Links to the Future

The Role of Information and Telecommunications Technology in Appalachian Economic Development

By Michael Oden and Sharon Strover

With Nobuya Inagaki, Martha Arosemena, Jeremy Gustafson, and Chris Lucas

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ARC's Mission

Created by Congress in 1965, when Appalachia was considered "a region apart" from the rest of the nation, the Appalachian Regional Commission (ARC) is a unique federal-state partnership working to bring all of Appalachia's 23 million people into America's economic mainstream. ARC's mission is to be an advocate for and partner with the people of Appalachia to create opportunities for self-sustaining economic development and improved quality of life.

The Appalachian Region includes all of West Virginia and counties in 12 other states: Alabama, Georgia, Kentucky, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, and Virginia. The Region contains 410 counties with a combined area of over 200,000 square miles.

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EXECUTIVE SUMMARY

Communities across the Appalachian Region, especially those in rural areas, face serious challenges exploiting new information, computing, and telecommunications (ICT) technologies to expand their economic development horizons. Access to advanced technologies is often uneven and limited, while the capacities to use these technologies to improve performance in public and private sector institutions are often not as developed as in wealthier urban centers. Despite serious challenges, there are many examples and opportunities in Appalachia for using information technologies to spur economic and community development. Numerous businesses and public sector institutions in the Region have successfully leveraged advanced information and communications technologies to improve productivity, the quality of their services, and their market reach.

This report documents the status of ICT technologies in the Appalachian Region, assessing their potential relationship to economic growth and the range of federal, state, and local policies that influence their development. This work is based on in-depth field research and telephone interviews; analysis of primary, archival, and secondary documents; and Web-based investigations to gather and analyze data.

An analysis of industry trends shows that digital technology and applications are strongly influencing national and regional economic development. Fast-growing ICT industries made substantial contributions to employment and output growth over the 1990s. More importantly the use of new ICT technologies in commercial and public sector organizations has increased productivity growth and profoundly altered the ways in which numerous industries do business.

A detailed analysis of industry data revealed that use of ICT-related industries in the Appalachian Region grew rapidly across the 1990s.

- The Appalachian Region shared in the late-1990s boom in ICT-producing industries. Employment grew by 45.6 percent between 1996 and 2000, adding over 91,000 jobs.

- However, this robust growth was less than the 54 percent growth experienced nationally in ICT-producing industries.

- The growth in the number of business establishments in the Appalachian Region in both ICT-producer and -user sectors was above the national average for all business sectors (ICT and non-ICT related).

- However, leading producers of ICT products and services have a relatively weak presence in the Appalachian Region. The Region is becoming more dependent on external suppliers, especially in higher-technology segments of producer industries, and did not share fully in the growth and innovation generated by these industries over the past decade.

The telecommunications infrastructure in the Appalachian Region is less developed than that in other parts of the country, and compares negatively to national averages on various broadband indicators. Statistical analyses show that varying levels of access are directly associated with the levels of economic activity: more distressed counties have less developed broadband telecommunications infrastructure.

- Many parts of the Appalachian Region □especially the more rural areas□ have lower penetration rates of home computers, Internet access, and even basic telephone service than the national average.

- DSL-capable lines, an attractive, lower-cost broadband technology that can be used by small- and medium-sized businesses, are not currently available over broad swaths of rural Appalachia. While many telecommunications provider central offices are DSL-ready, not many are offering such services as yet.

- Cable modem services are very spotty throughout the Region. Furthermore, security concerns make cable modems unappealing for many businesses. More advanced technologies are not on the immediate horizon for rural Appalachia.

- The lack of advanced telecommunications services—at prices affordable to local businesses and public organizations—is a significant barrier to economic and social development in parts of the Appalachian Region.

In-depth research on the cost and quality of telecommunications services in Appalachian states and subregions traces access and cost barriers to frictions in recently deregulated markets for these services.

- Alabama, North Carolina, Tennessee, Kentucky, Georgia, South Carolina, West Virginia, and Mississippi all have average loop cost that exceeds the national average.

- The Appalachian Region—especially its rural areas—is highly dependent on incumbent telephone companies for high-speed and basic telecommunications services. Competitive pressures are relatively low in the Appalachian subregions.

- Absent universal service support for carriers that serve high-cost areas, rural telephone markets are not likely to see local telephone competition.

- Most of the Appalachian states have fairly low numbers of competing local exchange companies, although in two—New York and Pennsylvania—the Bell Operating Companies have been approved to offer long-distance services.

Federal, state, and local policies to mitigate the effects of deregulation have had important positive outcomes as well as limitations.

- Federal E-Rate and various state programs, including state-sponsored data networks, have enabled widespread high-speed connectivity among schools and libraries in the Appalachian Region.

- Nonetheless, Federal Universal Service Funding of E-Rate and the Rural Health Programs indicate that Appalachian counties taken together have received a significantly lower per-capita allocation of funds than that of the nation as a whole.

- Federal Universal Service Support favors the most rural of the Appalachian states. Mississippi, Alabama, West Virginia, South Carolina, Georgia, and Kentucky have a net positive inflow of funds through the program, although the other Appalachian states have made significant internal adjustments from larger, urban-serving companies to smaller, rural companies.

- Several states have proactively initiated programs to enhance telecommunications infrastructure. By using state telecommunications networks through resource sharing, demand aggregation, or anchor tenancy programs, states are able to leverage their considerable investment and offer benefits to other public sector users—and, in some cases, even private sector users.

- While several state universal service programs have been developed--in part to ameliorate the revenue losses local exchange companies attribute to deregulation (especially reduced access rates)--the scope of such programs varies considerably.

- High-speed infrastructure development leads to the creation of alternative networks under the auspices of communities or utilities.

- Coordination among state agencies appears to enhance state potentials for improved telecommunications. By coordinating network design and use, state-funded infrastructure can be used optimally.

- On balance, a more concerted focus on the economic development implications of IT access, capacity, and training is needed across the Region.

Findings

A crucial report finding is that information failures operate with access barriers to limit the effective adoption of ICT and network services in businesses across Appalachia. Other findings include:

- ICT barriers in rural communities are having the most profound effect on the growth and diversification of local manufacturing, service, and trade sectors.

- In the manufacturing sectors, branch plants largely relied on parent companies to provide ICT access and training, while small- and medium-sized companies have been at a clear disadvantage.

- In the service sector, there is growing awareness that innovative use of computer and Internet technologies is becoming central for marketing and sales, especially for small businesses and entrepreneurs in sectors such as tourism and leisure, local crafts, and specialty agriculture.

- In the health-care sector in rural communities, limited ICT access and use was found to be a particular problem.

- Case studies demonstrate that effective local leadership has strongly driven improvements in IT access to businesses and public sector institutions.

To enhance opportunities in the less populous, more remote areas that are unlikely candidates for the operation of robust market forces, ARC has several policy options available:

- Expand and scale up technical assistance to small- and medium-sized firms in rural communities.

- Aggressively support the formation of user groups in rural communities.

- Assist states and localities in applying for E-Rate and Rural Health assistance under Federal Universal Service Funds.

- Support the expansion of public institutions' role in offering broadband access.

- Support demand-aggregation strategies to enhance infrastructure and access in underserved regions. These strategies improve the bargaining power of communities with incumbents and other telecommunications providers.

- Identify and disseminate information on model programs.

- Monitor state regulatory efforts to leverage improvements in infrastructure and service.

- Support demonstration projects with alternative technology providers.

- Continue to monitor broadband deployment and work with organizations attempting to initiate national or statewide deployment policies.

I. INTRODUCTION

There is a growing consensus that information, computing, and telecommunications industries (typically labeled ICT industries) have become critical drivers of the U.S. economy. These industries have had a dominant influence on recent growth performance due to their direct contribution to output and employment and through their pervasive impacts on industries and households that use ICT products and services (U.S. Department of Commerce, 2000). Several studies emphasize the potential benefits that the new technologies could bring to rural or distressed areas by reducing the importance of market proximity and transportation costs in business location (Williams, 1991; Parker et al., 1989, 1995).

However, like earlier keystone technologies, the integrated architecture of computing and telecommunications exhibits a clear pattern of uneven proliferation. There are two crucial barriers affecting the ability of households and businesses to exploit new ICT technologies. One barrier is securing access to computers, software applications and advanced telecommunications services. The second is the gap that arises once the hardware and software is turned on—the lack of knowledge and ability to use the technologies effectively to improve individual capacities or business performance.

Population density, income, educational attainment, and the initial presence of innovative producers are the main factors that influence access and capacity to use the new technologies (National Telecommunications and Information Administration 1999, 2000; U.S. Department of Agriculture, 2000). The Federal Communication Commission's (FCC) recent *Report on the Availability of High-Speed and Advanced Telecommunications Services* notes in particular that high-speed services are not readily available in rural and low-income areas (FCC, 2000a).[1] The socioeconomic factors associated with the "two barriers" suggest that lower income communities and rural regions actually risk falling further behind as the new ICT technologies proliferate and become more central to household earning capacity and business performance.

Uneven access to information technologies and varied capacities to use these technologies represent the primary challenges the Appalachian region faces in exploiting ICT to spur economic development. The region must secure cost- and quality-competitive access to advanced telecommunication services while rapidly building local expertise, training and service capacities to improve local workforce capabilities and business performance.

This report seeks to provide a comprehensive map of current telecommunication infrastructure and user patterns, and assess the possible effects of access and use barriers on businesses and economic development processes in the region. Furthermore, this report seeks to document successful efforts in Appalachian communities to bridge the digital divide. Specifically, the report has the following objectives:

- To provide an understanding of the importance of ICT producer and user industries for the Appalachian region as a whole and for urban and rural counties within the region.

- To provide an up-to-date inventory of the telecommunications infrastructure across the Appalachian region.

- To provide a profile and analysis of state policies and programs, as well as federally supported investments and incentives, to expand telecommunication access and use in the 13 Appalachian states.

- To investigate in detail the access, adoption and implementation barriers currently affecting rural communities and highlight successful efforts to overcome these barriers.

The report is organized into six major sections to address these issues. In the first section we define the set of technologies and related industries that are driving the so-called digital economy, and specify how these technologies are shaping current and future economic development opportunities. We delineate the complex decision making process that firms and public institutions must undertake to select and effectively implement ICT technologies and emphasize that both access and capacity barriers represent significant economic development challenges in rural and low-income areas. A strong argument for specific types of public sector involvement and innovative partnerships follows from distinct market failures that limit access and effective adoption of ICT in rural and low-income communities.

In the second section we analyze the results of an economic base study of the ARC region to gauge how the region participated in the dramatic growth of ICT industries over the 1990s and how industries that are heavy users of the new technologies fared. Data are summarized for four sets of industries: 1) producers of manufactured telecommunication products and providers of telecommunication services; 2) industries that use telecommunication products and services as key inputs to their business operations; 3) Transportation equipment manufacturing industries that are increasingly adopting ICT in their operations and 4) Non-Store Retail sectors where much consumer-oriented Internet commence is conducted. Different geographic areas within the ARC region are designated for analysis to discern industry structure and growth patterns among urban and rural counties.

In the third part we analyze a number of measures of telecommunications access and network infrastructure in the Appalachian Region. Beginning with basic adoption characteristics—phone, personal computer and Internet penetration—we show the wide variation in household use across states in the ARC region. We then look at so-called "middle mile" characteristics of the regional infrastructure, focusing on fiber backbone points of presence (or POPs, the nodes where phone/data traffic converge and are switched to other carriers) in the ARC region.[2] The availability of Digital Subscriber Line (DSL) and Cable Modem service, two key technologies providing high speed Internet access to households and small businesses, is analyzed at the county level for the region. We further develop measures of the number of high-speed subscribers of all broadband technologies in state and sub-state areas in the ARC region. Finally, we look at evidence of local competition between local telecommunication providers to ascertain if competitive market conditions are contributing to the availability of advanced services across the region.

The fourth section of the report focuses on the role of state regulatory policies and programs in the deployment of telecommunications services. The 13 states within the ARC region are represented by a number of telecommunications companies, state-level regulatory authorities

and attendant regulatory philosophies. We inventory the regulations and projects pertinent to telecommunications infrastructure developments in the 13 target states. The report focuses on key elements of state policy including: deregulation legislation over the past five years; state-level competitive assessments or "competition reports" that include data bearing on "last mile" infrastructure; agreements to extend service to communities or state and local governments in exchange for state-level approval of telecommunication company mergers; and special state initiatives, including public-private initiatives as well as state networks, that influence the infrastructure (particularly broadband) serving rural areas in particular.

In the fifth section, we focus upon federal universal service support and other national programs to improve ICT access and use. Surveys of secondary data sources and phone interviews with federal and state officials responsible for implementing telecommunication development programs in the ARC region delineated the size and distribution of federal assistance in the region. We look at funding distribution across the region and the importance of these federal programs in improving capacity at the local level.

In the sixth and final major section of the report we provide a concrete, "on the ground" perspective of ICT access and use challenges through case studies of four rural ARC counties. The counties examined include: Scott County, Virginia; Washington County, Virginia; Monroe County, Mississippi; and Noxubee County, Mississippi. This analysis provides a deeper understanding of the specific challenges and opportunities new ICT technologies present to rural regions and how these communities are responding. The case study analysis also highlights successful initiatives that are improving access and effective use of ICT technologies at the community and firm level.

In a concluding section we summarize the results of this research effort and provide a series of conclusions and recommendations. We emphasize that affordable access to current ICT, especially advanced telecommunications services, is a problem in many parts of Appalachia. The ability to understand, select and effectively implement ICT technology in private and public sector organizations is a serious additional barrier in many rural communities across the ARC region. Together these access and capacity barriers to ICT adoption may act as a drag on future economic development. We argue for a mix of supply-side strategies to open up access to advanced services and demand-side policies that would stimulate use of advanced ICT by small and medium- sized businesses to improve their competitiveness and market reach.

II. THE ROLE OF INFORMATION AND TELECOMMUNICATIONS TECHNOLOGIES IN ECONOMIC DEVELOPMENT

Computers, software, and telecommunications products and services are becoming increasingly integrated, constituting a powerful new infrastructure for generating, organizing, analyzing and communicating information. The set of technologies constituting ICT evolved in new and profound ways over the past decade and will continue to change in the future. The advances in digital technologies in the 1990s involved the networking of software, computers and telecommunications systems, and a vast increase in interconnectivity between end users. Increased networking involved the growing integration of subsystems (computers, software, servers, browsers, wire-line and wireless telecommunications), and interconnectivity was accelerated through open networks and standards such as the Internet and World Wide Web. Under labels such as the digital economy or the new information economy, the rapid development of this new infrastructure and related technologies was an important factor in economic growth over the 1990s.

Defining Contemporary Information and Telecommunications Technologies

Since there are a number of different and often overlapping definitions of advanced telecommunications and/or information technology, it is important to delineate some basic definitions and distinctions. There are four major components in the contemporary telecommunication/IT infrastructure (Choi and Whinston, 2000; Kling and Lamb, 2000; U.S. Department of Commerce, 1997):

- End user computer hardware and appliances that store, process, receive and transmit information include personal and mainframe computers, hand held devices, modems, and computerized manufacturing and office systems;

- Software applications that allow the hardware to operate and perform myriad operations include common applications (word processing, spreadsheets), network applications (emailing, teleconferencing, electronic data transfer and payment) and special integrated applications (supply chain or process management, CAD/CAM software, remote banking, online shopping);

- Network applications that manage efficient data, graphic and video transfer and support content on networks include hardware such as servers and routers and software such web browsers, HTML and http protocols, Java and Web authoring software;

- The telecommunications equipment, networks and services used to transfer information between various end users of hardware and software includes wire line, wireless and satellite communications networks, which are the means for telecommunications providers to supply basic and advanced telecommunications, including Internet services.

Advanced telecommunications has a more specific definition. This relates to the speed and quality of voice, data, graphic and video transmission between end users. We rely upon the

basic definition embodied in Section 706(b) of the Telecommunications Act of 1996 as, "high speed, switched, broadband telecommunications capability than enables users to originate and receive high quality voice, data, graphics and video telecommunications using any technology" (U.S. Congress, February 1996). The FCC has further specified advanced telecommunications as having the capability of supporting, in both the provider-to-customer (downstream) and the customer-to-provider (upstream) directions, a speed in excess of 200 kilobits per second (kbps) in the last mile (FCC, 2000).

There is a strong focus in this report on advanced telecommunications access because broadband represents a leading edge in information transfer, processing and networking capabilities. However when we refer to ICT, or ICT industries, in this report we are referring to all four layers of the advanced telecommunications and information technology infrastructure detailed above, not simply advanced transmission capability. A prominent feature of this ensemble of technologies and applications is that they are highly dynamic, with new simple and complex devices, applications and forms of connectivity emerging and older devices and applications fading away. Despite the current slowdown in high technology investment, these complementary ICT technologies will continue to evolve and become increasingly integrated into private commerce, social and community activities, education**,** and entertainment and leisure (Business Week, 2001).

The Potential Influence of ICT on Economic Development

The advance of digital technology and applications strongly shapes economic development through the contribution that fast growing ICT industries make to employment and output and through the improvements in economic performance stemming from the utilization of new technologies in commercial and public sector activities.

Industries that produce information and communications products and services were a crucial factor in the U.S. economy's sustained and rapid growth during the 1990s. There is a common group of Standard Industrial Classification code industries that, together, represent the sectors that produce (ICT) goods and services (See Appendix #1)[3]. These industries accounted for less then 10 percent of U.S. output during 1995-1999, but contributed close to 30 percent of the country's real GDP growth over this period (U.S. Department of Commerce, 2000). Employment in these industries grew from 3.9 million in 1992 to 5.2 million in 1998, a 33 percent increase (U.S. Department of Commerce, 2000) Our analysis of more recent data suggests a rapid acceleration of employment growth in ICT producing industries in the 1990s. We estimate that national employment in ICT producing industries grew from 4.408 million in 1996 to nearly 6.756 million by 2000, a 53.3 percent increase over the period. The ARC region shared in the late 1990s boom in these industries with employment growing from 200,569 in 1996 to 291,980 by 2000, a 45.6 percent increase (The Brandow Company, 2001).

Even as dynamic ICT producing industries added to economic growth, the more profound economic development impacts stemmed from the application of new information and telecommunication technologies to business, non-profit and government sector operations. A central measure of the proliferation of new technologies is investment in ICT technology, which nearly doubled, from $243 billion in 1995 to $510 billion in 1999 (U.S. Department of Commerce, 2000). Telecommunications infrastructure is a critical component in these indicators. The presence of and ability to use computers, particularly in a networked

environment, and access to appropriate software applications, as well as access to fast communications networks for rapid information flow, are critical to extracting the benefits of information technology. Cronin et al. (1993) found, for example, that telecommunications investment rises with economic growth, while economic growth likewise rises with investment in telecommunications. Parker has reported similar results (1995), as have Dholakia and Harlam (1993).

But how exactly does the new and evolving infrastructure of networked computing and telecommunications translate into enhanced economic performance? The ensemble of technologies delineated above can, if implemented effectively, spur growth and development through four main channels: increased innovation; improvement in product or service quality; increased productivity; and expansion of markets.

Innovation: In terms of new product and process innovation, networked computing and communication offer firms continuous access to external sources of information from research centers, laboratories and even competitors. (Orlikowski and Iacano, 2000). Real time interactivity offered by proprietary and open networks allows more rapid acquisition and transfer of knowledge, problem solving, and joint collaboration within and between innovating organizations. Rapid access to information, the ability of ICT technology to screen and correlate information, and the high level of interactivity offered by contemporary networks also allow innovating firms to reduce the time between prototyping and testing a new product and getting it to the market. The "paperless" design process characterizing the rapid development cycle of the Boeing 777 is seen as an example of how new ICT applications can speed the innovation process (Tapscott, 1996). A more recent example is Ford Motor Company's Web based collaboration with internal and external designers to improve fuel efficiency. Through this real time collaboration, the effect of proposed design changes on productivity are instantly analyzed and amended by the team as vehicle designs unfold (Business Week, 2001).

Product and Service Quality Improvement: The embedding of microprocessors in numerous products and services including automobiles, household appliances, communications devices and ATMs has improved quality, speed, reliability and usability (Cohen et al., 2000). Improved forms of communication combined with computer based quality control and delivery systems can improve quality and speed of product or service delivery (Porter and Millar, 1985). Computerized and interactive ordering and supply systems, together with the open architecture of the Internet, allow companies to offer and rapidly deliver products and services customized to the demands of individual customers. Dell Computer focuses on allowing customers to configure their own computer systems while ensuring fast delivery of the product. The company intensively utilizes ICT to coordinate its highly efficient “just in time” supply system to provide the components, produce the computer and deliver it to the final customer in a week’s time (Choi and Whinston, 2000)

Productivity Gains: Utilization of ICT technology can lead to increases in output given a certain quantity of labor and capital inputs. Computerization of manufacturing processes took off in the 1970s and 1980s, while the automation of management, accounting and other office services accelerated with the introduction of personal computers in the 1980s. This earlier phase of ICT implementation was associated with a so-called “productivity paradox.” In the 1980s a number of studies demonstrated that ICT investments could lead to significant

productivity gains for individual firms and industries, but adoption of the new technologies did not appear to stimulate increases in aggregate productivity growth. By the mid-1990s ICT investment grew to be a major share of capital investment and there was evidence that ICT investment was providing some boost to aggregate productivity growth (Sichel, 1997; U.S. Department of Commerce, 2000). There are numerous examples of ICT utilization increasing productivity at the firm level. An example from the ARC region is Eastman Chemical in Kingsport, Tennessee. Eastman is implementing, with its major suppliers and customers, a web based collaborative planning, forecasting and replenishing system. According to the company, use of the Internet has improved revenues per employee by an average of 9 percent in each of the past five years (*Business Week*, 2001).

Expanding Market Reach: Electronic connections and ordering systems with suppliers and customers have been used for over two decades in the form of electronic data interchange (EDI). However, EDI systems were typically private secure networks run over secure leased lines and were, due to high costs, available primarily to large corporations and their major suppliers. The Internet offers major advantages over closed proprietary networks; entry and exit are relatively cheap and the open standards of the Internet create a potentially huge marketplace for buyers and sellers. Cheaper networking opportunities allow organizations to move outside established supply channels to purchase more generic inputs. United Technologies and General Electric are now buying 15 to 20 percent of their supplies on e-marketplaces and report significant cost savings (Ibid, 2001; *The Economist*, 2001). Many firms have moved to the Internet to reach beyond their traditional or local customer bases. Computer and software firms now lead the way with companies such as Dell and Cisco garnering over half of their sales via the Internet. Banks and real estate companies are also dramatically increasing their sales and services via the Internet (Business Week, 2001). The availability of advanced telecommunication service allows more complex data, graphic and video transactions opening up new markets for video- and music-on-demand, and other content rich automatic ordering and processing services. **Also** smaller enterprises in travel and leisure industries, specialized retail and wholesale and manufacturing can also expand their market reach via the new ICT technologies.

Actualizing the Economic Development Potential: Access and Capacity to Use ICT

The new technologies unquestionably have great potential to spur growth and development. However, the transformative power of contemporary ICT is being felt very unevenly across regions, industries and public sector institutions. Indeed the current slowdown and shakeout in information and telecommunications technology has deflated more extravagant claims about the immediate revolutionary effects of these new technologies on business and household behaviors. As noted, there are significant barriers and frictions to the proliferation and successful adoption of the new technologies across regions and institutions.

Access: Like earlier fundamental technologies such as electricity and telephony, computing and advanced telecommunications technologies originate and grow first in high-income urban regions, only reaching poorer and/or less urbanized areas after considerable delay. As will be shown in Section IV of this report, many parts of the Appalachian region have lower penetration rates of home computers, Internet access and even basic telephone than the national average. In terms of advanced telecommunication services, only two-thirds of the

U.S. population has access to DSL, an attractive lower-cost broadband technology that can be used by small and medium sized business and much of local loops' cooper wire is not adaptable to DSL (Price Waterhouse Coopers, 2000, p. 346). DSL-capable lines are not currently available over broad swaths of rural Appalachia. Also, in some rural communities basic Internet access still requires a toll call generating large local service bills for businesses and households (Strover, 1999). More advanced fiber optic network access and use is quite concentrated with about 86 percent of the total network growth in the U.S. in the 20 largest cities. One estimate is that only 5 percent of buildings in the U.S. have direct access to fiber networks (Price Waterhouse Coopers, 2000).

Subsequent parts of this report will demonstrate that access to advanced telecommunications at prices affordable to local businesses is a significant barrier in parts of the ARC region. While personal computers and Internet access are proliferating quite rapidly and gaps in access to broadband telecommunications may close somewhat over the next five years, important access gaps exist today that disfavor certain areas and regions. (Schement and Forbes, 2000; Thierer, 2000; Price Waterhouse Coopers, 2000). Moreover, because new innovations and applications are constantly emerging, as gaps close in older technologies new gaps appear with new technologies and applications. So, for example, as more households and businesses adopt "narrow-band" Internet, advanced users in higher income urban regions are turning to broadband (Van Dijk, 2001).

Capacity to use: Access to the new technologies must, however, be seen as a necessary but far from sufficient condition for the successful utilization of the new technologies to sustain or improve economic performance. The second barrier is the capacity in business and public organizations to effectively use the technologies to actually improve their performance. For organizations to add value through ICT investments they must understand technological options, select the appropriate set of technologies, and reorganize their operations to competitively exploit new technical opportunities. As many have noted, fulfilling the promises of the new technologies seems in reality much more challenging than proponents and futurists have suggested (Orlikowski and Iacono, 2000).

The architecture of new information and advanced telecommunication is complex and rapidly changing, making it considerably more difficult for the end user to understand and adopt than earlier fundamental technologies such as electricity and telephony (van Dijk, 2001). Implementing ICT involves choices and knowledge about such things as line or wireless options, computers and other devices, complex software, and Internet service options. Selecting the specific set of ICT technologies that can best complement the activities of a particular organization may be even more challenging. The costs of selecting the appropriate package of computers, software and telecommunication services, developing the know-how to effectively implement technologies in a business plan, training personnel, and acquiring specialized services to support and upgrade technologies may cost up to ten times the acquisition and service costs for personal computers and Internet access (David, 2000).

The effective implementation of new ICT technologies in private or public organizations can be seen to involve the following five steps:

- Obtaining information about alternative technologies including their direct and indirect costs and performance characteristics;

- Understanding how various technology options relate to specific requirements of the organization and how they will be integrated into revised business plans;

- Selecting the appropriate mix of technologies and associated workforce training to ensure that the new technologies can be implemented effectively;

- Making the organizational changes required to fully leverage the technologies;

- Securing the capacities to maintain, adapt and upgrade the technologies to obtain a high return on ICT investments.

Organizations everywhere are challenged in moving through these steps to implement ICT technology in ways that realize economic and social value. The information, knowledge and experience to make the proper technology choices and changes in organizational practices come from within firms or public sector institutions or from outside experts or consultants.

Larger firms in industries that are significant users of ICT typically have an information technology (IT) group or administrative unit that informs the firm's leadership about strategic technology choices and have major responsibility for implementing, maintaining and updating ICT. The relationship between the group responsible for technology implementation and other divisions of the firm is crucial, as effective ICT implementation requires more than providing new tools or technology systems to an organization. Getting strong returns from ICT investments often requires major changes in organizational practices, work norms, and incentives. Strong buy-in from upper management and close collaboration between the IT group and other units is critical to foster the organizational changes necessary to effectively implement ICT (Kling and Lamb, 2000; Tallon et al., 1999). Small to medium-size firms may be severely disadvantaged because they often do not have individuals and groups dedicated to evaluating and implementing ICT. Smaller companies typically lack the resources, and leading personnel often lack the time to build the requisite set of competencies for effective adoption.

On the other hand, many sources of know-how for successful technology adoption are external to the firm. External sources are central even in the case of larger companies with large internal IT groups (Grant and Huston, 2000). Information about technology choices, for example, often comes from competitive vendors who provide characteristics of their systems, comparisons to other sellers and demonstrate the usefulness of the technology to customers. Internet service providers and telecommunication companies in areas where there is meaningful competition provide information and in many cases support services for firms moving into Internet commerce and related applications (Greenstein, 2000). Industry associations are an additional source of information, and in some cases technical support, for technology adoption. Learning by observing competitor or supplier firms is another important means to assess and evaluate technology needs and requirements. Finally, outside consulting services are commonly used to help inform management about choices, to supplement the ICT capacities of the firm, to train personnel and to maintain and update technologies (Grant and Huston, 2000). The same set of external sources and institutions (vendors, competitors, suppliers, trade groups, and service firms) are also important to effective ICT adoption by government and non-profit organizations.

Access to the external sources of know-how essential for successful ICT adoption is strongly related to where firms or government institutions are located. The above discussion suggests that making the right technology choices and effectively implementing ICT in the context of a compelling business strategy requires exposure to emergent technologies and relationships with vendors or advanced users (Barr and Riis, 2000). Such exposure and experience is much less costly to acquire in innovating urban regions with many competitive vendors, technology users, and trade and industry associations (Gaspar & Glaeser, 1998). Research clearly shows that production and use of new devices and software, and use of high-speed broadband networks is a function of population density (urbanity), income, education, and initial presence of innovative producers (NTIA, 1999; Silverstein, 2000; USDA, 2000). The strongest correlates of these factors occur in large metro areas with high tech industrial bases.

Other Economic Development Challenges: A third barrier, especially in many rural communities, is the prominence of other economic development challenges. Even if there is substantial evidence that new ICT applications are having measurable impacts on aggregate growth and on the performance of specific industries and firms, this should not obscure the importance of other more conventional factors associated with economic development. Basic infrastructure including power, roads, water and wastewater, as well as workforce quality and proximity to markets, remain as or more important in shaping economic development prospects as access and adoption of ICT. To date, the competitive advantages offered by more rapid and systematic ICT adoption are not clear to many local businesses and development practitioners. The struggle to improve basic conditions for economic development may indeed be seen as a more important priority than focusing scarce resources on major efforts to upgrade ICT capacities. Unfortunately, this potentially rational weighting of economic development priorities makes it difficult to generate the necessary focus on technology issues needed to make the substantial progress needed in many rural communities.

The risk for economic development, especially in rural Appalachia, is the emergence of another vicious cycle. Service providers continue to skip areas with limited demand, firms spurn communities with poor ICT access and weak technical capacities, and the stimuli to improve local access and know-how fail to emerge because people do not have the level of exposure to the new technologies at work or at home as their urban counterparts. In rural communities a very keen focus on ICT access and adoption challenges by local public and private organizations is needed to overcome severe initial disadvantages.

In this context, government supported initiatives to promote universal service and accelerate training, innovative regulatory approaches, and public-private partnerships to provide technical assistance must be seen as critical in closing the digital divide. As will be shown in more detail below, public investments in education, and health care have led to improvements in ICT literacy and skills and have in some cases acted as a market pull to bring in new services and providers. But many challenges remain in ensuring that information and telecommunications capacities of small and medium-sized businesses in rural communities are significantly enhanced. State and local institutions must make focused efforts to ensure access to advanced services affordable in rural and low-income areas. In addition, overcoming the hurdles to successful adoption of ICT by local firms will require much more extensive efforts to fill the severe information and service gaps present in many rural communities.

III. PROFILE OF THE INFORMATION AND TELECOMMUNICATIONS INDUSTRY COMPLEX IN THE APPALACHIAN REGION

This section of the report develops detailed evidence about the recent growth of ICT and related industries across ARC counties. The aim is to detail what is known about the relative strength and future prospects of leading ICT manufacturing and service producer industries in Appalachia. We further profile growth in industries that rely heavily on ICT technologies to develop, produce and market their products to better understand the broader implications of the new digital technologies for regional development. In addition, this study analyzes four geographic levels to discern industry structure and growth patterns: an aggregate region incorporating all 406 ARC counties; counties within MSA areas in the ARC region (that may include select counties outside the region); metro-adjacent counties including rural counties that share some border with MSA counties (either in or adjacent to the ARC region); and core rural counties defined as counties that do not border any MSA counties in, or adjacent to, the ARC region.

This analysis provides more specific evidence about how the ARC region participated in the boom in ICT industries over the 1990s. In addition, profiling the recent growth and current strength of ICT producer and user industries provides an important benchmark for measuring how the ARC region has fared in keeping pace with the growth of the digital economy in the 1990s. Finally, as access and capacity to use the new technologies are likely to be associated with the density and vibrancy of producing and using firms, these data may serve as an additional proxy indicator of ICT adoption capacity across the region.

Definitions and Methods

Industry Categories: The following ICT industry analysis drew upon two key data sources to determine the growth in employment and business establishments in the selected industries from 1988-2000 in each of four geographic regions (defined below). Data are summarized for four related sets of industries in the ARC region: 1) core industries producing telecommunication and information technology products and services (producing industries); 2) a diverse set of industries identified as heavy users of telecommunications and information technologies in their business operations (user industries); 3) transportation equipment industries identified as important users of telecommunications and information technologies and as an important component of the ARC manufacturing sector; 4) non-store retail industries that rely heavily upon telecommunications capabilities to market and sell their products.

Several sources were used to delineate the above industry categories. The primary source used to specify telecommunications and information technology producing industries was the 1999 U.S. Department of Commerce report, *The Emerging Digital Economy II* (U.S. Department of Commerce, June 1999). For a full list of ICT producer industries see Appendix #1.

The delineation of industries as heavy users of telecommunication and information technologies drew upon three major sources: the Input-Output Accounts of the United States

from 1996 published by the Bureau of Economic Analysis (BEA,1996); the U.S. Department of Commerce, *1998 Capital Expenditure Survey* (U.S. Department of Commerce, Business Investment Branch, 2000) and the new *E-Stats* survey series (U.S. Department of Commerce, 2001). An industry was classified as a "user" industry if: 1) direct industry purchases from telecommunication/information technology producer industries as a share of total direct industry purchases were greater than the average for all industries; or 2) if investment spending for computers and peripheral equipment, communications equipment, and instruments and software were greater than mean investment purchases by all industries. Applying the above criteria yielded 166 four digit SIC industries in addition to the ICT producer industries that are that heavy users of ICT products or services. For a full list of ICT user industries see Appendix #1.

It is important to note that many of the industries that have highest levels of purchases or investment in ICT products or service are the ICT producing industries themselves. Telecommunications services, Computers and Office equipment, and Radio-T.V. Broadcasters, for example, rely heavily on the products and services of the ICT producing industries category in their own operations. Our broad category of user industries excludes these sectors that are considered separately as producing industries.

Transportation equipment manufacturing industries did not stand out as a “user” industry according to the above criteria. However, there is strong evidence that the use of telecommunications and information technology has been growing in these sectors in recent years. Aircraft and automotive-related manufacturers are increasingly deploying telecommunication and information technology for procurement, logistics management and sales (Mandel and Hof, 2001). While overall ICT investment in the transportation equipment sector was not among the leaders in 2000, a 2001 Department of Commerce survey indicates that Transportation Equipment accounted for the largest share of e-commerce shipments in manufacturing. Industries in this sector accounted for $140 billion or 29 percent of manufacturing e-commerce shipments (both sales between producers and suppliers and between producers and consumers) (U.S. Department of Commerce, 2001). Furthermore, the ARC has identified the Transportation Equipment sector as an important element of the regional manufacturing base, especially in non-metro counties (see Appendix #1).

Contrary to certain popular and media perceptions, the retail sector has not been a leader in the deployment of new telecommunication and information technologies (Department of Commerce, 1999). Recent surveys suggest that non-store retailers, including catalog and mail-order businesses and retail sites selling primarily over the Internet accounted for 77 percent of retail e-commerce sales (U.S. Department of Commerce, 2001). We therefore look at industry presence and growth across the Region in two retail sectors, Catalog and Mail Order Houses and Direct Selling Establishments (see Appendix #1).

Geographic Areas: Four geographic categories were established to determine aggregate employment and establishment growth in telecommunication and IT sectors in the ARC region and patterns of growth between metro, metro adjacent and rural counties.

- The Aggregate Region: Includes all 406 ARC counties. Industry data in all four industry categories detailed above is aggregated into a single region to analyze industry structure and dynamics in the region as a whole.

- Metro Counties: Includes 110 counties included in 41 metro areas (MSA's or PMSAs) in the ARC region. If one or more ARC counties were part of a metro area, all counties in the metro area were included in this class. For example, while only three counties in the Atlanta CMSA are in the ARC region, all Atlanta CMSA counties are included in the metro county analysis group.

- Metro-Adjacent Counties: Includes 148 ARC counties that share some border with a metro county in the ARC region or outside the ARC region. If a ARC county borders on a metro county that is not in the ARC region this county is classified as a metro adjacent county.

- Rural Core Counties : Includes 156 counties in the ARC region that are neither in, nor adjacent to, a metro area.

Two distinct databases were used to generate detailed industry employment and business establishment data for the region. The first database combined Regional Economic Information System (REIS) and *County Business Patterns* data from 1988 and 1996 to determine employment growth in selected industries in each of four geographic regions detailed above. To overcome data suppression problems in *County Business Patterns* data we used the CLEANCBP model that provides estimates of industry employment at the four digit SIC code level for all industries.[4] The second source was a proprietary database on detailed industry employment provided by The Brandow Company. This source provided estimates of industry employment for 1996 and 2000 at the four-digit SIC code level based primarily on upon credit reporting databases. The Brandow Company amalgamates databases from different sources, identifies and codes firm information, and aggregates them by address and SIC industry codes.

Because each of these databases uses very different methods to estimate industry employment and number of establishments and to classify firms in SIC industries, they are not fully consistent. We cannot, therefore, combine the two databases to look at industry change over the entire 1988-2000 period. Despite significant differences, the two databases do have a degree of comparability, with relatively high correlations across the main industry categories of the common year, 1996 (see Appendix #2). In the following discussion of results we will focus on the results over the last five years 1996-2000 using The Brandow Company database.

For each of the four "region" classifications and each of the four industry groups, the following results were derived: 1) establishment and employment growth over the 1996-2000 period; 2) location quotients measuring industry presence or specialization in each "region";[5] and 3) Shift share components used to analyze industry growth in the region relative to industry growth in the nation[6]. In the sub-sections that follow we report and analyze the structure of ICT and related industries and change in these industries over time. Also, the regional analysis tools detailed above will be used to better understand the position and performance of these industries in Appalachia relative to national trends.

ICT Related Industries in the Aggregate Region

Analysis of industry data indicates that ICT producer and various categories of user industries experienced healthy growth in the ARC region in the latter half of the 1990s. As Table 1 below indicates, the region added a large number of business establishments in producer industries, with establishment growth approaching a remarkable 65 percent over the period. Business formation was also strong in various categories of ICT using industries. Most notable was the very rapid growth in the number of non-store retail establishments, the sector where much business to consumer e-commence takes place.

Employment growth in all ICT related categories during the period 1996-2000 was greater than overall region employment growth for all industries. The ARC region clearly benefited from the boom in ICT producing industries, adding over 91,000 jobs over the period for a 45.6 percent increase over 1996 levels (Table 2). The results of this data analysis, therefore, provide some good news; ICT producer industries in the region constituted an emerging growth sector in the 1990s. Further, the user industries that rely heavily on ICT outputs in their business operations accounted for 24 percent of total ARC private sector employment in 1996 and continued to experience growth over the late 1990s. The region also increased its share of user industry employment over the period 1996-2000 indicating that the region maintained a healthy competitive position in this large segment of the economy.

Table 1: Aggregate Region, Growth in Business Establishments - ICT Sectors

Industry Group	Number of Establishments 1996	Number of Establishments 2000	Change 1996-2000	Percent Change
ICT Producer Industries	11,302	18,616	7,314	64.7%
ICT User Industries	151,055	178,080	27,025	17.9%
Trans. Equipment Industries	962	1,198	236	24.5%
Non-Store Retail	1,141	2,006	865	75.8%

Source: The Brandow Company database

Table 2: Aggregate Region, Growth in Employment - ICT Sectors

Industry Group	ARC Region Jobs 1996	ARC Region Jobs 2000	Change 1996-2000	Percent Change
ICT Producer Industries	200,569	291,980	91,411	45.6%
ICT User Industries	1,868,410	2,379,017	510,607	27.3%
Trans. Equipment Industries	85,585	107,323	21,238	25.4%
Non-Store Retail	14,254	18,615	4,361	30.6%
Total Private Employment	7,913,697	9,870,167	1,956,470	24.7%

Source: The Brandow Company database

Closer examination of the data, however, reveals both troubling and encouraging signs. Most troubling for economic development prospects is the relatively weak presence of ICT producer industries in the region. Employment growth in ICT producing industries in the region was significantly less than national employment growth in these sectors, especially in the period 1996-2000. This suggests a regional loss in market share in these key industries.

