited by a lack of knowledge. They are not informed of where broadband services are and are not available, the quality of such services, or the varying conditions of the telecommunications infrastructures that are providing broadband. Implementing a monitoring system will require professional telecommunications expertise at the state level in conjunction with the development of an effective working relationship with the array of telecommunications providers in the state. An effective state monitoring program and evaluation process will facilitate relationships between various telecommunications providers and enhance coordination among providers system-wide.

By actively assessing the deployment of broadband and telecommunications infrastructures more generally, the state can identify underserved areas and work with telecommunications providers to ensure increased availability of broadband in such areas.

3. Monitor and promote the demand for broadband services within Pennsylvania.

Based on thorough community level analysis, the state should identify areas within communities where it could actively promote increased use of broadband and the Internet.

In rural areas without broadband infrastructures, it is not only difficult to ascertain demand for advanced telecommunications services, but difficult also to understand how such communities might use advanced telecommunications infrastructures if they were in place. Thus, the state should assess the possibility of unmet demand for broadband services in rural areas and facilitate relationships between communities and broadband providers where supply is not meeting

demand. Considering the nature of the digital divide, especially as it may relate to income, race, and educational background, such analyses should be designed to garner an improved understanding of broadband use and needs within communities. These analyses should include local schools, libraries, hospitals, not-for-profit organizations, businesses, and perhaps some individual users. These analyses would likely involve coordinated efforts within particular communities between local governments, schools, businesses, and perhaps even telecommunications providers to recognize how advanced telecommunications infrastructures are being used and identify particular users that could benefit from increased availability of advanced telecommunications technologies and services.

4. Support the use of broadband services in communities.

The state should coordinate providers among themselves and the communities they serve, especially in areas where there may be latent demand for advanced telecommunications infrastructures and the broadband services that such infrastructures can provide.

Though a range of telecommunications infrastructures are already in place, and various members of the telecommunications industry are constantly building out new infrastructures or improving existing infrastructures at the regional and local levels, there is little coordination in terms of the development and use of such infrastructures among the state's telecommunications providers. In some instances, the state has already attempted to facilitate the interconnection of telecommunications networks, especially at the regional level, through coordinating cooperative arrangements between the various owners of these infrastructures. In other instances, consortiums of telecommunications providers have already developed cooperative arrangements on their own, resulting in improved economies of scale for the providers and relatively high quality telecommunications services being available to an array of region-wide urban and rural users. While significant progress has been made in this area, nonetheless, there is still much to be done. The state should actively facilitate the further development of such arrangements.

The sharing and coordination of last mile telecommunications infrastructures should be considered along with regional middle mile and backbone networks. As mentioned in this report, certain last mile providers in the state have already developed some highly innovative arrangements. The state should work to further facilitate such arrangements through promoting the joint use of existing last mile infrastructures and encouraging joint ventures related to the building of new last mile networks. These types of arrangements are not only beneficial to the participating providers but to underserved communities as well. In short, the state could facilitate the process of telecommunications infrastructure deployment at various scales based on cooperation and coordination among providers.

5. Facilitate development of demand for broadband services in Pennsylvania keeping in mind that broadband is only a part of the rural development equation.

Further developing a technology-literate population in a community can help in promoting and sustaining the community's social and economic vitality. Perceived lack of demand inhibits broadband service providers from extending infrastructure to more remote areas of the state. In rural areas especially, telecommunications providers are often hesitant to deploy high-quality telecommunications infrastructures because of perceived lack of demand for such services and fears of receiving inadequate returns on their investments. In such instances, the state should act as a broker between communities and providers, working with providers and communities to create a situation where the deployment of advanced telecommunications networks could be profitable for the providers and socially and economically beneficial to the communities.

Amid the clamor for broadband services and the importance of such services for rural areas, it is crucial not to lose sight of other issues that can relate to the sustainability and growth of rural communities. Such issues may include out-migration patterns of the young and educated, the diversity of the community's economic base, educational opportunities for students and adults, access to quality health care, and the availability of quality modern infrastructure. At the same time, modern telecommunications technologies are linked to all of these issues. Thus, it is important to remember that telecommunications is only a part of the rural development equation, and telecommunications alone is a necessary but not sufficient condition for rural social and economic vitality.

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APPENDIX A. SPEEDS AND COSTS OF BROADBAND SERVICES

The following table shows a random selection of broadband costs and speeds based upon conversations with providers and information available from provider websites. The information was compiled from October 2002 through February 2003. Information may not reflect speeds and costs of similar providers in other areas of the state. Speeds are download/upload. M = Mbps (megabits per second); K = Kbps (kilobits per second). "Slow service" is not necessarily the slowest service offered, and "fast service" is not necessarily the fastest but includes only speeds that typically allow for advanced applications. The one exception is a small cable company that offers 1.5M/250K as its fastest service. Various factors may affect speeds of broadband service, and speeds are often slower than indicated in the table so providers often do not guarantee speeds. Especially for cable modems, speeds may be lower due to middle mile congestion during times of high use. Speed for DSL can relate to distance from a central office and various other factors and can therefore vary.

Prices in the table are approximate and in some instances modem rental costs have been included. Sometimes users can purchase their own modems and save costs over the longer term. Cable company prices are often higher if the user does not have cable television service. Prices do not include local tax or cable franchise fees in some instances. Wireless service requires an initial purchase of equipment. For slower speed, residential service equipment costs are in the range of $125 to $150 while synchronous business services equipment costs in the range of $800. Satellite does not include initial costs of equipment, which can be as high as $500, or professional installation fees, which can be in the range of $200. For cable and telephone companies, installation fees of $50 to $100 may apply as well.

Many providers offer more than two speeds. Some providers limit the amount of data transfer per month (e.g. 5000 megabytes per month).

Type of Provider	*Primary Service Area(s)*	*Slow Service*	*Price/month*	*Fast Service*	*Price/month*
Large Cable	Metro	1.5M/256K	$50	Various	Various
Large Cable	Metro; Non-Metro Urban/Rural	256K/128K	$39.95	2M/512K	$600
Medium Cable	Metro; Non-Metro Urban/Rural	600K/190K	$34.90	800K/800K	$44.90
Medium Cable	Non-Metro Urban/Rural	128K/128K	$29.95	768K/768K	$69.95
Small Cable	Rural	128K/128K	$29.95	1.5M/1.5M	$145
Small Cable	Rural	128K/128K	$34.95	1.5M/250K	Prices Set Individually
Large Phone	Metro; Non-Metro Urban	768K/128K	$49.95	7.1M/768K	$204.95
Large Phone	Metro; Non-Metro Urban	512K/128K	$49.99	Various	Various
Small Phone	Non-Metro Urban/Rural	128K/128K	$29.95	512K/512K	$49.95
Small Phone	Non-Metro Urban/Rural	512K/384K	$39.95	Various	Various
Wireless ISP	Non-Metro Urban	2M/128K	$35	500K/500K	$180
Satellite	Not Applicable	500K/50K	$59.99	Not Applicable	Not Applicable

Compiled from October 2002 through February 2003.

APPENDIX B. BROADBAND SUPPLY ANALYSIS

KEY DEFINITIONS

BLOCK GROUP (BG): UNITED STATES CENSUS BUREAU, 2000 CENSUS

A block group (BG) consists of all census blocks within a census tract having the same first digit of their four-digit identifying numbers. For example, block group 3 (BG 3) includes all blocks in the tract numbered from 3000 to 3999. BGs generally contain between 600 and 3,000 people, with an optimum size of 1,500 people. BGs never cross the boundaries of states, counties, or statistically equivalent entities, except for a BG delineated by American Indian tribal authorities, and then only when tabulated within the American Indian hierarchy.

CENSUS BLOCK: UNITED STATES CENSUS BUREAU, 2000 CENSUS

Census blocks are areas bounded on all sides by visible features, such as streets, roads, streams, and railroad tracks, and by invisible boundaries, such as city, town, township, and county limits, property lines, and short, imaginary extensions of streets and roads. Generally, census blocks are small in area; for example, a block bounded by city streets. However, census blocks in sparsely settled areas may contain many square miles of territory. All territory in the United States, Puerto Rico, and the Island Areas has been assigned block numbers.

URBAN AND RURAL: UNITED STATES CENSUS BUREAU, 2000 CENSUS

The United States Census Bureau classifies as urban all territory, population, and housing units located within urbanized areas (UAs) and urban clusters (UCs). It delineates UA and UC boundaries to encompass densely settled territory, which generally consists of:

- A cluster of one or more block groups or census blocks each of which has a population density of at least 1,000 people per square mile at the time.
- Surrounding block groups and census blocks each of which has a population density of at least 500 people per square mile at the time.
- Less densely settled blocks that form enclaves or indentations, or are used to connect discontiguous areas with qualifying densities.

Rural consists of all territory, population, and housing units located outside of UAs and UCs. Geographic entities, such as metropolitan areas, counties, minor civil divisions, and places, often contain both urban and rural territory, population, and housing units.

METROPOLITAN AREA (MA) : FEDERAL OFFICE OF MANAGEMENT AND BUDGET, 1990S

The general concept of a metropolitan area (MA) is one of a large population nucleus, together with adjacent communities that have a high degree of economic and social integration with that nucleus. Some MAs are defined around two or more nuclei. The MAs and the central cities within an MA are designated and defined by the federal Office of Management and Budget following a set of official standards that are published in a Federal Register Notice. These standards were developed with the aim of producing definitions that are as consistent as possible for all MAs nationwide. Each MA must contain either a place with a minimum population of 50,000 or a United States Census Bureau-defined urbanized area and a total MA population of at least 100,000 (75,000 in New England). MAs are composed of entire counties. This includes one or more central counties and may include one or more outlying counties that have close economic and social relationships with the central county. An outlying county must have a specified level of commuting to the central counties and also must meet certain standards regarding metropolitan character, such as population density, urban population, and population growth.

The territory, population, and housing units in MAs are referred to as "metropolitan." The territory, population, and housing units located outside territory designated "metropolitan" are referred to as "non-metropolitan." The metropolitan and non-metropolitan classification cuts across the other hierarchies; for example, there is both urban and rural territory within both metropolitan and non-metropolitan areas.

Note that the new Core Based Statistical Area definition that replaced MAs was not yet in place at the time of this study.

METHODOLOGY

The definition of rural in the broadband supply analysis was developed through the combination of some of the above definitions. Counties in MAs are called metropolitan while non-metropolitan county populations are divided into rural and urban according to the Census definition. In this analysis, rural metropolitan area residents were simply considered metropolitan. Many of these "rural" metropolitan residents live in suburban areas. There are 15 metropolitan areas in Pennsylvania including the Philadelphia and Pittsburgh areas as well as smaller areas such as Erie, Johnstown, Lancaster, and State College. Applying the area distinctions used in this report, non-metropolitan urban areas typically have populations ranging from about 5,000 to 15,000 and often serve as places of employment for people in outlying rural areas. Non-metropolitan rural areas are either especially small towns with populations of about 1,000 or less, areas of low-density population outside of such towns, or areas without a central location. These population figures provide only a general indication of the types of places discussed in this report.

The data used to conduct this analysis was collected through detailed interviews with the state's telephone and cable providers. These providers were contacted directly by phone largely from October to December 2002. Cable companies provided information about service availability at the franchise level, which were often relatively small spatial units such as townships and boroughs. Data were collected from 45 of the approximately 90 cable providers in the state.[59] For telephone companies, data were collected by ILEC central office location, of which there are more than 800 in the state, and providers were further questioned about the extent to which they were using remote technologies to deploy DSL beyond their central offices. In total, 21 of the state's 26 ILECs provided information about their service areas.

After the data was collected, broadband availability coverages were generated in a geographic information system (GIS). For the cable companies, coverages were developed at the minor civil division (MCD) or municipality level. There are about 2,600 MCDs in the state. For the telephone companies, coverages were developed by individual service areas. There are 841 distinct service areas covering the entire state. GIS coverages were developed to indicate where providers were and were not providing broadband services. Then, block group data from the 2000 U.S Census was overlaid on these coverage data to allow for the analysis of the various characteristics associated with the availability of broadband.

Block group level data allowed for the most detailed assessment possible of geographic and socioeconomic characteristics associated with broadband deployment. Block groups are a more refined unit of analysis than zip codes, census tracts, and still larger counties. In many respects, an analysis of broadband availability at any unit of analysis greater than the block group level has the potential to be problematic and in some ways meaningless. With the 2000 Census, there are 10,387 block groups in Pennsylvania. Of these, 36 have no population according to Census data and were therefore eliminated from the analysis.

CABLE MODEM COVERAGES

Various technical issues have likely resulted in the overrepresentation of the availability of broadband services in the state. For example, a cable company may not have infrastructure passing all homes in any particular franchise area. "Total homes passed" in any given franchise area are typically anywhere between 85-100 percent, and many of the homes not passed are in the most rural areas.[60] For this analysis, franchise areas were determined to either have or not have service, although some areas classified as having cable modem service had homes that were not passed by the

[59] One major cable provider did not participate in this analysis. Information about this provider was available from researchers at the University of Pittsburgh. However, this information only indicated this provider's broadband service areas and did not provide information about where the provider was not offering services. Thus, this information was only used to make comparisons for some aspects of the analysis and was not used in any of the models or comparisons *among* cable providers, where analyses were used to determine why cable providers *are* and *are not* providing services. The information about this provider was only for areas in the two major metropolitan areas of the state, which clearly have cable modem available, so using these data did not bias results about availability of cable modem services in non-metropolitan areas. Also, four of the cable companies interviewed were subsidiaries of telephone companies that were providing DSL service. They stated that they felt it would be redundant for them to provide cable modem service, so they were not included as cable companies that were not providing cable modem service. Thus, their service areas are not included in the database at all.

[60] See Warren (2001).

cable company's infrastructure. Furthermore, data for this analysis were collected from virtually all of the large providers in the state and only about one-third of the smaller providers. The small cable providers tend to be those that are not providing cable modem service, so since the large majority of those being left out are small providers, it is likely that rural cable modem service availability is overestimated. However, the small cable providers not included in this analysis account for less than 2 percent of the non-metropolitan cable television customers in the state. There are issues that likely have led to the overrepresentation of the availability of DSL as well, including issues of line quality that may be problematic in non-metropolitan rural, non-metropolitan urban, and metropolitan areas.

Also, the centroid approximation technique in the GIS used to match block groups with the cable and telephone provider coverages may have slightly overestimated or underestimated availability in some instances. Matching the various coverages was not seen as a problem since block groups outnumber both cable modem service areas, at a rate of approximately 4:1, and telephone service areas, at a rate of more than 10:1. Cable service areas and block groups often matched perfectly because block groups are often based upon minor civil divisions, which in turn are often the boundaries of cable franchise areas. In short, a large number of block groups typically "fit" within a given cable or telephone company service area, and typically only the edges of some block groups were outside of these areas. Virtually no other publicly available research has used such small units of analysis, and analysis conducted here could serve as a model for future research related to the geographic and socio-economic characteristics associated with broadband availability.

Cable company service area information was available from the FCC and "The Warren Factbook." Cable companies were asked if they were providing two-way cable modem service by each of their franchise areas. Although some cable companies have well over 100 franchise areas, and even small companies often have quite a few, companies were invariably familiar with their levels of broadband service in each franchise area. In instances where providers suggested that they were providing to most of a given area, they were assumed for this analysis to be providing in the entire franchise area and coded accordingly. Conversely, if they suggested that they were not providing very much service in a given franchise area, such an area was considered to not have service for the purposes of this analysis.

Data were collected for approximately 1,500 cable franchise areas, and these areas were matched up with all but 104 minor civil divisions in the Census data. There was no pattern to data not corresponding between the franchise areas and the minor civil divisions, and mismatches were geographically random.

DSL COVERAGES

Creating DSL service areas in the GIS was a bit more elaborate largely because the distance sensitivity of these services needs to be accounted for. Furthermore, telephone company service areas need to be accounted for in developing DSL service coverage areas. Though research elsewhere has assessed DSL service availability by central office location, it seems apparent that no other publicly available research has gone to the extent to precisely define areas of service availability as has been done here. In short, the research methodologies discussed below are in some ways unique, and a number of people within the telecommunications industry, including those especially familiar with telephone system infrastructures, were consulted about the details of this methodology in order to confirm its utility.

DSL service information was collected from the state's telephone providers. The central office and wire center boundary information described below was purchased from a private company. When providers suggested that they were offering DSL throughout a given service area, which typically involved the deployment of remote DSLAMs, such service areas were treated accordingly. The process described below relates to instances where a provider indicated a central office but no remote technologies in place in a given service area. Various GIS techniques were employed to create this service area information, including buffering, clipping, and centroid approximation techniques. Due to the detailed nature of how this information was developed, images are included with the description of this process. The images do not include data from actual providers, and any relationship between actual service availability and depicted service availability is coincidental.

In Figure 1, the outlined areas are ILEC service areas corresponding with an ILEC central office (CO). The gray areas are service areas of "Company A," while the white areas belong to other telephone companies. The dots represent the location of the CO within each service area. COs that have a DSLAM (and are therefore DSL ready) are represented by a light dot, while the dots for COs that do not have a DSLAM (and therefore are not DSL ready) are dark.

In rural areas COs are typically located in a small town, and the "local loops" emanating from such COs typically extend out through the service area from the CO. Since COs are not necessarily located within the center of a service area, local loops are often a range of lengths.

A buffer of 18,000 feet was then created around the COs with DSLAMs. This 18,000-foot buffer corresponds with the typical distance limitations of DSL availability confirmed in the literature and by the providers contacted in this analysis.

However, only users within the service area that has the DSLAM will be able to access DSL services from that DSLAM. Therefore, if a buffered area extends into a neighboring service area, users in that service area will not be able to receive DSL, as they are reliant upon local loops emanating from the CO that corresponds to their own service area.

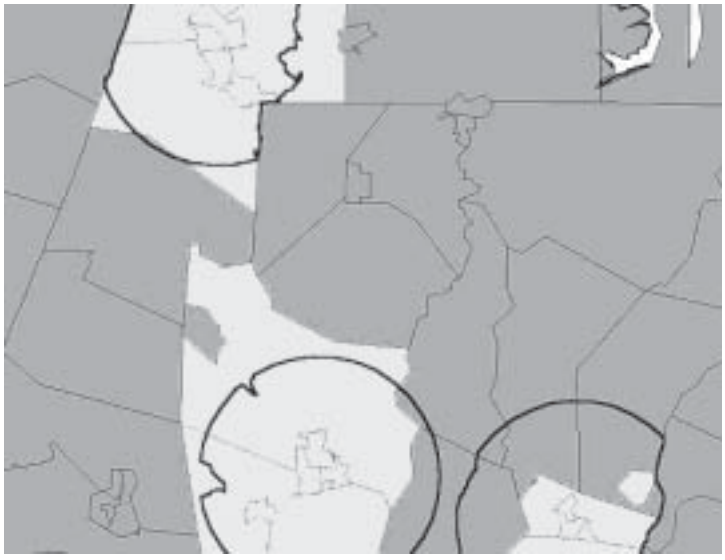
Thus, any given DSL service area has a maximum extent of 18,000 feet, but does not extend beyond the borders of the CO's service area. The extent of the availability of DSL service from the COs that have DSLAMs is more darkly shaded in Figure 2.

Figure 3 shows block groups that correspond with the geographic area depicted in Figures 1 and 2. The block groups that have their geographic center located within a DSL service area are shaded more lightly above. A centroid approximation technique was used to determine block groups that had their centers within a DSL service area. For this analysis, these lighter shaded block groups would be classified as block groups that have DSL service.

Figure 1

Figure 2

Figure 3



APPENDIX C. BUSINESS SURVEY

The business survey pilot study was part of a class project at Penn State in spring 2002 that included two professors, two graduate students, and 10 senior undergraduate students. The interview format and protocol were based on academic and professional resources related to conducting surveys, while the particular survey questions were largely based upon similar survey instruments used by researchers elsewhere that had assessed business use of the Internet. Due to the dearth of research related to business use of the Internet, the students and professors in the course often relied on their own understanding of business Internet and telecommunications issues to develop the survey instrument. The survey instrument was pre-tested and revised. The surveys were then conducted over the course of about six weeks, from mid-March to early May 2002. Those who were interviewed ranged from company presidents to secretaries, and each interview took approximately 15 minutes. Not all of those interviewed were willing or able to answer all of the questions.

From a list of counties designated rural by the Center for Rural Pennsylvania, the students selected 20 counties that were of interest to them and randomly selected 10 businesses from each county.[61] The professors and graduate students took care to assure that a range, in terms of population size and metropolitan proximity, of counties were selected for the survey. For further rural/urban analysis, each business location was determined to be rural or urban according to the Census definition.

All survey participants were assured that information concerning their companies and them as individuals would remain confidential in this research. Some companies and individuals would not have participated were it not for such confidentiality assurances. Each participant filled out a Consent to Participate Form which stated, "Names and identifying information will be removed from the file; thus, the information you provide is confidential."