Figure 1: Growth in ICT Industry Employment 1988-2000

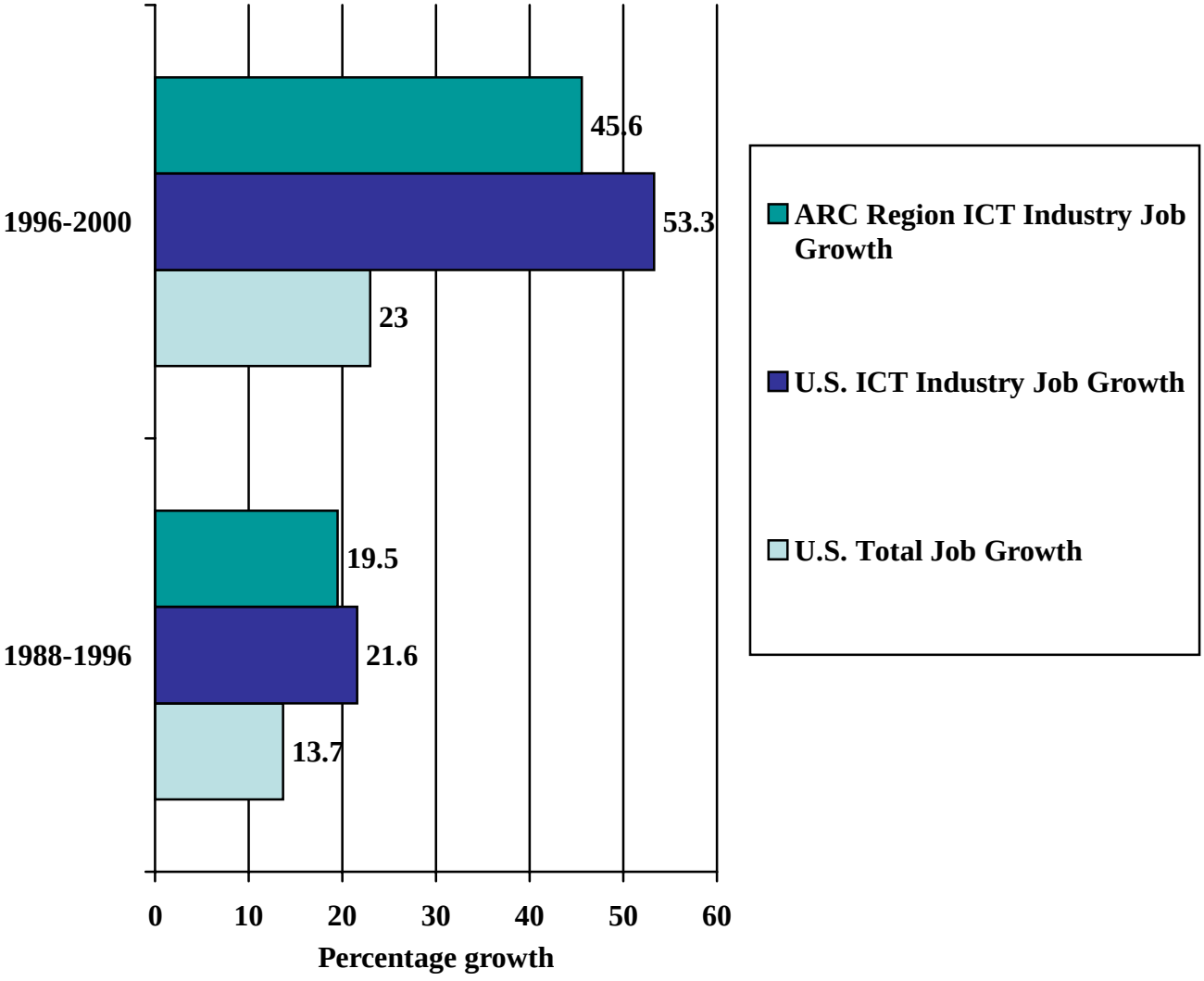


Table 3 below breaks out these trends in shift-share components, underscoring the fact that ICT producing industries lost share, growing slightly slower than the corresponding national growth in the industries (job loss due to Regional Shift). Moreover, the growth in the producing industry category experienced over the late 1990s came off a relatively small base. In 2000 the ARC region accounted for just 6.6 percent of total U.S. ICT producer jobs, while accounting for 7.3 of total U.S. private non-farm employment (The Brandow Company).

Table 3 Employment Change 1996-2000: Shift-Share Components

Industry Group	1996 ARC Region Jobs	2000 ARC Region Jobs	Job Change 1996-2000	National Growth Effect	Industry Mix Effect	Regional Shift Effect
ICT Producer Industries	200,569	291,980	91,411	46,213	49,978	-4,780
ICT User Industries	1,868,410	2,379,017	510,607	430,501	-53,428	133,534
Trans. Equipment Industries	85,585	107,323	21,738	19,720	-210	2,229
Non Store Retail	14,254	18,615	4,361	3,284	1,895	-819

Source: The Brandow Company database

As Table 4 below indicates, the region appeared to be a net importer in 30 of 35 ICT producer industries in 2000. Those industries where the region appeared to be a net exporter—Electronic capacitors and connectors, Process control instruments, and Radio broadcasting stations—are not in high-tech ICT segments. In system and software industries and core telecommunications services segments, the region generally exhibits weak measures of specialization, indicating that the area is a net importer in these higher-end industries. While location quotients are a very rough indicator of specialization or export/import characteristics of industries, the relatively low location quotient values for most core ICT industries suggests that the ARC region cannot be considered a center of ICT production. This evidence shows that despite healthy growth in ICT sectors, the region still lags other parts of the nation in the larger and more dynamic segments of ICT production and service.

More encouraging was the healthy expansion in the ICT user industries and Transportation Equipment industry categories. The ARC region gained competitive share in both areas over the period 1996-2000, even though these industries exhibited slightly slower growth than national aggregate private sector employment (Job loss due to Industry Mix, see above). The region experienced strongest growth in user industries in the Finance, Insurance and Real Estate (FIRE) sectors, health-related sectors, and business services.

Table 4: Export Posture ICT Producing Industries - 2000

	ICT Producing Industries with Export Specialization	
SIC Code	Industry	Location Quotient
3675	Electronic capacitors	4.98
3678	Electronic connectors	1.46
3823	Process control instruments	1.10
4832	Radio broadcasting stations	1.18
7376	Computer facilities management	1.08

	ICT Producing Industries with Weak Regional Specialization	
SIC Code	Industry	Location Quotient
3571	Electronic computers	0.96
3572	Computer storage devices	0.08
3575	Computer terminals	0.23
3577	Computer peripheral equipment, nec	0.62
3651	Household audio and video equipment	0.81
3661	Telephone and telegraph apparatus	0.46
3663	Radio and t.v. communications equipment	0.74
3672	Printed circuit boards	0.69
3674	Semiconductors and related devices	0.11
3676	Electronic resistors	0.80
3677	Electronic coils and transformers	0.52
3679	Electronic components, nec	0.76
3695	Magnetic and optical recording media	0.66
3825	Instruments to measure electricity	0.46
3826	Analytical instruments	0.36
4812	Radiotelephone communication	0.59
4813	Telephone communication, except radio	0.54
4822	Telegraph and other communications	0.18
4833	Television broadcasting stations	0.69
4841	Cable and other pay television services	0.79
4899	Communication services, nec	0.32
5045	Computers, peripherals, and software	0.63
5734	Computer and software stores	0.73
7371	Custom computer programming services	0.40
7372	Prepackaged software	0.39
7373	Computer integrated systems design	0.59
7374	Data processing and preparation	0.60
7375	Information retrieval services	0.28
7377	Computer rental and leasing	0.28
7378	Computer maintenance and repair	0.82
7379	Computer related services, n.e.c.	0.55

In the non-store retail industries, the region experienced a net loss in share suggesting that businesses lost some competitive advantage in these Internet intensive retail segments. In addition, the region had location quotients significantly less than one in the two industries in non-store retail (not shown above), suggesting little specialization in retail Internet commerce. It should be noted that non-store retail does include much on-line catalogue activity, but most call center type activities are not in this category. Many call centers are classified in the four-digit product category of the industry they are associated with. For example, a credit card call or banking service center would likely be classified in a financial service industry. It is hence difficult to break out general service or call center activity in the SIC classification system

The Regional Distribution of ICT Industries in the Appalachian Region

Examining employment patterns in the three sub-regional categories allows for a comparison between urban and rural areas in ICT industry development. The three categories include: counties within metropolitan regions; rural counties adjacent to metro counties; and rural counties not adjacent to any metro county. These geographic classifications allow for the testing of certain propositions concerning uneven economic and industrial development. The expectation, based upon existing studies of the regional distribution of ICT industries, is that these high technology industries strongly favor urban or ex-urban locations (Lentz and Oden 2001; Parker, 2000; DeVos, 1999). While more isolated rural counties (the rural core) may have had modest success attracting branch plant manufacturing facilities, they have not had success attracting high technology industries in the ICT producing sectors (Jensen, 1998; Glasmeier and Howland, 1999). These findings contradict predictions of some commentators who have stressed that ICT technologies should act as a boon to rural development in general by reducing the importance of market proximity and transportation costs for firm location decisions (Williams, 1991; Gilder, 2000).

Table 5: Sub-Region Shares of ICT-Related Employment in Producer and User Industries, 2000

Regional Category	Region Share of Total ARC Employment	Total Employment Telecom Producer Industries	Sub-Region Share of Telecom Producer Industries	Total Employment Telecom User Industries	Sub-Region Share of Telecom User Industries
Metro Counties	63.8%	231,604	79.3%	1,657,374	69.7%
Rural Adj. To Metro	21.0%	33,531	11.5%	430,398	18.1%
Rural, Not Adjacent	15.2%	26,845	9.2%	291,245	12.2%
Total	100%	291,980	100%	2,379,017	100%

Source: The Brandow Company Database

Our analysis shows that employment in the core ICT producing industries is highly concentrated in the metro counties in the ARC region. Nearly 80 percent of ICT producer employment was in metro counties in 2000. Only 9.2 percent of producer industry jobs were located in the core rural counties of the region, a considerably lower share than the total

employment share of these core rural counties. Although all rural counties (metro adjacent and non-adjacent) accounted for over 36 percent of total regional private employment, only 20.7 percent of ICT producer industry employment was located outside urban counties (Table 5). Moreover, growth in ICT producing industries over the period 1996-2000 was 52.9 percent in metro counties, but only 23 percent in rural metro adjacent and 20.9 percent in core rural counties. This indicates that non-metro counties are losing out in the intra-regional growth of ICT producing sector jobs.

Telecom user industry employment is also somewhat disproportionately concentrated in urban areas, with nearly 70 percent of total employment in metro counties. However, user industry activity was more important for both metro adjacent and core rural counties, constituting 20.7 and 19.5 percent of total sub-region employment respectively in each category. In addition, job growth in ICT user industries was slightly higher in metro adjacent counties 1996-2000 (30.2 percent) than in metro counties (27 percent). The core rural counties also registered strong employment growth in user industries (24.9 percent), but a slightly lower rate than in metro and metro adjacent counties.

Transportation equipment sectors are a small but relatively important growth area for rural counties. Metro adjacent and core rural counties retain more proportionate shares of employment in transport equipment industries and have gained relative to metro counties in these sectors (Table 6). The dominant industry in this segment in the ARC region is Motor Vehicle Parts and Accessories, accounting for 55 percent of regional employment in the category. Ex-urban and rural counties have benefited as firms in this and other industries in the Transportation equipment category have been migrating to lower cost "greenfield" sites outside major urban areas.

Table 6: Sub-Region Shares of ICT-Related Employment: Transportation Equipment and Non-Store Retail Industries, 2000

Regional Category	Sub-Regional Share Of Total ARC Employment	Total Employment Transportation Equipment Industries	Sub-Regional Share of Transportation Equipment Industries	Total Employment Non-Store Retail Industries	Sub-Regional Share of Non-Store Retail Industries
Metro Counties	63.8%	67,043	62.5%	13,355	71.8%
Rural Adj. To Metro	21.0%	24,549	22.9%	4,105	22.1%
Rural, Not Adjacent	15.2%	15,751	14.7%	1,141	6.1%
Total	100%	107,323	100%	18,601	100%

Source: The Brandow Company Database

Some have suggested that rural regions can potentially benefit from mail order and Internet retail opportunities. Selling by mail or over the Internet in a rural setting might be feasible

since proximity to customers is less crucial to retail success. However, the analysis of industry data provides only weak evidence of a growing advantage for rural counties.

Table 6 shows that non-store retail jobs are very concentrated in urban and metro adjacent counties. There was a significant rate of job growth in non-store retail employment in core rural counties over the 1996-2000 period (from 702 jobs 1996 to 1,141 in 2000). However, this growth was off a small 1996 employment base. Moreover, our analysis of the data showed that the location quotients in the two industries that comprise non-store retail are considerably less than 1 for the region as a whole and for the core rural counties, suggesting weak specialization in Internet based retail.

Table 7: Sub-Region Shift Share Component of Employment Change in ICT-Related Industries 1996-2000

Metro Counties Shift Share	1996 Metro Region Jobs	2000 Metro Region Jobs	Job Change 1996-2000	National Growth Effect	Industry Mix Effect	Regional Shift Effect
Telecom Producer Industries	151,433	231,604	80,171	34,892	38,612	6,668
Telecom User Industries	1,304,915	1,657,374	352,459	300,666	-22,387	73,821
Trans. Equipment Industries	54,531	67,043	12,512	12,564	964	-1,016
Non-Store Retail Industries	10,307	13,355	3,048	2,375	1,377	-704
Metro Adjacent, Rural Counties Shift Share	**1996 Metro Adjacent Region Jobs**	**2000 Metro Adjacent Region Jobs**	**Job Change 1996-2000**	**National Growth Effect**	**Industry Mix Effect**	**Regional Shift Effect**
Telecom Producer Industries	26,940	33,531	6,591	6,207	6,735	-6,352
Telecom User Industries	330,470	430,398	99,928	76,144	-17,423	41,207
Trans. Equipment Industries	18,517	24,529	6,012	4,267	-517	2,263
Non-Store Retail Industries	3,240	4,105	865	747	422	-304
Core Rural Counties Shift Share	**1996 Core Rural Region Jobs**	**2000 Core Rural Region Jobs**	**Job Change 1996-2000**	**National Growth Effect**	**Industry Mix Effect**	**Regional Shift Effect**
Telecom Producer Industries	22,196	26,845	4,649	5,114	4,631	-5,096
Telecom User Industries	233,025	291,245	58,220	53,691	-13,618	18,146
Trans. Equipment Industries	12,537	15,751	3,214	2,889	-657	982
Non-Store Retail Industries	702	1,141	439	162	95	182

Source: The Brandow Company Database

The intra-regional dynamics of the four main categories of ICT producing and using industries can be further delineated through an analysis of the shift-share components of employment change. Table 7, above details the components of 1996-2000 employment change, showing

first that there was an intra-regional shift in activity in ICT producer industry jobs from non-metro counties to the urban centers of the ARC region. This tends to support the proposition that these industries draw distinct location advantages from cities.

Shift-share trends in ICT user industries and in Transportation Equipment industries are more encouraging for non-metro areas of the region. While these industries did not experience the strong growth of the producer industries overall, the ARC region as a whole gained share in these sectors. Moreover, both the metro-adjacent rural counties and the core rural counties gained share in both user and transport equipment categories. It is further noteworthy that these segments are crucial to both metro adjacent and core rural counties in terms of their contribution to total employment and growth. The shift share components show some growth in rural counties in non-store retail, but again this comes off a very small base.

Implications of Industry Trends for Regional Development Prospects

On balance the trends in ICT-related industry activity puts into relief both troubling and surprisingly positive developments. The weak presence and low growth in ICT producing industries is a cause for concern for future economic prospects. The region essentially relies upon other regions of the country to supply a significant share of ICT products and services. There is further evidence that the region is becoming more dependent on external suppliers of ICT products and services, especially in higher technology segments. The region did not fully share the growth and innovation generated by these industries over the 1990s. While these industries may be in the doldrums for the next two to three years, it is likely that they will continue to generate above average growth over the long term.

Perhaps more importantly, the weak presence of more advanced producer industries may have wider implications for long-term growth in the region. The absence of leading edge producer firms might negatively affect the size and capacity of the regional ICT user community—firms, public institutions, and households. Personnel in producing industries are exposed to the technologies, often gaining know-how and becoming early adopters in emerging technologies. Hence, initial concentration and subsequent growth of producer industries can play a role in creating and attracting specialized labor with superior skills in exploiting advanced technologies (Castells, 1996; Egan, 1995). New technologies are often deployed and tested in their home region, which fosters the development of sophisticated end users (Marceau, 1994). Regional concentration, furthermore, fosters the growth of firms and individuals offering specialized support services for ICT that increase the effectiveness of local firms deploying new technology. Greater exposure and readily available support services expand the general use of new technologies through producer and user relationships.

The good news is that this industry analysis provides no evidence that the weak presence of leading producers has negatively affected user industry performance to date. Indeed, the region as a whole and all sub-regions have experienced healthy growth in user industries and, with the exception of metro areas, in the Transportation Equipment segment as well. Only in the small Non-store retail area does it appear that the region is losing ground in industries that rely on the new technologies.

However, these results should not make regional development leaders and practitioners sanguine about the future. While there may be a pause in the proliferation of new ICT

technologies in the current downturn, the long-term effects will likely pose continuing challenges for the region. For the critical user-industries in rural regions, competition from networked firms in urban areas offering an array of advanced services over the Internet will likely represent a growing challenge. Local establishments in the tourist and leisure industries, banking and financial services, and producer services (accounting, design, engineering, advertising, etc) are already feeling this competition. Attracting back office service centers and on-line catalogue is a popular economic development strategy in some rural areas. But increasingly as such activities move to the Internet, they require high levels of connectivity with high capacity, redundant broadband connections that are often not available in rural counties.

Even in such locally based industries as government and health care, access to information and services from distant centers may divert local demand. Firms in urban centers that are ahead in exploiting advanced telecommunication capacities will continue to represent a threat to the rural industries that are heavy users of ICT services—crucial sectors in many rural economies.

IV. TELECOMMUNICATIONS INFRASTRUCTURE IN THE ARC REGION

This section reviews aspects of the telecommunications infrastructure in the Appalachian region. Wherever possible, data specific to the ARC counties are presented. However, telecommunications data are not typically organized or aggregated at the county unit; some of the data presented below is gathered at the zip code level, the wire center level (the geographical boundary commonly used within the telecommunications industry), or even the state level. First some basic telecommunications statistics for each state are presented, including telephone penetration, and computer and Internet use. This is followed by an examination of Internet backbone nodes in the region, and then by a breakdown of high-speed services subscribership as well as cable modem and DSL presence in the region. Finally, the extent to which competition has developed in the region is investigated.

Certain sub-areas within the Appalachian states have particularly poor telecommunications infrastructure, while other areas may have excellent capabilities. For example, while North Carolina boasts the Research Triangle with its advanced facilities, it also has five counties that lack any access to high-speed Internet lines (N.C. Department of Commerce, 2000), and one quarter of its telephone central offices are in rural counties considered to be economically distressed.[7] Tennessee reports that its own "digital divide" far exceeds the national average (Tennessee Regulatory Authority, 2000). Our research shows that some rural and economically distressed areas do indeed have Internet connectivity and even access to high-speed services. However, the poorest regions of Appalachia seem to lack alternatives, and may pay more for Internet connectivity than their urban counterparts. Table 8 illustrates the state-by-state disparities, and the huge growth rates of the past few years.

Interviews in October, 2001 with the National Telephone Cooperative Association (NTCA) as well as the Organization for the Protection and Advancement of Small Telephone Companies (OPASTCO), both industry professional associations, indicate that nearly all small cooperative or privately owned telephone companies provide local dial-up ISP services to their subscribers. Those companies face limited competition for their ISP services. The larger incumbents including the Bell Operating Companies typically do not offer ISP services but have begun to offer DSL in certain areas. They too face very limited competition in all but the metropolitan areas for high-speed services provision. At this time, we find very limited evidence that cable operators are offering high-speed services in the rural regions of the ARC. Nonetheless, that small rural phone companies are offering dial-up access is a positive development in rural areas' infrastructure picture.

Table 8 shows that the ARC states joined the national trends toward higher computer penetration and rates of Internet access. Virginia and Maryland stand out with the high penetration rates for both measures, which probably reflects the intense business development in the Washington D.C. area. In 1998, Mississippi and West Virginia had the lowest computer penetration, although both made huge gains from 1990 to 2000 (they still retain the lowest rates among the ARC states even in 2000). Mississippi, West Virginia and North Carolina all had rather low Internet access rates in 1998, but those too increased considerably by 2000, with Mississippi and West Virginia nearly doubling their penetration. However, the high rate

of growth was off a very low base, leaving Mississippi with the lowest overall Internet penetration rates, followed closely by South Carolina and West Virginia.

Table 8: Computer, Internet Access, and Telephones

	Percent of Households with Computers			Percent of Households with Internet Access			Percent of Households with Telephone		
	1998	2000	% Change	1998	2000	% Change	1998	2000	% Change
AL	34.3	44.2	28.9	21.6	35.5	64.4	93.3	91.9	-1.5
GA	35.8	47.1	31.6	23.9	38.3	60.3	91.4	91.1	-0.3
KY	35.9	46.2	28.7	21.1	36.6	73.5	93.3	93.3	0.0
MD	46.3	53.7	16.0	31.0	43.8	41.3	96.5	95.0	-1.6
MS	25.7	37.2	44.7	13.6	26.3	93.4	89.5	89.2	-0.3
NY	37.3	48.7	30.6	23.7	39.8	67.9	94.8	95.1	0.3
NC	35.0	45.3	29.4	19.9	35.3	77.4	93.1	93.9	0.9
OH	40.7	49.5	21.6	24.6	40.7	65.4	95.6	94.8	-0.8
PA	39.3	48.4	23.2	24.9	40.1	61.0	96.8	96.6	-0.2
SC	35.7	43.3	21.3	21.4	32.0	49.5	92.9	93.2	0.3
TN	37.5	45.7	21.9	21.3	36.3	70.4	94.6	95.5	1.0
VA	46.4	53.9	16.2	27.9	44.3	58.8	93.9	95.4	1.6
WV	28.3	42.8	51.2	17.6	34.3	94.9	93.8	94.0	0.2
U.S.	**42.1**	**51.0**	**21.1**	**26.2**	**41.5**	**58.4**	**94.1**	**94.4**	0.3

RED: above national average

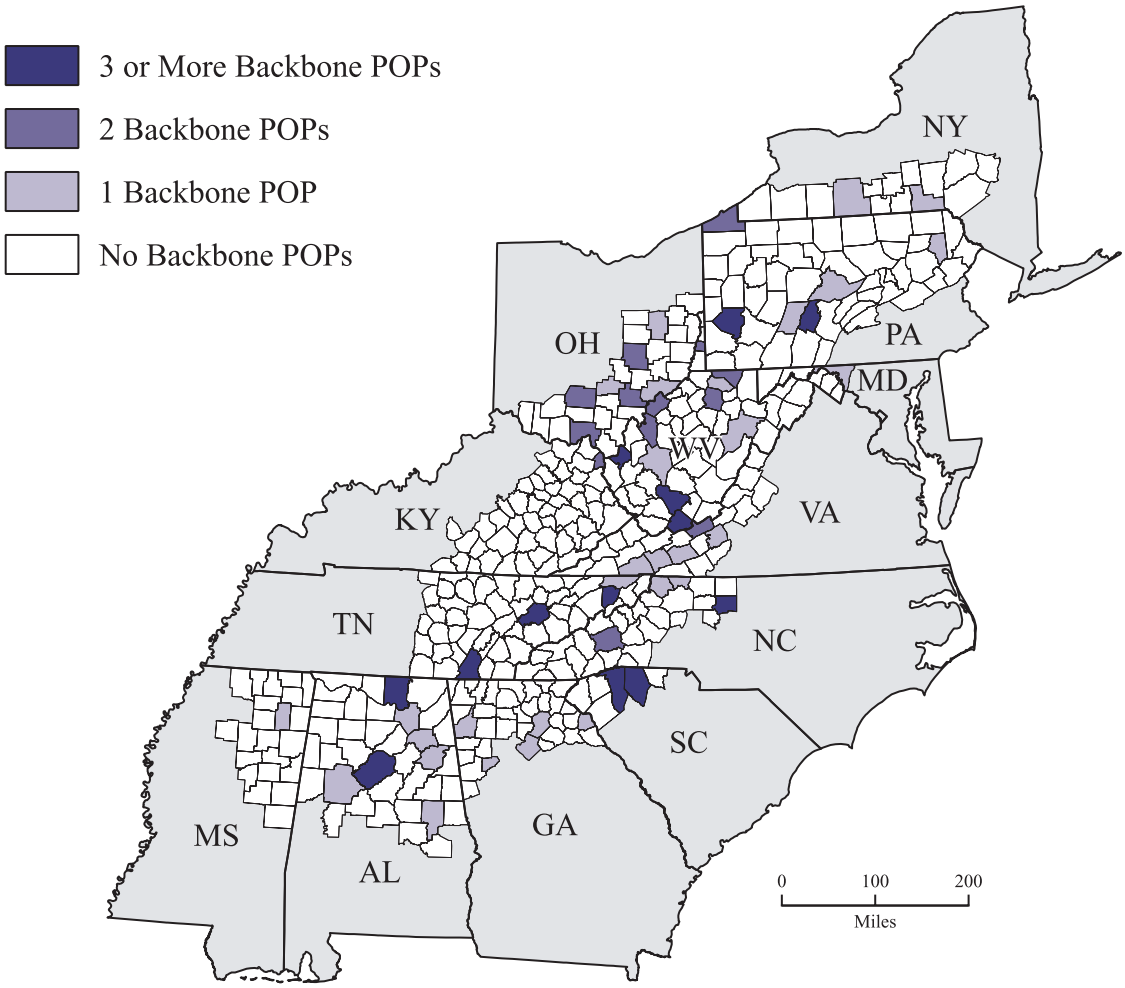
Sources: NTIA. (July 1999). Falling Through the Net: Defining the Digital Divide; NTIA. (October 2000). Falling Through the Net: Toward Digital Inclusio
FCC. Telephone Subscribership in the US (February 1999 and March 2001).

Telecommunications Infrastructure and Networks

When it comes to the underlying services—the infrastructure—that facilitate access, a picture of very spotty networks and end-user facilities emerges. For example, Figure 2 offers a plot of the locations of fiber backbone points of presence (or POPs) in the Appalachian region. A point of presence is the node at which telecommunications traffic is handed off to another carrier to be routed to its ultimate destinations. Traffic may have to go through several POPs, but the critical feature with respect to Internet traffic concerns the distance from a local Internet Service Provider (ISP) to an Internet Backbone Provider. The latter maintain POPs or nodes at locations that are generally proximate to metropolitan areas. Distances to the Internet Backbone Providers translate into costs for the ISP, since the provider must pay distance-sensitive prices to get traffic to those locations.

Traffic in Mississippi and Kentucky faces clear disadvantages since there are few POPs within the ARC regions of those states. In Mississippi, for example, data traffic must be hauled either to Tupelo (the location of the marked POP) or south to Jackson (not in the Appalachian region) or even further north to Tennessee, incurring additional costs. Locations with more POPs correspond to metropolitan areas as well as to counties along major highways (as is the case in Virginia).

Figure 2: Broadband POPs in the ARC Region



Source: Authors' telephone conversations with backbone network providers; Boardwatch Magazine's Directory of Internet Service Providers, 13th Edition. (2001).

The National Exchange Carrier Association recently reported on the costs of "middle mile" facilities in order to gauge the costs facing rural carriers that haul Internet traffic to the backbone (NECA, 2001). They conclude that a high percentage of carriers serving rural areas are extremely disadvantaged by the relatively great distances their transmissions must travel in order to reach backbone facilities. In rural regions, this can mean that a cross-town email might have to travel hundreds of miles to reach its intended recipient one mile away. Some of the Multi-Service Access Point (MSAP) ideas discussed later in this report are particularly pertinent to this problem. MSAPs encourage local peering so that traffic does not have to travel great distances, thereby reducing costs for Internet Service Providers. The principle is that ISPs can "peer" at each others' destination addresses, and remove traffic that is destined to stay within the region, instead of sending it to a distant node where it will simply be sent back to the region again. Peering introduces network efficiencies, and saves data transport costs. In any case, the backbone nodes of rural Appalachia are sufficiently distant from most rural regions that the transport cost issue is significant, particularly to smaller companies. NECA points out that even as market penetration rises, transport cost per customer predictably will fall; however, that relationship levels off at higher market penetration. The

telephone companies with fewer than 5000 lines have the worst operating margins for hypothetical DSL service, while those within 40 miles of an Internet backbone node and 25,000 lines have positive operating margins with just 5% DSL penetration (NECA, 2001, p. 31). The map above underscores the relatively larger distances of Appalachian facilities from the nodes and the consequent higher costs that might be incurred for providing broadband services.

Types of Internet Access

Technologies linking the end user to a provider can vary. This report focuses on cable modem and DSL (digital subscriber line) services, the two broadband technologies currently being deployed widely to residential and small-to-medium business customers. Cable modem services typically deliver transmission speeds of about several hundred kilobits per second (Kbps) up to 1.5 megabits per second. This compares favorably with the fastest dial-up modem speeds of 56 kilobits per second – it is up to about 30 times faster. In order to offer cable modem services, cable operators must upgrade their plants to digital technology. One disadvantage of cable modem services is that since they operate on a shared network, more people using the services means that the speed slows.

DSL speeds are lower than those of cable modem services. The most common DSL service is ADSL or Asymmetric DSL, in which uploading speeds are slower than downloading speeds. Many ADSL speeds operate at about 200 Kbps downstream, with a slower speed for upstream traffic. An advantage of DSL service is that it operates on an ordinary phone line that has been "conditioned" for this application. From the consumer perspective, the same phone line can be used simultaneously for voice and computer transmissions. The telecommunications company's local central office also must be equipped with the appropriate technology in order to offer DSL to its neighborhood. DSL services are limited to about 18,000 feet from a central office location.

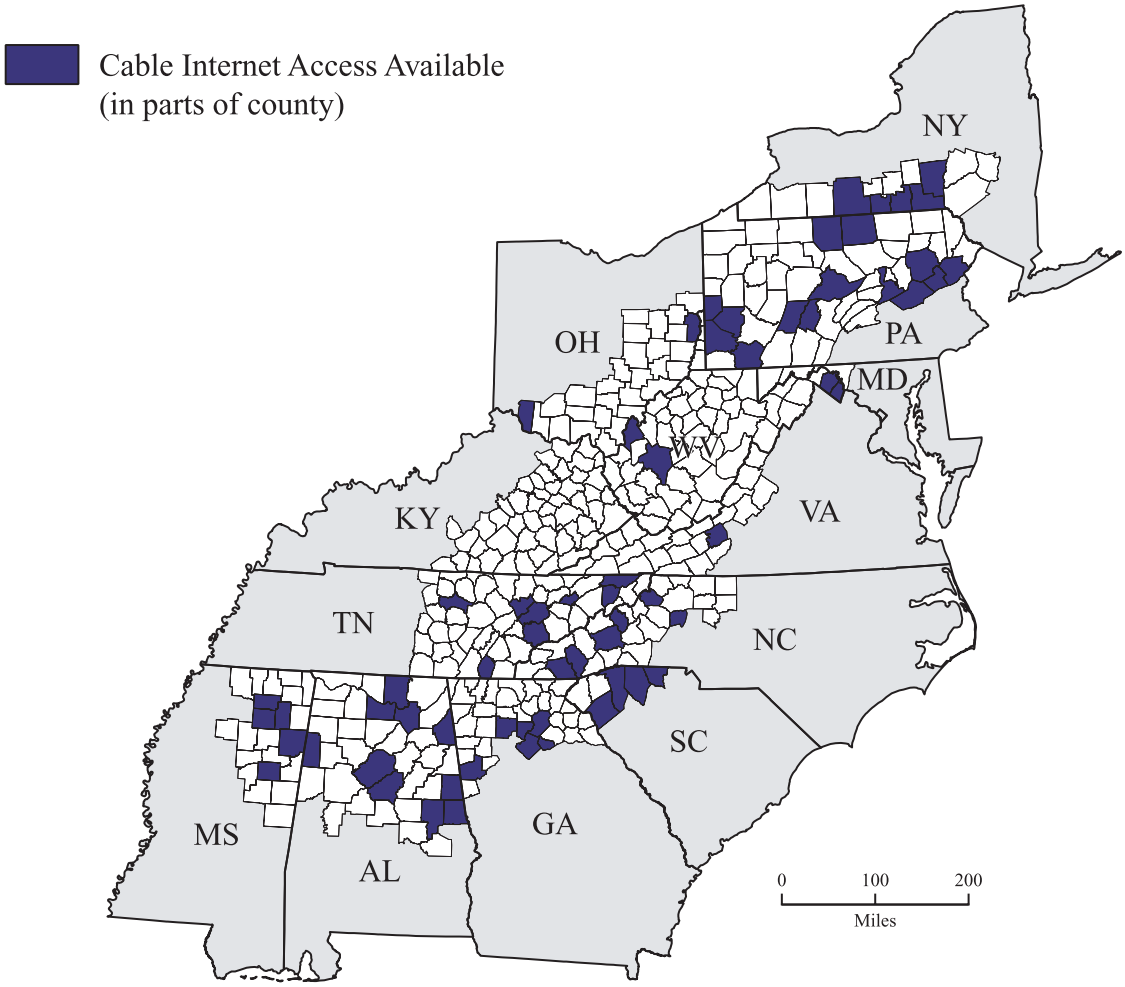
Another high bandwidth service, the T1 line, provides a dedicated circuit of 1.544 megabits per second bandwidth. Its cost is generally distance sensitive, with large pricing variation from state to state, and its most common users are medium and large size businesses. Fractional T1's are available at varying speeds. Because they are dedicated circuits, T1 lines offer security and control over transmissions.

When the penetration levels of cable modem and DSL services are examined, we see evidence that these technologies are underrepresented in the Appalachian region compared to national averages. Figure 3 illustrates the locations of cable modem service, although the map is misleading in that it displays the counties where there is cable modem service even though we do not mean to imply that the entire county is actually served in these cases. Cable modem service typically is available only within towns, not in rural areas. The Appalachian region is sparsely served by this technology, which is confirmed in additional FCC data presented below.

DSL, the other major broadband service, is not broadly available to subscribers in the ARC region. Kentucky, Ohio, Virginia and West Virginia are light in DSL-equipped central offices. The other ARC states illustrate much broader penetration of DSL-equipped central offices, suggesting deployment is proceeding well. However, our field visits to Mississippi and

Virginia demonstrated that the presence of a DSL-ready central office does not necessarily translate into actual DSL service for the region. For example, the Mississippi counties we visited did not have operational DSL even though Bell South, the dominant local exchange company, said its central offices either were or would shortly be equipped for the service and those offices appear in public documentation as so equipped.

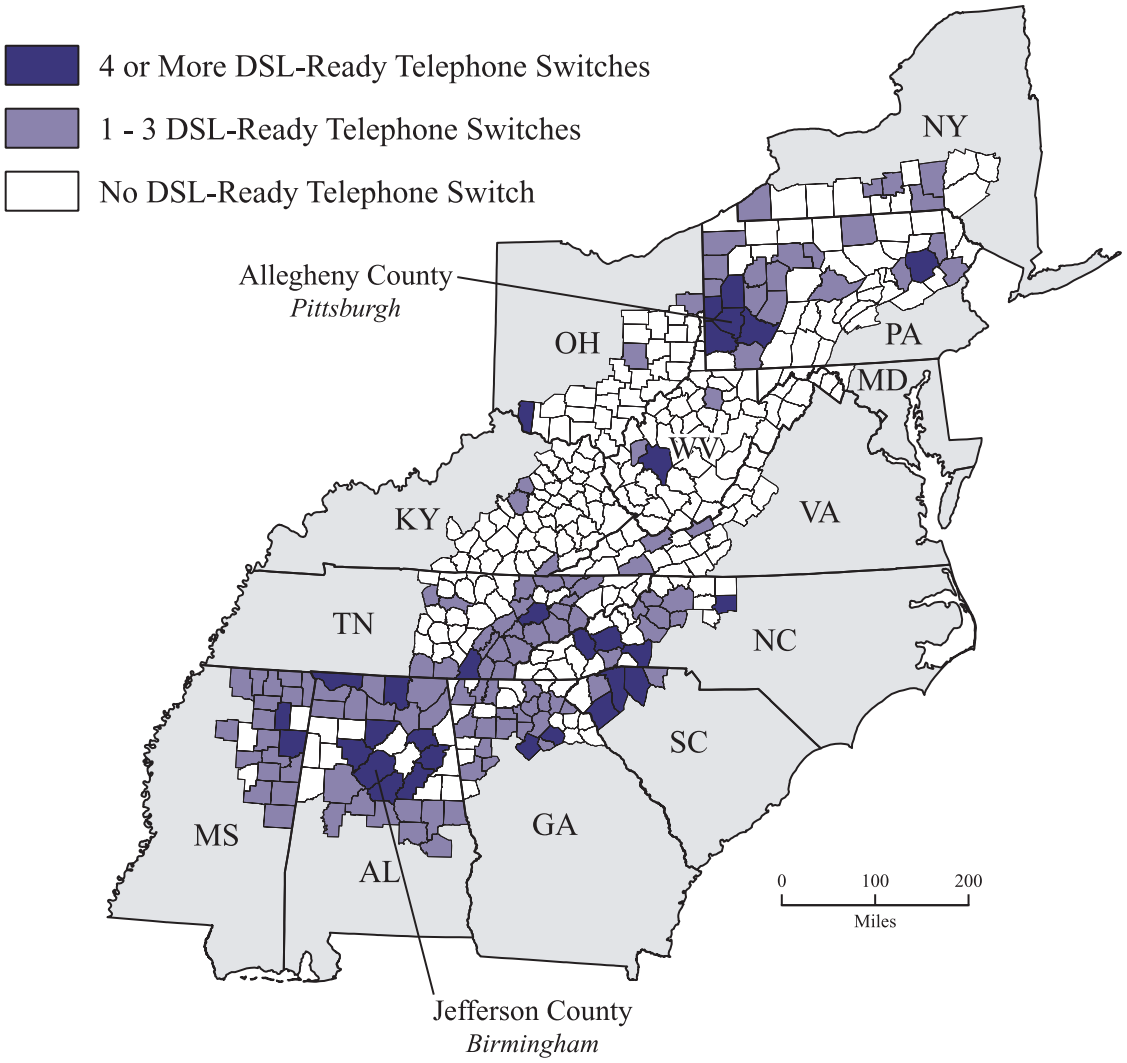
Figure 3: Cable Modem Service in the ARC Region



Sources: CableDataCom News. (2001, March 7). Commercial Cable Modem Launches in North America. [Online]. Available: http://www.cabledatacomnews.com/cmic/cmic7.html; Cable Modem Deployment Update. (2000, March). Communications, Engineering and Design (CED) Magazine. M, cited in National Telecommunications and Information Administration & Rural Utilities Service. (2000, April). Advanced Telecommunications in Rural America: The Challenge of Bringing Broadband Service to All Americans. pp. 46-59. [Online]. Available: http://www.ntia.doc.gov/reports/ruralbb42600.pdf

We find a statistically significant relationship between the economic vitality of a region (as classified by the ARC as either distressed, transitional, competitive, or in attainment) and numbers of DSL-ready central offices: the more economically vital the county, the greater the presence of DSL. This is not too surprising since population size also is correlated with both indicators as well. Among the 114 distressed counties, 81 percent have no DSL-ready central offices, compared to 63 percent of the transitional counties and 27 percent of the competitive counties.[8]

Figure 4: DSL equipped offices in the ARC Region



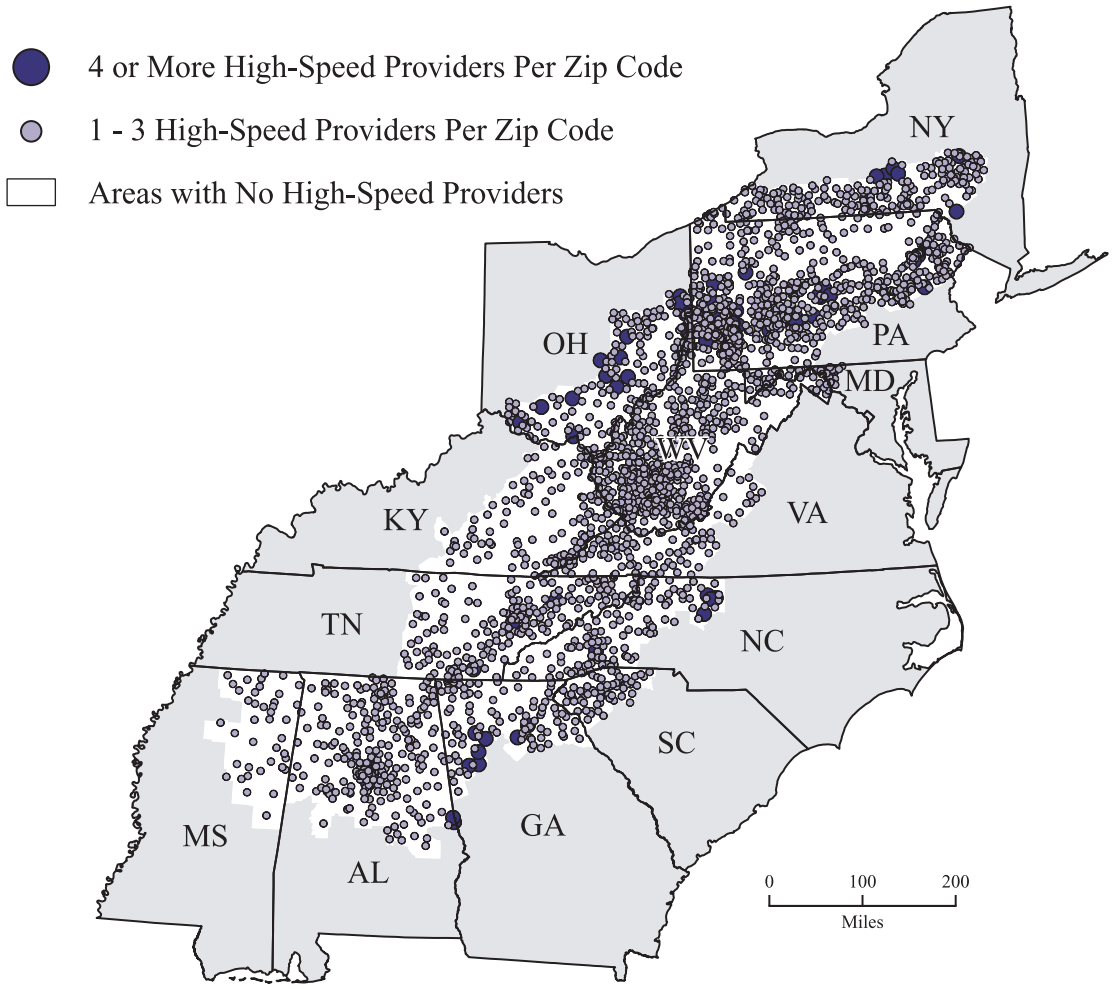
Sources: Authors' search in the Central Office Finder database at DSL Reports web site. [Online]. Available: http://www.dslreports.com/coinfo; National Telecommunications and Information Administration & Rural Utilities Service. (2000, April). Advanced Telecommunications in Rural America: The Challenge of Bringing BroadbandService to All Americans, pp. 60-72. [Online]. Available: http://www.ntia.doc.gov/reports/ruralbb42600.pdf

The FCC's data from Form 477 categorize high-speed providers as any service providing at least 200 kbps in at least one direction (user-to-provider or provider-to-user). Their data are somewhat misleading in that the high speed provider is indicated through the existence of any provider serving in a zip code; the type of service the customer receives is not specified. Therefore, the high speed service could be a T1 line to a company, or it could be residential cable modem service to a community. Moreover, the FCC aggregates its data at the low end,

grouping 1 to 3 services providers in one single category. Thus, the data cannot comment on competition or choice among high speed services in much of the U.S. These data generally illustrate that the more populous regions of Appalachia have obtained high-speed services, but many other regions have none.[9]

In fact, we find that 47 percent of the Appalachian region's zip codes have one or more high-speed service subscribers, compared to the nationwide average of 59 percent, a statistically significant difference. However, the availability of high-speed service can be extremely misleading as an indicator of regional connectivity. In our fieldwork we saw that even in economically distressed counties, the largest businesses had T1 connectivity or better, but that fact said nothing about broader connections and capabilities in the county or zip code. Again, a T-1 line registers in the FCC database simply as a "1-3" subscribership entry in a zip code.

Figure 5: High-speed Providers



Source: The Federal Communications Commission. (2000, August). Deployment of advanced telecommunications capability: Second report. [Online]. Available: http://www.fcc.gov/broadband/ .

Competition in the Local Exchange

Basic line quality and switching features vary tremendously across the Appalachian region, as in other parts of the country. With the passing of the 1996 Telecommunications Act, Congress envisioned that incumbent telephone companies would make their physical facilities such as switches and lines available to would-be competitors on a leased basis. In this way, competitive services would grow without the initial, large expense of building entirely new facilities. The basic approach resembles the way equal access for large distance carriers was handled in the 1980s. After the 1996 Act, telecommunications companies and the FCC decided which equipment at a central office was to be "unbundled" and made available to competitors. Competing local exchange companies or CLECs challenge incumbent local exchange companies (ILECs) in providing local services, although most studies report that CLECs target businesses rather than residential users. The dominant ILECs are the Bell Operating Companies (BOCs), including Verizon (the product of Bell Atlantic's merger with GTE), but they also may be small rural telephone companies. CLEC activity is an index of competition in a market, and an indicator of service alternatives. We examine competition in the Appalachian region in order to understand the extent to which these communities must rely wholly on incumbent service providers.

For the most part, competitive pressures are relatively low in the Appalachian sub-regions, as demonstrated in Table 9. For example, most of the states with counties in the Appalachian region have fairly low numbers of competing local exchange companies (CLECs), although in three, New York, Georgia and Pennsylvania, the Bell Operating Companies have been approved to offer long distance services; the latter is granted when regulators ascertain that sufficient competition exists in a market.[10]

Table 9 End user lines (as of December 1, 2000)

STATE	Incumbent Local Exchange Carriers	Competing Local Exchange Carriers	Total Lines	CLEC Share (percent)	BOC Share (percent, 1999)	Other Price-cap companies (percent, 1999)
AL	2,351,704	191,299	2,543,000	8	79.3	12.8
GA	4,820,788	551,316	5,372,104	10	83.3	0.6
KY	2,122,021	56,392	2,178,413	3	56.6	34.7
MD	3,802,622	165,502	3,968,124	4	99.8	0.0
MS	1,304,145	68,891	1,373,036	5	93.4	0.4
NY	10,962,969	2,769,814	13,732,783	20	89.5	8.3
NC	5,071,853	286,436	5,358,289	5	50	35.9
OH	6,935,139	264,461	7,199,600	4	59	33.5
PA	8,017,391	870,618	8,888,009	10	77.1	13.1
SC	2,260,645	108,233	2,368,878	5	64.5	13.8
TN	3,291,602	296,281	3,587,883	8	79.6	10.3
VA	4,317,626	414,432	4,732,058	9	76.2	21.3
WV	927,432	--	--	--	83.7	14.8

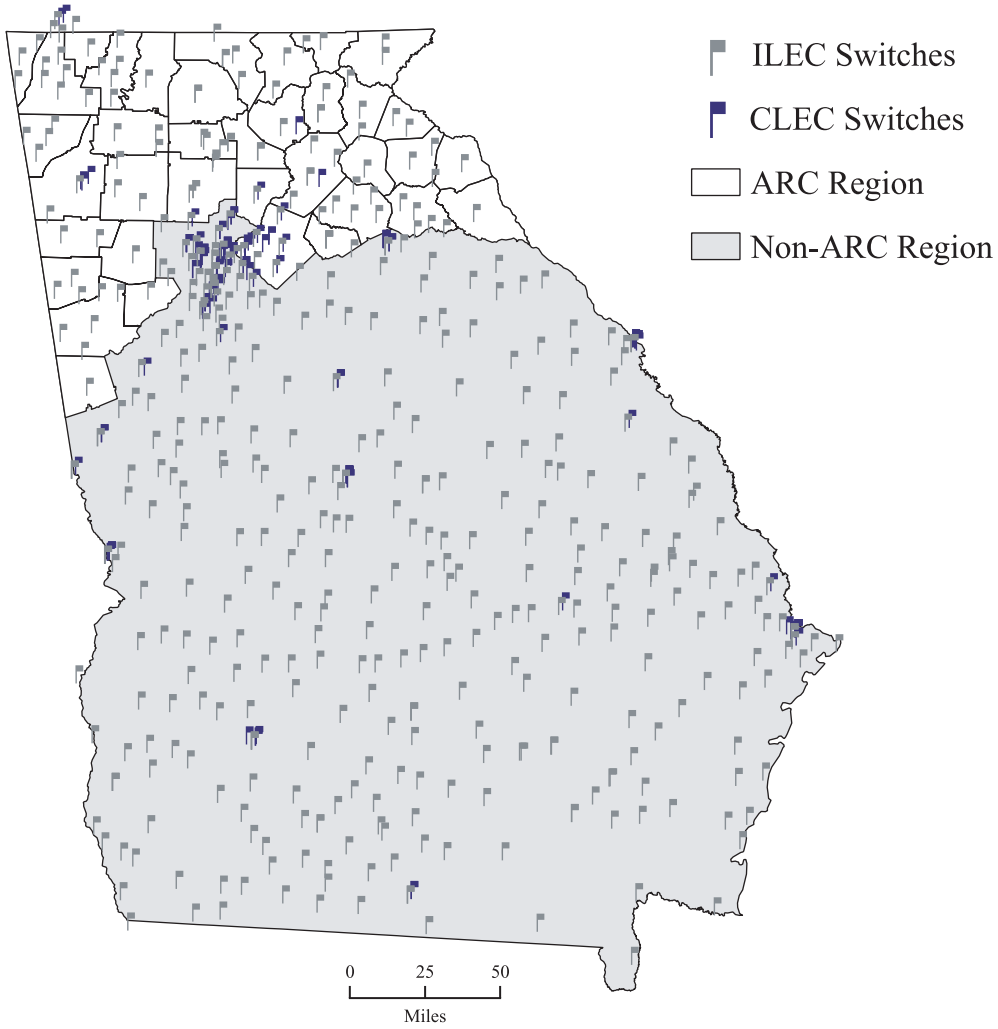
Source: FCC, Common Carrier Bureau statistics, 2001. Dashes indicate data that were withheld by the FCC to protect firm confidentiality.

Table 9 illustrates that New York has the highest CLEC presence among Appalachian states-indeed, the highest in the country—followed by Georgia and Pennsylvania, both with 10% of

their end user lines serviced by CLECs. The final column in Table 9 presents data for other non-BOC telecommunications companies providing local services that have elected for a "price cap" method of regulation, in which prices are capped for certain services in exchange for those companies having flexibility on pricing (or no regulatory oversight) for other services.

It is probably safe to predict that the Appalachian sub-regions in even these states have lower CLEC activity than that enjoyed by other portions of the state since there are few cities in those areas. Figure 6 below illustrates these locations for Georgia. The map demonstrates the relative paucity of CLEC switches in the ARC region of the state and in other rural counties in Georgia. Similar maps of other 12 Appalachian States are available from the Appalachian Regional Commission, and show a similar pattern. CLECs generally locate in metropolitan regions. This means the benefits of competition are not present in the more rural portions of the states, which generally overlap the Appalachian region.

Figure 6: Georgia ILEC and CLEC switch locations



Looking at the telephone infrastructure from a telephone switch standpoint, we also notice that the Appalachian portions of our 13 target states have low levels of CLEC activities compared to the rest of their respective states (Table 10). Competitive telephone activity is lower in those regions in all states except South Carolina.

Table 10 CLEC and ILEC Switches in ARC and Non-ARC

State	ARC region			Non-ARC region		
	ILEC Switches	CLEC Switches	CLEC Switches (percent)	ILEC Switches	CLEC Switches	CLEC Switches (percent)
Alabama	218	74	25.3%	170	60	26.1%
Georgia	107	19	15.1%	365	169	31.6%
Kentucky	140	4	2.8%	268	70	20.7%
Maryland	28	6	17.6%	218	139	38.9%
Mississippi	66	23	25.8%	218	128	37.0%
New York	195	24	11.0%	808	335	29.3%
North Carolina	127	27	17.5%	412	231	35.9%
Ohio	230	6	2.5%	711	183	20.5%
Pennsylvania	628	134	17.6%	267	164	38.1%
South Carolina	55	39	41.5%	262	70	21.1%
Tennessee	192	48	20.0%	222	92	29.3%
Virginia	115	5	4.2%	391	158	28.8%
West Virginia	258	32	11.0%	NA	NA	NA
Average			**16.3%**			**29.8%**

Source: FCC Common Carrier Bureau, 2001

One of the goals of this research was not only to assess competition but also to assess line quality and upgrade activity in the ARC region. The statistics and maps presented above already point to certain deficiencies in the local and regional networks. The actual cost of providing services in the Appalachian states is important insofar as longer loop lengths (to serve rural areas, for example) and low population densities mean that those regions should receive more support in order to maintain universal service. (Universal service is the name of a handful of programs that try to equalize the cost and quality of phone service across the nation.) Data from the FCC in Table 11 show that five of the 13 states in the Appalachian region have loop costs either at or below the U.S. average of $239 (for 2001). Longer loop lengths also suggest practical difficulties in offering DSL since that service has distance limitations from the central office, as noted earlier.

Alabama, North Carolina, Tennessee, Kentucky, Georgia, South Carolina, West Virginia and Mississippi all have an average loop costs that exceed the national average cost, and this results in their receiving certain types of universal service support (detailed later). The loop costs plus the low population densities in those states indicate that telecommunications

infrastructure faces some market barriers. Although these data cannot be broken out for the Appalachian regions of the states, it is likely that those sub-regions would have somewhat lower population densities and probably longer loop lengths as well.

Table 11: States' Universal Service Fund Loops and Loop Costs

STATE	USF Loops	USF Cost per Loop	Persons per square mile
Maryland	3,840,931	193.58	541.9
Ohio	7,005,959	200.03	277.3
Pennsylvania	8,468,821	215.41	274.0
New York	12,818,544	220.00	401.9
Virginia	4,762,112	239.54	178.8
National Average		**239.86**	**80.0**
Alabama	2,521,633	272.31	87.6
North Carolina	5,093,322	278.71	165.2
Tennessee	3,447,390	278.78	138.0
Kentucky	2,191,588	298.09	101.7
Georgia	5,208,825	304.10	141.4
South Carolina	2,329,487	318.00	133.2
West Virginia	1,014,109	335.81	75.1
Mississippi	1,420,042	352.68	60.6

Source: NECA's Overview of Universal Service Funds (October, 2000)

The FCC recognizes 1301 rural local exchange companies, which serve approximately 6 percent of U.S. households and cover 35 percent of the country's landmass, excluding Alaska. These companies typically have longer loops and consequently higher loop costs than companies serving metropolitan regions. They receive routinely receive Universal Service funds. However, larger companies, including the BOCs, which are not considered primarily rural telephone companies, also serve numerous rural households. Bell South, for example, serves most of Mississippi's households. Determining the appropriate amount of support companies serving high cost regions should have in order to maintain the goals of universal service has been a topic of considerable study and lobbying. The FCC adopted a formula for universal service support first for non-rural areas in October 1, 1999.[11] The impact of universal service support will be examined below.

Wireless Services

Many hope that wireless technologies will solve some of the connectivity problems in rural areas. Currently, some satellite services in the region advertise wireless Internet connectivity, however, their services are often unreliable or require telephone upstream communications. Some vendors are offering fixed wireless broadband on a terrestrial basis, as compiled in Table 12. However, services are spotty. It does not appear that the wireless opportunities available in Appalachia present any notable competition to wireline facilities.[12]

Table 12: Wireless broadband providers in the Appalachian Region

State	County	City	Network Name	Owner-ship Type	Service Launch	Upload/ Download (bits per second)	Description
GA	Gwinnett	Norcross	AccessNowTM	Private	2001-1	above 2M/above2M	Wireless broadband ISP based in Boca Raton, Florida. The company provides broadband wireless services in South Florida, Denver, Charlotte, Orland, Rochester, Toronto, and Latin America. Connection speed varies between 500Kbps and 155Mbps.
KY	Madison	Richmond	Firecracker	Private	unknown	up to 2M/up to 2M	Wireless broadband ISP serving the Richmond area. Connection speed up to 1.4M (both ways).
NC	Buncombe Polk Greenville (South Carolina)	Asheville (Buncombe County) Tryon (Polk County)	SKYRunner	Private	1997/1998	up to 2M/up to 2M	Wireless broadband ISP serving five locations: Asheville (Buncombe County), Tryon (Polk County), and two other non-Appalachian locations, as well as Greenville County in South Carolina.
NC	Cherokee	Not specified	CommTech Wireless	Private	unknown	unknown	Wireless broadband ISP
NC	Rutherford		Bluestreak Wireless Internet Service	Private	6/1/2001	up to 2M/up to 2M	Wireless broadband ISP
NY	Otsego Chenango	Unadilla (Otsego Co) Bainbridge and Afton (Chenango County)	RealEthernet Wireless Service	Private	unknown	up to 2M/up to 2M	Wireless broadband ISP serving the Tri-County Area in the Susquehanna Valley.
NY	Tri-county area, NY	Not specified	Servinet	Private	unknown	unknown	Wireless broadband ISP
OH	Laurence (Ironton)	Ironton	Southern Ohio	Private	1/1/2000	above 2M/above2M	Wireless access, VoIP services, and T1 to OC12 access to business and residential customers. Technologies: copper, fiber, satellite, wireless, etc.
PA	counties in Central PA	Not specified	PA Wireless wireless network	Private	7/25/2000	above 2M/above2M	The company provides broadband Internet access and data WANs to customers in underserved areas.

PA	Elk	Not specified	Wireless Internet access	n/a	7/15/2000	above 2M/above2M	New and existing communication towers to transmit internet data to remote areas.
PA	Schuylkill	Not specified	Farber Technology wDSL	Private	8/15/2000	up to 2M/up to 2M	Provides high speed wireless service to rural areas, and in areas where phone service is simply to poor to allow reliable Internet access.
SC	Cherokee	Gaffney	Bluestreak Wireless Internet Service	Private	unknown	up to 2M/up to 2M	Wireless broadband ISP
SC	Greenville	Not specified	SKYRunner	Private	unknown	up to 2M/up to 2M	Wireless broadband ISP
TN	Coffee	Manchester, Tullahoma	Wireless Broad Band Communications	Private	2/14/1999	up to 2M/up to 2M	WBBC will provide wireless broad band Internet access infrastructure to rural communities for existing local communications companies, industrial and commercial businesses, and other medium to large business type clientele.
TN	SmithPutnam (planned)Macon (planned)Dekalb (planned)	Carthage, Gordonsville, and surrounding areas. Cookeville (planned)Lafayette (planned)Smithville (planned)	Micro Wise Solutions	Private	5/20/2000	above 2M/above2M	Wireless broadband ISP serving businesses and homes in both urban and rural areas.
WV	Ohio	Wheeling	WVWireless.Net	Private	unknown	unknown	unknown
WV	Wood	Parkersburg	WireFire Wireless Internet	Private	unknown	unknown	unknown

Source: National Regulatory Research Institute. (2001). Community Broadband Deployment Database. [Online]. Available: http://www.nrri.ohio-state.edu/programs/telcom/broadbandquery.php

The distribution of wireless alternatives has limited potential to solve the problems presented by the absence of other broadband services.

In summary, small business and residential broadband alternatives such as DSL and cable modem services are deployed far less widely in the ARC region than in the rest of the country, and less widely than in other portions of the Appalachian states. While the available data on the presence of broadband subscribers in zip codes may imply less demand for those services in Appalachian counties, it also could illustrate the non-availability of those services. Our fieldwork (see Section VII) suggests that deployment patterns and local vendor efforts to

market advanced telecommunications services are highly dependent on both population density and local leadership. To the extent that more remote regions of Appalachia lack both, the potential for telecommunications infrastructure to receive much attention by ILECs or CLECs is low. Some state policies have begun to address such issues with demand aggregation strategies and with the use of state-supported networks to leverage the state's own presence as an anchor tenant on a network. With the prospect of substantially altering population densities being unlikely, new ways of tackling telecommunications infrastructure problems must be found. Some possible models are discussed in Sections Five and Six.

V. FEDERAL INITIATIVES IN THE ARC REGION: UNIVERSAL SERVICE AND OTHER PROGRAMS

Under the deregulation framework set forth in the Telecommunications Act of 1996, the Federal government recognized the need to address access gaps typically dubbed the digital divide. There are two general channels of federal support for ICT access and capacity building: programs under the Universal Service Fund (USF); and a set of related federal programs launched in the 1990s intended to improve ICT capacities of rural and low-income communities. In this section we examine the federal support programs under universal service: the high cost support fund; the E-Rate Program; and the smaller programs related to rural health. We also examine those federal programs aimed at providing resources and assistance to enhance ICT capacities in low income and rural communities such as Community Technology Centers (through the Department of Education) and the Technology Opportunity Program (through the National Telecommunications and Information Administration).

One critical issue we address is whether the resources allocated under these programs are reaching their target communities across the ARC region. Although the results appear mixed in general, it is difficult to make assessments that distinguish rural from urban outcomes simply because certain programs are directed to entire states rather than to specific regions within a state. A second issue we attempt to address is whether these universal service and other programs are meeting critical needs in term of improving access and capacity to use advanced ICT technologies in rural and low-income communities.

Federal Universal Service Programs

While the concept of universal service dates back to the early 1900s with the deployment of electricity and the telephone, its meaning and mechanisms have undergone several changes.[13] Today, federal universal service refers to a series of FCC rules intended to make various classes of telecommunications services available at just, reasonable, and affordable rates throughout the county, as mandated by Section 254 of the Telecommunications Act of 1996. Current federal universal service policy can be best described as an evolving process, a mixture of funding mechanisms, formalized regulations, interim regulations, and ongoing debates and proceedings. As such, a thorough description of each component of federal universal service support is beyond the scope of this paper.[14] Instead, we summarize the three key components of federal universal service support—the high-cost program, E-Rate program and the rural health program—and discuss their implications for the particular telecommunications needs of the Appalachian region.[15]

Table 13: Federal Universal Service Components

Component	Policy Goals	Mechanism	Implications for Appalachia
High-Cost Program	• To prevent the extra cost of providing services to high-cost areas from being reflected in the rates of these areas. • To create a competitive environment by subsidizing the carriers who serve high-cost areas. • To transform the historical method of universal service (i.e., implicit cross-subsidies of residential local service by long-distance, business, and non-basic services) to an explicit method in which long-distance, business, and non-basic rates will reflect truer costs.	• All telecommunications companies in the country make contributions to the federal Universal Service Fund according to the contribution factor (percentage of end-user revenues), which is decided quarterly by the FCC. Carriers may or may not transfer the burden of contribution to rate payers. • A portion of the Universal Service Fund is disbursed to eligible *non-rural* carriers that serve high-cost areas. The Fund offsets the cost for the portion that exceeds 135% of national average cost. • The Fund also supports *rural* providers	• Affordable telecommunications services in remote communities that have geographic (e.g., mountains) and economic (e.g., small demands) disadvantages. • Greater incentives for carriers to enter markets (e.g., rural markets) where service provision is cost prohibitive in the absence of universal service support.
E-Rate	• To provide access to basic and advanced telecommunications to schools and libraries across the country.	• Each school or library that applies to the program receives discounts for connection (e.g., telephone line, T1, Internet access) and inside wiring. • The level of discounts ranges from 20% to 90% depending of the economic needs (the number of students eligible for the National Free Lunch Program) and location (i.e., rural or urban).	• Affordable access to advanced services (e.g., T1) in the areas where such services are costly. • Make public access terminals with sufficient bandwidth available to rural and **low income** residents who lack access at home. • Greater incentives for carriers to upgrade lines and switches for advanced services (e.g., ATM) because infrastructure upgrades can be partially and indirectly subsidized by the E-Rate when the school or library in one area makes service request for such services. (See the State Network section for detail.)
Rural Health	• To provide reduced rates to rural Health Care Providers (HCPs) for telecommunications related services related to the use of telemedicine and telehealth.	• Support is available to HCPs for long distance charges for accessing the Internet. Can be for existing or upgraded service. Available only to public, nonprofit of rural health clinics.	• More affordable access to Internet and broadband crucial for many rural medical facilities. Subsidy may not be adequate to make access affordable to many rural clinics.

Sources: Federal Communications Commission. 2000, http://www.fcc.gov/ccb/stats .Universal Service Administrative Company. (2001). *2000 Annual Report: Reaching and Connecting Americans*. Washington D.C.: Universal Service Administrative Company. Universal Service Administrative Company. (2001) http://www.sl.universalservice.org/.

Table 13 summarizes the major components of these programs. Although the 1996 Act does not explicitly state it, the high-cost program goes hand in hand with rate reductions in non-basic services (including long-distance service) so that prices can move toward real costs. Such rate reductions essentially eliminate implicit cross-subsidies between non-basic and basic services, one of the main goals in the 1996 Act's reformulation of universal service.

In FY2000, the Universal Service Administrative Company distributed $4.4 billion to eligible recipients across the county (Universal Service Administrative Company, 2001). The high-cost program (with five separate components) received the largest share of the federal Universal Service Fund (USF), with the amount of disbursement reaching $2.2 billion in FY2000. The E-rate program received the next highest share of the fund with a little over $2 billion. The rural health component varies from year to year, but in FY2000 about $7.8 million in rural health grants were made.

The High-Cost Program: The High Cost Program provides funds directly to carriers serving rural or high cost regions in a state. A precise measurement of the distribution of the High Cost funds intra-regionally is virtually impossible because of the way the federal USF is disbursed to eligible companies.[16] This is problematic for our purpose because except for West Virginia, all Appalachian states contain areas (i.e., counties) that are not designated as part of the Appalachia region. For this reason, we use statewide data.

Table 14: Distribution of The Federal High-Cost Program In Appalachia, 2000

State	Rural Telcos[1]	Non-Rural Telcos[2]	Total
Alabama	$27,833,107	$60,203,436	$88,036,543
Georgia	$73,429,979	$5,919,045	$79,349,024
Kentucky	$18,839,297	$10,608,807	$29,448,104
Maryland	$552,276	$1,852,272	$2,404,548
Mississippi	$23,442,921	$109,658,352	$133,101,273
New York	$43,566,507	$9,015,372	$52,581,879
North Carolina	$24,432,168	$9,638,988	$34,071,156
Ohio	$15,579,591	$3,908,757	$19,488,348
Pennsylvania	$27,296,823	$1,459,563	$28,756,386
South Carolina	$37,895,032	$11,613,882	$49,508,914
Tennessee	$29,524,563	$4,487,319	$34,011,882
Virginia	$10,656,944	$26,516,103	$37,173,047
West Virginia	$25,761,273	$37,249,836	$63,011,109
Total	$358,810,481	$292,131,732	$650,942,213

Source: Universal Service Administrative Company. (2001). 2000 Annual Report: Reaching and connecting Americans, Appendix B. Washington D.C.: Universal Service Administrative Company.

1 "Rural" carriers for the purpose of federal universal service are local exchange carriers that either serve study areas with fewer than 100,000 access lines or have less than 15 percent of their access lines in communities of more than 50,000 in 1996.

2 "Non-rural" carriers are local exchange carriers that do not meet the criteria for "rural" carrier designation.

Of the $2.2 billion High-Cost portion of the federal USF, about 30 percent or $650 million was distributed to the 13 Appalachian states (Table 14: Distribution of The Federal High-Cost

Program In Appalachia, 2000). We can further evaluate the federal USF by analyzing the relative importance of the federal high-cost program in each of the 13 states.

Table 15 aggregates the amount of per capita federal high-cost support for all programs for each of the 13 Appalachian states and compares them with the national average. Because of the problem of disaggregating the High Cost program to the county level, these numbers represent funding for the entire state.

Table 15: Per capita federal high-cost support in Appalachia in 2000

State	2000 Appalachian Population	Persons per square mile	Total high-cost support	Per capita high-cost support
Mississippi	2,844,658	60.6	$133,101,273	$46.79
West Virginia	1,808,344	75.1	$63,011,109	$34.84
Alabama	4,447,100	87.6	$88,036,543	$19.80
South Carolina	4,012,012	133.2	$49,508,914	$12.34
Georgia	8,186,453	141.4	$79,349,024	$9.69
Kentucky	4,041,769	101.7	$29,448,104	$7.29
Tennessee	5,689,283	138.0	$34,011,882	$5.98
Virginia	7,078,515	178.8	$37,173,047	$5.25
North Carolina	8,049,313	165.2	$34,071,156	$4.23
New York	18,976,457	401.9	$52,581,879	$2.77
Pennsylvania	12,281,054	274.0	$28,756,386	$2.34
Ohio	11,353,140	277.3	$19,488,348	$1.72
Maryland	5,296,486	541.9	$2,404,548	$0.45
Appalachian avg.	7,235,737	198.0	$50,072,478	$12.00
Nation	281,421,906	80.0	$2,241,237,733	$7.96

Source: U.S. Census Bureau (2001); Universal Service Administrative Company (2001).

The amount of per capita high-cost support roughly represents the relative ease of providing basic telecommunications at a rate that is affordable and of a quality comparable to urban areas. There is clearly an inverse relationship between population density (i.e., persons per square mile) and per capita high-cost support. The amount of per capita high-cost support decreases as the population density increases. In six states—Alabama, Georgia, Kentucky, Mississippi, South Carolina, and West Virginia—per capita high-cost support either exceeds or is approximately equal to the national average. These six states are the primary beneficiaries of the federal High-Cost program among the 13 Appalachian states. However, receiving a large amount of universal service distribution does not necessarily translate into a positive net inflow of USF funding, or the balance between a state's receipt of USF distribution and the USF contribution made by the state's telecommunication consumers (see below and Table 17 for further discussion).

E-rate and Rural Health: Unlike the federal High-Cost program, E-rate and Rural Health funds are dispersed directly to institutions. As a result, it is possible to detail funding at the county level and to specifically examine funding levels in ARC and non-ARC parts of each state separately. Data on these categories of universal service funding indicate that ARC counties taken together have received a per-capita allocation of funds significantly lower than that of the nation as a whole. As Table 16 shows, funding for these program on a region-wide

basis was over $291 million during the period 1998-2000 or $12.76 Per Capita—significantly below the national average of $20.32 per capita. This is a surprisingly low level of funding given the number of rural and economically distressed counties in the region.

Until recently, however, many eligible institutions found application procedures for the E-rate and Rural Health programs to be complicated, which probably prevented many communities from applying. A recent evaluation of E-Rate noted that larger school districts and library systems are more likely to apply for E-Rate funding (Urban Institute, 2000). This report also noted that in the first year of the E-Rate program, application rates of the most impoverished public school districts were significant lower than those of all program applicants (Urban Institute, 2000). States that provided assistance to individual E-Rate applicants are likely to have greater success rates securing support. For instance, two states that do have state-level groups assisting applicants, Kentucky and Mississippi, have higher than average per-capita funding rates. In addition, some states such as Pennsylvania and Maryland may have more counties with higher income levels and hence may not receive the same level of E-Rate subsidy. Nevertheless the relatively low per-capita funding level in most states is an issue that state policy makers should examine.

Table 16: E-Rate and Rural Health Funding 1998-2000: Distribution to ARC Counties in the 13 States

Appalachian State-Portion	Appalachian/US Population	E-rate and Rural Health Funding	Per-Capita
Alabama	2,837,224	$53,986,836	$19.03
Georgia	2,207,531	$11,892,948	$5.39
Kentucky	1,112,422	$55,372,473	$49.78
Maryland	236,699	$1,839,379	$7.77
Mississippi	568,989	$12,748,523	$22.41
New York	1,072,786	$13,621,793	$12.70
N. Carolina	1,526,207	$10,304,230	$6.75
Ohio	1,455,313	$11,824,669	$8.13
Pennsylvania	5,819,800	$57,356,315	$9.86
S. Carolina	1,028,656	$4,520,636	$4.39
Tennessee	2,479,317	$25,973,903	$10.48
Virginia	665,177	$7,707,561	$11.59
West Virginia	1,808,344	$23,950,996	$13.24
TOTAL: ARC Counties	22,818,465	$291,100,261	$12.76
TOTAL: National Funding	281,421,906	$5,719,775,769	$20.32

Source: U.S. Census Bureau (2001); Universal Service Administrative Company. (2001)

Balance of USF Funding Within States: The current federal USF is designed to create a national pool of funds to which the nation's telecommunications providers make contributions according to the rules set by the FCC. Once contributions are collected, the USF is distributed to eligible telecommunications carriers (ETCs) to support the four universal service programs (i.e., high-cost, E-Rate, low-income, and rural health care programs) without regard to the parity of each ETC's inbound (contribution) and outbound (distribution) flows. In other words, some ETCs contribute more than they receive, while others receive more than they contribute. There are some states that are net contributors and states that are net recipients.

Table 17 below aggregates all categories of the USF, showing the balance between USF payments to carriers (inflow) and USF contributions (outflow). A positive number in the net flow of funds for a state means that the state's ETCs receive a greater amount of USF payments than USF contributions made by the telecommunications carriers in the state. That is, those states with positive net flows can be seen as the *true* beneficiaries of the federal high-cost support program. Among the 13 Appalachian states, six states exhibit positive net flows of USF payments and contributions. These states—Alabama, Georgia, Kentucky, Mississippi, South Carolina, and West Virginia—correspond to the six states that indicate heavy reliance on the high-cost program in Table 15, above.

Table 17: Flow of USF Disbursement and Contribution in Appalachia, 2000 (in dollars)

State	USF Payments to carriers	Contribution to USF	Net flow of funds
Mississippi	$133,052,000	$18,872,000	$114,180,000
Alabama	87,650,000	30,116,000	57,535,000
West Virginia	63,061,000	12,557,000	50,503,000
South Carolina	50,342,000	32,031,000	18,312,000
Georgia	79,527,000	72,344,000	7,184,000
Kentucky	29,606,000	27,969,000	1,637,000
Tennessee	34,352,000	42,882,000	-8,530,000
Virginia	37,126,000	66,613,000	-29,487,000
North Carolina	34,304,000	65,174,000	-30,870,000
Maryland	2,394,000	48,742,000	-46,348,000
Ohio	19,587,000	76,213,000	-56,626,000
Pennsylvania	28,812,000	92,096,000	-63,285,000
New York	53,021,000	159,102,000	-106,081,000

Source: The Federal Communications Commission. (April 2001). State-by-state telephone revenues and universal service data. [Online]. Available: http://www.fcc.gov/Bureaus/Common_Carrier/Reports/FCC-State_Link/lec.html Note: The figures for the payments from USF to carriers are slightly different from the comparable figures in the total high-cost support column of Table 6 because the figures in Table 7 are rounded up and the two tables are compiled from different source materials. However, the two sets of figures are close enough for the purpose of our analysis.

Large discrepancies exist among different Appalachian states in terms of both the amount of support flowing into these states and the degree to which they rely on the federal support in maintaining rates that are affordable and comparable to urban areas. Indeed, one ARC state, Mississippi, is the country's biggest net recipient of the federal high-cost support while another ARC state, New York, is the country's third highest contributor to the federal USF. Strictly speaking, those states that make larger contributions than they receive back are not benefiting from the federal high-cost program. On the other hand, the federal high-cost support program already has generated positive results among net recipient states.[17]

When considering "net gain states" it is important to consider that local service is more costly to provide when there are fewer ratepayers and when the ratepayers are geographically dispersed. Indeed, this observation corresponds to the universal service policy goal of the Telecommunications Act of 1996, which underpins federal universal service rules. The Act has attempted to introduce competition to all aspects of telecommunications services, particularly to the local telephone market without sacrificing the affordability of services.

Absent universal service support for carriers that serve high-cost areas, rural telephone markets are not likely to see local telephone competition.

Other Federal Programs to Improve ICT Capacity

There are three significant federal program initiatives to improve connectivity and ICT capacity outside of the Universal Service Fund category: the Technology Opportunities Program; the Community Technology Centers initiative; and the Neighborhood Networks Program. Each of these programs and their utilization in the ARC region is described below.

Technology Opportunities Program: The Technology Opportunities Program (TOP) is managed by the Department of Commerce. TOP is a merit-based grant program that promotes the availability and use of advanced telecommunications technologies in the public and non-profit sectors. As part of the Department's National Telecommunications and Information Administration (NTIA), TOP gives grants for projects that demonstrate innovative uses of network technology. TOP evaluates and shares the lessons learned from such projects to ensure that benefits are broadly distributed across the nation, particularly in rural and under-served communities (U.S. Department of Commerce; 2001).

Table 18: TOP Funding 1994-2000: Distribution to ARC Counties in the 13 States

State	Total ARC County Pop.	TOP Funding	Per Capita
Alabama	2,837,224	$1,070,040	$0.38
Georgia	2,207,531	$ 0	$ 0
Kentucky	1,112,422	$4,618,398	$4.15
Mississippi	569,989	$347,349	$0.61
New York	1,072,786	$2,149,655	$2.00
North Carolina	1,526,207	$5,963,446	$3.91
Ohio	1,455,313	$1,017,719	$0.70
Pennsylvania	5,819,800	$5,589,092	$0.96
South Carolina	1,028,656	$392,272	$0.38
Tennessee	2,479,317	$2,875,949	$1.16
Virginia	665,177	$1,167,237	$1.75
West Virginia	1,808,344	$6,057,077	$3.35

Source: U.S. Department of Commerce, National Technical Information Administration, http://ntiaotiant2.ntia.doc.gov/top/index.cfm, 2001.

Started in 1994, TOP has provided matching funds to state, local and tribal governments, health care providers, schools, libraries, police departments, and community-based non-profit organizations. The goal of the TOP program is to demonstrate how the use of computers and networked communications can improve the performance of educational programs, organizations involved in public safety and health care, and other community organizations. (U.S. Department of Commerce, 2001). TOP projects are designed to serve as models that can be replicated in similar communities across the country, thereby extending project benefits beyond the communities in which they take place. The majority of TOP recipients are educational institutions including K-12 and community colleges, followed by heath care organizations and non-profit community groups (U.S. Department of Commerce, 1996).

Most TOP projects focus on providing information and training opportunities via the Internet and establishing access sites in communities that are under-served (U.S. Department of Commerce, 1996).

By the end of 2000, the TOP program had awarded a total of 456 grants in all 50 states. Total funding amounted to $149.7 million and according to agency sponsors, the program leveraged $221 million in matching funds from public and private sector partners (U.S. Department of Commerce, 2001). Congress appropriated $42.5 million for grants for FY2001. There are 35 sites/recipients in the ARC region, with many in rural counties. Table 18 shows the distribution of TOP funding in the period 1994-2000 to ARC counties by state.

Community Technology Centers: A second, smaller scale ICT support program is the Community Technology Centers (CTC) initiative of the Department of Education. This program, started in 1999, funds projects that provide access to computers and technology, particularly educational technology, to adults and children in low-income communities who otherwise would lack such access (U.S. Department of Education, 2001). Applicants under the program are encouraged to propose an array of services and activities that provide access to computers and information technology for local community residents, such as:

- After-school activities for children of all ages to use software that provides homework help and academic enrichment, exploration of the Internet, and multimedia activities, including web page design and creation;

- Adult education and family literacy, including GED, English as a second Language, and adult basic education classes or programs, introduction to computers, intergenerational activities, and lifelong learning opportunities through technology and the Internet;

- Career development and job preparation, such as computer skills training (basic and advanced), resume writing workshops, and access to databases of employment opportunities, career information, and other online materials;

- Small business activities, such as computer-based training for basic entrepreneurial skills and electronic commerce, as well as access to information on business start-up programs;

- Home access to computers and technology, such as assistance and services to promote the acquisition, installation, and use of information technology in the home through web-based television, network PCs, or other computer technology.

In its early stages, the CTC program has been highly competitive, funding 40 projects out of 750 applications in 1999. In the ARC region, there were only four CTC recipients in 1999 and 2001. These grantees received approximately $2.1 million for multiyear projects in these two cycles (U.S. Department of Education, 2001).

Neighborhood Networks Program: The third federal program supporting ICT capacity building is the Department of Housing and Urban Development's (HUD) Neighborhood Networks Program. This program helps people in public and assisted housing learn computer

and Internet related skills. Neighborhood Networks Centers are private/public partnerships that establish computer-based, multi-service centers to help people in public and assisted housing learn computer skills related jobs (HUD, 2001). HUD facilitates technical assistance and provides space in housing projects but does not provide direct funding for the Centers. The agency encourages local businesses, other non-profits, educational institutions, faith-based organizations, and other civic organizations to form partnerships and make actual or in-kind contributions to the Centers. The strategy emphasizes housing officials partnering with computer hardware, software, Internet and technical companies. Residents take classes, work on homework, and learn computer skills. Some centers have mentoring arrangements with partners such as Americorps, local boys and girls clubs, community colleges and universities.

The majority of Neighborhood Networks Centers are in urban areas where most public and non-profit housing projects are located. There were approximately 108 Neighborhood Networks Centers in Appalachian region counties as of 2001. Table 19 lists the number of local ICT initiatives supported by federal programs in NTIA- Department of Commerce, the Department of Education, or HUD programs for each ARC state.

Table 19: Number of Technology Opportunity Project, Community Technology Centers, and Neighborhood Network Project Sites in Appalachia

State	Number of Projects or Centers
Pennsylvania	47
Alabama	25
West Virginia	14
Tennessee	13
North Carolina	12
Kentucky	11
New York	9
South Carolina	8
Ohio	5
Mississippi	3
Georgia	2
Maryland	2
Virginia	1

Sources: The Neighborhood Network page, HUD web site: http://www.hud.gov/nnw/nnwindex.html; the TOP database in the NTIA web site: http://www.ntia.doc.gov/otiahome/top/grants/search.htm; the CTC database in the Community Technology Center's Network web site: http://www2.ctcnet.org/ctc.asp

Results of Federal Funding Initiatives in the ARC Region

In aggregate terms, Universal Service Funds seem to be meeting essential policy aims, with combined USF support going disproportionately to lower income and more rural states. An important caveat to this conclusion is that we could not break out High Cost funding at the county level and hence could not determine specific distribution to ARC counties in the 13 states. In the case of E-Rate there was evidence that ARC school districts and library systems in ARC counties in a number of states had poor capture rates of available funding. Because E-Rate funding requires each institution or jurisdiction to devise a plan and apply for funds, some poorer or more rural districts may have been left out due to weak capacity for creating

strategic technology plans and applying for assistance. In addition, procedures and aid from state agencies in completing E-rate applications vary from state to state. However, the situation may be improving as the application process has been simplified and more states are offering assistance to local applicants (Urban Institute, 2000). In terms of the other non-USF programs, ARC counties are participating but the levels of funding across the 13 states are very uneven. With the TOP program for example, Kentucky and West Virginia have been very active in securing TOP support while ARC counties in Georgia and Mississippi have not accessed this program at all.