The following is an unedited version of the research questions in the order they were asked.

1. What is your name and title?
2. What is your direct contact information, including e-mail address?
3. What is the name of your business?
4. Where are you located?
5. Please give a brief overview of your business. For example, what types of products or services do you provide, how many employees do you have, and so on?
6. What types of customers do you service?
7. Who are your suppliers?
8. Does your business use the Internet? If "yes" to question 8, the interviewer then asked questions 9-23. If "no" to question 8, the interviewer then asked questions 24-29.
9. What are your organization's primary applications of the Internet? (*after giving their* answer interviewees were often prompted about applications such as emailing customers or suppliers, exchanging documents, customer service, tracking shipments, purchasing products or services, online research or obtaining news, *videoconferencing,* and *educational/training purposes*)
10. How critical is Internet access to your organization, and is it becoming increasingly critical?
11. Does your business maintain a website? If so, what are the primary purposes of the site?
12. Does your business have any plans for future uses of the Internet that are especially different from the way it is being used now?
13. Is there anything else that you can tell me about your businesses' use of the Internet?
14. Who is your Internet Service Provider?
15. What has been the most important factor or factors in selecting your Internet Service Provider?
16. How do you connect to the Internet?
17. What is your connection speed to the Internet and does your connection speed vary? If so, what is your approximate range of speed?
18. Is reliability an issue, as in are there times when you are unable to access the Internet? If so, how often is this a problem?

[61] At time of this research, the Center classified counties as rural when more than 50 percent of the county's population was rural according to the 1990 Census. While the classification system has since changed, all but one of the counties used in this survey remain rural.

19. What are the costs of your Internet services and do you feel as though they are reasonable?
20. The project we are working on is looking at Internet access in rural places. As a comparison, advanced telecommunications services in urban areas such as Philadelphia and Pittsburgh can be ten times as fast as typical dial-up services and cost roughly $200 per month. Would this type of service be valuable to you at this price? Why or why not?
21. In general, has your organization encountered any barriers to acquiring high-speed, reliable Internet services? If so, what types of barriers or problems have you had?
22. Has the inability to secure better Internet services hindered the activities of your organization? If so, in what ways?
23. In general, are you satisfied with your Internet services, and is there anything else that you can tell me about your use of the Internet that I have not covered?
24. Why doesn't your business use the Internet?
25. Do you think that use of the Internet could be important to your business, either now or in the future? If so, in what ways?
26. Has not being able to have a reliable Internet connection been in any way responsible for your businesses' reluctance to use the Internet?
27. Have costs of Internet services been in any way responsible for your businesses' reluctance to use the Internet?
28. Have there been any other barriers to your business using the Internet? If so, what have they been?
29. In general, is there anything that you could comment upon regarding your businesses' non-use of the Internet that I have not covered?

APPENDIX D. MONOPOLY, COMPETITION, AND REGULATION: APPLICATION FOR BROADBAND

BY ANDREW N. KLEIT

To understand the competitive nature of broadband services, one must understand the basics of competition in the telephone and cable television industries and how these industries are regulated, especially considering these industries' current domination of the broadband telecommunications services markets. Competitive aspects of the interface between telephone and cable providers are also important. This analysis addresses competition in the provision of telephone and cable services and discusses regulatory and competitiveness issues related to broadband services.

The provision of telephone and cable television services has natural monopoly characteristics and, in fact, some aspects of the production process of these services arguably cannot naturally exist in a competitive market. Thus, they, and broadband in general, experience rate of return regulation, the typical regulatory response to natural monopoly. For telephone companies, the recent regulatory trend has been towards partial deregulation of telephone services, which has proven to be difficult in the context of a relatively complicated product. The cable television industry has historically been and continues to be largely deregulated.

THE THEORY OF NATURAL MONOPOLY

The basic economic model of competition assumes two or more firms in a market where market price equals the marginal cost of providing a product. This marginal cost is the same for all of the firms in the market. In competitive circumstances, the social surplus created by the market—the total benefit to consumers and the total benefit to producers—is at a maximum, and there is no economic rationale for government regulation of prices or services. In reality, the assumptions for this model of competition are often not fully realized. For example, the competitive model assumes that two or more firms can economically exist over a long period of time without going bankrupt. If at least two firms cannot coexist, the market is understood to be a natural monopoly and the assumptions of a competitive market are unrealized.

In general, the economic condition for a natural monopoly relates to whether it is more costly for one firm or more than one firm to serve a given market. From a regulatory perspective, a framework that allows for a monopoly provider can make sense for efficiency. For example, having several telephone companies building similar infrastructures side-by-side can result in unnecessary redundancy and reduced social surplus. So, regulating to allow for a monopoly provider may be especially pertinent for industries such as telecommunications and utilities where sites for locating infrastructure such as power lines or fiber optic cable may be limited.

From a competitiveness perspective, if one firm serving the market is the lowest cost arrangement, then two-firm competition is not stable and monopoly conditions can be expected to prevail. One sufficient condition for a natural monopoly is when the marginal cost is less than the average cost of providing a service. For example, if a cable television network is strung through a neighborhood, it may cost the cable provider very little to offer service to an additional household. With two or more providers in such circumstances, the competition could be expected to drive prices down to the marginal cost of providing the service. Because neither firm would be covering its fixed costs, those of stringing a network, eventually one of these firms would exit the market leaving a monopoly to the other.[62]

On the other hand, if demand for a product is large enough, then the relevant marginal costs may increase above average costs. However, demand for broadband and telecommunications services in rural areas is limited by relatively small populations and

[62] See Carlton and Perloff (1994, pp. 869–876) for more information.

low population density. Thus, it may be less likely in rural areas than urban that competition for broadband will arise, and natural monopolies for telecommunications services may be expected to persist.

THE REGULATION OF NATURAL MONOPOLY

In instances where there is a natural monopoly, some oversight may be necessary to curb monopolistic behaviors that may not be in the public interest, such as a firm limiting its output or charging exceptionally high prices. Thus, state public service commissions or other regulatory bodies often limit the rate of return on an incumbent monopoly firm's investment, the optimal outcome of which is that the monopoly provider will be induced to offer the lowest price possible to consumers. However, rate of return regulation can have its problems. For example, it guarantees profits for the regulated firm, providing limited incentives for the firm to respond to consumer desires or to engage in innovation.[63] The firm may also have limited incentives to reduce costs because such costs often are passed directly on to consumers.

An additional problem with rate of return regulation, which has become evident in the past several years with products marked by rapid technological change, is that such regulation assumes that the product is simple enough that a slow-moving regulatory body can effectively regulate it. In instances where products are complex and have constantly changing technologies, quality-of-service issues are often a particular challenge to regulators.

One means to solving the monopoly regulation problem, especially in rural areas, is through establishing a local cooperative. The local cooperative is a non-profit entity owned by its members that supplies services such as electricity or telecommunications without the intention of making a profit. In such a scenario, the local cooperative acts to give local consumers services that are justified by local demand and supply conditions. Some of these cooperatives exist in Pennsylvania. Such cable television cooperatives typically either already provide or are seriously appraising the provision of broadband services to local residents, typically at a reasonable cost. A relatively large number of community cooperatives throughout the United States have had significant success in providing highly advanced and reliable telecommunications services to local residents at a reasonable price. On the other hand, cooperative arrangements in the supply of telecommunications or other services such as electricity are not without controversy, as there can be circumstances where the cooperative management becomes unresponsive to its members while the members have no effective method of replacing the management.

TELEPHONE SERVICES AND REGULATION

Historically, there have been few effective substitutes for most telephone services. Furthermore, local telephone service has been subject to relatively high fixed costs and relatively low marginal costs making it a natural monopoly. Given these circumstances, local and long-distance telephone services were subject to direct rate of return regulation starting early in the 20th century. By 1980, however, technological progress in the provision of long-distance services made it clear that the provision of long-distance services was no longer a natural monopoly. Thus, the 1982 antitrust consent decree between the United States Department of Justice and AT&T, which was then the monopoly provider of local service and dominant provider of long-distance service in most areas of the country, provided for monopoly local service to continue but for a competitive long-distance sector to arise.[64] This mixed monopoly/competitive regime posed some problems. For example, the Federal Communications Commission (FCC) had to grapple with the difficult task of determining how much long distance carriers should be charged for access to local telephone provider networks. These and other issues, however, did not prohibit competition in long-distance services from moving forward successfully.

The Telecommunications Act of 1996 allowed for competition in local telephone services. Regulating access to local telephone networks, however, has

[63] There is a long-standing literature on the impact of regulation on innovation, beginning with Fellner (1958).
[64] See Besen (1991) for a further discussion.

proven difficult. Furthermore, significant legal uncertainty that was more complex than in long distance competition, strong inertial tendencies on the part of customers, and anticompetitive activity on the part of incumbent providers in providing network elements to rivals have deterred competition from successfully taking hold in local telephone services.[65] Furthermore, regulatory problems have been made more difficult by the increased complexity of telephone services and infrastructures. Simply put, it may be that the telephone industry is now too complex to allow for effective regulation of the interface between competitive and non-competitive sectors of the industry.[66] Wireless telephone technologies, which have recently decreased in price and grown in popularity, are increasing this complexity and are threatening the monopoly provision of local telephone service.

CABLE TELEVISION SERVICES AND REGULATION

Cable television appears to have all the attributes of a natural monopoly. The fixed costs of supplying cable TV are high and the marginal costs are low. Moreover, especially in areas of limited over-the-air TV service, there may be few effective substitutes for cable television service. The federal government, through the FCC, has attempted to regulate various aspects of cable television service in the past, but such regulation has met with little success. For example, the FCC required that cable providers offer "basic services" for a fixed monthly fee. Specifying the meaning of "basic services," however, proved difficult, and cable providers circumvented regulatory measures by excluding popular channels such as ESPN from "basic" packages and then charging an extra fee for such channels. With so many potential services being offered, the FCC could find no adequate method for designating between "basic" and "premium" channels. Thus, while the FCC found that it could regulate "basic" cable rates, the result was a reduction in products offered in the "basic" package.[67] Realizing the limited effect they were having, state and federal government entities curbed regulatory measures, and the cable industry is now subject to almost no regulation.

There are, however, some limits to the market power that can be exercised by cable providers. In some areas, there are "overbuilders," which are competitive cable companies that overbuild and compete against an incumbent provider. In such regions, cable TV subscribers often receive services for relatively low rates. However, as suggested previously, it is difficult for two firms to survive in a market, such as the cable television market, where there is a tendency toward natural monopoly. Thus, it is not surprising that instances of overbuilding in the cable industry are rare. Satellite television also offers an element of competition to cable providers. However, this service is limited in its competitive viability by both high fixed costs—the customer must buy a satellite dish—and by limited access to network television affiliates.