An additional question is if this array of federal programs is improving access and ICT capacity in areas disadvantaged under recent deregulation. We draw upon national evaluations of the E-Rate and TOP programs, as well as our case study work in four ARC counties to provide some insights on the effectiveness of these programs.

The two large USF programs, High Cost and E-Rate, have the scale and scope to significantly improve telecommunications access and quality in rural communities. In our case study work, we did find evidence that local telecommunications providers were using high cost funds to improve basic service through upgrading antiquated lines and switches. Because the quality and reliability of basic service was identified as a significant problem in three of our four case study counties, high cost funding for these upgrades is important for economic development. In addition, high cost funding seemed to be accelerating the deployment of DSL-capable central office infrastructure in the Mississippi case study counties, although DSL deployment was not occurring at the time of our fieldwork (August 2001).

National evaluations of E-Rate suggest that the program is leading to substantive improvements in access and connectivity in K-12 schools and libraries. In a 2000 evaluation it was estimated that through 1999 about 84 percent of E-Rate funding went to public schools, with the balance going to libraries and private schools (Urban Institute, 2000). This study found that 58 percent of E-rate funding supported the acquisition of equipment and services for internal building connections. Due to older buildings and infrastructure in many rural schools, installing quality internal connections is an essential step in supporting the development and active use of internal computer networks and access to external telecommunications services. The remaining share of funding went to secure telecommunications services (34 percent) and pay for the cost of Internet access (8 percent) (Ibid, 2000).

A recent study of the effects of E-Rate funding on ICT capacity in four urban school districts argues that the program has played a crucial role in allowing the districts to create high quality networks and upgrade ICT training and curriculum for their students (Carvin, 2000). The impact of E-Rate can be credited not only to the resources provided, but also to the planning and implementation associated with the program and the fact that the program encouraged district administrators to leverage complementary state and local funds (Carvin, 2000). This report emphasizes that securing the maximum benefits of E-Rate requires that state and local governments make complementary investments in computer hardware (not funded by E-Rate) and in intensive training of teachers and school personnel in the use of computer, software and Internet tools (Carvin, 2000). The report warns, however, that the growth of computer and Internet use and work over networks will generate growing costs. Meeting these costs and

continuing to upgrade capacities will require a steady stream of E-Rate discounts in future years.

Another report from the Federal Reserve Bank of Kansas examines the unequal per capita E-rate funding characterizing several rural states (Federal Reserve Bank, July 2001). They observe that differences across (and within) states may be due to (1) unequal infrastructure—some places have newer schools and require less refurbishing than other sites with very old wiring and walls; (2) local geography and topography that affects the cost of a T-1 line necessary to connect schools and libraries to the Internet; and (3) school districts in one state may be more aggressive than those in another state in pursuing E-rate funding. On the latter point, states that have centralized processing for E-rate requests may be more efficient at obtaining funding than states that leave the matter entirely up to individual schools. An Urban Institute report (Puma et al., 2000) likewise finds large variations in states' applications rates and funding levels of E-rate. They note that state differences are related to poverty and rural location in concluding that on a per capita basis the big E-rate "winners" include Alaska, Kentucky, Puerto Rico, Mississippi, New Mexico and the District of Columbia. Furthermore, this report notes that schools and libraries in larger districts are more likely to apply for E-rate discounts, suggesting that larger institutions have the social capital to both apply for and effectively use the program's funding (Puma et al, 2000).

The impacts of E-Rate on ICT access and capacity in schools and libraries in our four case study counties were dramatic. We discuss these findings in more detail in the case study section below. However, in all of the case study counties, E-Rate funding allowed the development of local and wide area networks and connected schools and libraries to powerful state networks and data systems. The level of exposure to and classroom use of computers and network resources had expanded significantly over the last four years, due to E-Rate investments and related support by state and local governments. In three of our counties, high level computer based curricula had been developed. For example, in Monroe County, Mississippi, the school district partnered with Cisco to provide students the opportunity to take classes to obtain the Cisco Advanced Networking certification. In general we found that E-Rate was helping to significantly improve ICT literacy and stimulating training in more advanced skills in districts that had previously lagged.

The other relatively large Federal program affecting ICT capacity in rural regions is the Technology Opportunities Program. With the first grantees receiving funding in 1995, the NTIA/U.S Department of Commerce has carried out several evaluations of TOP project characteristics and outcomes (Frechtling et. al, 2000; Johnson and Johnson Associates, 2001). As noted in the previous section, TOP grants fund a range of ICT equipment acquisition and training activities in low income and rural areas. Over 74 percent of the projects evaluated reported serving end users in rural areas. A survey of 36 TOP demonstration and access projects launched in 1996 found that:

- 94 percent of projects sought to improve ICT training opportunities in their communities with over 67 percent exceeding their expectations.

- 75 percent of the projects sought to enhance long term telecommunications access in their communities, with over 96 percent of these meeting or exceeding their expectations.

- 72 percent of the projects aimed to coordinate community-wide communications services with 50 percent exceeding their program goals.

- About 64 percent of projects evaluated were attempting to enhance community development outcomes, with 43.5 percent of these exceeding their expectations. (Frechtling et al, 2000)

While we did not have any TOP programs in our case study counties, as we noted above there are 35 TOP projects across the ARC region. Given the flexible character and generally positive evaluations of this program, TOP should be viewed as an important tool to improve access and to foster the better utilization of ICT resources to meet the needs of rural and low-income populations.

Of the remaining federal program areas, there were no evaluations of the CTC initiative of the Department of Education or the HUD Neighborhood Networks program. We did visit a Neighborhood Networks site. This project was located at the Southview Apartments, a 90-unit affordable housing complex in Aberdeen, Mississippi. In this complex only about a third of the residents were fully employed. The Neighborhood Networks Center has a computer lab, funded through crime prevention grants, that contains seven networked computers and a 56K Internet connection. The Center also has a printer, tutoring software, a television, and a VCR. The Center's staff partnered with the East Mississippi Community College to host Microsoft Office training classes. Although relatively small in scale, the Center provides crucial “at home” access to school ages youth and seeks to expand services to adults attempting to acquire better jobs.

On balance this set of federal programs provide critical resources to help overcome access and capacity barriers in rural and lower income communities. Most of the evidence from national evaluations and from our case studies indicates that these programs are making a difference, especially in increasing Internet access and training in ICT applications for K-12 students. However three issues should be considered to better understand and exploit these programs. First, many of these programs replace resources that were previously available under old universal service requirements; cross subsidies to under-served users are being replaced with the direct subsidies offered through these programs. Second, if this array of programs is going to continue to overcome access and capacity barriers, the commitment must be durable and program funding must be continued and perhaps increased. If changes in the political environment cause major program restructuring and loss of funding, the progress achieved through these mechanisms could be quickly reversed. Third, many of these programs are based on a fairly complex application process to receive grants or subsidies. It is crucial that eligible institutions across the ARC region are made aware of these resources and receive assistance with grant applications and with planning and implementation. Counties throughout the region should be aggressively accessing and leveraging these critical resources to improve their ICT infrastructures and skills.

VI. STATE POLICIES AND PROGRAMS

States vary tremendously in how they have addressed telecommunications regulation and telecommunications infrastructure. Every state in the Appalachian region has initiated some program designed to use telecommunications more effectively or to broaden capabilities. Some use state programs such as state universal service funds or special initiatives – often under the aegis of Governors' Commissions or Task Forces, while others, such as Mississippi, have benefited from the federal universal service program. Each state has a unique context in terms of its telecommunications regulatory systems, relationships with dominant incumbents (typically the Bells or Verizon), and existing infrastructure.

This section examines state deregulation activity, particularly legislation or regulatory commission actions, in order to understand how each region has dealt with the goal of extending broadband capabilities. We examine state universal service funds, how states are using their statewide networks to extend services to various constituencies, how they have dealt with the question of allowing utilities to offer telecommunications services, and other special circumstances or events, including merger approval and over-earnings cases, that have influenced how states are able to provide for improved telecommunications infrastructure.

There is a broad policy and regulatory landscape behind the supply and demand features of providing infrastructure, one that encompasses actions on the local, state and federal levels. A "pure" market situation, devoid of constraints as well as incentives devised by policymakers, will not characterize the growing availability of broadband in the US – even as no purely market-driven deployment environment characterizes broadband in other countries. At this writing, there are two major bills before the Congress that would enhance the supply-side economics for providing broadband throughout the country – including more rural, less populous regions. A number of vendor companies are proposing broadband policies or offering White Papers that justify government interventions that would (they believe) accelerate deployment (Pultz and Girard, 2001). As will become apparent, some of the states in the Appalachian region likewise have adopted explicit broadband policies as well, although there are perhaps stronger models in non-ARC states such as Michigan and Oregon.

Legislative and Regulatory Commission Actions on Deregulation

Several states in the region implemented deregulation in advance of the 1996 Telecommunications Act. New York's aggressive pro-competition activities are broadly taken as 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 in order to make adjustments for a competitive process that seemed to be working for businesses but not for residential users. Pennsylvania also has had numerous hearings and regulatory actions around

deregulating telecommunications within the state. There was so much strife around the issue of fair network unbundling that at one time the commission there recommended that Verizon be separated into two companies, one to provide voice services and the other to provide advanced services. The fundamental complaint heard in Pennsylvania and in many other states was that the Bell Operating Companies were unfairly slow in making their networks available to competitors.

West Virginia's attempt to creatively use state rights of way ran into trouble with large carriers that worried about the state's ability to unfairly leverage its control over rights of way. This development is interesting in that several other states have followed this same practice with no objections or legal disputes.

Table 20: Selected Telecommunications Deregulation Initiatives

STATE	ACTION	COMMENTS
Alabama	Price cap regulation in 1995	
Kentucky	Order in the Matter of Review of BellSouth's Price Regulation Plan	Rate rebalancing plan with broadband upgrade requirement
Maryland		
Mississippi	Approved BellSouth for Section 271 compliance	Many considered this approval premature, and the BOC never followed through with the FCC filing that would enable it to offer long distance in the state.
New York	"Competition II" (1994), or formally Cases 94-C-0095 and 95-C-0095.	Adopted a regulatory framework to transition to a competitive framework, and created incentive regulation for NYNEX (now Verizon) and Rochester Telephone
North Carolina	HB 161: An Act to provide the Public with Access to Low-Cost Telecommunications Service in a Changing Competitive Environment (1995)	Facilitate competition in the state
Ohio	*Local Competition proceeding, Case No. 95-845-TP-COI (concluded 1996); * Telecommunications Rule Reform, Case No. 99-998-TP-COI (1999) and 99-563-TP-COI	Created local competition for local exchange services *Telecommunications rule reforms to enhance competition in the local exchange
Pennsylvania	Ordered a structural split of Verizon (March, 2001); this was later rescinded	
West Virginia	Attempted a plan to trade state right of way access for installation and maintenance of a statewide telecommunications system (2000)	This initiative failed after objections from dominant incumbent local exchange carriers.

Source: Authors' survey of state legislation and commission hearings

Much of the late 1980s and early 1990s have been periods for regulatory commissions to gradually adjust to more aggressive deregulatory pushes from their large, incumbent carriers. Often, improved infrastructure deployment in rural areas was held out as a carrot **to states** in return for a lighter regulatory hand. Table 20 summarizes a few highlights of these initiatives.

Assessing Infrastructure

Several state governments or Commissions have considered undertaking an inventory of telecommunications facilities. Such inventories are 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 such 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, Maryland and North Carolina join the efforts of several other states in the country in attempting to assess telecommunications infrastructure in the state 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/). The same group performed a similar assessment for Maryland. (The Ecom-Ohio maps are based on more current data than were available for the current report with respect to cable modem coverage.)

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 attempting to insure that every county has flat-rate dial-up modem access to the Internet. In its second phase, the program will attempt to insure that each county has 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 is 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 the state that a combined look at the location of POPs and fiber trunk lines would help businesses evaluate their options in the state.

Pennsylvania has maintained web-accessible maps of telecommunications infrastructure for many years. This effort was initiated as the state attempted to rationalize its investments in educational telecommunications infrastructure. The Link-to-Learn program sponsored the maps initially. Pennsylvania's maps are available at http://www.oit.state.pa.us/atlas/. Pennsylvania's Rural Development Council recently decided to fund research that will document that state's telecommunications services and profile the difficulties faced by rural regions in particular (personal communication, Dr. Amy Glasmeier).

These mapping endeavors are a first step in assessing the difficulties and opportunities regarding broadband capabilities in a state. In the cases noted here, some of the mapping endeavors were the product of university-government partnership efforts. In all cases, economic development was a primary goal behind the drive to map infrastructure.

State Universal Service

The Telecommunications Act of 1996 allows individual states to implement appropriate support mechanisms for carriers and telephone subscribers to preserve and advance universal service in states.[18] It must be noted that neither the Act nor any other federal laws and regulations require states to create intrastate universal service funds. Therefore, each state must make its own decision as to whether it is appropriate to create an intrastate USF and what is the right size of its USF should be. Such discretion given to individual states has resulted in heterogeneous activities among the 13 Appalachian states (and the rest of the country) in devising and implementing intrastate universal service mechanisms. States opted to establish USF programs largely to respond to industry claims for recovering revenue lost due to reduced access rates (and other deregulation initiatives). In other words, the federal reform of universal service that was mandated under the 1996 Telecommunications Act would result in lower federal universal service funding going to carriers serving rural areas. It was expected that the states would come up with sufficient funds to ensure that universal service goals could still be met. In this sense, their USF programs have had little to do with direct responses to citizen needs although in certain states (e.g., North Carolina) some citizens have tried to persuade legislatures to allow community networks to receive universal service funds.

Implementing complicated regulatory mandates demands a tremendous amount of resources, time, and expertise on the part of state regulators. Formulating a universal service policy requires that regulators assemble a complex mix of interventions with complicated cost calculations, associated changes in intrastate and interstate tariffs, consistency with the federal universal service policy, and the requirement to achieve affordable telecommunications rates and competition all at the same time (see Allen et al., 1999, for a brief review). Quite predictably, there is no uniformity in creating state USFs among the 13 jurisdictions in Appalachia, as shown in the Table 21.

Table 21: Public utilities commission actions for the creation of state USFs in Appalachia (as of August, 2001)

State	USF created or planned[1]	Amount	State	USF created or planned[1]	Amount
Alabama	No		Ohio	No	
Georgia	Yes	$40m	Pennsylvania	Yes	$32m
Kentucky	Yes		South Carolina	Yes	$41m
Maryland	Partial				
Mississippi	No		Tennessee	Yes	
New York	Yes		Virginia	No	
North Carolina	No		West Virginia	No	

Source: Personal interviews with state public utilities commission staff; the authors' survey of public utilities commissions web sites, the FCC web sites, and general publications. "Planned" means that the state public utilities commission at least has entered an order defining procedural rules toward the creation of a state USF. "Partial" in Maryland's case refers to its actions to facilitate discounted lines for schools and libraries.

About half of the 13 states have created or will create in the near term state USFs in one form or another. Recalling the six states that are net beneficiaries of the federal high-cost universal service program (Alabama, Georgia, Kentucky, Mississippi, South Carolina, and West Virginia), there seems to be no relationship between a state's status in federal funding and its commitment to intrastate support.[19]

The universal service policies in four states (Georgia, New York, South Carolina, and Tennessee) were produced through state legislation. Universal service bills (or telecommunications reform bills that contained universal service requirement) typically define the general policy goals as well as some aspects of implementation procedures for state USFs. In all four states, state PUCs carried out the actual implementation of USFs. In contrast to these four states, Kentucky and Pennsylvania's universal service policies were instituted by PUCs and are not codified into their state statutes.

South Carolina presents an interesting case regarding how fund sizes and provisions are established. Many of the rates set by the PSC in that state were established as long ago as the early 1970s. Since then the cost of service has generally declined, and many companies also have broadened the range of services they offer, but many rates are unchanged. The Consumer Advocate for the State requested that the PSC examine the financial condition of every local telephone company that was subject to rate of return regulation in order to establish what each company was currently earning and then use that data to size the USF. Telephone companies objected to this request, and the Consumer Advocate's arguments were dismissed by the state PSC in early 2001, meaning that its state USF size would have little reference to what companies were actually earning and consequently little reference to actual financial needs.

In addition to these six states, the possibility of creating state USFs has been discussed at one point or another by the PUCs in six more states (Maryland, Mississippi, New Carolina, Ohio, Virginia, and West Virginia), but none had initiated specific proceedings for setting procedures and guidelines as of fall, 2001. Some have proceeded piecemeal nonetheless. For example, Maryland's PSC approved intrastate discounts for schools and libraries, and West

Virginia's PSC issued an emergency rule allowing schools and libraries to apply for federal funds.

Types and Nature of Universal Service Support

The types of universal service support funded by state USFs are varied (Table 22).

Table 22: USF-supported services in Appalachia

State	High-cost	Low-income[1]	Schools/Libraries	Telephone Relay System[2]
Georgia	✓			
Kentucky		✓		
New York		✓		✓
Pennsylvania	✓	✓		
South Carolina	✓	✓		
Tennessee	✓	✓	✓	✓

Source: Personal interviews with state public utilities commissions' staff; the authors' survey of public utilities commissions web sites, the FCC web sites, and general publications.

Note: All 13 Appalachian states but Ohio provide low-income support at a state level, but those states that are not listed on the table have not created explicit USFs.

1 Low-income support includes Lifeline and/or Linkup, and the state low-income support supplements the federal low-income universal service support.

2 Telephone relay system is a service for people with a hearing disability.

The pattern among the universal service policies among the six states is an emphasis on low-income support and high cost support. Each has a unique combination of USF-supported services, but high-cost support and low-income support are the most popular types of intrastate USF support. The high-cost component is the most prominent aspect of a state USF from a regulatory perspective because low-income support by states is a relatively *passive* policy measure supporting demand side dynamics, while the high-cost component of state USFs is an *active* policy measure supporting the supply side. We can understand this difference by considering the relationship between the federal and state USFs.

The Lifeline portion of the low-income customer USF support has a three-part design. The federal USF provides a baseline assistance of $6.1/monhth/line to all 51 states. States then decide whether to provide additional support (up to $3.5/month/line). For those states that provide additional Lifeline assistance, the federal USF provides matching support (1/2 of the amount of state-level support).

In contrast, there is no regulatory mechanism or requirement to coordinate state and federal high-cost support. The creation of a state USF with a high-cost component is completely a discretionary activity of each state. In this respect, the four states with their own high-cost programs (Georgia, Pennsylvania, South Carolina, and Tennessee) are arguably the most active states in Appalachia in terms of universal service policy.

A state's decision to create a USF may not be directly contingent on the size of its federal USF distribution and may, in fact, reflect different local policy priorities. For example, Pennsylvania, whose federal high-cost support for non-rural carriers is considerably smaller than the support the state's rural carriers receive, excludes Verizon, a non-rural carrier, from its list of state-USF eligible carriers. Pennsylvania's state USF is not designed to compensate

for the shortage of federal support to non-rural carriers (an historical nod to revenue lost from the move toward reduced access fees), but rather its goal is simply to increase the support for rural carriers.

State Networks

Ever since AT&T's divestiture became effective in 1984, state legislatures and their utilities commissions have had much more responsibility for monitoring and regulating telecommunications activities in their boundaries. Each of the Appalachian states has chosen distinctive paths to handle its regulatory responsibilities. Some appear to have much closer relationships to large, incumbent companies than others; some have considerable staff resources and expertise to help establish policy, while others, such as Mississippi with its two telecommunications staff people, have very limited resources.

In this section we briefly review the range of state programs used to enhance the delivery of telecommunications services. Some mechanisms include using state networks to extend non-state communications opportunities, using utility commission approval over mergers or network unbundling[20] 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. Here we discuss on how states develop their own state networks to help develop telecommunications capabilities more broadly across their regions.

So far we have examined the status of telecommunications infrastructures in the Appalachian region as developed primarily by private telecommunications companies. However, the state governments of the 13 Appalachian states have developed numerous infrastructure and connectivity projects over the years. These projects have broad goals ranging from simply making state telecommunications bills cheaper to upgrading public telecommunications infrastructure throughout the state for the benefit of state government, business users, and the general public. Accordingly, the technological underpinnings and mechanisms of state telecommunications networks vary from one state to another. Our observation of different state networks in Appalachian states illuminates some features common to several state networks. In this section, we offer a typology of state telecommunications networks in the 13 Appalachian states, and make an assessment of the impacts of each network type on the overall connectivity and access to advanced telecommunications technologies in these states.

Table 23 summarizes our observations of state telecommunications networks in the 13 states. We have identified three major types of networks that are not necessarily mutually exclusive: the demand aggregation model, the resource sharing model, and the anchor tenancy model.

Table 23: Typology of State Telecommunications Networks

	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 telcos 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 sate and other government users. • To maximize the efficiency of existing and new telecommunications infrastructures in key routes.	The state government and a telco 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 sate and other government users • To upgrade public telecommunications infrastructure in all parts of the state.	The state government and a telco or telcos 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

Demand Aggregation

A state telecommunication network under the demand aggregation model creates a single large telecommunications customer by consolidating telecommunications service purchases of state agencies and other eligible users (e.g., public schools and libraries, local governments, universities and colleges, etc). The advantage of the demand aggregation strategy resides in the cheaper telecommunications services for participating users. The model leverages the state government to negotiate services prices that individual users could not receive.

The Commonwealth of Virginia Network (COVANET) exemplifies the demand aggregation strategy. COVANET, like many other state telecommunications networks, is built upon the public telecommunications infrastructure, owned and operated by a private telecommunications company (MCI Worldcom). Prior to the COVANET contract in 2000, at

least five separate state-funded telecommunications systems had existed in Virginia. The principal goal of COVANET was to consolidate the voice, data, and video transmission requirements interspersed among existing, separate networks into a unified system. As a result of the network and demand consolidation, COVANET succeeded in substantially lowering various telecommunications rates for the public sector users, including schools and local government.[21]

One problem created by demand aggregation strategies occurs in their effect of removing business from potential private carriers. This is a trade off many government-provided services must face when private sector vendors offer services similar to those offered by the public sector. Evaluating the utility of demand aggregation therefore would require careful consideration of its possible downsides even as it requires fiduciary responsibility to maximize returns on public investments.

Resource Sharing

State governments maintain relatively few assets at their disposal that they can turn into economic gains to the state governments. However, states can potentially gain desired outcomes for economic development strategy and meet their own telecommunications needs by taking advantage of their ownership and control of highway rights-of-way (ROW).

Different states have different policies in authorizing the use of highway ROW; some states grant private telecommunications companies the right to lay telephone and fiber lines on highway ROW free of charge, while others demand monetary compensation from telecommunications companies. Under a resource-sharing arrangement, the state government and a telecommunications company "barter" the company's free access to highway ROW and the state government's access to and/or ownership of a portion of telecommunications facilities developed under the resource-sharing arrangement. The primary benefit of the resource-sharing model to states is that the state government gains access to new (typically fiber optic) infrastructure without using any public money. The model also allows the state government to create incentives for infrastructure expansion to its partner (i.e., the telecommunications company under the contract). A resource-sharing agreement is typically a long-term contract that extends over a few decades. Thus, the telecommunications company under the contract is assured of the predictability and stability. The downside of the resource-sharing model is the problem of technological obsolescence. Because the contract locks the state into the types of technologies and services specified in the contract, the state may not be able to adopt future new technologies without bearing additional costs. In addition, the model is discriminatory by its nature, limiting the contract's economic opportunities to one or a small number of select companies.

Several states in Appalachia have adopted the resource-sharing strategy to develop their state telecommunications networks.[22] Maryland is one example, with its innovative approach in linking the resource-sharing model to the development of a statewide telecommunications network. Unlike many other states, Maryland has designed its state network, Net.Work.Maryland, on newly constructed infrastructure. In order to alleviate the enormous costs associated with such a ground-up project, the state government entered into three resource-sharing contacts with private telecommunications companies. Net.Work.Maryland—currently being built in several phases with a schedule of first service delivery in October, 2001 in limited areas—is envisioned as a network to provide state of the

art telecommunications service to Maryland's state agencies, local governments, educational institutions, health care facilities, and notably, private businesses.[23]

Maryland has entered three separate resource-sharing contracts with four telecommunications companies.

1 A 40-year contract with MCI Worldcom and Teleport Communication Group. The companies provide 75 miles of fiber optics and the services required to activate the fiber along the Baltimore/Washington corridor. The state receives free bandwidth service (OC-48). The estimated value of the contract is $32.8 million.
2 A 40-year contract with Level 3 Communications. Level 3 would provide 330 miles of fiber optics from the southern portion of the state to the central, east, and west portions. The estimated value of the contract to the state is $222.8 million.
3 A 10-year contract with Williams Communication. The company provides fiber lines and related equipment in the Baltimore area. The estimated value of the contract to the state is $9.4 million (Association of Telecommunications Professionals in State Government, 2000).

Together, these resource-sharing contracts form a 13-node high-capacity (10 Gbps) fiber optic backbone connecting all four Local Access Transport Areas (LATAs) in the state. Each county will have at least one POP (at least 45 Mbps), which will be supplemented by 133 fiber "drops" at various highway intersections for future connections. Maryland anticipates leasing state advanced capabilities to private providers in underserved regions where no broadband capability exists (Lee, 2001).

Anchor Tenancy

The third model of state telecommunications network strategy is the anchor tenancy model, and this model has been most widely adopted by the states in the Appalachian region.[24] Like the demand aggregation model, the anchor tenancy model is characterized by the reliance on public telecommunications infrastructure owned by private telecommunications companies. Indeed, the difference between the two models is small, yet explicit. In the anchor tenancy model, the state government becomes the principal (anchor) tenant of a private telecommunications company's public network, guaranteeing a certain level of service will be purchased. In turn, its contract with a provider requires the telecommunications company to make a commitment to infrastructure upgrading and service deployment as requested by the state government. The key to understanding the benefit of the state network is the use of public telecommunications infrastructure. The state makes the request to the telecommunications company under the contract to make infrastructure upgrades to meet the telecommunications needs of the state government (and other eligible users). However, since the state network is built upon leased public telecommunications infrastructure, the improvement in the technological capabilities in the public system benefits all telecommunications users who share the same system.

The experience of Mississippi illustrates the anchor tenancy model mechanisms. Started as a frame relay network in 1995, the State of Mississippi revamped its network in 2000 and converted it into the Statewide Asynchronous Transfer Mode (ATM) Backbone Network. The Statewide network consists of seven ATM nodes or "clouds" located in Jackson, Greenwood, Tupelo, Meridian, and Hattiesburg within the state's primary LATA, and in Memphis and Gulfport to serve the Northwest Mississippi LATA and the South Mississippi

LATA. (LATAs, or Local Access and Transport Areas are the geographic boundaries that define the service territories of local versus long distance services.) Although all but one of these nodes are located outside the Appalachian portion of Mississippi, the contract explicitly requires the contractor (BellSouth) to make necessary upgrades in all the state's counties including the 22 Appalachian counties in order to bring ATM access to all counties. Each user of the Statewide Network is responsible for furnishing the "last-mile" (typically a T1 connection) connection between the user site and the nearest BellSouth telephone central office, but the contract requires the connection to be a non-mileage sensitive rate that is uniform across the state. The Statewide Network is open to state agencies, universities, community colleges, K-12 schools, public libraries, and local governments.

Mississippi's telecommunications infrastructure has lagged behind the nation for years in part because of the rural nature of the state.[25] The anchor tenancy model adopted by Mississippi envisions radically changing the infrastructure capabilities of Mississippi's public telecommunications infrastructure since the Statewide Network project requires the contracting telecommunications company to convert most of wire centers into digital systems to transport data to ATM nodes. Such improvement at the wire center level benefits businesses and other telecommunications users because wire center facilities contain a lot of shared equipment that equally benefit the Statewide Network users and other users. Thus, the anchor tenancy model in Mississippi is designed to bring technologies and services to areas that would otherwise be considered "uneconomical" markets that do not justify upgrading.

North Carolina's model is similar. After passing the Information Highway Bill in 1994, the general assembly directed the Secretary of Commerce to implement a statewide broadband network that would service state, county and local public agencies, educational institutions, health care facilities, and research entities. GTE (now Verizon), Sprint, BellSouth and AT&T built that network, but balked when state legislators were interested in amending state law so that the network would be made available to businesses and the general public.

Kentucky's Information Highway is a public-private initiative to create a statewide backbone with access points in all 120 counties. The usual public sector agencies are eligible to use the network, as well as any entity that has been approved for economic development purposes. This language opens the possibilities of exploiting the anchor tenancy model for development purposes in the state's Appalachian region.

Utility Commission Authority

Of all the Appalachian states, New York has sought most aggressively an orderly and monitored deregulation program. It began deregulating its local exchange companies in 1985, well before the 1996 Telecommunications Act was passed. In 1995 it opened local exchange markets to competition, and undertook a variety of price controls, gradually lifted, in order to grow competition in the state. Its Public Service Commission required Bell-Atlantic to commit to a one billion dollar infrastructure upgrade program in 1997 as part of its approval of that company's merger with Nynex, and the commission was one of the first to initiate a rigorous review of Verizon as it sought approval under the Section 271 requirements.

Ohio and Pennsylvania also have taken advantage of occasions requiring merger approval to stipulate new or improved services from telephone companies. In approving the Bell-

Atlantic-GTE (Verizon) merger in 1999, the Pennsylvania PUC required that the new company provide broadband capability to 50% of the state by 2004 and to the rest of the state by 2015, with the proviso that deployment be balanced across urban, suburban and rural areas. In addition to its active role taken in the Bell-Atlantic-GTE merger proceeding, the Pennsylvania PUC stands out by having attempted to restructure its dominant Bell provider. In March 2001, the Pennsylvania PUC entered an order demanding the functional structural separation of Verizon into retail and wholesale units.[26] The goal of the structural separation of Bell companies was to remove barriers for local telephone competition by "structurally" preventing Bell companies from favoring their own local telephone services over those of competing local exchange carriers who lease Bell local facilities. Although the functional separation order was rescinded, this effort indicates Pennsylvania's active commitment to the creation of competitive telecommunications markets. Ohio also required the newly merged Ameritech-SBC to deploy DSL in both rural and urban areas in its 1999 merger approval. It also required a $2.25 million fund to assist rural and low-income areas in accessing advanced telecommunications technology (SBC-Ameritech Merger Proceeding, Case No. 98-1082-TP-AMT, 1999). When Bell Atlantic merged with GTE to create Verizon some additional requirements likewise were imposed on the companies, including that all central offices in the state would have at least 56K line connection capability within three years (Case No. 98-1398-TP-AMY, 2000). Virginia also established several conditions for approving the Bell-Atlantic-GTE merger in 1999, including infrastructure and service upgrade requirements.

Utility Companies and Telecommunications Services

The states in the Appalachian region vary in how they address the provision of telecommunications services by utility companies. On the face of it, these companies can play a useful role in extending services to various constituencies: utility companies own rights-of-way; they have established billing practices; they have a great deal of dark fiber in the ground already; they use telecommunications for load management already, and have expertise in establishing networks.

However, state policy is mixed on whether or not utilities should be allowed to offer telecommunications services. Municipally-owned utilities are a sticking point in particular, since private telecommunications companies object to public institutions competing with them in providing services.

Table 24 provides a snapshot of the most notable Appalachian states' policies regarding utilities providing telecommunications services.

Some states see utilities as sound alternatives for providing broadband services, and others are convinced that doing so is anti-competitive. Virginia is a particularly interesting case. Its current proceeding around the City of Bristol's municipally owned fiber network may catalyze a reversal of the state's prohibitions on utility involvement in telecommunications. Interestingly, that state does have a provision allowing municipalities, industrial development authorities, and economic development authorities the ability to lease dark fiber to local exchange companies and non-profit educational and health institutions, upon case-by-case approval from the State Corporation Commission.

Table 24: Utility Provisions for Telecommunications

STATE	PROVISIONS	COMMENTS
Alabama	Utilities may offer telecommunications services	
Georgia	Municipal governments can provide telecommunications services (1995)	
Kentucky	Municipal government may provide telecommunications services. Barbourville, Knox County, provides cable and Internet services.	Kentucky Revised Statutes 96.531, amended Jun, 2000
North Carolina	Electric membership corporations can acquire and operate subsidiaries that provide telecommunications and other utility services	HB 476: An Act Concerning the Grant of Powers to Electric Membership Corporations Regarding Subsidiary Organizations (1999)
South Carolina	Approved municipal utilities offering telecommunications	
Tennessee	Approved Municipal utilities offering telecommunications (1997)	
Virginia	Forbids municipally owned utilities from providing telecommunications services, excepting Abingdon (VA Code Section 15.2-1500)	Under court review in 2001-2002
West Virginia	Approved utilities offering telecommunications services	

Special Programs or Initiatives

Georgia stands out as a state that enabled municipal governments to be eligible for local exchange carrier licenses as early as 1995. The Governor of Georgia announced a rural broadband initiative in May 2000, which promised to bring broadband infrastructure to rural regions. The network will support download speeds of 1.5Mbps. Another more modest project in collaboration with BellSouth will connect all K-12 school districts to the Internet with a T1 connection; all of Georgia's Appalachian counties are scheduled to receive these connections. As of summer, 2001, the state approved a novel non-profit consortium of 31 towns and cities and one county to offer broadband telecommunications services in a wide variety of locations (GeorgiaPublicWeb, 2001).

Maryland, dominated by Verizon, has several programs to encourage e-commerce and an overall statewide information technology program. In 1998 it instituted a property tax credit (HB 477) that awards commercial and residential tax credits for renovations to accommodate advanced computer and telecommunications systems. Additionally, there are two investment funds to support innovative technology efforts in the state. Its key architecture, however, is its statewide network plan to have a point of presence in all three Appalachian counties and to link communities via high-speed fiber. EMaryland is the cornerstone of its contemporary digital initiatives (framed in HB 276, passed in 2000), and this program positions the statewide fiber backbone as its core resource (see http://www.techmd.state.md.us/ for more information). The network is administered by the Task Force on High Speed Network Development (created in 1998 under HB 847). Maryland's site is positioned for e-commerce as well, and publicizes state work available for bid.

Virginia has a unique resource in the form of Virginia Tech University, which has purchased four wireless spectrum licenses in the rural western portion of the state in order to experiment

with alternative broadband services. This University also has spearheaded several "electronic village" initiatives. Its best known Electronic Village in Blacksburg continues to spearhead novel methods of providing telecommunications services. Its latest innovation is the creation of a regional MultiService Access point (MSAP), a local peering point that several local ISPs have joined to reduce data transport costs (Blacksburg Electronic Village, 1999).

Tennessee is one of the seven Appalachian states that approved municipally owned utilities providing telecommunications services (in 1997). The others include Kentucky, North Carolina, Alabama, South Carolina, West Virginia and Georgia. The Electric Power board of Chattanooga was the first municipal utility to be certificated for telecommunications services under that law, and it serves five counties in the Appalachian region. Utility companies are predictably quiet about their roles in providing telecommunications, but under the right circumstances they can be viable alternative vendors.

In addition to sponsoring a statewide network that is available to non-government users, North Carolina's 2000 bill to create a new state agency charged with overseeing rural economic development and information technology infrastructure in the state is innovative. The Rural Internet Access Authority serves as a rural Internet access planning body, and appears to be meeting many of its goals for extending Internet access. A companion program, called Connect NC, was an educational campaign operating from 1996-1999 to educate public and private sector leaders in the western portion of the state regarding telecommunications' relationship to economic competitiveness. In the Appalachian region, some outcomes of the Connect NC campaign include Caldwell and Alexander Counties establishing wide area networks to connect certain public sites together for Internet access purposes.

Some states have used over-earnings cases to leverage additional technology commitments from telecommunications providers. For example, in Ohio, a Public Utility Company settlement in 1994 forced Ameritech into two major concessions (Case No. 93-487-TP-ALT; Case No. 93-57Z-TP-CSS). The company had to contribute to SchoolNet Telecommunity initiatives over six years, and it paid $2.2 million to fund 14 community computer centers in low income neighborhoods in seven Ohio cities. One of those centers was in Washington County's Marietta location in the Appalachian region. Similarly, a regulatory settlement before the New York State Public Service Commission in 1995 resulted in an agreement from the incumbent carrier to commit $50 million to develop and deploy broadband telecommunications services in economically depressed communities. This money was used to fund proposals from 22 public sector organizations to offer telecommunications services in low income zip code areas (Venkatesh, 2001).

Pennsylvania used its approval of the Bell-Atlantic-GTE merger to obtain concessions on broadband infrastructure deployment that specified that 20% of lines would have access to broadband by 1998, 50% by 2004, and 100% by 2015. Ohio did likewise, and established a $2.25 million funds to assure that rural and low-income areas in Ohio have access to advanced telecommunications technology as part of its merger approval dealings.

West Virginia, Mississippi, South Carolina and Alabama stand out as a handful of states that have sponsored or pursued few initiatives to aggressively enhance their telecommunications infrastructure. Incumbents BellSouth and Verizon have been very effective in guiding state policies there. Nevertheless, Alabama has initiated three technology-related programs under

its Science, Technology and Energy Division of the Alabama Department of Economic and Community Affairs to generate a strategic plan for telecommunications, to undertake a telecommunications demonstration project and to initiate a technology assistance program. Furthermore, E-Bama legislation created an Office of Information Technology to undertake a comprehensive plan for information technology infrastructure for state government and public schools.

Conclusion

This review of state policies underscores the highly variable nature of the ways states view their roles in facilitating broader deployment of infrastructure. Some generalizations include:

1) Many states are looking at their statewide networks as ways to enhance Internet connectivity for educational, library, and health facilities. Some states have extended their network capabilities further and make them available to business users or to regions that lack broadband access.

2) Mergers and over-earnings cases have provided occasions to extract improvements in infrastructure from the affected companies.

3) About half of the Appalachian states have authorized utilities to provide telecommunications services. These providers, while not generally perceived as aggressive competitors to conventional telecommunications companies, could muster several advantages to provide broadband access.

4) Several states have initiated programs to map statewide telecommunications infrastructure. Such maps are intended to help local economic development efforts, and possibly to help state planning and program efforts, as in the case of North Carolina.

VII. THE LOCAL VIEW OF TELECOMMUNICATIONS

One component of our study investigated two counties in rural western Virginia and two in rural Mississippi using extensive in-depth interviews with businesses, elected officials, community leaders, school and library workers, and members of local economic development efforts (including Extension agents). These interviews were important checks on the secondary information and statistical data we had gathered, and they underscored features of the relationship between telecommunications and economic development that are difficult to glean from reports. Our visits highlighted the significance of political leadership and the local leadership of community organizations that seek to develop ICT capabilities to improve community and economic conditions. These case studies also shed light on the local dynamics that competitive telecommunication vendors can introduce into an area. The powerful position of regional ILECs Sprint, Verizon, and Bell South in this process comes into relief in the cases. Our interviews pointed out the crucial role of having access to local expertise when it comes to integrating and effectively using information and telecommunications technologies. In addition, the case studies portrayed the very different circumstances facing small and large businesses, as well as locally owned ventures in comparison to branch plants. The studies capture the perspectives and actions of ICT users in the communities as they confront "first mile" connectivity problems—why and how to connect with advanced services and how this access can be effectively used to improve business capabilities and economic development performance.