While cable companies have the legal right to expand into telephone services, as yet they have failed to do so aggressively. One reason may be the difficult legal environment for competing in local telephone service. Another reason may be reluctance to provoke entry into cable services by telephone companies. Given that two firms cannot survive in most cable markets, it is not surprising that incumbent cable firms do not venture into offering telephone services knowing that their profits are highly vulnerable to telephone companies' entry into cable services.

COMPETITIVE ANALYSIS APPLIED TO BROADBAND

Much of the broadband supply system is naturally competitive. For example, several providers offer backbone and middle mile services. The last mile of service, however, may have competitive problems, especially when there is only one provider or one of each type, telephone and cable, in an area. In rural areas, the lack of demand density may make last mile cable and television services natural monopolies. While the cable and telephone industries have faced

[65] For more information on anticompetitive activity by incumbent providers, see Sibley and Weisman (1998).
[66] For more information, see Harris and Kraft (1997) and Hazlett (1999).
[67] See Otsuka (1999) and Crawford (2000).

virtually no competition for their more traditional services in such instances, some competition has emerged between these two industries and from other industries, such as wireless, when it comes to broadband Internet services.

Rate of return regulation could be imposed to control the natural monopolies, but, based on experiences in telephone and cable services, it is not yet clear how direct regulation of broadband services could be helpful to rural consumers. Broadband cooperatives might be a method by which consumers could be provided with an efficient level of broadband services. Other options are for communities to share in the overhead costs of last mile services or to pool their resources or use monetary inducement to attract broadband providers. However, financially constrained communities may lack the funding to support such services.

In sum, competition among broadband providers in rural areas confronts many of the same difficulties as in cable and telephone services separately. While the cable and telephone industries in such areas are natural monopolies in many respects, increasing consumer demand for broadband is resulting in these industries competing more directly with one another.

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APPENDIX E. THE POLICY ENVIRONMENT FOR BROADBAND TELECOMMUNICATIONS IN PENNSYLVANIA

BY SHARON L. STROVER

This report has documented the many efforts of vendors to provide and of consumers to obtain broadband services in Pennsylvania. One conclusion of this research is that the pricing of broadband services is too high to encourage universal adoption in some areas. Therefore, state-level policy should consider possible avenues for reducing consumer prices for broadband and for extending the reach of the existing infrastructure. A discussion of policy environments for expanding broadband penetration requires a brief look at the broader federal context.

TELECOMMUNICATIONS DEREGULATION

Telecommunications in the United States has changed dramatically in the last 25 years. Competition in the long-distance market developed after the major restructuring prompted by AT&T's divestiture in 1984, eventually bringing pressures for competition to the local services market as well. In the 1990s, new types of services, notably Internet Service Providers (ISPs), developed in ways unanticipated in either federal legislation or Federal Communications Commission (FCC) regulations. The FCC decided that the latter fell into the category of "information services," which meant it was exempt from federal regulation. Consumer satellite communications also emerged, first providing multichannel television programming services and, later in the 1990s, Internet connection services. Cable television was substantially deregulated in 1984; its household penetration grew steadily throughout the 1980s and the 1990s. Ironically, deregulation brought with it a new and more important role for state-level regulation as utility commissions were obligated to preside over the operations of newly constituted Regional Bell Operating Companies (RBOCs).

The RBOCs and other large independents (e.g., GTE) in turn argued for rate deregulation at the state level, and many states adopted methods of incentive regulation that moved away from the standard rate of return regulation. New incentive regulation schemes, particularly price cap plans that promised the incumbents more opportunities to offer new services without having to go through lengthy tariff proceedings, were taken up at the state level. In several states, including Pennsylvania, such plans were tied to intentions to upgrade network capabilities within states.

The year 1996 was a watershed in telecommunications deregulation with federal legislation that permitted competition in local telephone services. The 1996 Telecommunications Act ushered in a process by which incumbent monopoly local service providers would open up their markets to competitors who could lease portions of the existing network. Both the FCC and the states were called upon to define which portions of the existing network would be subject to such unbundling provisions, adding more authority to state utility commissions.

Universal service was redefined in terms of marketplace language and rationales, and the Act's new formulations required modification of the internal subsidy processes that supported the Universal Service Fund (USF). New definitions for USF were hinted at in the Act; indeed the creation of E-Rate for schools and libraries constituted a novel conceptualization of USF goals, explicitly embracing Internet connectivity as an important social tool for those public institutions.

The Act also anticipated competition between cable companies and telephone companies for television services and established a timetable for deregulating the cable industry as part of its competition plan. There is nothing in the Act to suggest that its authors anticipated competition between these two industries to be most vigorous around high speed Internet connections. Further, the Act loosened ownership limits in various media, notably radio.

The rapid pace of telecommunications company consolidation was not entirely anticipated by the 1996 Act, even though such consolidation had begun even before 1996 with the shrinking of the number of RBOCs. The original eight now stand at four (BellSouth, Southwestern Bell or SBC, Verizon, and Qwest). The large regulatory burden after the 1996 Act that shifted many obligations to the states also was unanticipated.

FEDERAL ACTIVITIES AROUND BROADBAND DEPLOYMENT

Federal activities regarding broadband deployment are located in several agencies that administer programs to encourage investment in broadband facilities. These agencies include the Department of Education (DoE), Housing and Urban Development (HUD), the National Telecommunications and Information Administration (NTIA) within the Department of Commerce, and Rural Utilities Service (RUS) within the Department of Agriculture. Other activities take place in the FCC and in congressional legislation.

• NTIA's Technology Opportunities Program is probably the best known and oldest of these programs. It began funding telecommunications-based projects that reflect innovative technologies targeting underserved communities, but as of 2003, its funding was cut to only about $15 million. NTIA also sponsored four studies in the late 1990s that documented the Digital Divide in the country (NTIA 1997, 1998, 1999, 2000).

• The DoE's Community Technology Center program provided matching grants to states and localities for programs to improve technology training for low-income communities, but in the recent budget downturn it too had its budget cut and its future threatened.

• HUD has supported some technology programs within housing units. Both HUD and DoE programs provided aid to specific sites around the country, although their programmatic impact has not been assessed to date.

• RUS has several programs designed to improve telecommunications, including broadband deployment, in rural regions. Its loan program is available to rural telephone carriers and has been credited with dramatically improving Internet access in rural regions. For 2003, the RUS announced $1.4 billion in loans and loan guarantees for broadband access, defined at 200 Kbps (kilobits per second) or more, available to communities of up to 20,000 people. It also maintains a Distance Learning and Telemedicine program to provide funds to schools and health facilities in rural regions. In addition, it supported a Broadband Pilot Program that provided $100 million in loans to enhance the rate of technology deployment to rural areas. This pilot has since been superceded by the larger loan program.

• The FCC has issued studies that assess broadband deployment progress throughout the country, and through its administration of the E-rate program it indirectly promotes high-speed links at public institutions such as schools, libraries, and not-for-profit health clinics. The FCC has resisted any effort to define universal service as including broadband. Finally, through its competition policies, the agency influences the progress of broadband deployment.

The FCC began to gather data on what it calls 'advanced services' in 1999 as part of its obligations under Section 706 of the Telecommunications Act. Its definition of advanced services is a conservative 200 Kbps or greater and distinguishes symmetric services from asymmetric services (designated as 'high speed' by the FCC). Its reports have examined the national telecommunications backbone, middle mile facilities, and last mile infrastructure (FCC, 1999, 2000, 2002). To date, each of its three reports has concluded that broadband deployment is proceeding in a "reasonable and timely fashion" (FCC, 2002, p. 2), although it notes that certain groups of consumers (for example, people on Indian reservations, rural populations) are more vulnerable to "untimely" access than others.

The FCC's recent Triennial Review of February 2003 is a recent and controversial regulatory development that will affect broadband deployment. That decision addresses the unfolding of competition—local services, long distance, and data—between

incumbents and competitors, and alters the terms under which the would-be competitors can use incumbents' networks to provide local and advanced (broadband) services (FCC, 2003). The 1996 Telecommunications Act anticipated that competition in telecommunications services would unfold through three mechanisms: facilities-based entry, in which a competitor would make the substantial investment in building entirely new infrastructure; the purchase or lease of unbundled network elements from the incumbent local exchange company; and resale of the incumbent's retail services. The Review sought to assess how well these mechanisms are working and to modify the conditions of competition if necessary.

Although the full elaboration of the new rules will be released in June 2003, the initial decision signals a change in competitors' access to unbundled network elements in the near term. [68] The decision elicited five separate statements from the FCC Commissioners and was the product of internal brokering among them.

The Triennial Review includes the decision not to require incumbents to unbundle fiber-to-the-home loops or bandwidth for providing broadband services that use fiber loops for loops deployed further into the neighborhood but short of the customer's home (hybrid loops). (Requesting competing carriers that provide broadband services today over high-capacity facilities will continue to get that same access, however.) The Commission will no longer require that line-sharing be available as an unbundled element, although the final language implementing the review's provisions may modify this. The net effect may well be that certain competing companies that have not invested in facilities will drop out of the marketplace.

The Commission also found that switching, a key element of the unbundled network element platform, for business customers served by high-capacity loops will no longer be unbundled based on a presumptive finding of no impairment.[69] States have 90 days to rebut the national finding. For mass market customers, the Commission establishes criteria that states can apply to determine whether economic and operational conditions exist in a particular market that merit different treatment. The decision anticipates a three-year period for competing carriers to move from the unbundled network element platform (UNE-P) to facilities-based services. Pertinent to broadband services, the intention of the Triennial Review decision is to make new network investment by incumbents unavailable to competitors through UNE-P, a response to claims by incumbents that new investment is unwarranted when it must immediately be shared with competitors.

The 1996 Telecommunication Act created the E-Rate program, which provides discounts on telecommunications connections for Internet service and also underwrites various computer-related equipment purchases. The FCC is in charge of and monitors the universal service programs, which are administered by the Universal Service Administrative Company. They include the High Cost, Interstate Access, Interstate Common Line, Low Income, Rural Health Care, and Schools and Libraries programs. The last one, commonly called E-rate, is probably the best known of the universal service programs and accounts for roughly half of the universal service budget. (The High Cost fund is somewhat higher, at $3.15 billion in 2002.) With the amount of E-rate funding indexed against a school's percentage of students eligible to participate in the National School Lunch Program and a school's or library's rural location, the discounts can be sizable (up to 90 percent off of market charges). The E-rate program is capped at an annual funding level of $2.25 billion. An analogous program supports connections and equipment for rural, not-for-profit medical facilities under the Rural Health Care label. In 2001, Pennsyl-

[68] Editor's note: The Triennial Review was actually released on August 21, 2003, just before this research went to print. It is expected that the report will be litigated by several parties. The net effect of the rules is more responsibility at the state level. See www.fcc.gov for more information.

[69] The FCC defines impairment in its press release on the Triennial Review as follows: "Impairment Standard – A requesting carrier is impaired when lack of access to an incumbent LEC network element poses a barrier or barriers to entry, including operational and economic barriers, which are likely to make entry into a market uneconomic. Such barriers include scale economies, sunk costs, first-mover advantages, and barriers within the control of the incumbent LEC. The Commission's unbundling analysis specifically considers market-specific variations, including considerations of customer class, geography, and service." (FCC, 2003) The FCC adopted new rules for network unbundling and the obligations of incumbent local phone carriers.

vania received $35.6 million in high-cost support, $6 million in low-income support, and $49.3 million in schools and libraries support.

State agencies and programs can help schools and libraries to make the most of the E-rate program. As one report commented:

> *State agencies have played an important role in helping to expand the availability of the Internet and other digital technologies, and such leadership is associated with a higher fraction of districts applying for, and receiving, E-Rate discounts. This leadership includes state investments in creating educational networks linking districts and schools; providing state regional technology assistance centers; finding ways to use other funds, such as the TLCF [Technology Literacy Challenge Fund]; creating purchasing consortia to help lower the cost of acquiring hardware and software; and providing state guidelines for the design of school technology-related facilities (Urban Institute, 2002, pp. vii–viii).*

• Finally, federal legislation influences broadband deployment. The 1996 Telecommunications Act was a major endeavor that both changed and drew more public attention to telecommunications infrastructure in the United States. Since the early 2000s, several members of Congress have offered legislation that they believe would speed broadband access around the country.

The best-known effort is the Tauzin-Dingell bill. It includes major provisions that would allow the RBOCs to engage in interLATA data transport, a line of business that currently is available to them only when they are in compliance with Section 271 of the Telecommunications Act.[70] More widespread and speedy deployment of broadband services was offered as the primary benefit of the bill[71], with the justification that such infrastructure is linked to improved economic development opportunities (Curtis, 1998). Indeed, the Tauzin-Dingell bill (H.R. 1542) has been lauded as a rural broadband deployment opportunity.[72]

H.R. 1542 essentially would allow the former RBOCs to carry long-distance data traffic without meeting the Section 271 standards established in the 1996 Telecommunications Act. Section 271 establishes the process by which local exchange providers are allowed to offer long-distance services. H.R. 1542 forbids the FCC or any state from regulating the rates, charges, terms, or conditions for offering or entering into high-speed data services, Internet backbone service, or Internet access service. It likewise prescribes that Bell companies must upgrade their central offices to provide high-speed data services within the five years following the bill's passage, although the definition of upgradeable loops is limited to those under three miles from the central office. In other words, the logical candidate loops for Digital Subscriber Line (DSL) services—the primary high-speed end-user service currently offered by telephone companies—would receive the appropriate infrastructure so that the former RBOCs could offer high-speed data services to subscribers.

Proposals such as H.R. 1542 join several other similar legislative and regulatory efforts that purport to ensure greater network investment in parts of the country that appear to be slow in the race to wire America for faster network access.

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[70] Local Access and Transport Areas, or LATAs, are the basic geographic units differentiating local from long-distance service.

[71] H.R. 1542 essentially would allow the former RBOCs to carry long-distance data traffic without meeting the section 271 standards established in the 1996 Telecommunications Act. Section 271 establishes the process by which local exchange providers are allowed to offer long-distance services.

[72] Ordinarily, compliance with Section 271 requirements depends on having demonstrated to both state-level utility commissions and the FCC that these incumbent networks have sufficiently opened their markets to competitors such that they should be allowed to enter competitive, interLATA services such as long-distance telephony. The idea is to allow competitors access to incumbents' network elements so that they can offer new services such as Internet connections and high-speed data connections. H.R. 1542 would permit BOCs to provide high-speed data transmission service without demonstrating that their networks are available to competitors as well. A corollary provision of the bill withdraws or modifies some of the obligations on incumbents (BOC and others) to share network elements that enable would-be competitors to use their facilities for high speed data services, limiting that obligation to line-sharing provisions already spelled out in Section 251 of the 1996 Telecommunications Act, but exempting access to remote terminals. Previously, such access had been permitted. For access to the high-frequency portion of a loop, incumbents can charge requesting carriers an amount equivalent to what they impute to their own provision of the service. H.R. 1542 mandates that incumbents must resell, at wholesale rates, any high-speed data service they offer for a three-year period following the bill's enactment.

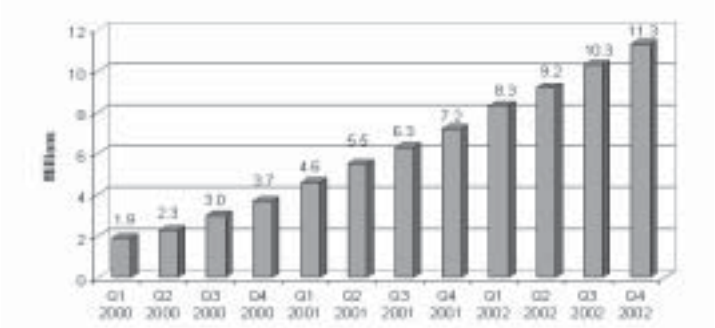
In summary, some federal policymakers approach the problem as one of greater investment in networks, but that investment always seems to carry "strings" that advantage one element of the industry at the expense of others or at the expense of ratepayers. The deregulatory thrust of the 1996 Act prompts policymakers to find solutions to such problems in market dynamics rather than government subsidies, although government incentives can be favored mechanisms. On the whole, various approaches at the state and federal levels aim to enhance broadband infrastructure: proposed legislation as well as FCC regulations attempt to enhance competitive circumstances by prescribing which network elements an incumbent must share with a competitor; some agencies channel subsidies directly to telecommunications providers, as with the RUS's low-interest loans; and some proposals would reduce entirely state government restrictions or oversight of industry behaviors in the broadband arena.[73] The prospect of additional high-speed or "advanced" services serving rural regions is highly attractive, but may come with too high a price no matter which approach is chosen.[74]

INCUMBENT LOCAL EXCHANGE PROVIDERS (ILECS), COMPETING LOCAL EXCHANGE PROVIDERS (CLECS), AND CABLE MODEM SERVICES

The landscape of competing telecommunications providers pits the services of incumbent telecommunications companies (ILECs), composed of the former regional Bell Operating Companies and various smaller, often rural telephone companies, against competing telecommunications companies (CLECs) that have three choices in establishing their services: they can build new facilities; they can lease or purchase unbundled network elements facilities from the incumbent at discounted rates under the unbundled network element platform, or they can take advantage of resale opportunities to use the incumbent's network. The large incumbent RBOCs are rapidly entering long-distance services and seek to enter the interLATA data transport business. CLECs have been hurt greatly by the technology sector downturn of the last three years, and their funding sources have withdrawn, leaving many of them no choice but to close. Many remaining companies rely heavily on the unbundled network element platform to compete with incumbents. In Pennsylvania, for instance, the FCC reports the facilities-based competition accounted for 512,126 lines while UNEs accounted for 515,883 lines; resale accounted for only 158,887 CLEC end user switched access lines (as of December 2001, reported in July 2002). This means that about 1.18 million lines in Pennsylvania were served by CLECs, with about 7.5 million remaining lines served by incumbents.

Cable companies are the third major industry providing broadband services, and to date they account for more broadband connectivity to residential and small businesses than does the wireline industry. In the broadband domain, cable modem services operate quite differently from telephone line-based Digital Subscriber Lines (DSL). Currently, cable modem services are more widespread than DSL services. Cable modem services have no unbundled requirement associated with them—a sore

Figure 1. Cable Modem Subscribers



Source: NCTA statistics as of December 2002

[73] Several state-level Tauzin-Dingell types of bills, often called 'broadband parity' legislation, are under consideration in 2003.
[74] The National Exchange Carriers Association has defined broadband as a service supporting data rates above 1.544 megabits per second, a much higher threshold than the FCC's definition. In H.R. 1542, high-speed service is defined as transmitting data at 384 kilobits per second in at least one direction, using packet-switched technology. This exempts technologies such as ISDN service from the definition. Dial-up modems can support speeds of only up to 56 kilobits per second (although the typical top speed is less).

point with the telecommunications companies. Cable operators throughout the country were well positioned to move into Internet service provision because they had made substantial investment in their physical plant in the 1990s in order to offer digital television. Having a digital plant meant that adding on cable modem services as another revenue stream was quite easy for the industry. Some critics believe the entry of the telephone companies into DSL services was a late response to the early lead established by cable television operators, and that without the spur of cable modem services the telecommunications companies would have moved into broadband even later than they did.

Of the nation's 107 million television households, the cable industry states that it offers cable modem service to 83 million and that 11.3 million currently subscribe as seen in Figure 1 (NCTA, 2003). FCC statistics (from 2001) are considerably lower than NCTA's (from 2002), but still indicate that cable modem outstrips telephone-based broadband services: 5.2 million lines are cable modem services while 2.7 million lines are DSL (FCC, 2002b).

The primary issues for the providers of high-speed or broadband services concern the competitive playing field and how regulations affect business opportunities. The incentives and motivations of some of the smaller incumbent companies differ from those of the larger telecommunications companies insofar as many of them are cooperatives and closely tied to their local communities. Nonetheless, nationally, roughly 80 non-rural companies (including the large RBOCs) serve roughly 90 percent of the rural areas, so it is important to understand the business decisions faced by such larger companies. Doing so may entail quite different approaches to urban regions than to rural areas.

REGULATORY REFORM AT THE STATE LEVEL

Pennsylvania joined other states in approving price cap regulation for incumbent local service providers in the early 1990s. Around the country at that time, several telecommunications companies sought to deregulate certain categories of service, and in exchange for opportunities to move into new lines of business with charges that were supposedly responsive to the market, they agreed to cap or freeze their prices on certain other services. Pennsylvania's rate deregulation is embedded in the Public Utility Code, particularly under Chapter 30, and the incumbents subject to its provisions have been scrutinized for not conforming to the intent of the reform.