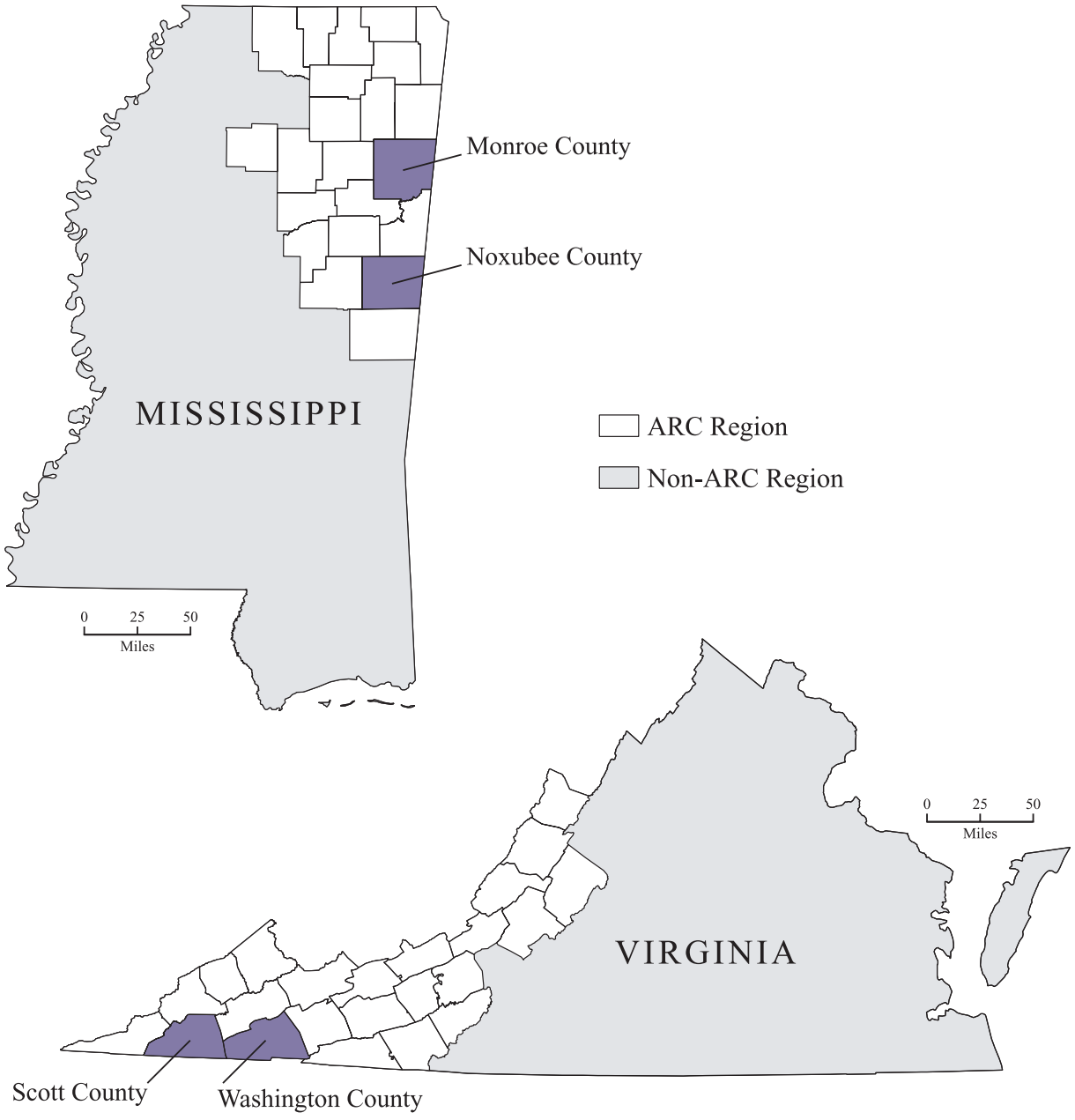
The following case studies of the counties in Mississippi and Virginia illustrate these points.

Case Selection and Study Methods

The selection of study counties was based on four criteria. We first focused on a subset of ARC counties defined as rural distressed or transitional according to the ARC classification system (ARC, 2001). The evidence and literature strongly suggest that such counties, with lower income and higher rates of poverty and unemployment, are where connectivity and ICT adoption challenges are likely to be most severe. From this category we selected two sets of companion or neighboring counties that are adjacent or in close proximity in the same state: Noxubee and Monroe counties in Mississippi, and Washington and Scott counties in Virginia (see Figure7). This approach allowed us to control to some degree for regional differences and differences in state telecommunication policies, which, as shown above, exhibit significant variation. While the two Virginia counties are formally in metropolitan regions, they are on the edge of the Tri-Cities MSA and retain a decidedly rural character. A final criteria involved ensuring at least one case in each pair with documented evidence of significant community-wide initiatives to improve telecommunication connectivity and ICT capacity and one case with less evidence of significant community-wide action to address access and adoption problems. Deriving this classification included examining the presence of ICT producer and user firms, the number of local Internet service providers, per-capita capture of universal service funds, and presence of innovative local programs such as Neighborhood Networks, Community Technology Centers or "Electronic Village" type initiatives.

Within these matched communities, we investigate critical factors that enter into supply and demand for ICT technology, especially advanced telecommunications infrastructure. The cases analyze the relative significance of: (1) economic structure and private sector demand for ICT services; (2) the character, quality and cost of local telecommunication service provision, especially broadband services access; (3) the quality of information and support services related to new ICT applications; and (4) the emphasis local leaders and economic development practitioners place upon ICT access and adoption in local economic development strategies. In addition, we profile specific initiatives and programs that are improving local capacities to exploit advanced ICT technologies to build better economic futures in the study communities.

Figure 7: Scott and Washington County locations in Virginia, Noxubee and Monroe County locations in Mississippi



The Mississippi Regional Context

The two Mississippi cases, Monroe and Noxubee counties, are rural counties in northwestern Mississippi classified by the ARC as distressed counties. The economic deficits of the region reflect a range of problems, including low educational attainment and per capita income and a business climate that offers limited institutional support for entrepreneurship. The area's economy, its social setting—including educational, library, economic development and other resources—and the local telecommunications capabilities all interact. A steady wave of industry departures over the past decade, particularly in the textile and furniture businesses, have depressed the local economy and caused local officials to actively seek out job-producing replacement industries. Monroe County has not fared as badly as Noxubee. It is home to several chemical-manufacturing plants whose better paying jobs provide an economic haven in the rather poor region. Noxubee's major industries are food processing and light manufacturing connected to a local resource base of timber and aquaculture. For both counties, local leaders and development practitioners did not see ICT access and use as central factors shaping current or future economic development.

These two cases must be considered in the context of important infrastructure characteristics and policy variables at the state level. Bell South is the dominant incumbent local exchange company throughout Mississippi with about 1.3 million access lines. By contrast, independents serve only about 100,000 access lines. Compared to the other nine Bell South states, Mississippi has a larger territory, and there are high loop costs for its local infrastructure. Bell South is on a price cap plan with the state regulators.

The state received a large Universal Service Fund grant in 2000 amounting to $98 million in new money and $113.6 million total—the largest any state received that year. Their priority expenditures have been infrastructure upgrades and the removal of subsidies. The regulatory focus of Mississippi State policy was on spreading the benefits of the universal service funding broadly, consequently they emphasized reduced costs for residential services. Infrastructure improvements are also being funded with USF resources, which may be adding some push to the slow deployment of DSL. Beyond this, it is not clear that state polices have reduced costs or extended key aspects of advanced service to businesses. For example, the T1 service that is perhaps the most important current option for businesses, especially fractional T1 for smaller businesses, has a mileage sensitive tariff that is generally perceived as rather expensive in Mississippi.

Telecommunications competition is not flourishing in Mississippi; Bell South remains the dominant local exchange company. Although over 100 companies are certificated, only about 50 are operating and the majority of them are prepaid local calling companies, serving people who have been disconnected for one reason or another. Interexchange companies with regional points of presence include AT&T in Tupelo, and MCI Worldcom and Sprint in the town of Columbus.

Monroe County, Mississippi

Socio-Economic Background

Monroe County with a 2000 population of 38,014 is lodged between two larger, more populous counties: Lowndes County to the south and Lee County to the northeast. The County is relatively proximate to major market areas such as Memphis and Birmingham and is connected to the Gulf of Mexico by the river/canal system of the Tombigbee Waterway. These advantages have helped stimulate a relatively diverse manufacturing base with major establishments in the chemical, furniture, apparel, sports equipment, and boat manufacturing industries. However, the County's reliance on branch manufacturing has limited economic and population growth and exposed residents to cyclical shifts and restructuring in basic manufacturing industries.

County population and economic activity is concentrated in two small cities, Aberdeen in the southern end and Amory in the north. The current industrial structure of the county underscores the crucial importance of the manufacturing economy, with nearly 30 percent of employed residents working in the manufacturing sector (U.S. Department of Commerce, Regional Economic Information System (REIS), 2001). The northern reaches of the County have been hard hit by plant closures in the textile and apparel and furniture industries over the 1990s. Population grew at a slow 3.9 percent rate over the 1990s and full and part-time employment in the County actually fell over the period. The County unemployment rate has increased between 1990 and 2000. At 10.3 percent in 2000, it was nearly twice the average for Mississippi. High poverty rates combined with low rates of educational attainment point to the profound challenges of diversifying the economy toward higher skill, higher wage activities (see Appendix Four for socioeconomic indicators). Most available jobs in the Monroe County manufacturing sector tend to require relatively low skill levels. Accordingly, wages also tend to be low. Most jobs are operator/factory laborer positions and, according to Syracuse University's Transactional Records Access Clearinghouse (TRAC), in 1990 Monroe County ranked 30th among the top 50 U.S. counties with the highest percent of persons employed as laborers or operators[27].

Service and retail, the other major employment pillars of the local economy, are somewhat underrepresented (relative to the State). A significant number of Monroe County residents commute outside the county to work, as evidenced by a relatively low employment/population ratio. With an employment/population ratio of 43.4 percent, compared to about 53 percent for the state of Mississippi, it is likely that a number of local residents commute to Columbus (from the southern end of the county) and Tupelo area (northern parts) to work (see Appendix Four). On a somewhat brighter note, the over-65 share of the population is decreasing and is only marginally higher than the State (U.S. Census, American Factfinder, 2001) suggesting that the area is not seeing a significant out-migration of young individuals or households. The manufacturing economy appears to provide decent employment opportunities for these younger residents.

Telecommunication Services and Connectivity in Monroe County

Bell South's ILEC status is unbroken throughout the county except for a small pocket in the north-central portion, where Smithville Telephone, a 6-employee, privately owned company, serves a small area. Smithville's customer base encompasses approximately 33 square miles and they currently serve about 2,000 customers with entirely buried plant (i.e., they do not use overhead wires throughout their system). There are no active CLECs in the county, and basic local service to residents and most businesses are from these two providers. ISDN is not available in the region, and must be ordered from Columbus, adding to its overall cost.

Population densities and household income have acted as major constraints on the provision of advanced telecommunication services. A number of business managers complained that Bell South was not highly responsive to requests for maintenance or to extend lines or services. These kinds of service problems are likely related to the relatively small number of demanding customers in the region and Bell South's limited deployment of personnel and resources to service this relatively small market. Interestingly, the Smithville Telephone customers interviewed expressed a high degree of satisfaction with this company's service.[28] There is currently no DSL or cable modem service in the Monroe area. However, Bell South was expected to roll out DSL service in the Aberdeen area in October of 2001, and Bell South personnel did state that this service would soon be available in Aberdeen and nearby areas. However, it was less clear when DSL service would be available in Amory and northern areas of the County. There were no current plans to extend cable modem services in the County.

There did seem to be a somewhat higher adoption rate of dial-up Internet services in Monroe County (in comparison to the Noxubee case, below). For example, locally based Smithville Telephone began providing dialup Internet service in 1997 and currently charges $19.95 a month for that service for commercial and residential customers. They now have 800 Internet subscribers and service around 1,200 access lines out of a customer base of 2,000.

There are a number of ISPs, both local and regional, serving Monroe County. Smithville Telephone provides a variety of ISP services, including Web hosting and technical support, but they operate more as a wholesale dial-up access provider. MidSouth Computers is a 6-employee company located in Amory that offers dialup Internet access, dedicated frame relay service, e-mail service, Web design and hosting. MidSouth currently has approximately 21,000 customers in the broader eastern Mississippi region and hosts web sites of about 40-45 companies in the Amory area. In addition, several local businesses surveyed got ISP service from a number of regional or national ISP providers from outside the County.

Both of the local ISPs underscored the difficulty that smaller players had in extending their services. The "backhaul" costs or the cost of reaching a POP on the Internet backbone are significant. MidSouth, for example, must buy its trunk lines from a major provider (in this case UUnet via Bell South lines). This cost can be considerable, especially when spread over a fairly small customer base. The cost of backhaul is not a problem for the major providers who do not have to factor tariff rates for backhaul facilities into their service costs. This cost structure presents a major impediment to small local ISPs in extending Internet services to their customer base or moving into DSL provision. Yet, it is such locally based ISPs that often provide better information and more hands-on assistance to rural businesses.

Businesses in the County complained primarily about basic service problems from the major service provider. However, there was general satisfaction with ISP services available locally. One informant emphasized that there were two or three "good" local ISPs and a number of "poor" providers who could not deliver on their promises to customers. One problem, according to this informant, is that "business customers don't know the difference, and the choice of a poor ISP service can be very costly and time consuming."

Table 25: Telecommunications Connectivity among Monroe County Businesses

Type of Business	Employment	Ownership	Dial-up	Dedicated Data Connection	Remarks
Chemical Manufacturer	140	International Branch		√	T1, Internal IT
Health Clinic	25-30	Local	√		Problems with dial up transfer of records
Boat Manufacturer	150	Local			No Internet, access options not clear to owner
Bank	7	Local		√	Shares T1 line
Auto Parts Manufacturer	120	National Branch		√	T1 Line, parent ICT support
Furniture Manufacturer	200	National Branch	√		Minimal ICT
Hospital	Over 500	Local	√		Major barriers getting broad-band access
Newspaper	5	Local	√		Broadband too expensive
Chemical Plant	530	National Branch		√	T1, Strong ICT support from parent
Bank	19	National Branch		√	T1, ICT support from parent
Computer Service Firm	11	National Branch		√	T1, T-2 high connectivity
Computer Store/ISP	6	Local		√	A local ISP provider with T1 Links to backbone

Larger externally owned firms in manufacturing, banking and business services use T1 connections to secure high-speed access, as shown in Table 25. Larger branch facilities of national companies can secure the ICT capability and telecommunication service that they need through support provided by their parent corporations. The main complaints from larger users were the costs of T1, and getting prompt installation and service from the major provider. In terms of dial-up and advanced Internet services, the options for small business and residential customers were quite limited. It is noteworthy, however, that none of the firms interviewed identified telecommunication service problems as a local barrier that would force them to consider re-locating.

Public sector institutions in Monroe County have not benefited from more comprehensive efforts to upgrade ICT capacities such as the Electronic Village and Virginia Link programs in Virginia. As a result, connectivity between public institutions was in some cases lacking and the use of the Internet as a clearinghouse for community events and regional marketing is not as developed in Monroe County as in the Virginia cases outlined below. However, E-rate and state and local programs have led to laudable advances in computer training and connectivity in K-12 schools and libraries across the county.

Business Adoption of ICT and Broadband Services in Monroe County

We interviewed 12 private firms in Monroe County. The sample focused more on telecommunication user industries and larger employers. The sample was a good representation of user firms in the manufacturing, financial service and health care segments, with the retail sector being poorly represented. We queried companies on five areas of ICT adoption and use: 1) their use of computers and software in a range of business functions; 2) their use of basic telephone services; 3) their level of connectivity (Internet or intranet, dial-up, advanced services); 4) their use of network services in a range of business functions (i.e., obtaining general information, email, interactive web sites); 5) Access and quality of ICT support services (especially if they were provided within or outside the company).

Computer and Software Use: All firms used personal computers in their business activities. All firms reported that computers and software were important (9) or somewhat important (3) in basic functions including accounting, word processing and record keeping. Seven of the 12 companies could be classified as at least "intermediate" users. These companies classified their use of computers and software for desktop publishing, email communications and the Internet as important or somewhat important to their business operations. Finally, four of the companies could be classified as intensive users of computers and software. The basic and intermediate functions were important, but these firms used computing for product design or process control, CAD/CAM applications, employee training or direct sales and marketing.

Basic Telecom Services: All firms interviewed were users of basic telecommunication services including voice, voice mail, fax, and call forwarding. Six of the companies reported using wireless calling in their daily operations. In terms of broadband, one business reported that because ISDN is not available in his area (near Aberdeen) they must import that line from Columbus, paying $300/month because it is priced as a "distance sensitive" service. Businesses in Aberdeen pay about $2,500 for dedicated T1 service, a rather high rate.

Use of Network Services: The interviews in Monroe County revealed major differences in the use of network services among the firms sampled. As noted above, one firm did not utilize network services to any extent. One of the 11 connected firms used the Internet for obtaining general information about business or markets and for internal or external email. Two of the companies reported intermediate use that included using the Internet to obtain price information and to place orders from suppliers or advertising through a basic web page. Eight companies reported more intensive uses of network services as being important to their operations. More intensive uses included marketing through an interactive web site (3 firms), processing orders, billing and arranging delivery (5 firms), ordering from suppliers linked to internal inventory and accounting (4 firms), communication and data transfer from other units of the company (5 firms), and transfer of data or graphics with suppliers or customers (4 firms).

On balance the companies interviewed relied heavily on computers, software and basic telephone services. The use of external networks either within or outside the company was also crucial to the majority of firms. Heavy use of ICT technology and network capacities was common in segments of manufacturing and among banks. However, the major hospital in the region expressed frustration in the quality and cost of local broadband access and the availability of local support services. They were pushing to expand telemedicine applications and more intensive connections with remote rural health service providers but felt constrained by weak local capacities.

The location of the interviewed firms in the Monroe County area was not seen to be an advantage for their ability to access and use computer and Internet technology. Five firms reported that their location gave them about the same ability to access and use computer and Internet technology as firms in other regions, while six reported that their location made it more difficult to access and use these technologies. There were three main complaints about the region. The first was the quality and service delivery record of the major telecommunication provider. Second, registered by smaller and locally owned medium-sized companies, were the difficulties in learning about the appropriate mix of ICT for their businesses and how new technologies could be utilized to improve business performance. Third, for a significant minority of firms (4) finding service companies or consultants who could provide reliable support services for their ICT activities and finding employees with the skills needed to effectively utilize ICT technologies was seen as an important barrier. One firm reported that it was easy to find people with basic skills but harder to find and retain someone with more advanced skills such as network administration.

The Role of ICT Adoption and Use in Local Economic Development Initiatives in Monroe County

A number of local and regional entities are involved in Monroe County economic development. We interviewed six city and county government leaders at economic development authorities or programs. With a few exceptions, the local economic development community seemed to share the view that economic growth depended mainly upon retaining and attracting larger manufacturing and service firms to the region. Although ICT adoption and use were recognized as potentially important for growth and development, these issues did not appear as a major priority in local economic development plans.

The Monroe County Chamber of Commerce is one of the County's more active local economic development entities. Current Chamber efforts include encouraging the development of a Monroe County industrial park and working with County officials to possibly build speculative industrial buildings. The Chamber is also involved in promotional efforts and supports local small businesses through their promotion of Main Street programs.

The skill and educational level of the workforce was seen as an important challenge in attracting firms to the region. As noted above, educational attainment levels are quite low in the County and opinions were mixed about the quality of the K-12 systems in the County. Our interviews did reveal energetic efforts to improve computer literacy and train more students in advanced computer and software skills in the local schools and through the libraries. The Aberdeen School District includes seven school sites and about 2,200 students.[29] All of the sites are connected through an ATM backbone, each classroom has at least one computer and larger computer labs are present in high schools. The District is responding to the Mississippi governor's initiative to make each student computer literate by the time they reach the 8th grade and ensure that high school students must have at least one computer credit or demonstrate computer literacy in order to graduate. They are conducting intensive teacher training on computers and are offering a mobile lab that includes laptops with wireless cards to "take the technology to the kids." The school district partners with Cisco to provide students the opportunity to take the Cisco Advanced Networking class. At the end of the four-semester program, students are able to take exams that, if they pass, will certify them as Cisco network engineers. Supplementing school district efforts, East Mississippi Community College (EMCC) and Itawamba Community College provide training and support to both private and public entities in Monroe County. The community colleges have also worked with local industries to provide courses that focus on skills needed in the workplace. EMCC representatives also work with Tombigbee Library System staff to teach basic computer skills and teach GED courses.

Economic development actions to stimulate and support indigenous business growth and development are more limited in the County. The Chamber of Commerce offers basic information and assistance, but there are no business incubator or assistance efforts targeted to small businesses. Nearby Mississippi State University (MSU) offers assistance targeted to small businesses ICT applications and web page design. However, none of the Monroe firms interviewed were involved in this program. Aside from this, ICT support for small businesses is confined to assistance from ISPs. In general small business assistance is an underdeveloped component of economic development strategy in the County.

Economic development in the region continues to concentrate on retaining and attracting branch plant manufacturing. This research revealed that large externally owned companies can typically manage their own ICT needs. A few local business and civic leaders pointed to the need for a greater focus on locally owned companies and small businesses in service or non-traditional sectors. Access and adoption of ICT technologies would likely be a more important component of an economic development strategy keyed more to this type of internally generated growth.

Noxubee County, Mississippi

Socio-Economic Background

Noxubee County, with a population of 12,548 in 2000, is further from the metro areas of eastern Mississippi and has a more rural economy than Monroe. Timber harvesting and milling and catfish farming are among the leading economic activities in the county, followed by row crop farming such as corn, soybean, and cotton and a few beef cattle, dairy, and swine farms. Due to difficult conditions in traditional farming sectors much of the County's farmland has been converted into catfish ponds over the last fifteen years. The County had about 15,000 acres in catfish ponds as of 2001 and aquaculture has supplanted crop farming in the local economy. Many other economic sectors in Noxubee County have some links to the area's agricultural and resource base.

The County has a handful of businesses that employ 50 or more individuals, including several establishments in food processing, timber and wood products, and light manufacturing. Major manufacturing and food processing employers employ low- to semi-skilled labor in assembly line settings and all pay roughly equivalent starting wages of $7-8 per hour. Naturally, the need for specialized training is rare in these jobs and opportunities for professional advancement are generally limited

The County's economic foundation of resource based industries and low wage manufacturing has failed to generate economic growth. The County experienced a small loss of population over the 1990s, and suffers from extremely high unemployment and poverty rates. Per-capita income was $16,700 in 1999 compared to $20,700 in the state, while child poverty rates were 35.5%, compared to 24.5% statewide (see Appendix Four). Moreover, educational attainment levels are far below the averages for Mississippi. The most dramatic statistic underscoring human capital deficits is that 67 percent of adults in the County over 25 had less than a high school education in 1990. As in Monroe County, the share of the population over 65 was close to the state average in 2000 and had fallen slightly over the 1990s (see Appendix Four). This suggests that the county has been able to retain a share of young workers and families although it has suffered from some out-migration in recent years.

Telecommunications Services and Connectivity in Noxubee County

Bell South provides local exchange telecommunications services throughout Noxubee County, and most local businesses commented that the services are adequate but costly. There appears to be minimal interaction between the businesses and the dominant telecommunications company, and no other local telecommunications vendors were mentioned in any of the interviews we conducted, save for those businesses whose parent companies arranged their telecommunications systems. A Bell South manager indicated that he knew of no CLECs operating in Noxubee.

Distances between central offices are even greater in Noxubee County than in Monroe, and those distances translate into higher costs for that region. Moreover, since Noxubee has lower population densities, Bell South sees little incentive to offer new services or to prioritize deployment of advanced infrastructure. One Bell South representative noted that they improve infrastructure based on demand, and Noxubee County's demand is too thin to warrant the

deployment of advanced services. There is no fiber in the local loop in Noxubee, and no plans to deploy DSL there.

Several private and public sector institutions mentioned the lack of adequate advice for their telecommunications needs. As the mayor of Macon put it, "We need help and don't know what we need." Many businesses noted the difficulty of finding skilled support people or service companies to help with ICT maintenance and with telecommunications. The hospital has a service contract with IBM because "local expertise doesn't exist." The businesses profiled in Table 26 below illustrate the patterns observed throughout this area. The branch plants of national companies obtain the expertise, planning and ICT deployment that they need through their parents.

Table 26: Telecommunications connectivity among Noxubee County businesses

Types of Business	Employment	Ownership	Dial-up	Dedicated Data Connection	Remarks
Hospitals and Medical Clinic	100-250	Local	√	√	IBM service contract
Bank	100	Local		√	IT outsourced but also in-house staff of three
Outdoor Furniture and Fence Manufacturer	100-250	National Branch	√	√	IT support from corporate headquarters; Web outsourced; orders primarily taken by FAX
Trailer Manufacturer	25-100	Local		√	
Catfish Farming and Processing	100-250	Local	√		Orders primarily taken by FAX, phone
Lumber Mill	Less than 25	Local	√	√	orders primarily taken by FAX; T1 from AT&T
Newspaper	Less than 25	Local	√		
Chicken Processing	250 or more	National Branch	√	√	IT support from corporate headquarters
Lillie Draper's shirt business	N/A	Local	√		

Locally owned businesses use few advanced services; some have internal networks and dial up Internet service, but many simply use 1-800 numbers for ordering. The fax machine remains the workhorse telecommunications technology for many Noxubee businesses.

Schools and the Macon library do have decent Internet connectivity largely because of the E-rate program. The district is extensively using classroom information technology and telecommunications access: every classroom in the district has at least three computers, and each facility (including the vocational school) has a computer lab with between 12-25 computers. All computers are networked and have Internet access. Each school has its own hub and is connected via T1 line to the Mississippi Statewide ATM Backbone Network. E-rate funds the district's connections at the 90% level. The district now adds 5-6 computers per school per year. The county's main library (in Macon) currently has a T1 connection to the Internet acquired with E-Rate support and other electronic resources via the Mississippi Statewide ATM Backbone Network.[30] Two branch locations also participate in the E-rate program, but their telecommunications connections are limited to dedicated 56K lines.

All of the ISPs providing connectivity for local businesses are based outside of the County most commonly in Columbus or Starkville (Oktibbeha County). However, one of the benefits of BellSouth's rate restructuring was flattening zone calling rates so that the costs of calling distant ISPs are fairly small (i.e., no per-minute or long distance charges). Because regional calling is relatively inexpensive, ISPs in these cities can extend their services to rural counties like Noxubee and provide more choices to inhabitants who under other circumstances would have no local ISP access. In sum, options for ICT access and capacity building are quite limited in the County. Those firms that utilize advanced services must connect through pricey T-1 lines and acquire expertise and support services from parent units or service providers from outside the area.

Business Adoption of ICT and Broadband Services in Noxubee County

Advanced telecommunications does not play a major role in the majority of manufacturing and service firms in the county. Several representatives we spoke with noted, however, that they do have Internet access and use the Internet to search for information relevant to their operation: for commodities prices for catfish, for example, techniques their competition is using, and general background information regarding equipment and so forth. Again, we queried companies on five areas of ICT adoption and use: 1) their use of computers and software; 2) their use of basic telephone services; 3) their level of connectivity; 4) their use of network services in a range of business functions; and 5) access and quality of ICT support services.

Computer and Software use: Most firms reported that computers and software were important in basic functions including accounting, word processing and record keeping. Several larger firms have internal networks and their applications generally entail email, payroll, and off-the-shelf inventory management and order processing software. However getting advice and service support for computer and software applications was a clear problem for Noxubee companies. One small business, the Macon local newspaper, remarked that their approach to maintenance is to simply buy a new computer since they lack the ability to fix anything on their machines. When they require trained people to help with a computer or telecommunications problem, they generally have to send someone away for training. The

bank uses a software company headquartered in Dallas (Peerless), to support their telecommunications needs.

Basic Telecommunications Services: Several larger local firms rely heavily on basic telecommunication services such as fax and voice mail. For example, an outdoor furniture company, a lumber company, a trailer company, and a catfish processing plant all rely primarily on faxed orders. Wireless service is available in one town in the county (Shuqualak), leaving the remaining towns (including the county seat) entirely without wireless connections. The larger businesses that need dedicated lines, such as the bank, commented that the T1s they use are fairly expensive.

Use of Network Services: Six of the nine Noxubee firms studied had access to broadband services. These advanced services must be obtained from Bell South, the only prominent vendor in the area and the only one mentioned by our informants. Bell South provides T1s and any other specialized connection such as ISDN.

Six of the nine firms could be classified as light users of network applications. They use the Internet primarily for obtaining information about markets or for internal or external email. A catfish processing business, for example, used the Internet to check on the catfish prices of one of its marketers. One firm uses Internet research to track market conditions and pricing, while another local firm uses basic email an essential marketing tool.

Three firms could be classified as intermediate or heavy users. The outdoor furniture company's parent, based in Illinois, told them which national telecommunications vendor to use and has sent design people to help them plan an Internet-based sales page. This company's information technology director operates an internal network for the plant, and manages communications (via frame relay) with a warehouse facility in Sparks, Nevada. This type of B-to-B application of telecommunications was rare in Noxubee County. Perhaps a more typical application of telecommunications technologies was at a food processing branch plant that used data transmission to exchanges production, order, payroll, and accounting data with its corporate headquarters in Tennessee over a dedicated channel. The lumber firm linked its saw and finishing mills (separated by one mile) by fiber for always-on communication of production data. In addition, the company markets some timber through the TALPX business network, an electronic marketplace allowing members of the building product industry to procure and market products over the Internet. However, most of this company's sales proceed through traditional channels.

In terms of capacity to select, use and maintain ICT technology to improve business operations, the largest companies in Noxubee are mostly branches of larger enterprises. They obtain advice and telecommunications expertise from their corporate parent. Computer service and maintenance for these larger businesses are outsourced. Smaller or "home grown" companies, however, often do not perceive particular advantages from advanced ICT use, and did not envision using the Internet for any essential operations. Major locally owned employers have not deployed current or more advanced Internet and e-commerce applications or integrated them systematically into business operations.

Public sector agencies in the County seemed particularly uninformed about telecommunications services and potentials. Medical providers such as the Noxubee General

Hospital, for example, are computerized in only very basic ways. They use the Internet to get regulations and to process insurance claims for Medicare and Medicaid. Although they are interested in tele-radiological services, they do not have the expertise to launch that service. Similarly, although county agencies have computers and Internet connections, there is no concerted effort to use the Internet to provide information or services to residents or government customers.

There is a miniscule level of Internet service entrepreneurship in Noxubee County. One small business owner in Macon attended a workshop in 2000 for small business opportunities. As a result of attending the workshop a college-educated family member of the informant is now designing and building web sites for other small businesses in the region. The same informant also uses the Internet as a member of the Mississippi Contract Procurement Center (MCPC), a private non-profit corporation established to promote economic development by assisting Mississippi businesses (particularly those in "Habitually Underutilized Zones") to obtain and perform on federal, state, and local government contracts. MCPC and its clients initiate and track the procurement process on-line.

In sum, small and medium sized local businesses are accessing and using the Internet, albeit in very limited ways. Small business operators and local entrepreneurs perceive the Internet as an opportunity, but not generally a business priority. Some are moving cautiously toward more advanced applications, but in some cases business owners may misperceive the nature of the opportunities presented by the Internet (or even the nature of the technology itself) in such a way that they are vulnerable to unreasonable expectations or unscrupulous practices. Difficulties in securing information, expertise and local support services are clearly constraints on more sophisticated and innovative utilization of ICT applications.

The Role of ICT Adoption and Use in Local Economic Development in Noxubee County

For Noxubee's main local economic development entity, the Noxubee County Economic Development Agency (NCEDA), facilitating the development of telecommunication infrastructure or ICT capacity has not been a priority. Formidable social and educational problems loom as far more important factors in growing a good economy and creating meaningful jobs. In the wake of extensive job out-migration, Noxubee County is more focused on agricultural and forestry-based operations—particularly catfish farming—for expansion. Computers, the Internet, and telecommunications applications are seen as potentially important, but rather minor tools in this agribusiness development scheme.

Economic development practitioners observe that industrial prospects to the region typically do not require advanced telecommunications services. Moreover, most existing industries in the county cluster around the Highway 45 corridor, a route well served by Bell South facilities. Local businesses have "made do" with T1 services from Bell South, and as noted above they use non-local dial-up ISPs for additional Internet services. The difficulties in finding trained ICT personnel were noted by some businesses, as were the difficulties in acquiring local expertise and services. However, there were few indications among local firms that the lack of advanced service availability constituted a major fetter to their operations.

Another economic development institution, The Golden Triangle Planning and Development District (GTPDD) serves a seven-county region in East Mississippi, one of ten planning and

development districts in the state.[31] In addition to helping counties apply for grants and loans for infrastructure projects, the GTPDD also provides business expansion assistance, computer training for government workers, childcare assistance, senior citizen programs, and solid waste management assistance, among others. In the telecommunications field, the GTPDD plays a unique role by providing connectivity to the region's public institutions. It maintains a leased frame relay network (provided by BellSouth) that serves the telecommunications and the Internet needs of Clay, Lowndes, Noxubee, and Oktibbeha counties, including some municipal government offices as well as the public libraries within these four counties. Providing telecommunication service to public entities in these counties fills an important access gap between costly commercial services and Mississippi's Statewide Frame Relay/ATM Backbone Network, whose main customers are educational institutions and state government offices.

Many interviewees targeted the educational system of this region as a major economic development barrier. Despite the progress in making computers and network access widely available in schools and libraries, the general lack of skilled jobs in the region was seen to stymie improvements in educational outcomes. The school superintendent reported that many students are unmotivated, with little sense that a high school diploma has any value in their circumstances. Because there are very few high-skill, high-wage jobs in the county, he pointed out, most workers can enter the work force with a high school diploma or less. Education is seen as irrelevant in an environment without the promise of advancement. As the superintendent said, “Why get good grades if you can’t get out of the box?”

Lacking any higher education system within the county boundary, Noxubee County relies on adjoining Lowndes and Oktibbeha counties to meet its higher education and workforce training needs. Among institutions in the region, the East Mississippi Community College (EMCC) offers important training programs as noted earlier. Two programs at EMCC are specifically designed for business and industry customers. The Skill/Tech One-Stop Career Centers provide fee-based worker training programs in such diverse fields as management skills, computer assisted design, electronics, welding, communication, and team building. The other targeted program is the Center for Manufacturing Technology Excellence (CMTE) that provides a multi-purpose facility for businesses to use as a high-tech manufacturing/service/training site. Ample power supply as well as broadband connectivity (multiple T1 lines) can accommodate large machinery (new production method testing) and bandwidth-intensive information technology training. More than 350 businesses in the region have participated in these two programs, although only one of our Noxubee interviewees (an outdoor furniture company) reported they had used the Skill/Tech program.

While these educational and training resources certainly have benefited the broader region, their effect on the economic vitality of Noxubee County is difficult to assess. Many of the training programs offered at EMCC or CMTE focus on high-tech training and skills development that are not currently in high demand in the area.

As a very poor county with a struggling economic base, adoption and use of advanced ICT remains a low priority for business development organizations and the businesses themselves in Noxubee County. This is due to the socioeconomic characteristics of the county and the region's focus on attracting external investment in agribusiness and basic manufacturing. Again, a bolder economic diversification strategy based on growing more local firms would

perhaps require more attention to more advanced workforce training and ICT access and capacity building. As Tim Heard, Computer System Analyst of the GTPDD noted, "the region's biggest telecommunications issue is not so much the lack of access but rather the relative lack of people's awareness of the capabilities of information technologies as commercial and administrative tools."

The Virginia Regional Context

Washington and Scott counties in western Virginia offer very interesting contrasts in terms of economic development efforts, leadership, and existing economic base. Washington has far more developable land (i.e., it is less hilly and mountainous) than Scott County, and economic development endeavors evidence a well connected network of people, many of them convinced of telecommunications' utility for the region's growth. Scott County evidenced little of the same awareness of or belief in telecommunications as an economic multiplier. The two counties provide a striking contrast in development attitudes and ways telecommunications uses have penetrated various endeavors.

An unusual feature of Virginia's governance structure requires some comment. Virginia's state constitution differentiates between cities, counties and other units of government. Cities are not parts of counties; rather they are organized units comparable to counties in jurisdiction and authority. From an economic development perspective, cities are important, independent stakeholders. In the Virginia region we focus on here, Bristol is a qualified City. Straddling the border between Tennessee and Virginia, Bristol is a particularly interesting city in terms of telecommunications since its municipal utility board invested in fiber optic facilities in the last five years and, as will be elaborated later, challenged a state law in so doing. With extensive telecommunications facilities and with its relatively larger population base, Bristol is a significant partner in some of Washington County's economic development planning and efforts.

The economic bases of the two counties differ. Located on the Virginia/Tennessee border, Scott County's economic development is closely linked to the fortunes of the Tri-City Metropolitan Statistical Area (which includes Bristol, Virginia, Kingsport and Johnson City, Tennessee). Its hilly terrain and historic dependence on coal, small-scale agriculture, and branch plant manufacturing has constrained economic development within county borders. The population depends upon jobs and income provided by large employers across the border in Kingsport, Tennessee. The county's status as a mountainous rural hinterland has impeded efforts to upgrade physical and telecommunications infrastructure and develop a more diverse economic base. While the nation and the Commonwealth of Virginia overall experienced vibrant economic and population growth across the 1990s, population and economic growth in Scott County was very sluggish between 1990 and 2000.

Washington County is also adjacent to the Tri-City MSS and like Scott County, Washington County is an economically challenged region. However, Washington County enjoys a relatively robust economy compared to its neighbors thanks to a diverse range of activity that includes major employment in the agricultural, public service, tourist, educational, and industrial sectors. Nonetheless, the economy is less vigorous than that of North and East Virginia.

The region's telecommunications environment has several unusual characteristics. First, state-level education policies have significantly contributed to the region's ICT. In 1998 the Virginia Department of Education "Standards of Learning Technology Initiative" established standards for public schools requiring technological competencies in instructional workers, curriculum standards for computer and network skills, and a student-to-computer ratio of 5:1. The state also has established computerized standardized testing that requires a minimum level of connectivity and speed. These requirements have helped drive school districts' adoption of technology.

Second, Virginia Polytechnic Institute (Virginia Tech) has been influential not only in the broader state networking endeavors but also in encouraging and offering models to communities that wish to better manage and develop local telecommunications capabilities. For instance, the Electronic Village model that is being replicated through web pages in many of the state's towns and cities was spawned at Virginia Tech. The Blacksburg Electronic Village, one of the country's oldest community networks, was an initiative sponsored by Virginia Tech.

Third, the entire state, particularly its rural regions, has benefited by various statewide networks that offer good connectivity at reasonable costs to public and more recently private organizations. Net.Work.Virginia, Virginia Link, and COVANET all provide connectivity to different types of users throughout the state.[32] Most prominent of these, Net.Work.Virginia offers low cost, advanced broadband network capabilities to state agencies, local governments and educational and library institutions and, through its spin-off Virginia Link, businesses. Virginia Tech manages Net.Work.Virginia in association with Old Dominion University and Virginia Community College System; a consortium of telephone companies provides intraLATA services to the network, and Sprint provides interLATA (long distance) links. The service pricing is neither distance nor usage sensitive.[33] The network has over 1000 sites and about 640 participants, and the capability of delivering simultaneous voice, data and video services. Eventually this network will support new Internet-based services such as IP videoconferencing and high definition TV. Its availability to public schools and libraries means that those public institutions are well connected and capable of delivering excellent services to students and individual citizens.

Finally, local Congressional representative Rick Boucher is a strong supporter of telecommunications efforts and his influence can be seen in several institutional efforts to explore the capabilities telecommunications could bring to the region—both in terms of business as well as education and services.

Many sectors that could form a foundation for healthier, more diverse economic growth in Washington and Scott counties increasingly will depend upon advanced ICT technologies to improve performance and expand market reach. Our interviews revealed that a number of firms in manufacturing, health services, and business services saw deficiencies in basic telecommunication services and the cost and limited access to advanced services as an important problem in their operations. It also seems clear from interviews with firm managers and economic development institutions that relatively poor access to telecommunication services might represent at least a minor barrier to attracting branch manufacturing and back office service facilities to the region. Finally, the growth of promising small business sectors

such as tourism and leisure, local crafts, and specialty agriculture increasingly will become linked to the innovative use of computer and Internet technologies in marketing and distribution.

Scott County

Socio-Economic Background

Scott County's population and employment growth over the 1990s has been marginal, particularly in contrast with robust growth in the state of Virginia. A significantly higher percentage of elderly in the population is an indirect indicator of that slow growth and related out-migration of younger individuals and households (see Appendix Four). Although the unemployment rate has fallen through the 1990s, it is still nearly twice the Virginia average. Decreasing unemployment, more significantly, seems to be related to residents finding work elsewhere rather than strong job growth within the County. In addition, relatively high poverty rates combined with low rates of educational attainment suggest that the area will continue to face structural challenges in diversifying the economy toward higher skill, higher wage activities (see Appendix Four). These data provide strong circumstantial evidence that the County is losing many of its younger, higher skilled workers to nearby and more distant urban growth centers.

Agriculture still plays a significant role in the economy of Scott County. Over 24 percent of employed residents work full- or part-time in agriculture, with key products including tobacco, beef cattle and some niche crops such as vegetables. Interviews with local officials and agricultural extension agents indicated that most residents supplement income from agriculture with other full- or part-time work. There are few full-time farmers. The other sector that provides modest export employment is manufacturing. Manufacturing is centered in the Duffield industrial park, primarily represented by branch plant manufacturing in sectors such as industrial machinery (mining equipment), furniture (bedding) and wood products. Retail and service industries have the highest employment levels. However, they serve the local market only and have not experienced rapid growth.

One striking statistic is the ratio of employment to county population. With a ratio of 32.6 percent, compared to 61 percent of the state of Virginia, it is obvious that many residents commute outside Scott County to work (see Appendix Four). Since the decline of the mining economy some 40 years ago, the county has had very limited success in rebuilding a strong and stable economic base. Economic development has focused on attracting outside manufacturing establishments, but with limited success. Local informants noted considerable instability in branch manufacturing over the last two decades, with a number of textile and apparel establishments moving to the area but shortly thereafter closing down and moving production off-shore. Local leaders continue to pursue outside investment, but several view the local economic base as essentially based on activity from ex-urban residential settlements associated with Kingsport and the Tri-cities Metro region.