Chapter 30 and Network Modernization

Pennsylvania adopted a competitive telephone framework in 1993 (Chapter 30, Public Utility Code, 66 Pa C. S. Sections 3001–3009) that provided for alternative regulation. Even though it contains language regarding competitive local service, the focus of the reform was on non-basic telephone services. The promises associated with Chapter 30 greatly outstrip the actual language in the legislation. In June 2003, the Pennsylvania Legislative Budget and Finance Committee issued a report on Chapter 30 entitled "Pennsylvania Public Utility Commission's Implementation of Chapter 30" that elaborates its history and intent.

Chapter 30 provisions traded pricing flexibility for the incumbent in some retail service classes in return for promises of substantial infrastructure upgrades throughout the commonwealth. For example, broadband services were supposed to be available throughout the state by 2015, and at the time that Chapter 30 was being formulated, it was sometimes referred to as the 'fiber optics bill.' The intent of the network upgrade commitment was to improve the voice network (especially by establishing fiber links among central offices) and to eliminate analog switches and multiparty lines despite contemporary interpretations that suggest that network modernization in 1993 related to the provision of DSL service. (DSL is barely mentioned in Chapter 30.) The network modernization component thus has more to do with modernizing the existing voice network than with delivering a mass market Internet connection. The Internet was not mentioned in the legislation. Indeed, with just over 100 sites in 1993, the World Wide Web was inconsequential to this reform at its inception.

When modernization is addressed in Chapter 30, it is in terms of a network reaching speeds of at least 1.5 megabits per second; Bell Atlantic's 1994 Chapter 30 proceeding discussed a 45 megabit per second network, and partly on that basis the financial terms

of its rate reform were generous. No particular technology is noted in the legislation. The thrust was to encourage incumbents to innovate in competitive services while shielding basic services from rate increases. A class of services, including basic local dialtone, was included under "protected" services, and their rates were frozen. Each telephone company in the state (roughly 40 including Verizon) was supposed to file a Chapter 30 plan, and most of these were approved in July 2001.

Chapter 30 provisions are supposed to sunset at the end of 2003, and hearings were held beginning in fall 2002 to evaluate whether Chapter 30 should be revised and extended or allowed to die. The Office of the Consumer Advocate in Pennsylvania, for example, has argued that Chapter 30 should be extended but with substantial modifications that would ensure broadband deployment (Popowsky, 2002). That office commented:

> *…it is not enough to throw ratepayer money at their telephone companies in the hope that some of that money will "stick" and will be spent on providing services to communities that would not be served under a business-as-usual approach. Chapter 30 tried to impose such a requirement on our telephone companies, but in retrospect it appears that the requirements were so long (from the year 1993 to 2015) and so vague ("access to broadband service [defined as a bandwidth equal to or greater than 1.544 megabits per second] by each bona fide telephone customer of a local exchange telecommunications company within five days after a request for broadband service is received by any telecommunications company") that it is difficult to assure that these benefits will be achieved in any particular community in a time frame or in a manner that meets that community's needs (Popowsky, 2002, p. 11).*

Because competition and infrastructure upgrades did not develop quickly even after Chapter 30 began and because the federal Telecommunication Act required changes in state provisions, the Commission adopted the Global Telephone Order in 1999 to promote additional competition and to adapt its provisions to the new federal law. Its provisions included:

- Capping Bell Atlantic (now Verizon) local rates until the end of 2003;
- Capping the local telephone rates of rural telephone companies at $16/month until the close of 2003;
- Keeping all Internet phone calls local;
- Lowering toll rates;
- Lowering access charges;
- Increasing the number of households eligible for Lifeline service; and
- Creating a $30 million universal service fund to offset costs in higher priced areas of the state.

One issue that has arisen alongside discussion of reforming Chapter 30 concerns the line speed assigned to dial-up modem service. The PUC regulations do not require that Internet providers guarantee specific line speeds associated with their services. Consumers, however, have complained to the PUC that their dial-up services for Internet access are sub par, prompting some critics to query whether guaranteed line speeds should be required under a revised Chapter 30.

The Bell Atlantic-GTE merger in 1999 created another opportunity to examine company commitments to building advanced infrastructure. As part of the merger approval, the company agreed to deploy a universal broadband network in phases, with 20 percent of it built 1998, 50 percent by 2004, and 100 percent by 2015. These obligations, however, have come under scrutiny in 2002–2003.

Frustrated with the continuing slow pace of competition, particularly Verizon's practice of slow compliance with competitors' requests to connect to or use elements of its network, in March 2001 the PUC ordered functional structural separation: Verizon would continue to operate as one company but the wholesale and retail divisions would be required to operate at arms-length pursuant to a code of conduct. An earlier decision in 1999 looked to structurally separate the company into two units but came under fire from Verizon. The Commission then adopted functional separation instead.

Regarding the smaller, independent or cooperatively based telephone companies serving regions of

Pennsylvania, no publicly available information was found on the extent of their system upgrades or Internet services. However, as noted earlier in this report, smaller telephone companies—many in rural regions—are more likely to offer DSL than are larger companies serving the same sorts of customers. The National Exchange Carrier Association writes that among the rural companies in its pool, 76 percent of 1,076 smaller telephone companies function as an Internet Service Provider. This figure is based on a survey of its Traffic Sensitive companies, which generally serve rural areas and have fewer lines in service (National Exchange Carriers Association, 2000).

UNBUNDLED NETWORK ELEMENT PLATFORM

As noted earlier, use of the unbundled network element platform has been an important mode for competitors to follow in entering markets. The UNE-P issue already has been addressed by the Pennsylvania PUC initially in 1997 and with revised rates in 1999 and late 2002. In Application of MFS Intelenet of Pennsylvania, Inc., et al., Docket No. A-310203F0002 (Final Order entered August 7, 1997) (MFS III), the Commission established the UNE rates based on a cost model proposed by Verizon, but it reserved the right to alter those rates. In 1999, the Commission modified some of the input costs in the model, resulting in reduced prices for several elements. A 2002 order describes alternative inputs and again anticipated reduced UNE prices. At this writing Verizon is required to compute this alternative model and to present the findings to the Commission. However, the FCC decision in the Triennial Review may alter this plan.[75]

CABLE MODEM SERVICES

On March 14, 2002, the FCC adopted a major rulemaking that sought to grapple with policy uncertainty regarding the regulation of cable modem services. In a declaratory ruling, the agency classified cable modem service as an "interstate information service" subject to FCC jurisdiction. In stating that modem service is not part of "cable service," the agency eroded any state claim to regulate cable modem access. Further, the FCC explicitly stated that cable modem service is not a separate "telecommunications service" and therefore cannot be subject to common carrier regulation. This was prompted in part by state claims that cable modem service is more properly treated as a common carrier component of cable service and therefore should be regulated in such a way as to require cable operators to open their networks so that other would-be competitors could use those facilities to provide broadband access. One impact of this ruling is to eliminate state jurisdiction over Internet services provided via cable operators.

STATES' ACTIVITIES

A review of how other states have addressed broadband deployment and related issues may help to frame possible approaches for Pennsylvania to consider. Many states have initiated programs designed to use telecommunications more effectively or to broaden capabilities, and many such programs focus on broadband infrastructure. Some programs are state universal service funds or special initiatives—often under the aegis of Governor's Commissions or Task Forces, while others, such as Mississippi, have benefited from the federal universal service program. Each state has a unique context in

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[75] Due to timing, the review could not be examined entirely prior to the printing of this research report. However, this paragraph from the review may be pertinent to the big picture on how states will determine whether there is competition or not and consequent needs for regulatory review on rates.
"We expect state commissions to follow a two-step process in determining whether to find 'no impairment' in a particular market. In the first step, states will apply selfprovisioning and wholesale triggers to a particular market to determine if the marketplace evidence of deployment of circuit switches serving the mass market requires a finding of no impairment. If the triggers are satisfied, the states need not undertake any further inquiry, because no impairment should exist in that market. If the triggers are not satisfied, the state commission shall proceed to the second step of the analysis, in which it must evaluate certain operational and economic criteria to determine whether conditions in the market are actually conducive to competitive entry, and whether carriers in that market actually are not impaired without access to unbundled local circuit switching. The states should evaluate evidence of switch deployment that does not automatically satisfy the triggers, but nonetheless may demonstrate the absence of impairment in the market."

terms of its telecommunications regulatory systems, relationships with dominant incumbents (typically the Bells or Verizon), and existing infrastructure.

Ohio's National Regulatory Research Institute undertook a survey of state strategies regarding broadband in 2001 (National Regulatory Research Institute, 2001). Their results, based on 39 responses from state regulatory commissions, sought to ascertain state definitions of advanced services, how states handled advanced services, their approaches to open access, and their programs on advanced services. The overwhelming finding was that at that time, the state regulatory commissions were not regulating advanced services. Their most direct approach occurred through their work to ensure fair competition through interconnection agreements, handling service quality complaints, or configuring universal service funds. Most of their regulatory attention is directed at the large ILECs. Several commissions reported that their states have other non-regulatory mechanisms that are being used to encourage broadband (tax incentives, line discounts, grants), and some noted that their state networks are being used to leverage better consumer network capabilities. The following state-level program types represent a varied collection from the survey.

LEGISLATIVE AND REGULATORY COMMISSION ACTIONS ON DEREGULATION

Some states implemented deregulation in advance of the 1996 Telecommunications Act and most used price cap or so-called "incentive regulation plans" to reduce explicit pricing obligations.

New York's aggressive pro-competition activities are models for several other states around the country, although the size and expertise of its regulatory staff are not duplicated in any other state. New York was one of the first states to adopt incentive regulation, whereby a carrier would meet certain performance thresholds in one realm and have an incentive to undertake (or to price) other activities without regulatory policies or tariffs defining them; prices for the latter would be set at "market rates" rather than rates determined within a utility commission's hearings. New York's policies attempted to ease competition into an environment in order to create a level playing field for new entrants.

Ohio joined several other states grappling with a competitive push from the dominant exchange companies. It deregulated in 1995 and revisited its rules in 1999 to make adjustments for a competitive process that seemed to be working for businesses but not for residential users. Pennsylvania had numerous hearings and regulatory actions around deregulating telecommunications within the state as early as 1993, when it adopted Chapter 30. Texas's major deregulation effort occurred through H.B. 2128 in 1995, deregulating Southwestern Bell in exchange for promised statewide infrastructure guarantees.

Subsequent to these deregulation efforts, complaints escalated around the country regarding service quality as well as incumbent reticence to comply with opening their networks to competitors. CLECs alleged that the Bell Operating Companies were unfairly slow in making their networks available to competitors, and many states held hearings on that matter, levied fines against the incumbents, and attempted to establish standards to cope with the RBOCs' behaviors.

BROADBAND PARITY LEGISLATION

The RBOCs, particularly SBC, introduced Tauzin-Dingell-style legislation in several states in 2002–2003. "Broadband parity"—referring to parity with cable companies' lack of an unbundling requirement––bills include Texas HB 1658 and SB 377 introduced in March 2003; Kansas HB 2019 that was rejected by legislators in February 2003; Oklahoma HB 2796 that passed on a 90–2 vote in 2002; Indiana HB 1627 that passed the House in February 2003 and is now in the state Senate; SB 826 in Connecticut; and Missouri SB 221 that passed a House Committee but died in a Senate committee at this writing. South Carolina[76] and Illinois both passed legislation. North Carolina, Alabama, and Nevada entertained similar bills in 2003. Such bills represent a way to bypass the federal layer of authority on regulating high-speed

[76] A bill advanced by BellSouth and introduced in the South Carolina legislature in January 2003 would deregulate all broadband services capable of transmitting information at rates exceeding 144 kb/s in at least one direction, or services that combine wire routing and transmission to allow users to access the Internet.

Internet services. Most of these bills are extremely brief (and many are identical). They generally prohibit any regulation of high-speed Internet services. Language from the pending bill in Texas (H.B. 1658, 2003) below is typical:

Notwithstanding any other provision of this title, the commission may not require the unbundling of a network element used in the provision of high-speed Internet access service or broadband service, the resale at a discount of a high-speed Internet access service or broadband service, or any other obligation prescribed by 47 U.S.C. Section 251(c), as amended, as that obligation relates to the provision of high-speed Internet access service or broadband service, unless the FCC specifically authorizes state regulatory agencies to impose such a requirement.

NON-REGULATORY STRATEGIES FOR ENCOURAGING BROADBAND DEPLOYMENT

States have adopted other non-regulatory strategies in order to push faster network capabilities out toward rural regions and different user groups. The

Table 1: State Network Strategies

	Goals	Mechanism	Adopted in
a. Demand Aggregation	To lower telecommunications costs for the state and other government users.	The state government receives volume discounts from telecommunications companies by consolidating telecommunications service demands of various state government agencies and offices into a single large purchasing unit.	• Virginia
b. Resource-Sharing	To lower telecommunications costs for the state and other government users. To maximize the efficiency of existing and new telecommunications infrastructures in key routes.	The state government and a telecommunications company barter free access to the state's highway rights of way and free telecommunications services to the state government and/or telecommunications infrastructure ownership. The state government and the vendor usually make a commitment to a long-term partnership that may last for several decades.	• Maryland • New York • South Carolina
c. Anchor Tenancy	To lower telecommunications costs for the state and other government users To upgrade public telecommunications infrastructure in all parts of the state.	The state government and one or more telecommunications companies enter a contract to make advanced telecommunications available to the state government. Telecommunications service to the state government is provided through public telecommunications networks, which would receive switching and transport capability upgrading as specified in the contract. Such an infrastructure improvement benefits all telecommunications users in the state (i.e., businesses and residents) because all types of users use public telecommunications networks.	• Alabama • Georgia • Kentucky • Mississippi • New York • North Carolina • Ohio • Pennsylvania • Tennessee • West Virginia

Source: Oden and Strover (2002).

three modes that characterize such efforts include demand aggregation, resource sharing, and using the state's own telecommunications traffic as an anchor tenant to build and finance a network that can be used more broadly by additional users. Various purchasing programs, consortium-building efforts, and state-sponsored grants can facilitate such approaches. Some are detailed in the following pages through thumbnail descriptions of different state practices. Mechanisms include using state networks to extend non-state communications opportunities, using utility commission approval over mergers or network unbundling proceedings to leverage concessions from carriers, establishing special programs targeting rural digital inequities, and establishing unique joint ventures with carriers in order to achieve improved statewide infrastructure. Certain cities and towns also have initiated telecommunications projects to enhance local connectivity and opportunities for economic development. A schema of such approaches as used by different states is laid out in Table 1.

INFRASTRUCTURE ASSESSMENTS AND MAPPING

Several state governments or commissions have inventoried telecommunications facilities. Such inventories offer baseline assessments of capabilities that allow states to more objectively determine deficits in services and capabilities. These assessments also play an economic development role in certain states by identifying locations of needed resources for businesses considering the location advantages of alternative sites. Some telecommunications companies resist assessments because they fear competitors will obtain information bearing on competitive advantage. However, the nationwide trend appears to be toward offering such information to the general public with the goal of inculcating more business and community awareness of infrastructure possibilities and alternatives.

Ohio and North Carolina have joined the efforts of several other states in attempting to assess telecommunications infrastructure in order to evaluate economic development potentials. For example, the Ecom-Ohio effort, conducted by the Technology Policy Group within the Ohio Supercomputer Center, "is now in its third year of measuring Ohio businesses' and citizens' ability to deploy the new tools of electronic commerce. Ecom-Ohio uses benchmarks based on those developed by the Computer Systems Policy Project in 1998" (Ecom-Ohio web site at http://www.ecom-ohio.org/). This endeavor is based on evaluating the connections of various institutions against a four-step framework that aims to assess the state's overall "readiness" for e-commerce. The project has spawned several detailed maps of county-level telecommunications capabilities and activity as gauged by amounts of data traffic (Ecom-Ohio, unpublished paper, 2001 and website at http://www.ecom-ohio.org/).

North Carolina took an even more detailed approach as it assessed telecommunications infrastructure at the wire exchange level of detail for each county in the state. This became the basis for a state program that attempted to ensure that every county had flat-rate dial-up modem access to the Internet. In its second phase, the program attempted to ensure that each county had broadband access to the Internet through its Rural Internet Access Initiative (created through SB 1343, An Act to Create the North Carolina Rural Internet Access Authority and to Direct the Regional Partnerships, with the Assistance of the North Carolina Rural Economic Development Center, to Study and Report on the Information Technology Infrastructure and Information Technology Needs of the State, passed in August 2000). The state's Rural Internet Access Authority was supposed to enable local dial-up Internet access in every telephone exchange by the close of 2001, make high-speed Internet access available to each NC citizen within three years, and establish two Telework Centers in the state's most distressed areas (http://www.ncruralcenter.org/internet/).

Georgia Tech has mapped some of that state's telecommunications infrastructure (available at http://maps.gis.gatech.edu/telecomweb/index.html) as an impetus for economic development. The team compiling the information persuaded telecommunications providers within Georgia that a combined look at the location of POPs and fiber trunk lines would help businesses evaluate their options there.

Michigan undertook a detailed infrastructure assessment in advance of passing legislation in 2002 directed at upgrading its statewide telecommunica-

tions facilities and networks. Its efforts can be seen at http://linkmichigan.michigan.org/index.html.

INFRASTRUCTURE INITIATIVES

COLORADO

Colorado's Multiuse Network (MNT) initiative is designed to pool the purchasing power of the state's telecommunications contracts for the improvement of statewide infrastructure. As part of this effort, United States West has been awarded a $37 million contract that will create a high-speed fiber-optic network connecting all state offices. The Colorado legislature also passed a "Beanpole Bill" to extend the geographical reach of the MNT initiative to the local level to include all public facilities (schools, colleges, libraries, and health care, municipal and county facilities), not just state agency offices. The bill provides $4.6 million for matching funds to communities as an incentive to pool their demand. Each self-defined community will issue its own RFP to private providers to connect these facilities to the nearest point of presence of the MNT. Communities then will apply to the state for funding to cover part of the overall cost. Local matches will vary depending on need.

IOWA

Several years ago, the state of Iowa created the Iowa Communications Network (ICN). ICN is a statewide, state-administered, fiber optics network. The capacity of the network enables hospitals, state and federal governments, public defense armories, libraries, schools, and higher education authorized users to communicate via high-quality, full-motion video, high-speed Internet connections, and telephones. The ICN is a statewide network with more than 3,000 miles of fiber optic cable reaching into all 99 counties, putting every citizen within 15 miles of a video site.

In order to construct the network, Iowa allowed vendors to submit proposals to either construct the fiber optic cable lines or lease capacity on existing fiber. Only two bids were received and both were for construction of the fiber optic cable, which meant the state had to become the owner and administrator of the network. In recent years, the state has tried to sell the network.

MICHIGAN

SB 881 (effective 3/14/2002) created the Michigan Broadband Development Authority (Authority) as a public corporate body within the Department of Treasury. The bill authorizes the Authority to: assist, through financing and refinancing, the expansion of broadband infrastructure services to residential, commercial, public, and nonprofit customers in this state; authorize the issuance of bonds and notes to finance or refinance the private and public sectors' development of the broadband infrastructure; authorize the making of loans to and joint venture and partnership arrangements with broadband developers and broadband operators; assist broadband developers and operators with all other matters necessary for the acquisition, construction, maintenance, and operation of the broadband infrastructure; make broadband services to schools and libraries a priority under authority financing programs; and ensure that the financing and refinancing of the development of broadband services includes provisions that small businesses from each region of this state have an equal opportunity to receive financing and refinancing.

The law prohibits any allocable portion of the broadband infrastructure financed by a loan to a governmental entity or a nonprofit organization from being used to serve residential, business, or other commercial customers. The bill also prohibits the authority from making loans to, or entering into any joint venture and partnership arrangements or participation with, any governmental entity or nonprofit organization except in connection with the financing or refinancing of development costs for that allocable portion of the broadband infrastructure used or to be used exclusively by governmental entities or nonprofit organizations.

SB 881 also requires the authority to establish a seed capital loan program to make capital loans to persons planning to apply to the authority for financing of broadband infrastructure and specifies that priority for the seed capital loan program be given for developments targeted to underserved areas. The bill requires the authority, during the initial two years of operations, to designate a minimum of $500,000 to be targeted to rural underserved areas and a minimum of $500,000 to be targeted to urban underserved

areas. In addition, the bill requires that community economic development programs and small providers be given a preference to receive loans.

MINNESOTA

Connecting Minnesota is a statewide fiber optic network project, which will consist of 2,000 miles of fiber optic cable to be laid in the interstate highway right-of-ways (land adjacent to the highway). The network will reach within 10 miles of about 80 percent of the state's population, including rural areas and small towns throughout Minnesota. Connecting Minnesota's fiber optic network will consist of a fiber optic "backbone" that consists of northern and southern Minnesota loops connected to a central network in the Minneapolis/St. Paul metro area.

The network project was initially being completely financed (at $195 million) by ICS/UCN, a Denver-based utility developer, with support from Boston-based LMAC Construction. It was to finance, build, maintain, and manage the network for both public and private sector use.