Telecommunication Services and Connectivity in Scott County

Low population density and income, combined with an industrial structure containing few ICT producing and using industries, has limited adoption of ICT technologies in Scott County.

There is no cable modem or DSL access, and business users reported T1 and ISDN rates are costly. A number of companies interviewed in the area complained about the quality of basic telecommunication services and the cost and limited access to advanced services. The spread of advanced telecommunications services in Scott County has been throttled by a basic gulf between the supply and demand sides of the market, characteristic of sparsely populated rural areas: telecom service providers in the County do not see the current market as large enough to justify the costly investments needed to provide advanced services to a small, widely dispersed customer base, while demand remains relatively weak among business and residential customers precisely because limited access has made it difficult evaluate the need for, or real value of, advanced services.

Sprint and Scott County Telecommunications are the primary incumbent local exchange carriers in Scott County. The county's only ISP, MountaiNet, is the only active CLECs in the county although several companies have CLEC licenses, according to one local informant. Sprint serves the most populous areas of the region, and Scott County Telecommunications (SCT) the less populous reaches. In the post-World War II era, large parts of the County still did not receive basic telephone and SCT was established as rural cooperative in 1955 to overcome access barriers to basic services.

Terrain is another significant constraint on providing basic and advanced telecommunication services. Telephone lines serving mountainous parts of the county are in some cases antiquated and in need of costly service and upgrading. The terrain also severely limits wireless service, which is available in only a few sections of the county. Additionally, a small segment of the county is in a separate LATA and toll charges are often required to get dial-up Internet service in this area.

ISP MountaiNet is a subsidiary of SCT serving 11,000 customers in Scott County and in Tennessee. They offer basic dial-up service primarily to residents and small businesses in Scott County. The firm offers a menu of ISP services including web hosting, web page design, and web page development. The company offers more advanced services to the Tri-City area, but not in Scott County.

Businesses complained primarily about unreliable basic service from the two major service providers, with occasional outages and delays in getting installation and repair service. A number of local customers interviewed also complained about slow Internet dialup service from MountaiNet. The company reported that their reliability statistics are quite high and that problems with speed are often related to poorly conditioned switches and wires (in Scott County Telecommunications' plant) rather than MountaiNet's own connectivity capacity.

Larger, externally owned firms in banking and manufacturing use T1 connections to secure high-speed access. ISDN is also available via Sprint and Verizon, but this technology is not widely deployed. Again the main complaints from larger users were the costs of T1, and service interruptions and service delays. One business owner in the Pioneer Center Business Incubator reported receiving a low flat rate T1 connection through VirginiaLink. Both major local service providers came in for criticism. As one company manager noted, "these companies are accustomed to dealing with people who don't demand much."

State initiatives including the Electronic Village and VirginiaLink programs have stimulated some ICT adoption, including broadband services. The former program has assisted in the development of SCARLET, the Scott County Electronic Village, which provides a bounty of information on public events, meetings, school happenings, and promotional material on the County from links to its main web page. The network further serves as an educational site with local students creating and maintaining web sites and exchanging school and social information.

In terms of dial-up and advanced Internet services, options for small business and residential customers are extremely limited in Scott County. A number of firms in manufacturing, health services, and business services saw deficiencies in basic telecommunication services and the cost and limited access to advanced services as an important problem in their operations. It also seemed clear from interviews with firm managers and economic development institutions that relatively poor access to telecommunication services might represent at least a minor barrier to attracting branch manufacturing and back office service facilities to the county. Nevertheless, despite specific complaints, none of the firms interviewed identified telecommunication service problems as a major local barrier that would force them to consider re-locating elsewhere.

Business Adoption of ICT and Broadband Services in Scott County

We interviewed ten private firms and several public sector organizations in our study of the County, including one that was a major employer of Scott County residents in the Kingsport area. While this was a heterogeneous group, it was roughly representative of manufacturing and service firms with only the retail sector not represented.

Computer and Software Use: All firms used personal computers in their business activities. All firms reported that computers and software were important or somewhat important in basic functions including accounting, word processing and record keeping. Six of the ten companies could be classified as at least "intermediate" users, using computers and software for desktop publishing, email communications and the Internet. Finally, four of the companies could be classified as intensive users of computers and software. The basic and intermediate functions were important but these firms used computing for product design, CAD/CAM applications, and employee training or sales and marketing.

Basic Telecom Services: All firms interviewed were users of basic telecommunication services including basic voice, voice mail, and fax, and call forwarding. The only unusual exception was that only two companies reported the frequent use of wireless services. One firm used wireless to communicate within a very large site, but most firms noted that wireless services were difficult in the region due to the limits posed by terrain and existing services. This evidence underscores the continuing importance of basic wireline telephony as essential to business performance across regions.

Three firms allowed employees only to have connectivity and access to company networks and did not provide open access to the Internet including external email. Five of the firms interviewed used advanced broadband services; four had a dedicated T1 line and one a fractional T1 connection. Four of the five firms that had advanced services were branches of large externally owned companies. The one small locally owned company with a T1

connection produced software, and broadband access was critical to their business operations. The other locally owned companies used basic dial-up services.

Table 27: Telecommunications Connectivity among Scott County Businesses

Type of Business	Employment	Ownership	Dial-up	Dedicated Data Connection	Remarks
Chemical Manufacturer	3,000	National Headquarters		√	T1, Internal IT group
Health Clinic	25-30	National Branch	√		Problems with dial up transfer of records, want to expand telemedicine applications but T1 access too expensive
Health Clinic	10-15	Local	√		Just acquired dial-up service, problems understanding network options, could benefit from better access, but too costly
Hospital	100-150	Local	√		Larger regional hospital, interested in connect-ivity with clinics and telemedicine, can't justify cost of T1 access.
Mining Equipment Manufacturer	200	National Branch		√	T1, parent ICT support
Newspaper	5	Local	√		Broadband too expensive
Wood Processing Manufacturer	70	National Branch	√		Dial-up services, some ICT support from parent
Bank	15	National Branch		√	T1, ICT support from parent
Computer Software	5	Local		√	T1, high connectivity
Home Sales	2	Local	√		Dial-up access, poor ISP Service hurts business

Use of Network Services: The interviews in Scott County revealed significantly different levels of use of network services corresponding to the importance of the Internet and/or electronic data transfer to the day-to-day activities of each firm. Eight of the ten firms noted

that basic use of the Internet for obtaining general information about business or markets or for internal or external email were important to somewhat important. Six of the eight companies reported intermediate use that included using the Internet to obtain price information and to place orders from suppliers or advertising through a basic web page as being important or somewhat important. Four companies reported more intensive uses of network services as being important to their operations. More intensive uses included marketing through an interactive web site (two firms), processing orders, billing and arranging delivery (one firm), ordering from suppliers linked to internal inventory and accounting (two firms), communication and data transfer from other units of the company (three firms), and transfer of data or graphics with suppliers or customers (for example, telemedicine).

On balance the companies interviewed relied heavily on computers and software and basic telephone services. The use of external networks either within or outside the company seemed less crucial to the majority of firms. However, four of the firms could be classified as advanced network users. All except one of these firms were larger, externally owned companies. Using network services is not seen as crucial in the current operations of smaller local firms and more traditional manufacturing establishments. Three firms reported that their location gave them about the same ability to access and use computer and Internet technology compared to other regions while six reported that their location made it more difficult to access and use these technologies, suggesting Scott County was somewhat negatively rated with respect to this infrastructure.

There were two main complaints about the region. The first was the poor quality and high costs of local telecommunication and Internet services. The second, registered especially by smaller local companies without dedicated IT departments or personnel, were the difficulties in learning how new technologies could help their businesses and finding companies or consultants who could provide reliable support services for their ICT activities. Interestingly, finding personnel with the skills needed to effectively utilize ICT technologies was not seen as a major barrier. This again seems to be a testament to the excellent training in computer and Internet use provided by the local schools and libraries.

The Role of ICT Adoption and Use in Local Economic Development Initiatives in Scott County

A number of local, regional and state institutions are active in Scott County economic development. We interviewed nine individuals from city and county government and economic development authorities or programs.

The local economic development community seems split over the fundamental vision and strategies needed to improve economic performance. Several actors point to a long and, in their minds, failed history of trying to attract large manufacturing or service firms from outside the region. This camp suggests that most future growth will occur from residential development spilling over from Kingsport and the broader Tri-Cities region. A large number of residents already commute to work outside the County and this trend is likely to continue. In this view, the County should provide high quality schools and other amenities and improve basic infrastructure to stimulate increased residential development, which in turn will bring new people and support the growth of local firms servicing a growing residential population.

The other view is that over-reliance on external growth is a risky strategy that will leave large parts of the County (northern and western) out of the development process. Leaders in this group note that many commuting residents depend on one firm, Eastman Chemical, for steady employment, which makes the County vulnerable to the shifting fortunes and investment decisions of this key employer. The County needs to build up its economic base through continued business attraction and by encouraging the increased growth and survival of small entrepreneurial businesses.

The second strategy of attracting industries and developing small businesses informed more specific economic development initiatives. Three major entities are involved in industrial recruitment efforts. The *LENOWISCO Planning District*, that encompasses Lee, Scott, and Wise Counties and the city of Norton, focuses on basic infrastructure needs rather than on specific recruitment of new businesses and industries. The *Virginia Coalfield Economic Development Authority* focuses more directly on recruitment. This entity was established to help Buchanan, Dickenson, Lee, Russell, Scott, Tazewell, and Wise counties and the City of Norton enhance their economic base, attract diversified industries, and assist in the expansion of existing industries.[34] Finally, the County's *Industrial Development Authority* is the county-level economic development entity reporting to the Scott County Board of Supervisors. Somewhat dormant in recent years, the Authority has recently hired a new director and is conducting a study to determine a possible location for a new industrial park site.

Industrial recruitment efforts have focused on metal fabrication, automotive parts suppliers, lumber-related industries, independent power production facilities, and tele-services such as call centers. The main barriers to recruitment are problems of basic infrastructure, especially water and wastewater and limited available sites.

Many of the facilities in Duffield Industrial Park, the main focus of development efforts, have T1 lines and utilize advanced telecommunications. However, each tenant's corporate offices had set up these systems—the industrial park had not provided the services. Informants mentioned that industrial park's phone lines are somewhat weak and that it is not uncommon to pick up the phone and not be able to get a dial tone. Nonetheless, economic development practitioners felt that offering improved basic and advanced services was a secondary factor in attracting new industry. Other, more basic locational factors remained more important. Several informants did suggest that access to very high performance advanced services was crucial to their targeting of telemarketing and call centers. There was also a general consensus that improved telecommunication services would likely become a more important element in future recruitment efforts.

Economic development actions to stimulate and support indigenous business growth and development are concentrated around two programs: the Pioneer Center Business Incubator and the Small Business Development Center that operates out of Mountain Empire Community College. The Scott County Chamber of Commerce also offers advisory services to existing small businesses and organizes forums and meetings for the local business community.

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The Pioneer Center Business Incubator, established in 1999, is located in a former grocery store building adjacent to the Duffield Industrial Park site. The Center provides a variety of services, including phone, fax, and copying services, a receptionist, a library, and small

business counseling services. The incubator's occupancy rate is only about 30-35 percent. The Center's two primary tenants are CornerPost Software and Independence Unlimited, a non-profit organization that recycles waste cloth into textile materials. The incubator has had one successful graduate, a farmers market wholesaling company that assembled produce from local farmers and distributed locally and throughout the Tri-City MSA. Two T1 lines serve the facility, one provided by MountaiNet and the other by CornerPost.

Even though this incubator offers modern, flexible office space, high quality business support services including access to advanced telecommunication, and makes technical assistance available through the Small Business Development Center, they have had difficulty attracting start-ups to the facility. The managers of these two initiatives attribute these difficulties to start-up problems of the incubator (they have until recently had a part-time manager) and the absence of a strong entrepreneurial spirit in the region. They do point toward an increase in entrepreneurial training at the high school and community college level and believe that full time attention to marketing the Center will bring in new tenants.

The heads of the Pioneer and Small Business Development Centers noted that information and support services to help small businesses and start-ups evaluate how ICT technologies might improve their performance were lacking. Other interviews with existing small businesses in the County underscored the information gap associated with new ICT applications emphasized throughout this report. Most use personal computers and basic business software and many may use dial up Internet services. However, few small firms in Scott County are expanding their use of the Internet beyond having a basic web presence, and they are not aggressively employing their ICT assets to expand markets or to integrate sales, billing and delivery. As one active small business owner noted, "many small business owners know the Internet is important but have a hard time figuring out what they need and are reluctant to devote time and resources make the changes and the investments without seeing a clear payoff."

Washington County

Socio-Economic Background

Professional jobs help secure Washington County's employment against its geographic limitations, which are similar to those of Scott County. Education and other public service institutions are important to the county's employment base. Beyond the public school system, the county has three private colleges, a community college, and the Southwest Virginia Higher Education Center. Abingdon, the County seat, is also home to a district court, the office of the Representative Boucher, and a regional hospital. As a result of these facilities and agencies, the County has a larger population of attorneys, professors, doctors, teachers, and other professionals than its neighboring Virginia counties, thus a generally higher standard of living, higher property prices, and more secure economic base.

According to Virginia Employment Commission statistics, unemployment in the county was 5.0% in mid-2001, higher than the statewide unemployment level of 3.1%.[35] The median household income in Washington County was $31,387 in 1997, well below Virginia's median income of $40,209; also, 20.4% of children lived below the poverty level, slightly more than the state average of 17%.

The county has several industries and enterprises employing more than 100 persons. The largest manufacturer in the county is Bristol Compressors, employing over 2000 people. Other major employers with workforce in the range of 100-500 persons include Universal Fiber Systems, a maker of synthetic fibers for the textile industry, K-VA-T Foods, owner of a grocery store chain and distributorship, Columbus McKinnon and Sandvik Tools, both makers of industrial tools and hoists, Strongwell and Twenty-first Century Containers, both producers of fiberglass and plastic parts, and HAPCO, a maker of aluminum poles.

Coal mining remains an important aspect of the economy across Southwest Virginia. Although Washington County lies east of the coalfields, the presence of a major railroad line and later an interstate highway gave the county an economic boost and made Abingdon a regional center. Some sandstone, limestone, and gypsum are mined in the county, constituting an important input for several of the county's manufacturers.

Farming in the county is typically small-scale and owner-operated. Beef cattle is now the county's major cash product, although tobacco has historically been the most significant agricultural output. Changing market conditions and the policy environment have eroded tobacco's significance.The dairy industry also has declined significantly. Other minor agricultural products in the region include Christmas trees and organic vegetable farming. Land prices are high in Washington County relative to surrounding counties, making agriculture a high capital investment industry and a difficult business for incumbents to maintain or young people to enter.

Tourism is also an important aspect of the county's economy. The region is easily accessible from metropolitan areas in North and East Virginia as well as parts of North Carolina and Tennessee. The Barter Theatre and related Virginia Highlands Festival attract tens of thousands of tourists to Abingdon each year. Accordingly, lodging, shopping, and dining are an important part of the local economy and a significant portion of its tax base. Campers and hikers are a crucial component of the economy for outlying areas around South Holston Lake and the Mount Rogers Recreation Area. The town of Damascus is a center for eco-tourism and has several businesses oriented around traffic from the well-known hiking and biking trails that pass through it, including The Appalachian National Scenic Trail, the Virginia Creeper National Recreation Trail, the Transcontinental Bicycle Trail, the Iron Mountain Trail, and the Daniel Boone Trail.

Telecommunications Services and Connectivity in Washington County

Several telephone companies provide local, long-distance, and Internet services to the Washington County area. The ILEC is Sprint/United, the local telephone arm of long-distance giant Sprint. One CLEC, NTELOS, offers comparable services to the area's residents and businesses. The Town of Abingdon operates a high speed fiber line in the town, and nearby City of Bristol operates a high-capacity fiber ring. In fact, the presence of multiple telecommunications vendors and projects is creating an interesting telecommunications environment that is not common to the typical Appalachian community (except for a few large metropolitan areas such as Birmingham and Pittsburgh). In this section we detail aspects of Washington County's ICT scenario that make its circumstances especially notable: the existence of competing backbone networks, the presence of Electronic Villages, the actions of

Bristol Virginia Utilities Board, very active ICT development in library and school systems, and the development of the Southwest Virginia Higher Education Center.

Competing Backbone Networks: Since Sprint/United is part of Sprint, one of the nation's largest backbone network providers, the ILEC is served by its own backbone network. This situation not only provides necessary bandwidth to Sprint/United itself, but also creates a backbone distribution system from which other telephone companies and Internet service providers can purchase bandwidth for their own services. For example, NetAccess, an Internet service company of NTELOS, relies heavily on the backbone capacity of the Sprint fiber network for its Washington County operation. At the same time, these entities have competitive relationships to each other in end-user markets, such as DSL service. Sprint, in turn, can recoup its network construction/operation costs from transport customers (e.g., Internet service providers, non-facilities based telephone companies).

As we have discussed earlier, the availability of backbone network POPs is limited in the Appalachian region, making many locales monopoly markets for the incumbent telephone companies for both end-user and transport markets. But in the Washington County area, the non-dominant telecommunications providers (including the ISPs) have more choices for their backbone needs. In many other markets where the local telephone service is a Bell monopoly, non-Bell telecommunications providers often have to negotiate separate contracts with a local facility owner (i.e., Bell) and with backbone providers (e.g., MCI Worldcom, Williams Communications). By purchasing the backbone distribution service from Sprint, Washington County telecommunications providers can avoid the transaction costs associated with dealing with multiple vendors.

The backbone distribution system offered by Sprint is not free of downsides, however. Sprint's POP is currently the only direct ramp to national backbone networks in Washington County.[36] If a customer (whether a telecommunications company or a private business) elects a third company as its backbone provider, it has to use Sprint facilities in order to reach the nearest POP of the alternative backbone provider. This means that until other backbone companies extend their networks to Washington County, the Sprint network will remain the bottleneck facility for the telecommunications users in the County. Several interviewees indeed expressed a concern over the area's dependency on Sprint and desired greater backbone capacities to the area.

Electronic Villages: Access Damascus (ADAM), a project funded by the Appalachian Regional Commission, is a website and on-line community resource maintained by the Town of Damascus (www.damascus.org), similar to the dozens of content-based websites in the region dedicated to promoting and supporting particular communities (e.g., SCARLET in Scott County). ADAM primarily functions as a promotional tool for the town's eco-tourism industry, but also contains contact information, schedules, and archives of town meeting minutes of use to citizens.

The Electronic Village of Abingdon (EVA), initiated in 1996, refers to two related efforts undertaken by the Town of Abingdon. First, EVA (www.eva.org) is a website and on-line community for the Town of Abingdon, similar in form and structure to ADAM. Second, EVA is a fiber optic network built by the town to offer low-cost ($35-70 per month per computer) broadband Internet access to residences and businesses in central Abingdon. Expansions of

EVA since 1996 have extended the fiber loop from its initial connection to the Town Hall through Abingdon's historic central district (a distance of approximately one mile). The network serves about 80 customers, principally small businesses, practices of doctors and lawyers, and various city and County offices. The Town has invested $40-50,000 in EVA per year and earns about $36,000 per year in subscription fees for what the staff characterized as a "breakeven" operation.

EVA has been a boon for those residents and businesses in central Abingdon and may have attracted some small businesses to the area. The network has been a great aid to the municipal and County administration, the library, and the local hospital. However, the network as installed is limited in scope, limited in speed, and is quite expensive to install. Thus, expansion has been slow and the network still serves only a very small portion of the town, creating some resentment among town residents. Furthermore, EVA's partnerships with Sprint and NetAccess may be unstable and probably require more formal arrangements if the system is to expand. In short, EVA effectively solved connectivity problems within downtown Abingdon in a time of need, but it may have reached a plateau as far as its long-term impact on the town's telecommunication infrastructure. The network probably has had negligible financial impact on Washington County's larger economic development issues, although its psychological impact may be huge.

Bristol Virginia Utility Board: The Bristol Virginia Utilities Board (BVUB), the utilities service arm of the City of Bristol, provides water, sewer, electric power, and telecommunications services to Bristol and several nearby communities. The BVUB provides electric power service to the western half of Washington County.

Bristol is a fairly insulated, small, and poor community. About 21 percent of the city's population is below the poverty line. Economic development in Virginian cities like Bristol presents some unique challenges. For instance, it is very difficult for Bristol to expand its city limits (annexation) or expand its tax base because of the Virginia law that declares city government and taxation independent of county government and taxation. Such limitations have required creativity in the city's economic development efforts, and BVUB has historically been a leader in such efforts.

BVUB commenced a fiber optic network project in 1998 as a response to the lack of high-speed telecommunication in the area. BVUB recognized an absence of local telecommunications competition and foresaw need for bandwidth if Bristol were to advance economically. The first fiber hookup, a 17-mile loop, was installed in 1999 at a cost of $5 million. BVUB was well positioned to tackle this ambitious project, thanks to an unexpected cash surplus. The system's first users included Bristol's city government offices, schools, libraries, and other public institutions.

BVUB has since begun providing a range of telecommunications services to the community, including services to commercial customers and an ISP. In 2001, the utility launched a marketing campaign to sell their fiber optic services to the community, with a goal of quickly taking fiber-based services into private homes. BVUB plans to continue expanding its services to offer telephony, cable television, and data services. BVUB's managers reported that the network has an "open access" policy, making the fiber network available for anyone who wants to resell services over BVUB's facilities.[37]

The main economic development strategy in Bristol is to make the city into an attractive site for business re-location. BVUB and the Economic Development Authority hope their fiber system will draw industry and employment to Bristol. One theory that underlies this project is that chronic workforce shortages in urbanized parts of Virginia will force industries out of those areas and into southwest Virginia. This position seems to recognize that the existing market for BVUB's fiber services is limited and the prospects for developing homegrown telecommunications-using industry are slim.

Library and School Systems: Public Internet access in Abingdon is abundant. The Washington County Library System operates a Main Branch in Abingdon and four branches in the county. The library's deployment of technology has accelerated over the last five years, a change that can be credited to significant changes in the town's telecommunication environment. Foremost of these, in 1996 the Main Library was connected to EVA as one of the first institutions on the fiber network. The library's website (www.wcpl.net) was one of the first on the EVA system and, according to NetAccess, became a popular local portal. Over the next five years, high-speed low-cost connectivity enabled the library to upgrade and integrate many of its administrative functions across the entire library system, including offering email to all employees, automating circulation management, and joining a regional consortium of libraries to share automated resources.

Since 1996 the library has offered five "public access" terminals on the EVA network and a laptop connection station. In 1998 the Library System established a WAN to connect all branches with the Main Library via ISDN. The library recently received two important grants: One to employ a full time computer trainer and another to install an eleven-computer lab in the Main Branch and four new public access terminals at each branch. The library has also benefited from a close relationship with local ISP NetAccess, which subsidized the library's Internet connection for a time.

Currently, the Washington County School District has at least one networked computer in every classroom, as per the state requirement. There are also 35-40 labs in the system comprising approximately 1900 computers in total, with videoconferencing available in the high schools. The district built a countywide WAN using T1 leased lines, fiber-optic cables, and wireless technology and a DS3 line from Net.Work.Virginia provides connectivity.

Southwest Virginia Higher Education Center: Washington County is home to several institutions of higher education, including Virginia Highlands Community College (VHCC), Emory and Henry College, and the Southwest Virginia Higher Education Center (SVHEC). Of these, SVHEC merits special attention as an innovative public service and economic development project featuring state-of-the-art ICT. The Center is an independent state agency that operates a facility located on the VHCC campus shared by six higher education institutions (University of Virginia, Virginia Polytechnic, Radford University, University of Virginia at Wise, Emory & Henry, and Old Dominion). SVHEC contributes to the region's workforce and business development in three primary areas: academic degree programs and skills training, conference facilities, and an e-commerce development program.

1. The education/training programs are affiliated with seven higher-education systems from throughout the state. These affiliated institutions offer weekend and evening

courses toward Bachelor's and Master's degrees in a variety of fields.[38] These courses make an extensive use of information technologies, including videoconferencing, satellite downlink, and other interactive activities that use Net.Work.Virginia's fiber network. According to Jeff Webb, Director of Information Services, as much as 60 to 70 percent of classes at the SVHEC are taught from remote locations via satellite or fiber links.

2. SVHEC is also the area's only major conference facility, capable of accommodating trade shows and business meetings that require sophisticated communications and presentations. Conference halls and rooms have access to satellite downlink, videoconferencing equipment, Internet, numerous data ports, computer terminals, and other interactive media. SVHEC has hosted more than 130 conferences since 1998.

3. SVHEC started an e-commerce assistance project in 2001. *MerchantPoint* is available at cost to both small and large businesses, and in this project SVHEC effectively functions as a comprehensive e-commerce consultant and offers a range of services such as infrastructure assessment, low-cost financing, software, e-commerce web design, and training. According to Webb, SVHEC envisioned 40 clients in the first year (2001), but it already has received more than 100 applications.

While the activities at SVHEC primarily cater to existing businesses and workers in the area, other initiatives in Washington County target potential businesses and try to make the area more attractive in terms of telecommunications infrastructure. Washington County, in collaboration with the Town of Abingdon and the City of Bristol recently has developed its newest industrial park to house business incubators. During the planning, Washington County recognized telecommunications access would be as important as water, sewer, and electric power infrastructure in attracting businesses. Russell Owens, Chairman of the Washington County Industrial Development Authority, notes that planners have started to discuss telecommunications connection at an early stage of industrial park planning. Mr. Owens also reported that telecommunications companies are increasingly eager to string fiber optic lines—at their cost—to new industrial park sites because they anticipate heavy telecommunications use by the new businesses to these sites.

Business Adoption of ICT and Broadband Services in Washington County

Washington County and Bristol enjoy relatively abundant telecommunications resources—the fiber networks of the Electronic Village of Abingdon and the Bristol Virginia Utilities Board, DSL services from NetAccess and Sprint, and local POPs from Net.Work.Virginia, among others. In addition, the region is seeing the formation of IT support mechanisms, such as the presence of technology experts, political support, and state and local technology initiatives. As a result of such an agglomeration of technology resources (though in a smaller scale than in other traditional technology centers) some organizations and businesses have ventured into activities that require heavy use of advanced telecommunications technologies. At the same time, however, the region does not escape from the problem associated with any capital-intensive infrastructure development, that is, the limitations of geographically concentrated resources. For example, the benefits of the EVA fiber network reach only 150 feet from the fiber loop, which is itself only one mile long. And the DSL service offered in the region

likewise suffers from the common distance limitation (i.e., approximately three miles from a telephone central office).

Table 28: Business Use of Telecommunications in Washington County

Type of Business	Employment	Ownership	Dial-up	Dedicated Data Connection	Remarks
Computer Software	Less than 25	Local		√	
Bank	n/a	Local		√	Internal IT staff
Printing Shop	Less than 25	Local	√		
Newspaper	250+	National Branch		√	
Food Distribution Chain	250+	Local		√	VSAT; Internal IT staff
City and County Government	25-100	Local	√	√	Internal crew
Truck Parts Manufacturer	25-100	National Branch		√	Local IT crew; IT support from corporate parent.

The use of advanced telecommunications services in the Washington County/Bristol region reflects this mixed environment. In fact, the region's largest industry—tourism—has not been able to take advantage of telecommunications simply because most tourist establishments, such as horse stables and craft shops, are located in places where advanced telecommunications services are not available. The following are snapshots of how the area's businesses are using telecommunications technologies.

1. An injection molded plastic parts manufacturer for the trucking industry recently has made a $50,000 investment to integrate wireless scanning devices with the corporate network that links its Washington County facility to the company's corporate headquarters in Atlanta. The Washington County plant is strung with an ISDN connection, which is linked to the headquarters to exchange a variety of data including production information (time/day, production speed, shipping, tracking, etc.). The corporate headquarters soon will relocate to the Washington County site, and the company will build another plant in Washington State. The company is currently investigating the feasibility of linking these two sites with T1 lines. According to the company's information systems manager, this new system monitors every phase of production and is intended to improve quality control. However, the company had to make a substantial effort to implement the IT system because of limited technology resources in the area.

2. A large regional food distributor and retailer that maintains 86 stores in Virginia, Tennessee, and Kentucky is headquartered in Abingdon, and utilizes telecommunications technologies to coordinate its multi-store operation. The computerization of its operation started in the early 1980s, when scanning devices were introduced to stores. Since then, the company has adopted various information technologies, including store-level servers, direct store delivery coordination through modems, and the centralized server system at the corporate headquarters. The company currently uses a satellite uplink and downlink (Very Small Aperture Terminal) to exchange sales, inventory, and distribution data across the enterprise. The company's vice president in research and site development said that the motivation behind various information technology implementations was a belief that the company, which is relatively small compared to national grocery chains, can gain competitive advantage through the use of IT. The company has a plan to switch the telecommunications system from VSAT to frame relay by installing a T1 line at each store, but is concerned about service availability at some store locations. The vice president expressed the opinion that certain local telephone companies are resisting upgrades on switches to accommodate frame relay and other data transmission services.

3. A local bank in Abingdon has more than 10 branch offices in Virginia, Tennessee, and North Carolina, linking these sites through a frame relay connection provided by Sprint. The main branch office in Abingdon leases a private T1 line from Sprint through a special arrangement through EVA. In exchange for allowing EVA to install facilities on the bank's property, the bank shares EVA's rights of way for its T1 connection. Branch operations and the transactions at branch sites are centrally coordinated and recorded by the central server located in the main office in Abingdon. One bank executive reported that this arrangement tremendously cuts operations costs because the bank does not have to employ IT staff at each location.

Role of ICT Adoption and Use in Local Economic Development Initiatives in Washington County

Industrial park development comprises a major economic growth strategy for Washington County and the provision of advanced services to these facilities has become more crucial in recent years. Among the older, more-developed industrial parks in the county are Bristol-Washington County Industrial Park, with major tenants such as Bristol Compressors and Universal Fiber, and Oak Park, a largely undeveloped industrial park.

More recently, Washington County has partnered with neighboring Smyth County and Sprint on the Glade Highlands Technology Park. This project received $1.3 million grant from the State and a $500,000 grant from Appalachian Regional Commission. Sprint will serve the Technology Park with high capacity fiber optic infrastructure, including ATM, ISDN, and Frame Relay services. Washington County, the City of Bristol, and the Town of Abingdon have also been jointly developing the Stone Mill Technology Park located adjacent to the Virginia Highlands Community College within the corporate limits of Abingdon. Stone Mill Technology Park will offer advanced telecommunication services, and BVUB, Sprint, and the EVA have all been suggested as providers. Washington County, the City of Bristol, and the Town of Abingdon have jointly developed a plan for a small business incubator to be sited at

the Stone Mill Technology Park, in a 40,000 square foot facility. The Mount Rogers Planning and Development Commission funded the initial stages of the incubator project and further funding has been sought from the Virginia Tobacco Commission.

The current crop of economic development initiatives all contain some acknowledgement of the role of telecommunications for economic growth and for attracting the types of businesses that local leaders believe are most desirable for the region**.** Virginia Tech to the north of the county has been instrumental in inculcating local telecommunications leadership. Virginia Tech has been an important resources to the region through its shepherding of the Blacksburg Electronic Village project, its work in establishing Network.Virginia, its experimentation with wireless, and its recent efforts to establish local Multiple Services Access Points (MSAPs), and the regional peering points that can allow local communities to realize cost efficiencies in managing network traffic.

Many business people mentioned attracting and maintaining technical personnel as an important barrier. At a minimum, this acknowledgement along with the shifting development strategy from "Industrial Parks" to "Technology Parks" suggests that local economic development leaders in the Washington County/Bristol area are increasingly conscious of the potential benefits of having access to advanced telecommunications services. The presence of a federal Congressional representative in the area may have contributed significantly to this changing dynamic.

The actions of Rick Boucher, U.S. Representative from Virginia's 9th district, have been decisive at key points for some of the region's telecommunication developments, although linking those efforts to concrete economic development outcomes is difficult. Rep. Boucher makes his residence and keeps a district office in Abingdon. He has been a constant advocate for the region in both telecommunications and industrial development, with special concern for diversifying the region's historical dependence on agriculture, coal, and timber. Beginning in the mid-1990s, he organized a series of meetings in Abingdon to discuss ways of improving the area's Internet connectivity and telecommunication infrastructure. These meetings appear to have been instrumental in the creation of EVA and helped establish a presence for the ISP NetAccess. He filed an amicus brief on behalf of the BVUB's efforts to build its fiber optic network.

Rep. Boucher also sponsored the creation of the Southwest Virginia Technology Council (SWVTC) to promote regional cooperation and high-tech industrial development in Southwest Virginia. Recognizing that technology and telecommunications investments might be more properly considered as a regional economic development strategy, SWVTC was formed in 1999 as a 501(c) 6 institution to address high technology and telecommunication issues and industries in a 13-county region of Southwest Virginia and promote the region to other parts of the state. SWVTC is one of nine technology councils in Virginia. Because Southwest Virginia's interests are closely tied with the Johnson City MSA in Tennessee, SWVTC is also partnered with the Northeast Tennessee Technology Council. According to Nichole Sikora, Director of the Council, "amplifying" regional initiatives is part of the Council's mission.[39]

Rep. Boucher works closely with Washington County and the regional industrial development marketing councils—Peaks of Virginia and Southwest Promise—to promote the region to

corporate America. These efforts include extending invitations to corporate leaders the Congressman meets in Washington D.C. and conducting a tour program "Showcasing Southwest Virginia." It is difficult to assess the success of these tours. Nonetheless, these efforts may have helped increase the region's visibility and Rep. Boucher has been a successful agent for creating public-private and private-private partnerships and an atmosphere conducive for technological and economic development in the region.

The optimism of these key players is more than matched by significant development challenges. Local economic development leaders report that despite the relatively good telecommunications connectivity in the area, telecommunications technologies are underutilized because people fail to see new ways of using telecommunications beyond web browsing and email. Like many other Appalachian communities, the businesses and people in the area as a whole underestimate the economic potential of telecommunications technologies.

Related to this perception issue is the fact that many young people from the area do not come back after receiving post-secondary education in outside regions, making it difficult to enrich the local technology base. One economic development leader expressed her concern over the local shortage of innovative ideas and brain drain from the area. Furthermore, the relatively low educational attainment in the county (7 percent of the county population have Bachelor's degrees, and 50 percent have high school degrees) adds another barrier to the creation of more high-tech businesses.

The president of the Washington County Chamber of Commerce described education as one of the key challenges to the region, as it suffers from high illiteracy rates in the adult population and family legacies that undervalue higher education or even high school education. He was further concerned that the public high schools were chronically under funded and produce students ill prepared for either entering the workforce or post-secondary education. This is a formidable challenge considering the fact that Washington County is primarily an agricultural economy. In addition, the financial community in the area has not developed enough confidence in financing high-tech startups. One bank official from Washington County attributed the lack of confidence to the high bankruptcy rate of high-tech ventures and to the fact that many high-tech startups lack substantial assets that lenders can use as collateral.

Thus, although we observed some important indications that telecommunications is becoming part of the economic development strategies in Washington County, social, economic, and educational barriers remain.

Conclusion: The Role of ICT and Connectivity in Shaping the Economic Future of Four Counties

The four Mississippi and Virginia counties reveal important barriers and opportunities associated with enhancing ICT infrastructures and capacities to improve economic development prospects. Considering similarities and differences between the study counties helps identify the structural and policy variables that have the strongest influence on ICT access and capacity building. Moreover, the cases highlight policies and initiatives that are

bringing new technologies and know-how into local businesses and public institutions and suggest new opportunities to accelerate appropriate ICT adoption.

Socioeconomic conditions in each of the four counties clearly influence actual ICT adoption as well as attitudes about the importance of these technologies in economic development. In Noxubee and Scott counties, with lower population densities and thinner industrial structures based on basic processing and manufacturing, ICT adoption and connectivity are more limited and are not seen as priorities in ongoing economic development plans. Monroe County can be viewed as an intermediate case. While Monroe does not have the diverse service oriented industry structure or innovative initiatives of Washington County, the area does have more advanced business users and more apparent Internet connectivity than Scott or Noxubee counties. The higher level of broadband access and ICT adoption in Washington County is related to its larger, slightly more affluent population, more diverse industrial structure and its deeper links to the neighboring metro region.

State policies in Mississippi and Virginia, including the ways each state invests telecommunications service funds, influenced deployment and use of ICT in the study counties. Mississippi's receipt of High-Cost funds resulted in its regulatory commission working out arrangements with Bell South to expand the geographic range of local area calling, upgrade infrastructure and reduce loop lengths, all without raising rates (in fact, rates for some calling plans dropped). The high USF grant allowed some upgrading of basic service, and may serve to facilitate DSL deployment. High-Cost investments did not stand out as much in Virginia, but aggressive State and university initiatives to extend high capacity broadband networks to all state and local government institutions and even private firms has had measurable effects on ICT literacy and adoption. The more robust public networks in Virginia have improved public sector performance, and have increased engagement by youth and community groups via community web sites and networks and generated greater public awareness of the potential value and importance of ICT applications. A common success across the cases was the ability of school districts and libraries to leverage E-Rate and other federal and state programs to provide sophisticated high quality computer and Internet access and training to students and citizens. These efforts have significantly improved ICT literacy and skills in the emerging workforce, and this will facilitate more rapid business adoption.

In looking at the level of ICT access and capacity among the four counties, the role of local leadership stands out as a crucial factor. Washington County, with a federal representative and local political and civic leaders focused on the development potential of ICT, presents a stark contrast to the other counties. In Washington County there is tremendous optimism regarding the potential for ICT, and a focus on the role of advanced telecommunications. The County has moved in comprehensive ways to ensure that training is available for ICT, and it has forged solid working relationships with providers (Sprint and NTELOS). Local businesses are using some advanced telecommunications services, and with the active marketing of the City of Bristol's fiber project, it seems assured that additional service options will be introduced to the region. There are a few strong advocates in the private sector and in the school districts of the surrounding three counties, and civic and economic development leaders are aggressively pushing local telecommunication providers to expand services or making the adoption of new technologies a high profile local issue.

Local initiative is also a factor in stimulating a competitive environment of service providers.

The efforts of local institutions in Washington County to build local broadband networks has brought in private providers (in the case of the Abingdon/NetAccess/Sprint partnership on EVA) or created a new local vendor (Bristol Virginia Utilities Board). The presence of multiple telecommunications vendors and projects improves access, reduces costs and pushes providers to market their services aggressively and provide better information to potential customers.

Findings on business adoption of ICT were consistent on most levels across the four cases. Larger externally owned facilities in manufacturing, banking, and distribution were mostly advanced users of ICT that relied on their parent firms to secure network access and internal ICT expertise. While key branch plants do bring advanced ICT expertise to rural counties, this know-how does not spill over to local suppliers or other segments of the local economy. ICT use was generally quite limited in locally owned manufacturing firms and smaller local service sector firms. With the exception of Washington County, these firms could only gain broadband access through T-1 connections that were often cost prohibitive. Most locally owned establishments faced formidable barriers in understanding connectivity options or how to implement the new technology in amended business plans. Small and medium-sized businesses generally needed assistance in evaluating ICT options.

How important is improving ICT access and capacity to future economic development in rural Appalachian counties? It is difficult to draw firm conclusions from the information gleaned from local economic development personnel. Washington County is the only case where ICT access and deployment was a major component of the local economic development strategy. In the other three counties, ICT and connectivity issues were not seen as major economic development priorities. In Monroe, Noxubee and Scott counties, economic development strategies centered on retaining and attracting external branch plant investment. Given the ability of larger firms to manage their ICT needs, local officials do not get strong feedback from the business community about potential problems or opportunities. Problems of basic infrastructure, education and job readiness stand out as more obvious and immediate needs.

However, there were some indications that local development practitioners themselves did not fully understand the implications or opportunities associated with ICT. First, while inadequate and expensive access to broadband may not inhibit more basic manufacturing branches, it may limit opportunities to attract heavier users of ICT and broadband such as call and service centers. More significantly, if these counties wished to pursue economic development strategies based on growth of locally-based service firms or attraction of higher skilled manufacturing or service activities, current barriers to ICT access and adoption would need to be more energetically addressed.

For small to medium sized local businesses in sectors such as health care, tourism, entertainment and craft, and business services, the cost of broadband is a significant problem for expanding markets and improving productivity. With DSL services varying from $30-$50 dollars per month versus ISDN or fractional T1 starting at $150 per month and typically costing $300-$500, expanded DSL service in the three underserved counties would remove a major cost hurdle for smaller local enterprises. In Washington County, with DSL widely available, many smaller businesses are pursuing telecommunications-based opportunities

Overcoming information and capacity deficits faced by locally owned firms would require more intensive, tightly targeted technical assistance. Two programs, one in Mississippi and one in Virginia serve as valuable prototypes. The ICT technical assistance program targeted to small businesses operated out of Mississippi State University trained county agricultural extension agents in small business ICT applications so that they could provide basic technical information to local farmers and businesses. The MSU extension center also offers specialized training and consulting to farmers and agricultural processing firms, bed and breakfast establishments and small retail firms. The Center also offers a web-site analysis service for small businesses. The technical assistance project at Southwest Virginia Higher Education Center in Washington County, offering small businesses expert help in understanding e-business applications and aiding in web page and web site design, also represents the kind of intensive assistance needed to accelerate small business adoption.