In exchange for access to the right-of-way, ICS/UCN was to provide telecommunications capacity to meet the Minnesota Department of Transportation's need to connect district offices and wayside rest areas, to support new technologies used to manage road surfaces, and protect the public. ICS/UCN also would provide 20 percent of the network capacity for public use, which includes K–12 schools, universities, libraries, and state and local governments. The remaining 80 percent would be leased to the private sector, such as long-distance, Internet, and other telecommunications providers.

In mid-2002, ICS/UCN announced its withdrawal from this project, citing financial difficulties resulting from ongoing legal battles with United States West. Even though ICS/UCN had been winning the court challenges posed by United States West, the company fell victim to retracting capital markets. The state has indicated it will seek another contractor to take over this initiative.

NORTH DAKOTA

North Dakota will build a statewide, broadband telecommunications network connecting 552 locations in 194 cities throughout the state. The state's broadband infrastructure project has three primary goals: (1) to deploy an integrated network to meet current and future needs for government and education; (2) to reduce telecommunications rates by aggregating public demand and negotiating a lower price for bulk service; and (3) to promote economic development by making broadband services available in every county and in communities throughout the state.

The state awarded three separate contracts to complete its new network. Dakota Carrier Network (DCN) was selected to provide the transport services, which essentially involves building and managing the network. Sprint was awarded the contract to provide Internet services to all government and education entities. Corporate Technologies of Fargo won the bid for customer premises equipment, which involves routers and other equipment to connect endpoints to the broadband network. The state of North Dakota believes once the network is complete, it will provide North Dakota residents the greatest universal access to high-speed telecommunications services of any rural state in the nation.

WASHINGTON

"Washington Light Lanes" is a public-private partnership that will install a $100 million fiber optic backbone network across the State of Washington. The project is a joint effort of the Washington State Department of Transportation (WSDOT) and UCN of Denver, Colorado. Light lanes will connect the intelligent transportation systems (ITS) on state highways from cities across the state.

The project will construct a "backbone" system that will have more than 600 fibers in some locations. That backbone will consist of a series of small conduits placed along the highway with fiber bundles inside the conduits. In addition to that core backbone, WSDOT is to receive 48 fibers dedicated for highway uses. The remaining capacity will be leased to private-sector telecommunications service providers.

OTHER STATE ACTIVITIES AND INITIATIVES

ALASKA

Alaska obtained a waiver to FCC's E-rate policy on shared use of discounted lines, and now uses its E-rate discounted connections to use library and school sites for after-school programs and for other community purposes.

CALIFORNIA

The California Teleconnect Fund provides discounted telecommunications services for qualifying schools, libraries, hospitals, and community-based organizations. Efforts by the California Public Utilities Commission and the Corporation for Education Network Initiatives in California (CENIC) to overcome the barrier of the last-mile for schools statewide have taken shape in programs such as the Digital California Project (DCP). This is an effort to defray the cost to K–12 schools and districts for a high-bandwidth connection to the CalREN-DC network. CENIC (through DCP) planned to make awards totaling $1.4 million to 28 school districts in 2002 to establish or extend school networks to the CalREN-DC network or the commodity Internet at speeds of T-1 or better.

On a different front, community activists in California established a definition of a community technology program (Chapter 308) as part of state law. Such programs are neighborhood centers that provide technology access and training in low-income communities. The definition enables various federal and state funding sources to identify and support qualified providers of community technology services.

FLORIDA

HB 625, which would have created the Digital Divide Trust Fund, died in conference committee on March 22, 2002. The fund would have received and disbursed funds required to pay the costs of facilitating the design and implementation of programs using information technology to educate and train economically disadvantaged individuals to become qualified to compete effectively for high-skill, high-wage employment opportunities in Florida.

In 2003, two bills that have broadband implications were under discussion. H0531, the Technological and Economic Development Act, would create a new state commission to leverage research and development in strategic technologies for economic development purposes. S52, the Florida Emerging and Strategic Technologies Act, supports the creation of joint-use digital media research and production in Florida. South Florida currently has two Tier One Network Access Points (NAPs) that are fully developed, and another is underway in north Florida. These facilities, along with aggressive deployment of broadband facilities by providers, have led to a significant level of broadband deployment in populated areas of the state.

ILLINOIS

Two Illinois programs, the Community Technology Grant Program and the Eliminate the Digital Divide Infrastructure Program, were established to enhance access to technology and to support inter-city and rural community programs for computer and Internet training. The CTC program was funded through three sources: (1) a $1 million general revenue fund appropriation in the year 2000; (2) an additional $1 million from a general revenue fund appropriation in 2001; and (3) $15 million over three years (2002–2004) from a settlement between businesses and Ameritech that was tied to the revision of the state's telecommunications law, also in 2001. A $15 million, three-year program was created as a result of this settlement that funds the Eliminate the Digital Divide Infrastructure Program.

MONTANA

In 2000, the state of Montana instituted a tax credit program to accelerate the growth of a high-speed telecommunications infrastructure throughout the state. Administered by the Department of Commerce, one or more providers may receive the credit. In any one year, the maximum amount of the credit available to all providers is $2 million. Eligible companies may claim no more than 20 percent of their investments as credits. The credit is applied against the telecommunications excise tax of 3.75 percent on the sales price of retail telecommunications services.

NEW YORK

Deregulation began in 1985, well before similar efforts at the federal level were successful. The state opened competition with the local exchange companies by lifting the previous regime of price controls. In 2001, the New York Public Service Commission created a new incentive regulation framework for Verizon (formerly Bell-Atlantic). By creating incentive mechanisms and measuring the performance of the carrier in meeting customer satisfaction (as well as other metrics), New York has enhanced its competitive environment and expanded services into underserved areas. An evaluation of the progress of this system can be viewed on the Public Service Commission's website at http://www.dps.state.ny.us/telecom/telanalysis.htm.

The Wired Buildings program, which was first outlined by Governor George Pataki in his 2000 State of the State Address, helps developers to wire and outfit existing buildings to accommodate the needs of small information technology businesses by providing grants for the deployment of advanced telecommunications infrastructure and related amenities necessary for business growth. The program also works in conjunction with the Quality Communities Technology Advancement Task Force to expand access to broadband services in rural areas of New York. A number of grant projects in the second round of funding will target the North Country and Catskill Watershed regions for demonstration projects.

NORTH CAROLINA

North Carolina took a detailed approach to infrastructure assessment by mapping telecommunications infrastructure at the wire exchange level of detail for each county in the state. This map became the basis for a state program attempting to ensure that every county has flat-rate dial-up modem access to the Internet. In its second phase, the program is attempting to ensure that each county has broadband access through its Rural Internet Access Initiative (created through SB 1343, An Act to Create the North Carolina Rural Internet Access Authority and to Direct the Regional Partnerships, with the Assistance of the North Carolina Rural Economic Development Center, to Study and Report on the Information Technology Infrastructure and Information Technology Needs of the State, passed in August 2000). The Rural Internet Access Authority was to enable local dial-up Internet access in every telephone exchange by the close of 2001, make high-speed Internet access available to each state citizen within three years, and establish two Telework Centers in the state's most distressed areas.

In 2002, the legislature approved a bill that expands the definitions for the types of infrastructure that can be funded with money from its Industrial Development Fund (IDF) (Ch. SL 2002-172). The expanded definition includes expenditures on telecommunications and high-speed broadband lines and equipment.

OHIO

The Ohio Community Computing Network (OCCN) was established in 1995 as the oversight and evaluation organization for the 14 community computing centers created and funded by the Ameritech Advantage Ohio alternative regulation case settlement. This marked the first time in the United States that a settlement before a state public utility commission included the funding of community computing centers in low-income neighborhoods. This settlement has made computers and telecommunications technology accessible to people of all incomes through community technology centers. OCCN has expanded and is currently working with more than 40 community technology centers in urban and rural areas of Ohio. The centers are located in libraries, community centers, schools, churches, social service agencies, and residential housing complexes. Since its inception, OCCN has received or distributed to community technology centers $4.45 million from Ameritech and $90,000 from Cincinnati Bell.

OREGON

The state's program for rural build out of its broadband network is underway. Rules have been written and Requests for Proposals have been funded in many areas within Oregon. Most of the funding is concentrated on constructing fiber rings to local communities. To date, only Qwest has participated in legislation approved in 1999 in a cash payout to the state for funding rural telecommunications deployment in excess of $150 million.

TEXAS

As part of major telecommunications deregulation in 1995, Texas created a discounted T-1 line pricing program that enables schools, libraries, and rural medical facilities to obtain relatively inexpensive access to T-1 connectivity. The same deregulation initiative, HB 2128, also created the Telecommunications Infrastructure Fund Board (TIFB). This program was conceived as a 10-year investment in telecommunications infrastructure in rural and underserved regions of the state. Eligible recipients originally included schools, libraries, and not-for-profit medical facilities. This was expanded later to collaborative efforts of different partners that contained some complement of the original TIF-eligible institutions. The TIFB programs are funded by assessments on the telecommunications carriers serving the state, which generally appear as line items on customers' bills. The program has granted roughly $100 million per year to various infrastructure projects, primarily focused on establishing computer and Internet connectivity at various schools and library sites around the state.

More recently, Governor Rick Perry initiated a study among public and private stakeholders that resulted in the Broadband Stakeholder Report to Staff of the Governor's Policy Office (2003), which weighs the acceptability of various policy alternatives under consideration to stimulate broadband and included some telecommunications infrastructure maps. This report came out about the same time as the state Public Utility Commission's Scope of Competition Report, which gathered extensive carrier data in an effort to plot the availability of competitive local services as well as competitive broadband services.

VIRGINIA

Virginia created a program called the Advanced Communications Assistance Fund, which provides up to $50,000 per award to communities working to improve local telecommunications infrastructure. This program boosts connectivity in smaller communities.

Through VirginiaLink, contracted service providers will offer businesses throughout Virginia "one-stop-shopping" access to unbundled, high-capacity telecommunications services. Businesses access the communications services by joining VirginiaLink, the consortium buyers' group. The VirginiaLink Consortium is administered by Virginia's Center for Innovative Technology (CIT), a state-charted, nonprofit organization dedicated to the growth of technology and business in Virginia. To acquire discount services through VirginiaLink, a consumer must purchase a one-year membership, which will cost end users $100 per business location with a maximum fee per firm of $1,000. Service resellers and Internet service providers (ISPs) also will be able to join for a $500 fee per location with a maximum cost of $2,500.

Virginia also recanted its legislative prohibition on utilities offering telecommunications services, a response to the city of Bristol's initiative to extend fiber-based connectivity to various clients through its region.

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The Center for Rural Pennsylvania
200 North Third St., Suite 600
Harrisburg, PA 17101
phone (717) 787-9555
fax (717) 772-3587
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