One goal of such technical assistance might logically be to organize user groups in the regions so that smaller businesses can share experiences, help each other evaluate needs, and possibly combine their efforts to persuade vendors to present them with reasonably priced solutions to their problems.

In sum, if the three counties with severe access and capacity problems want to avoid being limited to their current branch plant attraction strategies, more focused and durable efforts to overcome ICT access and capacity must be considered. One low cost way to start this process would be to encourage the formation of ICT user groups. The case findings show that there are number of advanced users (e.g, IT managers at branch plants and IT personnel in K-12 and Community colleges). If these advanced users could be brought together into local groups they could spread important information about technology options, quality of various services, and could mentor smaller firms in ICT adoption. Such user groups could also provide a powerful collective voice to encourage service providers to improve and expand ICT services. User groups could also be a significant catalyst in counties with little history or expertise in evaluating ICT needs or options.

CONCLUSIONS

This report leads to a number of conclusions regarding supply and demand for telecommunications services in the ARC region and the relationship between economic development options and communications infrastructure. Uneven access to information technologies and capacity barriers to exploiting these technologies for development purposes represent the primary digital challenges for Appalachia. This study has documented both the technology access gap and the capacity barriers facing many rural and low-income Appalachian communities. Despite these challenges, there are numerous examples and opportunities in Appalachia for utilizing information technologies to spur economic and community development. For example, several states have adopted programs that seek to expand broadband availabilities, and numerous communities have sought to expand their telecommunications options by investing in improved infrastructure. Certain business sectors perceive the utility of telecommunications to improve their efficiency, and they have the capability of and interest in drawing services to their regions.

Furthermore there are numerous policy options that promise to improve the quality and breadth of infrastructure and access. These include demand aggregation strategies, regulatory leveraging, USF policies, technological developments and applications (particularly with wireless), and innovative ways of leveraging state network infrastructure.

Key findings include the following.

First, the leading producers of ICT products and services have a relatively weak presence in the Appalachian region and experienced below average growth over the 1990s. The region is becoming more dependent on external suppliers, especially in higher technology segments of producer industries, and did not fully share in the growth and innovation generated by these industries over the past decade. The absence of leading edge producer firms has likely had some dampening effect on the size and capacity of the region's user community and on demand for advanced services. Personnel in ICT producing industries are often the first to be exposed to new technologies, often becoming early adopters and advanced users.

However, the ICT-producer industries did grow faster than the overall rate for the region as a whole. The ARC region shared in the late 1990s boom in IT producing industries with employment growing by over 45 percent. In addition, the growth in the number of business establishments in both producer and user sectors was healthy, and this may promise some potential future growth in employment. Robust investment in ICT producing and using industries can spur growth and development through four main channels: increased innovation; improvement in product or service quality; increased productivity; and expansion of markets. The current size and export posture of ICT industries in the ARC region suggests opportunities to produce higher-end ICT products locally to substitute for current imports. This could be fostered by either selective business attraction strategies or innovative efforts to support and assist emerging regional firms in these sectors.

Substantial infrastructure deficiencies exist in more rural regions of ARC. While the metropolitan regions (e.g., Pittsburgh, areas surrounding Atlanta, and so forth) exhibit the

predictable patterns of more telecommunications options for high speed providers, other areas are generally left with only one service provider, the incumbent local exchange provider. The zip codes of the Appalachian region exhibit fewer high-speed service subscribers than zip codes outside of that region, according to FCC statistics. Many parts of the Appalachian region – especially the more rural areas – have lower penetration rates of home computers, Internet access and even basic telephone than the national average. DSL-capable lines are unavailable over wide swaths of the area. Cable modem is also not available in many areas and is not appealing for many businesses due to security concerns, and more advanced technologies are not on the immediate horizon for rural Appalachia. This report finds that access to advanced telecommunications at prices affordable to local businesses is a significant barrier in parts of the ARC region.

Nevertheless, there have been substantial changes in infrastructure in the past few years. Computer and Internet penetration statistics have risen rapidly in many ARC states, with growth rates particularly strong in areas that had lagged behind. Most states have school and/or libraries programs that help these important social institutions to obtain e-rate funding, foundation funding (the Gates Foundation has been particularly helpful to many rural libraries), or preferred rates and service on their Internet connectivity. Even so, the states experiencing substantial, recent growth in technology use are still behind by a variety of access measures, suggesting that the technology gap across the 13 states is still substantial.

Overall, the ARC region - particularly rural areas - is highly dependent on incumbent telephone companies for high-speed services as well as basic telecommunications infrastructure. Competitive pressures are relatively low in the Appalachian sub-regions. For example, most of the states with counties in the Appalachian region have fairly low numbers of competing local exchange companies, although New York's, Georgia's and Pennsylvania's Bell Operating Companies have been approved to offer long distance services. Maps of CLEC locations illustrate their disproportionate clustering in urban areas.

The presence of competitors, particularly competing local exchange companies or CLECs, can produce improved services at better prices. In urban areas where competition is more pervasive, there are alternative ways to obtain high quality basic as well as advanced services. Such competition exists only rarely in more rural regions. Washington County in Virginia presented a compelling illustration of how such competition can invigorate a community's vision of its economic future. Competing vendors can have the effect of educating the business and broader user communities about the value of network capabilities and the range of services that are available. Without such competition, an incumbent provider has a reduced incentive to work with the community to ensure that businesses are getting what they need. This is particularly important for local businesses that lack a corporate parent; the latter use telecommunications professionals for telecommunications facilities throughout their corporate structure.

The backbone providers' trunk lines and nodes are not plentiful in much of the ARC territory. We note that the distance of many telecommunications service providers to Internet backbones, the so-called middle miles facilities, is great enough to be a concern to many would-be providers. Backhaul costs are not insignificant in data transmission services from more remote regions of the ARC states; the locations of points of presence for local companies to "hand off" their data traffic are typically in metro regions and often across LATA lines that invoke long distance traffic rates. The National Exchange Carrier's

Association's study of middle mile facilities concludes that "long distances to Internet backbone provider nodes and lack of market size are key factors that raise the cost of offering high speed DSL service in many rural areas above the going retail rate in urban areas" (NECA, 2001). Some of the smaller telecommunications providers with whom we spoke noted the same.

Federal E-rate and various state programs, including state-sponsored data networks, have enabled widespread high-speed connectivity among schools and libraries in the Appalachian region. This is one bright spot in the Appalachian region telecommunications landscape. Such public facilities are in unique positions to ease the digital divide between citizens that have their own computers and Internet connections and those that lack either computers or Internet links. There is some untapped potential for these sites to be used as gateways to more widespread familiarity with network-based technologies and applications through after-school programs in schools or through training programs at libraries.

Another bright spot in high-speed infrastructure development is the creation of alternative networks under the auspices of communities or utilities. Virginia has several "electronic villages," and although some are simply websites, other entail the creation of high capacity networks. Some utilities also are undertaking the construction of such networks in their service territories. Although some states prohibit or limit such developments, others encourage it. Such network efforts create healthy competition for telecommunications incumbents. Some federal and regional funding has gone toward the creation of community networking efforts in places such as Blacksburg, Virginia and LaGrange, Georgia. Those endeavors are at root economic and community development efforts in that they seek to bring telecommunications capabilities to broader constituencies for the purposes of improving the local quality of life; they may ultimately contribute to business improvements, as the sponsors of the Blacksburg Electronic Village at Virginia Tech have noted. Indeed, several Virginia leaders' vision of community-controlled regional networks for telecommunications seems to combine the goals of community control with superior infrastructure capabilities with a view to attracting technology-related employers.

Universal service funding of E-Rate and the Rural Health Programs indicate that ARC counties taken together have received a per-capita allocation of funds significantly lower than that of the nation as a whole. Funding for these programs on a region-wide basis was over $291 million during the period 1998-2000 or $12.76 per capita, significantly below the national average of $20.05 per capita. This is a surprisingly low level of funding given the number of rural and economically distressed counties in the region. Among the 13 Appalachian states, six states exhibit positive net flows of USF overall payments and contributions. These states—Alabama, Georgia, Kentucky, Mississippi, South Carolina, and West Virginia—correspond to the six states most reliant on the high-cost program.

States in the Appalachian region have adopted a range of telecommunications infrastructure deployment policies with the aim of enhancing access in rural areas (among other goals). Overearnings cases, merger approvals, and deregulation legislation comprise some common policy occasions for negotiating broadband commitments with incumbent LECs. State USF programs, though still relatively young, may prove to be mechanisms to target the needs of rural regions. We noted that about half of the ARC states have created Universal Service Fund programs that may enhance services provided in the

target Appalachian regions. State USF funds offer opportunities to identify the neediest regions of a state and to channel support to those regions. Some states would benefit from understanding the range of USF plans other states have considered.

States can usefully leverage their investments in statewide public networks. As illustrated in Virginia, Net.Work.Virginia was developed to provide an ATM network and Internet service statewide. NWV is the result of the collaboration among Virginia Tech, Old Dominion University, and the Virginia Community College System, and aims at providing universal access to advanced broadband communication in the state. On an entirely different front, Virginia sponsors "Electronic Villages" throughout the states, at minimum facilitating a web presence for towns and cities. Every state we examined has a statewide network used for agency transactions, but some networks are friendlier than others as far as extending broadband capabilities to other users is concerned.

Many states have special initiatives, often organized out of Economic Development or a Governor's offices, focused on the digital divide. Those initiatives sometimes simply studied the problem in their regions, but sometimes they went considerably further. Alabama, for example, undertook an investigation of the local digital divide, but it led to no specific programs of which we are aware. North Carolina, on the other hand, undertook a careful telecommunications infrastructure assessment, and implemented some major programs to insure Internet access in each county.

Lack of information combined with access barriers limit the effective adoption of ICT and network services across Appalachia. Lack of access to affordable, quality telecommunications and broadband service cuts off many small-to medium sized locally owned enterprises from more advanced uses of leading edge ICT. However, these business segments encounter major difficulties when they do attempt to adopt new technologies and integrate them into their businesses. Locally based businesses have difficulty understanding and evaluating technology needs and choices, integrating new technology into amended business plans, and implementing new technologies in ways that improve competitiveness and market reach.

These difficulties are related to the lack of service associated with the current conditions of ICT related markets in rural and low-income communities.

Private sector production and dissemination of information regarding ICT hardware, software and connectivity integration options is under-supplied by the market, especially in rural areas. The lack of competitive vendors, noted above, reduces customer outreach and product and service information. Learning by observing competitor or supplier firms is also limited in areas with few leading producers or advanced users. Finally, access to competitive communities of ICT consulting firms and support service firms is limited, making it difficult for local firms to acquire quality information about technology choices or to maintain and upgrade ICT applications.

ICT access and capacity barriers disadvantage economic development in rural ARC counties. The case study research suggests that ICT barriers do not seem to be strongly influencing current investment and location decisions of large externally owned firms in rural counties. In large part, these firms have been able to secure the technologies, access and

expertise they need from parent organizations. However, in three of the case study counties large branch facilities voiced serious concerns about the quality of basic services and service delivery of the local provider. Additionally, it was clear that local non-profits and county and city governments could benefit from improved access to information and communication technologies, but access to consultant and advisors is scant or expensive.

The poor quality of local services is a function of the absence of competition and service delivery in rural counties, but deficient general service could influence future location and consolidation decisions of larger multi-plant firms. Moreover, limited and expensive access to advanced services precludes attracting larger firms in ICT intensive segments such as call centers and back office service facilities

Limited ICT access and use was found to be a particular problem for the health care sector in rural communities. The federal government and large insurance providers are increasingly demanding that health care organizations work through centralized databases for insurance and payment processing. Local heath facilities are also under pressure to secure the capacity to transfer records and patient information to retain membership in provider networks. Both larger hospitals and rural health clinics were having a difficult time securing the broadband access and implementing these more advanced data management and transfer applications increasingly being demanded in the sector. Moreover the exciting opportunities offered by more advanced telemedicine applications were not being widely exploited in the rural counties studied.

ICT barriers in rural communities are having the most profound effect on the growth and diversification of locally based manufacturing, service and trade sectors. Some dampening of market opportunities in these sectors is obvious while in other cases losses are more hidden. Firms and entrepreneurs in small business sectors such as tourism and leisure, local crafts, and specialty agriculture are aware that the innovative use of computer and Internet technologies are becoming central in their marketing and sales. Other firms, such as local retailers or manufacturers, may not see ICT adoption and network capacity as crucial to their business but will quietly and increasingly lose sales to more advanced national firms marketing and selling aggressively over the Internet.

DSL deployment in rural areas can be a very important factor in expanding advanced uses of ICT in the short to medium term. While DSL is an interim technology to extend broadband capability and eventually will be supplanted by fiber optic and wireless technologies, it constitutes the only option for low cost broadband for rural businesses over the next three to five years. With DSL services available in the $30-$60 range, versus ISDN or fractional T-1 lines starting at $150 per month and typically costing $300-$500, DSL service would eliminate a major cost hurdle for smaller firms. At the same time DSL offers the speed and capacity that most small to medium size firms currently require for data and graphic transfer. Policies and initiatives to accelerate the proliferation of DSL in smaller cities and towns in rural communities would be major advance in expanding broadband access and ICT adoption.

Case studies underscored the significance of the broader economic and demographic context for the relationship between telecommunications and economic development.

The influence of statewide policies or infrastructure issues (ranging from state regulatory structure issues to universal service funds to prohibitions on municipal utilities providing telecommunications services) must be acknowledged. There is no "cookie cutter" approach that will work everywhere.

Population density, wealth, and the presence of certain user industries do appear to explain different broadband development and adoption patterns. Against those structural features the strong role of leadership is apparent: it inculcates local visions for the telecommunications infrastructure that would bring economic aid. Local understandings and awareness of, and ability to exploit opportunities will condition the efficacy of any telecommunications deployment plan. Thus, whereas Washington County possesses local leadership and has been adept at growing local competitive telecommunications offerings, a county such as Noxubee has little chance of envisioning the types of economic opportunity that ICT could offer.

Policy Options

Policy options intersect the marketplace of telecommunications supply-and-demand at several points. Much of Appalachia does not offer the intrinsically lucrative market that will invite competition and plentiful supply of services. The goal of stimulating telecommunications competition in more rural regions of the country will always be elusive, and even the current federal proposals offer no guarantees that certain portions of the country will ever be served by more than a single incumbent telecommunications provider. The important consideration should be to identify policies which will enhance opportunities in the regions that are not intrinsically attractive to vendor - the less populous, more remote regions that are unlikely candidates for the operation of robust market forces. If alternative infrastructure is only sparsely developed - and current data certainly demonstrate that trend in the ARC counties - then economic development policies must locate creative ways to work with the incumbents or to stimulate the creation of alternatives; they also must work with the range of demand factors to which vendors will respond. Public initiatives to promote universal service and accelerate training, innovative regulatory approaches, and public-private partnerships to provide technical assistance must be seen as critical in closing the digital divide.

Expand and scale-up technical assistance to small and medium sized firms in rural communities. Overcoming the severe information gaps depressing the adoption of advanced ICT by locally owned businesses requires much more extensive, focused and aggressive outreach and technical support efforts. The two initiatives that we profile in the case study section, the ICT technical assistance project operating out of the Extension Service at Mississippi State and the "Merchant Point" program being initiated at the Southwest Virginia Higher Education Center in Abingdon, are models of the intensive training and technical support services that can make a difference in rural ICT adoption. The case study research revealed that improved information and more intensive training were needed on numerous levels.

As in conventional manufacturing extension, small rural firms in numerous sectors need assistance benchmarking their ICT and connectivity capacities to industry or "best practice

standards". They need additional assistance in understanding how ICT adoption relates to their current operations and how it could expand B2B and B2C opportunities.

In addition, firms need quality information and assistance to aid in selecting specific technologies and vendors. Public sector initiatives and public-private partnerships to overcome these information gaps could not only accelerate adoption and make local firms more competitive, but also could stimulate demand and attract support service providers.

Finally smaller firms need to be linked to an ongoing network of information sources and training opportunities to maintain and upgrade their systems as technologies change. Because small and medium size enterprises lack the internal know how and resources to secure these services, public sector support is necessary and warranted. There is an array of delivery mechanisms for this set of services, but the literature suggests that ongoing face-to-face and small group contact is needed to overcome psychological and know-how barriers and help transform smaller firms into sophisticated ICT users (Lasley et al., 2001).

Aggressively support the formation of user groups in rural communities. A second and highly complementary means to improve information and learning about technology and adoption choices is the formation of user groups in rural counties. This report has emphasized that small communities of advanced ICT users exist even in poor, relatively underdeveloped rural counties. These users (like the IT administrators of larger firms and administrators of school and library networks) could be brought together into groups that meet and provide outreach on a regular basis under the auspices of local development organizations or Chambers of Commerce. Such an organization could be an effective, low cost vehicle to improve service, ICT information and adoption in rural areas. Advanced users meeting together can voice their needs, and identify local problems and opportunities, and could provide a powerful collective voice to pressure providers to improve the quality of existing services and expand service options. As these user groups become more institutionalized they could complement the forms of technical assistance suggested above, mentoring or assisting smaller firms in ICT adoption. Such groups could act as catalysts in conducting needs assessments, bringing people together, and increasing awareness about ICT related issues.

Assist states and localities in applying for E-rate and Rural Health program funds under Universal Service. Eligible institutions across the ARC region should be made aware of the federal resources and receive assistance with grant applications as well as with planning and implementation. There is a varied rate of success with e-rate funding across the states. Certain techniques of applying for e-rate funds might be superior in some states, and it may be useful to understand the process by which e-rate funds are obtained in more detail from state to state. E-rate programs in particular have the potential to enhance the educational capabilities of areas that historically have not had equal access to information and training. Schools and libraries can be in the vanguard of information age services to rural regions.

Support the expansion of public institutions' roles in offering broadband access. Some schools and libraries participate in projects that allow their facilities to be used after hours, but programs like this could be more widespread, utilizing additional public facilities. Locating telecommunications access or facilities in public institutions expands the outreach potential of those sites. Non-profit and economic development organizations can take a leadership role in actually providing information and communication services to their regions.

Demand aggregation strategies should be supported. Such strategies improve the bargaining power of communities with incumbents and other telecommunications providers in order to enhance infrastructure and access in underserved regions. Creatively working with state networks in order to share resources and to use the state as an anchor tenant should be explored more thoroughly and encouraged where appropriate. Small businesses are sometimes left out of statewide demand aggregation strategies. Policies need to be crafted that will find ways to leverage improved services for these users as well as other public organizations and interests. Fragmenting local demand by removing large, public sector users from the demand pool should be avoided and instead replaced with policies that can extend services to multiple constituencies in economic ways.

Identify and disseminate information on model programs. Some telecommunications-related decision-makers (from utility commission staff to local economic development officials) in ARC states do not have the staff to research developments around the country, and many could use information about model programs, particularly if they note successes and failures. Insofar as every state's authority and governance structure regarding telecommunications is different from those of other states, it is worthwhile to insure that as many people as possible have the best information available. Such information could include rates (For T-1s, for ISDN, etc.), facets of Section 271 compliance, types of broadband deployment programs being developed regionally and statewide, the range of statewide network projects, and universal service funding programs. Above all, the broad range of policymakers requires better information on their options, the costs and benefits of those options, and on how they can interact with the vendor community most effectively.

Monitor state regulatory efforts to leverage improvements in infrastructure and service. Along with improved information sharing come ideas for adapting policies to other settings. Tracking what other states are doing can provide benchmarks as well as new ideas for improving infrastructure.

Support demonstration projects with alternative technology providers. There are several projects and experiments in place currently. Some of the better-known ones, such as the Blacksburg Electronic Village in Virginia, represent creative use of technology that does not rely entirely on large incumbent LECs, which often seem reticent to work with rural and/or less populous communities. The potential for wireless broadband ISP services is under active scrutiny, and satellite-delivered broadband services likewise are in their formative stages. With some foresight and financial support, a new crop of experimental projects may demonstrate the potential for broadband in the Appalachian region in ways that are more definitive than those so far in evidence. We encourage ARC to build careful, longitudinal evaluation plans into such efforts so that outcomes can be measured with the appropriate level of insight and with robust data.

Continue to monitor broadband deployment and work with organizations attempting to initiate national or statewide deployment policies. The year 2002 will be very significant for creating policy regarding broadband in the US. Providers and equipment manufacturers have a great deal at stake, and the business community recognizes that it too has a role in deciding where these technologies should be available, and at what cost – social, political and economic. Numerous consumer-oriented organizations are weighing in on the importance of

broadband, and many argue that broadband belongs in the definition of universal service. ARC could play an important role in keeping its regions informed about these debates and in organizing and channeling input from the regions that typically lack much voice in these debates.

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APPENDIX ONE: Information- and Telecommunications-Using and -Producing Industries:

1. ICT Producing Industries

Hardware 3571 Electronic computers 3572 Computer storage devices 3575 Computer terminals 3577 Computer peripheral equipment, n.e.c 3695 Magnetic and optical recording media 3672 Printed circuit boards 3674 Semiconductors and related devices 3675 Electronic capacitors 3676 Electronic resistors 3677 Electronic coils and transformers 3678 Electronic connectors 3679 Electronic components, n.e.c. 3823 Process control instruments 3825 Instruments to measure electricity 3826 Analytical instruments **Communications Equipment** 3651 Household audio and video equipment 3661 Telephone and telegraph apparatus 3663 Radio & TV communications equipment	**Software & Services** 5045 Computers, peripherals & software stores 7371 Computer programming services 7372 Prepackaged software 5734 Computer and software stores 7373 Computer integrated systems design 7374 Data processing and preparation 7375 Information retrieval services 7376 Computer facilities management 7377 Computer rental & leasing 7378 Computer maintenance & repair 7379 Computer related services, n.e.c. **Communications Services** 4812 Radiotelephone communications 4813 Telephone communications, exc. radio 4820 Telegraph & other communications 4890 Communication services, n.e.c. 4830 Radio and television broadcasting 4840 Cable and other pay TV services

2. ICT User Industries (in addition to those listed above)

Manufacturing Industries:

2752 Commercial printing, lithographic
2754 Commercial printing, gravure
2759 Commercial printing, nec
2760 Manifold business forms
3810 Search and navigation equipment
3821 Laboratory apparatus and furniture

3822 Environmental controls
3824 Fluid meters and counting devices
3827 Optical instruments and lenses
3829 Measuring & controlling devices, nec

Transportation and Public Utilities

4210 Trucking & courier services, ex. air
4724 Travel agencies
4725 Tour operators
4729 Passenger transport arrangement, nec
4730 Freight transportation arrangement
4740 Rental of railroad cars
4780 Miscellaneous transportation services
4920 Gas Production and Distribution

Wholesale Trade

5012 Automobiles and other motor vehicles
5013 Motor vehicle supplies and new parts
5014 Tires and tubes
5015 Motor vehicle parts, used
5021 Furniture
5023 Homefurnishings
5031 Lumber, plywood, and millwork
5032 Brick, stone, & related materials
5033 Roofing, siding, & insulation
5039 Construction materials, nec
5043 Photographic equipment and supplies
5044 Office equipment
5046 Commercial equipment, nec
5047 Medical and hospital equipment
5048 Ophthalmic goods
5049 Professional equipment, nec
5051 Metals service centers and offices
5052 Coal and other minerals and ores
5063 Electrical apparatus and equipment
5064 Electrical appliances, TV & radios
5065 Electronic parts and equipment
5072 Hardware
5074 Plumbing & hydronic heating supplies
5075 Warm air heating & air-conditioning
5078 Refrigeration equipment and supplies
5082 Construction and mining machinery
5083 Farm and garden machinery
5084 Industrial machinery and equipment
5085 Industrial supplies

5087 Service establishment equipment
5088 Transportation equipment & supplies
5091 Sporting & recreational goods
5092 Toys and hobby goods and supplies
5093 Scrap and waste materials
5094 Jewelry & precious stones
5099 Durable goods, nec
5111 Printing and writing paper
5112 Stationery and office supplies
5113 Industrial & personal service paper
5120 Drugs, proprietaries, and sundries
5131 Piece goods & notions
5136 Men's and boys' clothing
5137 Women's and children's clothing
5139 Footwear
5141 Groceries, general line
5142 Packaged frozen foods
5143 Dairy products, exc. dried or canned
5144 Poultry and poultry products
5145 Confectionery
5146 Fish and seafoods
5147 Meats and meat products
5148 Fresh fruits and vegetables
5149 Groceries and related products, nec
5153 Grain and field beans
5154 Livestock
5159 Farm-product raw materials, nec
5162 Plastics materials & basic shapes
5169 Chemicals & allied products, nec
5171 Petroleum bulk stations & terminals
5172 Petroleum products, nec
5181 Beer and ale
5182 Wine and distilled beverages
519\ Administrative and auxiliary
5191 Farm supplies
5192 Books, periodicals, & newspapers
5193 Flowers & florists' supplies
5194 Tobacco and tobacco products
5198 Paints, varnishes, and supplies
5199 Nondurable goods, nec

Finance Insurance and Real Estate:

6010 Central reserve depository
6020 Commercial banks
6030 Savings institutions
6060 Credit unions

6080 Foreign bank & branches + agencies
6090 Functions closely related to banking
6110 Federal & Fed.-sponsored credit
6140 Personal credit institutions
6150 Business credit institutions
6160 Mortgage bankers and brokers
6210 Security brokers and dealers
6220 Commodity contracts brokers, dealers
6280 Security and commodity services
6310 Life insurance
6321 Accident and health insurance
6324 Hospital and medical service plans
6330 Fire, marine, and casualty insurance
6350 Surety insurance
6360 Title insurance
6370 Pension, health, and welfare funds
6390 Insurance carriers, nec

Business Services:

7311 Advertising agencies
7322 Adjustment & collection services
7323 Credit reporting services
7331 Direct mail advertising services
7334 Photocopying & duplicating services
7335 Commercial photography
7336 Commercial art and graphic design
7381 Detective & armored car services
7382 Security systems services
7383 News syndicates
7384 Photofinishing laboratories
7389 Business services, nec
7513 Truck rental and leasing, no drivers
7514 Passenger car rental
7515 Passenger car leasing

Health Services:

8010 Offices & clinics of medical doctors
8020 Offices and clinics of dentists
8030 Offices of osteopathic physicians
8041 Offices and clinics of chiropractors
8042 Offices and clinics of optometrists
8043 Offices and clinics of podiatrists
8049 Offices of health practitioners, nec
8050 Nursing and personal care facilities
8060 Hospitals

8071 Medical laboratories
8072 Dental laboratories

Engineering, Accounting, Research and Related Services

8711 Engineering services
8712 Architectural services
8713 Surveying services
8720 Accounting, auditing, & bookkeeping
8731 Commercial physical research
8732 Commercial nonphysical research
8733 Noncommercial research organizations
8734 Testing laboratories
8741 Management services
8742 Management consulting services
8743 Public relations services
8744 Facilities support services
8748 Business consulting, nec

3. Transportation Equipment Industries:

3711 Motor vehicles and car bodies
3713 Truck and bus bodies
3714 Motor vehicle parts and accessories
3715 Truck trailers
3716 Motor homes
3721 Aircraft
3724 Aircraft engines and engine parts
3728 Aircraft parts and equipment, nec
3750 Motorcycles, bicycles, and parts
3761 Guided missiles and space vehicles
3764 Space propulsion units and parts
3769 Space vehicle equipment, nec
3792 Travel trailers and campers
3795 Tanks and tank components
3799 Transportation equipment, nec

4. Non-Store Retail Industries:

5961 Catalog and mail-order houses
5963 Direct selling establishments

APPENDIX TWO: Compatibility of County Business Patterns and The Brandow Company Data

We drew upon two databases to estimate employment composition and change in the various categories of ICT industries. The first database combined Regional Economic Information System (REIS) and *County Business Patterns* data from 1988 and 1996 to determine employment growth in selected industries in each of four geographic regions detailed above. The second source was a proprietary database on detailed industry employment provided by The Brandow Company. This source provided estimates of industry employment for 1996 and 2000 at the four-digit SIC code level based primarily on upon credit reporting databases. The Brandow Company amalgamates databases from different sources, identifies and codes firm information, and aggregates them by address and SIC industry codes.

The detailed industry employment estimates of the two sources for three industry classes were compared for 1996 by regressing four digit SIC employment estimates from the CBP data base on the same estimates in Brandow data base.

Although the correlation between the detailed industry estimates appeared strong we choose to report results separately for 1988-1996 using the CBP database and for 1996-2000 using The Brandow Company database. We do believe that there is sufficient comparability to consider trends over these two periods as capturing trends in a very similar set of firms and industries.

Table 1: Regression Results for County Business Patterns and The Brandow Company Industry Databases for 1996

	CBP 1996 Producer Industries	CBP 1996 User Industries	CBP 1996 Transport Equip. Industries
Brandow 1996 Producer Industries	**R2 = .707**	_	_
Brandow 1996 User Industries	_	**R2 = .984**	_
Brandow 1996 Transport Equip. Industries	_	_	**R2 = .988**

APPENDIX THREE: Incumbent Local Exchange Carriers in the ARC Region and Numbers of Switches

STATE	INCUMBENT LOCAL EXCHANGE CARRIERS	NUMBER OF SWITCHES
Alabama	BELLSOUTH TELECOMM INC DBA SOUTH CENTRAL BELL TEL	154
Alabama	CONTEL OF THE SOUTH DBA GTE SOUTH	52
Alabama	GTE SOUTH INCORPORATED - AL	39
Alabama	PEOPLES TELEPHONE CO. INC.	11
Alabama	ALLTEL ALABAMA INC.	8
Alabama	FARMERS TELEPHONE COOPERATIVE INC.	7
Alabama	BELLSOUTH TELECOMM INC DBA SOUTHERN BELL TEL & TEL	5
Alabama	UNION SPRINGS TELEPHONE CO. INC.	4
Alabama	INTERSTATE TELEPHONE CO.	4
Alabama	NATIONAL TELEPHONE CO. OF ALABAMA	3
Alabama	NEW HOPE TELEPHONE COOPERATIVE	3
Alabama	ARDMORE TELEPHONE CO. INC.	3
Alabama	BRINDLEE MOUNTAIN TELEPHONE CO.	3
Alabama	BLOUNTSVILLE TELEPHONE CO. INC.	2
Alabama	HOPPER TELECOMMUNICATIONS COMPANY INC.	2
Alabama	FRONTIER COMMUNICATIONS OF LAMAR COUNTY INC.	2
Alabama	ROANOKE TELEPHONE CO. INC.	2
Alabama	MOUNDVILLE TELEPHONE CO.	1
Alabama	RAGLAND TELEPHONE CO. INC.	1
Alabama	VALLEY TELEPHONE CO. INC.	1
Alabama	OTELCO TELEPHONE LLC	1
Georgia	BELLSOUTH TELECOMM INC DBA SOUTHERN BELL TEL & TEL	198
Georgia	ALLTEL GEORGIA COMMUNICATION CORP.	74
Georgia	GEORGIA ALLTEL TELECOMM INC.	40
Georgia	ALLTEL GEORGIA INC.	21
Georgia	STANDARD TELEPHONE CO.	13
Georgia	BELLSOUTH TELECOMM INC DBA SOUTH CENTRAL BELL TEL	7
Georgia	ELLIJAY TELEPHONE CO.	4
Georgia	TRENTON TELEPHONE CO.	3
Georgia	NELSON - BALL GROUND TELEPHONE CO.	3
Georgia	BLUE RIDGE TELEPHONE CO.	3
Georgia	CHICKAMAUGA TELEPHONE CORP.	2
Georgia	FRONTIER COMMUNICATIONS OF FAIRMOUNT INC.	2
Georgia	HART TELEPHONE CO.	1
Georgia	RINGGOLD TELEPHONE CO.	1
Kentucky	BELLSOUTH TELECOMM INC DBA SOUTH CENTRAL BELL TEL	185
Kentucky	GTE SOUTH INCORPORATED - KY	60
Kentucky	GTE SOUTH INC. - KY (FORMERLY CONTEL)	42
Kentucky	FOOTHILLS RURAL TELEPHONE COOPERATIVE CORP.	8
Kentucky	LESLIE COUNTY TELEPHONE CO.	7
Kentucky	MOUNTAIN RURAL TELEPHONE COOPERATIVE	7
Kentucky	THACKER/GRIGSBY TELEPHONE CO.	6
Kentucky	PEOPLES RURAL TELEPHONE COOPERATIVE CORP.	4
Kentucky	DUO COUNTY TELEPHONE COOPERATIVE INC.	4
Kentucky	GEARHEART COMM. CO INC. DBA COALFIELDS TELEPHONE	3

Kentucky	HIGHLAND TELEPHONE COOPERATIVE INC. - KY	2
Mississippi	BELLSOUTH TELECOMM INC DBA SOUTH CENTRAL BELL TEL	217
Mississippi	FRANKLIN TELEPHONE CO. INC.	10
Mississippi	DELTA TELEPHONE CO. INC.	7
Mississippi	BRUCE TELEPHONE CO. INC.	4
Mississippi	FULTON TELEPHONE CO. INC.	4
Mississippi	FRONTIER COMMUNICATIONS OF MISSISSIPPI INC.	4
Mississippi	CALHOUN CITY TELEPHONE CO. INC.	3
Mississippi	CENTURYTEL OF NORTH MISSISSIPPI INC.	3
Mississippi	MYRTLE TELEPHONE CO. INC.	1
Mississippi	NOXAPATER TELEPHONE CO. INC.	1
Mississippi	SMITHVILLE TELEPHONE CO. INC.	1
Mississippi	CENTURYTEL OF ADAMSVILLE INC.	1
New York	BELL ATLANTIC NEW YORK	575
New York	CITIZENS TELECOMM CO OF NEW YORK INC	127
New York	FRONTIER TELEPHONE OF ROCHESTER	49
New York	ALLTEL NEW YORK INC. - JAMESTOWN	15
New York	EMPIRE TELEPHONE CORP.	6
New York	CHAUTAUQUA & ERIE TELEPHONE CORP.	6
New York	DEPOSIT TELEPHONE CO. INC.	4
New York	FRONTIER COMMUNICATIONS OF SENECA GORHAM INC.	4
New York	TRUMANSBURG TELEPHONE CO.	3
New York	MIDDLEBURGH TELEPHONE CO.	3
New York	OGDEN TELEPHONE CO. NY	3
New York	MARGARETVILLE TELEPHONE CO. INC.	2
New York	CASSADAGA TELEPHONE CORP.	1
New York	HANCOCK TELEPHONE CO. NY	1
New York	DELHI TELEPHONE CO.	1
New York	DUNKIRK & FREDONIA TELEPHONE CO.	1
North Carolina	SPRINT MID ATLANTIC	158
North Carolina	BELLSOUTH TELECOMM INC DBA SOUTHERN BELL TEL & TEL	146
North Carolina	CENTRAL TELEPHONE CO. - NORTH CAROLINA	48
North Carolina	ALLTEL CAROLINA - NORTH INC.	32
North Carolina	GTE SOUTH INC. - NC (FORMERLY CONTEL)	27
North Carolina	SKYLINE TELEPHONE MEMBERSHIP CORP.	11
North Carolina	YADKIN VALLEY TELEPHONE MEMBERSHIP CORP.	10
North Carolina	SURRY TELEPHONE MEMBERSHIP CORP.	6
North Carolina	WILKES TELEPHONE MEMBERSHIP CORP.	4
North Carolina	BELLSOUTH TELECOMM INC DBA SOUTH CENTRAL BELL TEL	2
North Carolina	BARNARDSVILLE TELEPHONE CO.	1
North Carolina	SALUDA MOUNTAIN TELEPHONE CO.	1
North Carolina	CITIZENS TELEPHONE CO.	1
Ohio	AMERITECH OHIO	262
Ohio	GTE NORTH INCORPORATED - PH	256
Ohio	UNITED TELEPHONE CO. OF OHIO	179
Ohio	WESTERN RESERVE TELEPHONE CO.	45
Ohio	CINCINNATI BELL INC.	44
Ohio	CHILLICOTHE TELEPHONE CO.	11
Ohio	LITTLE MIAMI COMMUNICATIONS CORP.	2
Ohio	MINFORD TELEPHONE CO.	1
Ohio	PATTERSONVILLE TELEPHONE CO.	1
Pennsylvania	BELL ATLANTIC - PENNSYLVANIA INC.	407

Pennsylvania	SPRINT/UNITED TELEPHONE OF PENNSYLVANIA	93
Pennsylvania	GTE NORTH INCORPORATED - PA	86
Pennsylvania	ALLTEL PENNSYLVANIA INC.	84
Pennsylvania	COMMONWEALTH TELEPHONE ENTERPRISES INC.	78
Pennsylvania	GTE NORTH INC. - PA (FORMERLY QUAKER STATE)	22
Pennsylvania	GTE NORTH INC. - PA (FORMERLY CONTEL)	15
Pennsylvania	NORTH PITTSBURG TELEPHONE CO.	9
Pennsylvania	NORTH EASTERN PENNSYLVANIA TELEPHONE CO.	8
Pennsylvania	FRONTIER COMMUNICATIONS OF BREEZEWOOD INC.	4
Pennsylvania	PALMERTON TELEPHONE CO.	4
Pennsylvania	BUFFALO VALLEY TELEPHONE CO.	4
Pennsylvania	MAHANOY & MAHANTONGO TELEPHONE CO.	3
Pennsylvania	NORTH PENN TELEPHONE CO.	3
Pennsylvania	FRONTIER COMMUNICATIONS OF OSWAYO RIVER INC.	3
Pennsylvania	CITIZENS TELECOMM CO OF NEW YORK INC	2
Pennsylvania	FRONTIER COMMUNICATIONS OF CANTON INC.	2
Pennsylvania	LAUREL HIGHLAND TELEPHONE CO.	2
Pennsylvania	MARIANNA - SCENERY HILL TELEPHONE CO.	2
Pennsylvania	SOUTH CANAAN TELEPHONE CO.	2
Pennsylvania	DEPOSIT TELEPHONE CO. INC.	1
Pennsylvania	HANCOCK TELEPHONE CO. NY	1
Pennsylvania	BENTLEYVILLE TELEPHONE CO.	1
Pennsylvania	HICKORY TELEPHONE CO.	1
Pennsylvania	LACKAWAXEN TELEPHONE CO.	1
Pennsylvania	FRONTIER COMMUNICATIONS OF LAKEWOOD INC.	1
Pennsylvania	ARMSTRONG TELEPHONE CO. OF PENNSYLVANIA	1
Pennsylvania	ARMSTRONG TELEPHONE CO. - NORTH	1
Pennsylvania	PENNSYLVANIA TELEPHONE CO.	1
Pennsylvania	PYMATUNING INDEPENDENT TELEPHONE CO.	1
Pennsylvania	SUGAR VALLEY TELEPHONE CO.	1
Pennsylvania	VENUS TELEPHONE CORP	1
Pennsylvania	YUKON - WALTZ TELEPHONE CO.	1
Pennsylvania	CITIZENS TELEPHONE CO. OF KECKSBURG	1
South Carolina	BELLSOUTH TELECOMM INC DBA SOUTHERN BELL TEL & TEL	125
South Carolina	GTE SOUTH INCORPORATED - SC	37
South Carolina	WEST CAROLINA RURAL TELEPHONE COOPERATIVE INC.	9
South Carolina	ALLTEL SOUTH CAROLINA INC.	9
South Carolina	PIEDMONT RURAL TELEPHONE COOPERATIVE INC.	6
South Carolina	GTE SOUTH INC. - SC (FORMERLY CONTEL)	5
South Carolina	CHESNEE TELEPHONE CO.	1
Tennessee	BELLSOUTH TELECOMM INC DBA SOUTH CENTRAL BELL TEL	210
Tennessee	UNITED INTER-MOUNTAIN TELEPHONE	26
Tennessee	BEN LOMAND RURAL TELEPHONE COOPERATIVE INC.	17
Tennessee	TWIN LAKES TELEPHONE COOPERATIVE CORP.	16
Tennessee	CITIZENS COMMUNICATIONS COMPANY - TN	15
Tennessee	TENNESSEE TELEPHONE CO.	14
Tennessee	NORTH CENTRAL TELEPHONE COOPERATIVE INC. - TN	10
Tennessee	TELLICO TELEPHONE CO. INC.	8
Tennessee	HIGHLAND TELEPHONE COOPERATIVE INC. - TN	8
Tennessee	UNITED TEL CO INC.	8
Tennessee	BLEDSOE TELEPHONE COOPERATIVE	5
Tennessee	CITIZENS TELECOMM CO OF THE VOLUNTEER STATE LLC	5

Tennessee	CENTURYTEL OF COLTWEAH-COLLEGEDALE INC.	3
Tennessee	CENTURYTEL OF CLAIRBORNE INC.	2
Tennessee	SCOTT COUNTY TELEPHONE COOPERATIVE INC.	1
Tennessee	SKYLINE TELEPHONE MEMBERSHIP CORP.	1
Tennessee	CONCORD TELEPHONE EXCHANGE INC.	1
Tennessee	DEKALB TELEPHONE COOPERATIVE	1
Virginia	BELL ATLANTIC - VIRGINIA INC.	232
Virginia	GTE SOUTH INC. - VA (FORMERLY CONTEL)	97
Virginia	CENTRAL TELEPHONE CO. - VIRGINIA	63
Virginia	UNITED INTER-MOUNTAIN TELEPHONE	30
Virginia	GTE SOUTH INCORPORATED - VA	13
Virginia	SCOTT COUNTY TELEPHONE COOPERATIVE INC.	6
Virginia	CITIZENS TELELEPHONE COOPERATIVE	5
Virginia	MOUNTAIN GROVE - WILLIAMSVILLE TELEPHONE CO.	5
Virginia	ROANOKE & BOTETOURT TELEPHONE CO.	4
Virginia	CLIFTON FORGE WAYNESBORO TELEPHONE CO.	4
Virginia	HIGHLAND TELEPHONE COOPERATIVE	3
Virginia	PEMBROKE TELEPHONE COOPERATIVE	2
Virginia	NEW CASTLE TELEPHONE CO.	2
Virginia	BURKE S GARDEN TELEPHONE CO. INC.	1
Virginia	VIRGINIA TELEPHONE CO.	1
West Virginia	BELL ATLANTIC - WEST VIRGINIA INC.	155
West Virginia	CITIZENS TELECOMMUNICATIONS CO OF WEST VIRGINIA	75
West Virginia	ARMSTRONG TELEPHONE CO.	6
West Virginia	BELL ATLANTIC - MARYLAND INC.	3
West Virginia	WEST SIDE TELEPHONE CO.	3
West Virginia	CITIZENS COMMUNICATION COMPANY - WV	2
West Virginia	ARMSTRONG TELEPHONE CO. OF WEST VIRGINIA	1
West Virginia	HARDY TELEPHONE CO.	1
West Virginia	SPRUCE KNOB SENECA ROCKS TELEPHONE CO.	1
West Virginia	WAR ACQUISITION CORP. DBA WAR TELEPHONE COMPANY	1

APPENDIX FOUR: Socioeconomic Characteristics of the Four Case Study Counties

Employment by Industry, 1999, Monroe County, Mississippi

	Monroe County Employment	Monroe County Share of Total	Mississippi Employment	Mississippi Share of Total
Total full- and part-time employment	15,825	100.0%	1,493,441	100.0%
Farm employment	787	5.0%	55,203	3.7%
Ag. Serv., forestry, fishing, and other	137	0.9%	19,256	1.3%
Mining	167	1.1%	8,101	0.5%
Construction	1,101	7.0%	84,954	5.7%
Manufacturing	4,716	29.8%	250,824	16.8%
Transportation and public utilities	658	4.2%	67,269	4.5%
Wholesale trade	301	1.9%	51,052	3.4%
Retail trade	2,385	15.1%	244,023	16.3%
Finance, insurance, and real estate	502	3.2%	76,283	5.1%
Services	3,003	19.0%	371,730	24.9%
Government and government enterprise	2,068	13.1%	264,746	17.7%
Total Employment/Population	**43.3%**		**52.5%**	

Source: U.S. Department of Commerce, Regional Economic Information System (REIS), 2000.

Employment by Industry, 1999, Noxubee County, Mississippi

	Noxubee County Employment	Noxubee County Share of Total	Mississippi Employment	Mississippi Share of Total
Total full- and part-time employment	5,613	100.0%	1,493,441	100.0%
Farm employment	774	13.8%	55,203	3.4%
Ag. Serv., forestry, fishing, and other	na	0%	19,256	1.3%
Mining	na	0%	8,101	0.5%
Construction	257	4.6%	84,954	5.7%
Manufacturing	1873	33.4%	250,824	16.8%
Transportation and public utilities	169	3.0%	67,269	4.5%
Wholesale trade	85	1.5%	51,052	3.4%
Retail trade	556	9.9%	244,023	16.3%
Finance, insurance, and real estate	144	2.6%	76,283	5.1%
Services	809	14.4%	371,730	24.9%
Government and government enterprises	839	14.9%	264,746	17.7%
Total Employment/Population	**44.7%**		**52.5%**	

Source: U.S. Department of Commerce, Regional Economic Information System (REIS), 2000**.**

Monroe County, Mississippi Demographic and Economic Data

Population(a)	**1990**	**2000**	**Change**
Monroe County	36,582	38,014	3.9%
Mississippi	2,573,216	2,844,658	10.5%
Population Over 65/Total Population(a)	**1990**	**2000**	
Monroe County	14.4%	14.0%	-2.4%
Mississippi	12.5%	12.1%	-3.3%
Population by Race:Minority Share of Population(a)	**1990**	**2000**	
Monroe County:	30.6%	31.6%	3.4%
Mississippi:	36.5%	38.6%	5.7%
Total Employment(b)	**1990**	**1999**	
Monroe County	16,277	15,825	-2.8%
Mississippi	1,210,136	1,493,441	23.4%
Unemployment Rate (c)	**1990**	**2000**	
Monroe County	7.8%	10.3%	32.1%
Mississippi	7.6%	5.7%	-25.0%
Poverty Rate (d)	**1990**	**1999**	
Monroe County	17.4%	14.9%	-14.4%
Mississippi	24.6%	17.6%	-28.5%
Educational Attainment (a)	**1990**		
Monroe County:			
% over 25 with bachelors degree	8.4%	Na	Na
% over 25 with less than high school	44.4%	Na	Na
Mississippi:			
% over 25 with bachelors degree	14.8%	Na	Na
% over 25 with less than high school	35.7%	Na	Na
Per capita Personal Income(b)	1990	1999	
Monroe County	12,161	17,623	44.9%
Mississippi	13,164	20,686	57.1%

Noxubee County, Mississippi Demographic and Economic Data

	1990	2000	Change
Population (a)			
Noxubee County	12,604	12,548	-0.44%
Mississippi	2,573,216	2,844,658	10.55%
Population Over 65/Share of Population(a)			
Noxubee County	13.34%	12.84%	-3.8%
Mississippi	12.49%	12.08%	-3.3%
Population by Race /Minority Share of Population(a)			
Noxubee County:	68.6%	70.5%	2.8%
Mississippi:	36.5%	38.6%	5.7%
Total Employment(b)			
Noxubee County	4,209	5,613	33.4%
Mississippi	1,210,136	1,493,441	23.4%
Unemployment Rate(c)			
Noxubee County	11.8%	11.7%	-0.8%
Mississippi	7.6%	5.7%	-25.0%
Poverty Rate			
Noxubee County (1990 & 1998)	39.7%	28.3%	-28.7%
Mississippi (1990 & 1999)	24.6%	17.6%	-28.5%
Educational Attainment			
Noxubee County:			
% over 25 with bachelors degree	7.9%	na	Na
% over 25 with less than high school	50.4%	na	Na
Mississippi:			
% over 25 with bachelors degree	14.8%	na	Na
% over 25 with less than high school	35.7%	na	Na
Percapita Personal Income(b)			
Noxubee County	9,697	16,717	72.4%
Mississippi	13,164	20,686	57.1%

(a) U.S. Bureau of the Census -- American Factfinder http://factfinder.census.gov/servlet/BasicFactsServlet
(b)U.S. Departtment of Commerce, Bureau of Economic Analysis REIS http://fisher.lib.virginia.edu/reis/county.html
(c) U.S. Federal Deposit Insurance Corp. Regional Economic Conditions (in data collections in ECON DATANET)
(d) U.S. Census Bureau , Small Area Income and Poverty Estimates1988-1998 http://www.census.gov/hhes/www/saipe/estimatetoc.html

Employment by Industry Sector: Scott County and State of Virginia

	Scott County Employment 1999	Scott County Share of Total	Virginia Employment 1999	Virginia Share of Total
Total full- and part-time employment	7,623	100.0%	4,324,199	100.0%
Farm employment	1,856	24.3%	62,574	1.4%
Ag. Serv., forestry, fishing, and other	143	1.9%	45,023	1.0%
Mining	44	0.6%	12,391	0.3%
Construction	340	4.5%	270,197	6.2%
Manufacturing	493	6.5%	408,283	9.4%
Transportation and public utilities	346	4.5%	205,562	4.8%
Wholesale trade	129	1.7%	159,076	3.7%
Retail trade	1,300	17.1%	696,795	16.1%
Finance, insurance, and real estate	273	3.6%	319,697	7.4%
Services	1,534	20.1%	1,352,924	31.3%
Government and government enterprises	1,165	15.3%	791,677	18.3%
Total Employment/Population*	**32.6%**		**61.1%**	

Source: U.S. Department of Commerce, Regional Economic Information System (REIS), 2000.

Employment by Industry Sector: Washington County and State of Virginia

	Washington County Employment 1999	Washington County Share of Total	Virginia Employment 1999	Virginia Share of Total
Total full- and part-time employment	42,998	100.0%	4,324,199	100.0%
Farm employment	2,588	6.0%	62,574	1.4%
Ag. Serv., forestry, fishing, and other	na	—	45,023	1.0%
Mining	na	—	12,391	0.3%
Construction	2,268	5.3%	270,197	6.2%
Manufacturing	8,999	20.9%	408,283	9.4%
Transportation and public utilities	1,381	3.2%	205,562	4.8%
Wholesale trade	2,708	6.3%	159,076	3.7%
Retail trade	8,313	19.3%	696,795	16.1%
Finance, insurance, and real estate	1,980	4.6%	319,697	7.4%
Services	9,601	22.3%	1,352,924	31.3%
Government and government enterprises	4,784	11.1%	791,677	18.3%
Total Employment/Population*	**62.8%**		**61.1 %**	

Source: U.S. Department of Commerce, Regional Economic Information System (REIS), 2000.

Scott County, Virginia Demographic and Economic Data

Population(a)	**1990**	**2000**	**Change**
Scott County	23,204	23,403	.09%
Virginia	6,187,358	7,078,515	14.4%
Population Over 65/Total Population(a)	**1990**	**2000**	
Scott County	16.7%	17.8%	1.1%
Virginia	10.7%	11.2%	0.5%
Population by Race: Minority Share of Population(a)	**1990**	**2000**	
Scott County	0.7%	1.5%	0.7%
Virginia	22.6%	27.7%	5.1%
Total Employment(b)	**1990**	**1999**	
Scott County	7,478	7,623	1.9%
Virginia	3,727,194	4,324,199	16.0%
Unemployment Rate(c)	**1990**	**2000**	
Scott County	7.8%	4.0%	-48.7%
Virginia	4.4%	2.2%	-50.0%
Poverty Rate(d)	**1990**	**1999**	
Scott County (1990 & 1998)	22.3%	18.3%	-17.9%
Virginia (1990 & 1999)	10.5%	10.2%	-2.9%
Educational Attainment(a)	**1990**		
Scott County:			
% over 25 with bachelors degree	16.0%	na	na
% over 25 with less than high school	48.8%	na	na
Virginia:			
% over 25 with bachelors degree	24.6%	na	na
% over 25 with less than high school	24.8%	na	na
Per capita Personal Income(b)	**1990**	**1999**	
Scott County	12,193	16,882	38.5%
Virginia	20,538	29,794	45.1%

Washington County, Virginia & Bristol City

	1990	2000	Change
Population (a)			
Washington County & Bristol City	64,313	68,470	6.5%
Virginia	6,187,358	7,078,515	14.4%
Population Over 65/Total Population(a)			
Washington County & Bristol City	15.5%	16.6%	1.1%
Virginia	10.7%	11.2%	0.5%
Minority Share of Population			
Washington County & Bristol City	3.1%	3.7%	0.6%
Virginia:	22.6%	27.7%	5.1%
Total Employment*			
Washington County & Bristol City	38,445	42,998	11.8%
Virginia	3,727,194	4,324,199	16.0%
Unemployment Rate			
Washington County & Bristol City	7.9%	3.5%	-55.4%
Virginia	4.4%	2.2%	-50.0%
Poverty Rate			
Washington County& Bristol City (1990 & 1998)	16.7%	16.0%	-4.3%
Virginia (1990 & 1999)	10.5%	10.2%	-2.9%
Educational Attainment			
Washington County & Bristol City:			
% over 25 with bachelors degree	12.7%	na	na
% over 25 with high school degree	39.6%	na	na
Virginia:			
% over 25 with bachelors degree	24.6%	na	na
% over 25 with high school degree	24.8%	na	na
Per capita Personal Income*			
Washington County & Bristol City	14,579	22,385	53.5%
Virginia	20,538	29,794	45.1%

* Column with 2000 data is from 1999 data & Washington County data is combined with Bristol County

(a) U.S. Bureau of the Census -- American Factfinder http://factfinder.census.gov/servlet/BasicFactsServlet
(b)U.S. Departtment of Commerce, Bureau of Economic Analysis REIS
http://fisher.lib.virginia.edu/reis/county.html
(c) U.S. Federal Deposit Insurance Corp. Regional Economic Conditions (in data collections in ECON DATANET)
(d) U.S. Census Bureau , Small Area Income and Poverty Estimates1988-1998
http://www.census.gov/hhes/www/saipe/estimatetoc.htm

APPENDIX FIVE: Interview Questionnaire

Appendix Six - Interview Forms for Firms and Local Development Institutions

An Analysis of the Telecommunications and Information Infrastructure and Services, and an Assessment of Gaps in Universal Service in the Appalachian Region
University of Texas at Austin

Date of Interview _____

Name of Firm

_____

Informant(s)

_____
_____
_____
_____

Address

_____
_____

Phone

_____
_____
_____

Email

_____
_____
_____

Confidentiality Requested
YES

NO
BUSINESS SURVEY

Firm Characteristics and History

1. How long has your company been at your current address?

2. How long have you been located in The Tri-Cities Area?

3. Is your firm:
    a. Locally owned, single site?
    b. Locally headquartered, multi-site?
    c. A division of a firm headquartered elsewhere in U.S.?
    d. A division of a firm headquartered outside U.S.?

If you are a division of a larger enterprise, where is your headquarters located?

3. What are the top three product lines at your local facilities and their approximate share of your total sales?

4. What were the total sales at your local facility(ies) in 1997? In 2000?

5. What was the total number of employees at your local facility(ies) in 1997? In 2000?

6. Does your establishment produce:
    a. A final product?
    b. An intermediate product?
    c. A service?

7. Roughly what percentage of your sales are made direct to:
    a. Retailers or wholesalers?
    b. Manufacturers?
    c. Other firms?
    d. Government?
    e. Direct to the general public?
    f. Others, please specify?

8. Which of the following types of activities is located at your local facility/ies?
    a. Manufacturing?
    b. Research & Development (R & D)?
    c. Administration?
    d. Marketing/Sales/Distribution?
    e. Other?

9. [If R&D reported in #8] Do you conduct a significant amount of R&D at your local facility(ies) -- What percentage of your budget went to R & D in 2000?

10. What percentage of your customers are:
    a. Local (w/in 100 miles of your local facility)?
    b. In the U.S.?
    c. International?

11. What percentage of your suppliers are?
    a. Local (w/in 100 miles of your local facility)?
    b. In the U.S.?
    c. International?

Organizational Practices

13. Is your company ISO 9000/9001 2000 certified?

14. Have you recently changed your inventory control process?

15. Do you use Just in Time (JIT) delivery systems with your suppliers?

16. Do you use Just in Time delivery systems with your customers?

17. Does your workforce participate in training and re-training activities on a regular or ongoing basis?

18. Does your management participate in training and re-training activities on a regular or ongoing basis?

Use of Information and Telecommunications Technology

19. Do you use personal computers extensively in your operations ?

    - Roughly how many PCs do have at your local facility

20. What functions do you use PCs for ?

	Important	Somewhat Important	Not Important
Accounting and Bookkeeping	_____	_____	_____
Word Processing	_____	_____	_____
Record keeping	_____	_____	_____
Desktop Publishing (company&marketing materials)	_____	_____	_____
Product Design	_____	_____	_____
CAD/CAM Applications	_____	_____	_____
Training	_____	_____	_____
E-Mail Communications	_____	_____	_____
Internet Use	_____	_____	_____

21. What sort of telephone-related services do you use

	Frequently	Occasionally	Never
Basic voice communications	_____	_____	_____
Answering machine	_____	_____	_____
Voice mail	_____	_____	_____
Call waiting	_____	_____	_____
Wireless/Mobile phone Communications	_____	_____	_____
Fax Machines	_____	_____	_____
Call Forwarding	_____	_____	_____

22. What sort of network services do you use (ex. email, Internet, Electronic data interchange)

	Frequently	Occasionally	Never
E-mail communications within the company	_____	_____	_____
E-mail communications with customers or suppliers	_____	_____	_____
Electronic data interchange within the company	_____	_____	_____
Electronic data interchange with customers or supplier	_____	_____	_____
Internet service	_____	_____	_____

23. For what functions or activities do you use the Internet

	Important	Somewhat Important	Not Important
Obtaining general information about our business or markets	_____	_____	_____
Basic marketing through web page (providing basic information)	_____	_____	_____
Marketing through an interactive web site (allowing the customer to obtain additional product information, check availability and delivery options, place orders)	_____	_____	_____
Processing orders, billing and arranging delivery (linked to internal accounting and inventory systems)	_____	_____	_____
Obtaining price and availability information from suppliers	_____	_____	_____
Placing orders with suppliers	_____	_____	_____

CONTINUED NEXT PAGE

	Important	Somewhat Important	Not Important
Processing orders from suppliers ordering linked to internal accounting and inventory systems	_____	_____	_____
Communications and data transfer with other units of the company	_____	_____	_____
Transfer of data from customers or suppliers (ex. CAD files, product specifications, etc)	_____	_____	_____

ICT Service and Support

24. Who assisted your company when you decided to install or upgrade your computer systems ?

    An employee of the local facility (ex IT manger)

    Company personnel from another location

    A local consultant/ service provider

    A consultant or service provider from outside the region

    A consultant or service provider from the computer vendor

25. What company(ies) providers your telephone service ?

26. What kind of wireline services do you use

    Basic telephone wireline

    DSL (Digital Subscriber Line)

    T-1, T-3 Lines

    ISDN

    Cable Modem (likely for home or very small businesses only)

27. What company provides your wireline service

28. Who assisted you company when you decided to acquire your internet service

    An employee of the local facility (ex IT manger)

    Company personnel from another location

    A local consultant/ ISP

    A consultant or ISP from outside the region

29. Who provides the following Internet applications and services for your local facility ?

    Internet Access
        A service provided internally
        An ISP
        An ISP from outside the region
        A telecom company
        Another company
        Web page design
        An employee of the local facility (ex IT manager)
        Company personnel from another location
        A local consultant/ ISP
        A consultant or ISP from outside the region

    Interactive web systems design
        An employee of the local facility (ex IT manger)
        Company personnel from another location
        A local consultant/ ISP
        A consultant or ISP from outside the region

    Hosting
        A service provided internally
        An ISP
        An ISP from outside the region

    Network administration
        A service provided internally
        A service provided by company personnel from other locations
        A local computer service company or ISP
        A computer service company from outside the region

30. How do you train employees in the use of computers, and computer and Internet applications.

    Internal training by local personnel
    Training by company personnel from other locations
    Private training firms
    Community colleges
    Universities

Perceptions about barriers and opportunities associated with ICT

31. Do you think the effective use of computer and internet technology will be important for the competitiveness of you company over the next five years

    Not Important
    Somewhat Important
    Very Important

32. Do you think that your location in the Tri-Cities region influences your ability to access and use computer and internet technology in your business

    Location improves our ability to access and use computer and Internet technology compared to other regions

    Location gives us about the same ability to access and use computer and Internet technology compared to other regions

    Location makes it more difficult to access and use computer and Internet technology compared to other regions

33. Is it difficult to find personnel with the needed computer, software and Internet skills from the local area ?

    Very difficult
    Somewhat difficult
    Not difficult

34. Is it difficult to find and provide the appropriate training for employees in computer, software and Internet applications ?

    Very difficult
    Somewhat difficult
    Not difficult

35. Is it difficult to find cost effective service providers to assist your company with computer, software and Internet applications ?

    Very difficult
    Somewhat difficult
    Not difficult

36. How do you gauge the choices you have in obtaining the telecommunications services you need (telephone or data and graphics transmission) ?

    Enough choices
    Too much dependence on the local phone company

37. Have any programs or services provided by state or local government helped you improve your ability to use computers, software and Internet services in your business?

38. Have difficulties in any of the above areas affected your company's decision to remain or expand in this area.

39. If you think that your location in the TRI-Cities area hinders your ability to access and use computer and internet technology in your business, name some things that local government or the local business community could do to improve the situation.

ECONOMIC DEVELOPMENT INSTITUTIONS
Organization Characteristics and History

1. How long has your organization been active in the area?

2. What are your main economic development- related activities

    Marketing and promotion of the region
    Organizing and providing forums for local businesses
    Recruiting new businesses into the region
    Providing support services for existing local businesses
    Providing appropriate sites for new or expanding businesses
    Offering tax incentives to bring new businesses into the region
    Offering tax assistance to help local businesses retain employment or expand
    Voicing the concerns of local business to government organizations
    Targeted industrial development initiatives (ex tourism, specific manufacturing
    Telecommunications initiatives
    Employment and training initiatives
    Other
        Provide technical assistance to local firms
        Operate a business incubator
        Operate and industrial or business park

3. In your opinion what are the most important industries in _____ County ?

4. Have these industries grown or declined over the last five years ?

5. Are these industries likely to grow or decline over the next five years ?

6. What new industries have emerged over the last five years ?

7. Are these industries likely to grow or decline over the next five years ?

8. In your opinion how will the economy of this region fare over the next five years ?

Will grow rapidly
Will grow modestly or stay the same
Will decline

9. In your opinion what are the main assets in the local area that will contribute to economic growth ?

Good K-12 education system

Attractive natural environment

Good higher education system

Attractive/friendly community

Strong competitive industries

Good transportation access to major markets

Skilled workers

Low costs of doing business (wages, taxes, utilities, land)

Access to technology (computers, telecommunications, skills)

10. In your opinion what are the main barriers in the local area that might constrain economic growth

    Problems with K-12 education

    Lack of higher education facilities

    Loss of young people who migrate to other areas with greater opportunities

    Not much for people to do

    Large local industries in decline

    Difficulty in obtaining skilled workers

    High costs of doing business (wages, taxes, utilities, land)

    Poor access to technology (computers, telecommunications, skills)

Access to and Use of Information and Telecommunications Technology

11. Do you believe that most people in the local workforce have adequate computer literacy and computer skills given the needs of local companies ?

    Local workforce has good computer skills

    Local workforce has adequate computer skills

    Local workforce has poor computer skills

12. Do you believe the local area has good training resources to improve the computer skills of the local workforce ? (ex K-12, Community Colleges, Higher ed., Private training)

    The local area has good training resources

    The local area has adequate training resources

    The local area has poor train resources

13. In your opinion, how important is access to and use of the Internet for local businesses

    Use of the Internet is not important in the business operations of most local firms

    Use of the Internet is important in the business operations of a number of local firms

    Use of the Internet is important in the business operations of most local firms

14. In what industrial sectors does use of the Internet seem to be most important

    Manufacturing
    Wholesale and warehousing
    Banking
    Real estate
    Health care
    Travel and Tourism
    Business Services
    Education
    Government

15. In your opinion, do many businesses use broadband telecommunications services (DSL, T-1 or T3, ISDN, cable modem, other)

16. What industrial sectors seem to use broadband services the most

    Manufacturing
    Wholesale and warehousing
    Banking
    Real estate
    Health care
    Travel and Tourism
    Business Services
    Education
    Government

17. What are the local phone systems options?

    Who is the local exchange carrier ?
    Are there other local phone companies in the region ?
    Who is the main provider of services ?

18. Have you heard any complaints from local businesses that they cannot get economical access to broadband services.

    No complaints
    Some complaints
    Many complaints

19. Have you heard any complaints from local companies that they have a difficult time finding local consultants or support services for their computer, software and Internet applications ?

    No complaints
    Some complaints
    Many complaints

20. If local companies have complained about the lack of support services, what areas have they mentioned

    Gaining information about the computer and Internet technology appropriate for the firm's needs
    Internet access
    Internet access with broadband capabilities
    Web page design
    Interactive web systems design
    Network administration

21. Have you heard any complaints from local companies that they have difficulties finding personnel with adequate computer, software and Internet applications ?

    No complaints
    Some complaints
    Many complaints

22. Have you heard any complaints from local companies that they have difficulties finding training for their personnel in computer, software and internet applications

    No complaints
    Some complaints
    Many complaints

Perceptions about economic development barriers and opportunities in the region

23. Do you think the effective use of computer and Internet technology is a key economic development challenge for your region ?

24. Do you think that improving computer and internet technology will be important in attracting and retaining businesses in your area ?

    Very Important
    Somewhat important
    Not Important

25. Discuss the importance of the following actions for future economic development I the region ?

	Important	Somewhat Important	Not Important
Improve access to broadband services	_____	_____	_____
Provide information and encouragement to local firms to adopt and use the Internet	_____	_____	_____
Attract or support firms that provide computer and Internet services locally	_____	_____	_____
Improve training in computer and Internet applications in K-12	_____	_____	_____
Improve training in computer and Internet applications in colleges or universities	_____	_____	_____
Provide technical assistance to firms to help them adopt and use computer and Internet applications in their businesses	_____	_____	_____

26. Have local telecommunications service been affected by any state government policies in your view ? How about Federal Policies ? (probe: the "Abingdon exception" and the Bristol case).

27. How has E-Rate (in schools, libraries, not for profit hospitals) influenced telecommunications and computer use in the community ?

28. Are there any other government programs that have affected business access to, or use of telecommunications services ?

29. Are there any computer /Internet training facilities that you can say have made a major contribution to businesses or the community ?

30. Do any local businesses use Network Virginia ?

31. Do any educational or non-profit institutions that you are aware of use Network Virginia or any other public supported network ?

32. In your opinion, what are the local community's main economic development goals for the next five years ?

33. Is there a telecommunications plan related to your economic development strategy ?

    If yes, what is it, and what does it include?

APPENDIX SIX: Interviewees for Case Studies

Washington County, Virginia

Mr. Dan Adams
President
Washington County Chamber of Commerce
179 East Main Street
Abingdon VA 24210

Mr. Philip Blevins
Agricultural Agent
Virginia Extension Office
434 West Valley Street #B
Abingdon VA 24210

Mr. Jerry Brown
Director
Office of Economic Development
P.O. Box 16397
Bristol VA 24209

Ms. Becky Coleman
Chief of Staff
Office of Representative Rick Boucher
188 East Main Street
Abingdon VA 24212

Ms. Julie Finney
Jack Rabbit Printing
101 Charwood Drive
Abingdon VA 24210

Mr. Steve Galyean
Director
Abingdon Convention and Visitors Bureau
335 Cummings Avenue
Abingdon VA 24210

Mr. William Hall
Publisher
Bristol Herald Courier
320 Bob Morrison Boulevard
Bristol VA 24201

Ms. Johnna Hernandez
CEO
Champion Systems
510 Cumberland Street Suite 100
Bristol VA 24201

Mr. Ed Honaker
Director of Sales and Marketing
Net Access
P.O. Box 2303
Abingdon VA 24212

Mr. Marty Jessee
Information Systems Manager
21st Century Containers, Ltd.
18259 Westinghouse Road
Abingdon VA 24210

Mr. Jim Kelley
Director of Fiber Optic Services
Bristol Virginia Utility Board
P.O. Box 8100
Bristol VA 24203

Ms. Christine Leonard
Customer Care Manager
Sprint PCS
134 Commerce Court
Bristol VA 24201

Mr. Jason Lester
Director of Information Services
Washington County Public Schools
812 Thompson Drive
Abingdon VA 24210

Mr. Mathew Matt
Director of Information Services
Town of Abingdon
P.O. Box 789
Abingdon VA 24212

Mr. Sam Neese
Chief Executive Officer
Highland Union Bank
340 West Main Street
Abingdon VA 24210

Mr. Tom Nornhold
Associate Regional Director
Center for Innovative Technology
One College Avenue Room 130
Wise VA 24293

Ms. Patricia Oldham
Marketing Manager
Net Access
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Mr. Russell Owens
Chairman
Industrial Development Authority of Washington County
179 East Main Street
Abingdon VA 24210

Ms. Christianne Parker
Assistant County Administrator

County of Washington
205 Academy Drive
Abingdon VA 24210

Ms. Charlotte Parsons
Director
Washington County Library System
205 Oak Hill Street Northeast
Abingdon VA 24210

Mr. Tom Riffe
Chief Operating Officer
Highland Union Bank
340 West Main Street
Abingdon VA 24210

Mr. Lou Scudere
Vice-President
K-VA-T Foods
P.O. Box 1158
Abingdon VA 24212

Mr. Richard Settle
Area Manager
Verizon Wireless
700 Virginia Avenue
Norton VA 24273

Ms. Nichole Sikora
Executive Director
Southwest Virginia Technology Council
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Abingdon VA 24212

Mr. Jeffery Webb
Chief Information Officer
Southwest Virginia Higher Education Ctr
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Dr. David Wilkins
President
Virginia Highlands Community College
140 Old Jonesboro Road
Abingdon VA 24212

Scott Country, Virginia

Charles Adams
Chief Operations Officer
Physician's Access
Highway 58
Duffield, VA 24244

Margie Blalock
Principal

Rye Cove High School
Route 649
Clinchport, VA

Tim Blankenbecler
Director
Small Business Development Center
Mountain Empire Community College
P.O. Box 700
Big Stone Gap, VA 24219

Jim Brackens
Public Affairs Manager
Sprint
2444 Memorial Boulevard
Kingsport, TN 37664

Blane Clark
Executive Director
Scott County Telecom
Woodland Avenue
Gate City, VA

Randy Cook
Administrator
Indian Path Hospital
2000 Brookside Drive
Kingsport, VA

Danny Dixon
Scott County School District
261 East Jackson
Duffield, VA 24244

Charles Dougherty
Mayor of Gate City
158 East Jackson Street
Gate City, VA

Paul Elswick
Chief Executive Officer
Corner Post Software
4907 Boone Trail Road
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Ron Flanary
Executive Director
LENOWISO Planning District
6913 Duff-Patt Road
Duffield, VA 24244

Thomas Haynes
Principal
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Gate City, VA

Keith Inman
Manager
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Mike Kessel
Scott County Extension Office
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Mike Lane
Site Manager
Joy Mining Machinery
State Route 772
Duffield, VA 24244

Lisa McCarty
Journalist
Scott County Virginia Star
103 East Jackson Street
Gate City, VA

Jim Scott
Superintendent
Scott County School District
261 East Jackson
Duffield, VA 24244

Deborah Shepard
Branch Manager
Bank of America
141 East Jackson Street
Gate City, VA

LaDonna Smith
Office Manager
Mt. Region Medicine
Gate City, VA

Michael Shull
Chairman
Scott County Development Authority
104 East Jackson
Gate City, VA

Pat Tate
President
Scott County Chamber of Commerce
4907 Boone Trail Road
Duffield, VA 24244

<u>Noxubee County, Mississippi</u>

Mrs. Dorothy Baker Hines
Mayor

City of Macon
105 West Pulaski
Macon, MS 39341

Mr. Mike Banks
"Trailboss Trailers, Inc."
15560 Highway 45
Macon MS 39341

Ms. Phylis Benson
Project Analyst
Golden Triangle Planning and Development District
P.O. Box 828
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Mr. Scott Boyd
Publisher
Macon Beacon
403 South Jefferson Street
Macon MS 39341

Mr. Ike Brown and Ms. Dorothy Clanton
Noxubee Democratic Party
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Macon MS 39341

Mr. George Crawford
District Planner
Golden Triangle Planning and Development District
P.O. Box 829
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Ms. Lillie Draper
214 South Jefferson
Macon MS 39341

Ms. Beth Freshour
Director
Noxubee County Library System
103 East King Street
Macon MS 39341

Ms. Susan Hadaway
Outdoor Technologies, Inc.
1576 Magnolia Drive
Macon MS 39341

Dr. Kevin Jones
Superintendent
Noxubee County School District
P.O. Box 540
Macon MS 39341

Arthur Nester
Administrator
Noxubee General Hospital
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Macon MS 39341

Mr. Walter Norris
President
Pride of the South, Inc.
HCO-1, Box 2
Brooksville MS 39739

Mr. William Oliver
President
Noxubee County Board of Supervisors
County Courthouse
Macon MS 39341

Dr. Dennis Reginelli
Agricultural Agent
Noxubee County Extension Office
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Plant Manager
Peco Foods
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Mr. C.D. Smith
Regional Manager
Bell South
2310 7th Street
Meridian MS 39301

Mr. John Thomas
Shuqualak Lumber
Residence Street
Shuqualak MS 39361

Ms. Debbie White
Executive Director
Noxubee Coounty Economic Development Authority
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Mr. Jerry Wilson
President
Bank First
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Macon MS 39341

Monroe County, Mississippi

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Director
Evans Memorial Library
Aberdeen, MS 39730

Beth Bunch
Editor
Amory Advertiser
Amory, MS 38821

Frank Cockerham and Jim Pritchett
Kerr-McGee
Aberdeen, MS 39730

John Clingan
President
Amory Federal
Amory, MS 38821

Sheila Crowley
Marilyn Sumerford
Smithville Medical Center
Smithville, MS 38870

Russ Davis
Technology Coordinator
Aberdeen School District
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Randle Gray
Supervisor
Monroe County Board of Supervisors
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APPENDIX SEVEN: Glossary of Terms

The terms below use definitions from various sources, including the FCC and a previous TIPI Telecommunications Review from 1998.

1996 Telecommunications Act
A major deregulation initiative that allows telephone companies and cable companies to compete with each other, and prescribes a procedure whereby local exchange companies can enter the long distance telephone business. It also reformulated aspects of universal service and established a new basis for computing the program's assignments. The Act also established the "E-rate" program as part of universal service.

Bandwidth
A range of frequencies in the broadcast spectrum that is occupied by a signal (for example, a television signal may have a bandwidth of 6 MHz). The "necessary bandwidth" is the amount of spectrum required to transmit a signal without distortion or loss of information. In computer networks, bandwidth describes the capacity of network elements to carry and transmit data, measured in "Baud Rate". High bandwidth networks are able to carry more types of data simultaneously than low bandwidth networks.

Baud
A measure of the speed at which data is transmitted, computed in number of elements changed per second. The "Baud Rate" is the speed at which a computer can transfer data through a modem using communication software. See also: "Kbps", "Mbps", etc.

BIT (Binary Information Unit, Binary Digit)
The smallest unit of digital information used in computing. A single-digit number in binary code (either a "0" or a "1"). Bandwidth in telecommunications and data networks is usually measured in "bits-per-second" (bps). Hence, a network facility with a bandwidth that allows the transmission of 1,000 bits-per-second is designated on the scale of "Kbps" (Kilobits per second), while a network facility with the capability of transmitting data at a rate of 1 million bits-per-second is designated on the scale of Mbps (Megabits per second).

Bottleneck
Any point in a network at which network traffic gets backed-up because of insufficient bandwidth.

Broadband
A descriptive term for evolving digital technologies offering consumers a single switched facility offering integrated access to voice, high-speed data services, video-demand services, and interactive information delivery services. Broadband also is used to define an analog transmission technique for data or video that provides multiple channels. A cable TV system, for example, employs broadband transmission facilities (both analog and digital).

Byte
A set of "bits" that represent a single character. Usually, there are eight bits in a Byte.

Cable Modem
A device that allows a computer to send data via the cable TV network, where such service is available. Cable modems are capable of providing greatly increased bandwidth over dialup connections; however, the bandwidth available to each cable modem user is determined by the total number of users on the network at a given time. Typical downstream speeds can be up to 10-20 Mbps, while upstream speeds can be approximately 300 Kbps.

Common Carrier
The term used to describe a telephone company. It is a telecommunications company that is available for hire on a non-discriminatory basis to provide communication transmission services, such as telephone, to the public. See also: "Specialized Common Carrier"

Competitive Local Exchange Carrier (CLEC)
A telecommunications company which competes with the previously-existing telephone company to provide local service.

Dedicated Line / Circuit
A communications circuit of channel provided for the exclusive use of a particular subscriber. Dedicated lines are used for computers when large amounts of data need to be moved between points. See also: "Switched Line / Circuit"

Dialup
Using a computer, modem, and a standard telephone line to connect to another computer, network, or Internet Service Provider. Dialup provides "narrowband" data transfer rates. The fastest dialup modem offers a speed of 56Kbps, although line speeds may be slower than what a modem is capable of handling.

Digital Subscriber Line (DSL)
Broadband connection available to commercial or private subscribers, generally offered by local telephone companies. DSL typically refers to a connection offered on ordinary copper line that offers transmission speeds at about 6 Mbps downstream, bundling voice, data and Internet services on the same line. The term is sometimes used to refer to the "next generation" of network connections beyond ISDN. Sometimes, "xDSL" is used by a to refer to any of a number of emerging DSL technologies (symmetric, meaning same speeds up- and downstream, or asymmetric, referring to faster downstream speeds than upstream speeds). DSL services are limited with within about 12,000 feet of a telephone company's central office.

E-rate
A federally funded program to provide subsidies to schools and libraries in economically depressed and rural areas. Subsidies are used to help pay for the development of information technology-related services (including ISP subscription, the development of

Local Area Networks, the provision of broadband connections, etc.) for qualified entities. E-rate subsidies are limited to use specifically for network connection and development needs (they cannot, for example, be used to purchase computers) and can provide between 20 and 90 percent of the total cost of obtaining such commercial services. E-rate subsidies are administered by the Universal Service Administrative Company.

Ethernet
A process that allows the transmission of data at a rate of 10 Mbps over copper wires. Ethernet is generally used only in Local Area Networks (LANs) for connecting computers that are separated by a short physical distance. A network that uses Ethernet may or may not be connected to the Internet; Ethernet links do not automatically imply Internet connection.

Exchange
The electronic switch in the local telephone company's central office that routes traffic to and from individual phone lines.

Fiber Optic (Fiber)
A transmission technology in which light signals (sequenced to carry information in a digital format) are sent through compressed optical fibers. These fibers, made of glass, allow light to be transmitted without interference from other channels.

Gbps

Gigabits per second. A measure of transmission speed that in billions of bits per second, typically occurring in a digital transmission medium such as fiber.

Hosting
A "host" is a computer that houses data or software for another entity. For instance, the computer from which a web page is available is called the "host" or "web host" for that page.

Incumbent Local Exchange Carrier (ILEC)
A telecommunications company that provides local telephone service to a region or locality. ILECs generally are Regional Bell Operating Companies (RBOCs) – a member of the group of companies ("Baby Bells") that were created in the 1984 divestiture of AT&T.

Information Communication Technology (ICT)
Any of the set of rapidly-evolving technologies that join computers and communications networks for the transmission of data.

Integrated Services Digital Network (ISDN)
Switched network providing end-to-end digital connection for simultaneous transmission of voice and/or data over multiple multiplexed communication channels and employing

transmission that that conforms to internationally-defined standards. ISDN is considered to be the basis for a "universal network" that can support almost any type of communications device or service. ISDN lines generally can provide broadband connectivity to subscribers.

Internet Service Provider (ISP)
A company that provides access to the Internet for companies and/or individuals.

Kbps
Kilobits per second. See "BIT". Refers to a speed in thousands of bits per second.

Local Area Network (LAN)
A data network that is used to inter-connect a company's computer and data facilities, usually within a single building or localized area.

LATA

Local access and transport area. These are geographical boundaries established to identify where local telephone service begins and ends. When a signal crosses a LATA line, it is considered an interLATA transmission, and as such falls under different rules (conventionally applied to "long distance carriers"). LATA lines originally were instrumental in determining where long distance carriers operated.

Local Multipoint Distribution Services (LMDS)
A point to multipoint service with two-way capability to transmit voice, data, and other video information. LMDS can offer innovative consumer services such as two-way interactive video, advanced teleconferencing, telemedicine, telecommuting, and high-speed data services.

Location Quotient
An economic indicator which can help to determine a region's relative specialization in particular industries. Mathematically, it is a ratio of ratios. If the location quotient (LQ) result for an industry is greater than 1, this means that the region is more specialized in that industry than the national average and is likely to export some of the industry's product. If LQ is equal to 1, then the industry in the region and in the nation are equivalent in terms of specialization suggesting that the region is self-sufficient. If the location quotient is less than 1, then the industry is less specialized in the region than in the nation suggesting that the region is a net importer of the industry's products.

Mbps
Megabits per second. See "BIT". Refers to a speed of 1,000,000 bits per second.

Narrowband
A term applied to telecommunications facilities capable of carrying only voice, facsimile images, slow-scan video images, and data transmissions at "kilobit" speeds. The term is

commonly applied to voice-grade analog facilities (dial-up) and to digital facilites operating at low speeds (less than 1.544 Mbps).

Packet Switching
When information is in digital form, it may be broken up into small portions, called "packets". These packets may then be individually encoded so that they travel independently along a computer network or other communications channel. Transmitting information along a packet-switched network does not require that a single circuit be maintained throughout transmission.

PoP

Points of Presence or POPs are the physical connections where the local service provider joins a long distance carrier. Proximity to a POP can reduce mileage sensitive charges for accessing long distance service or data transmission.

Specialized Common Carrier
A company (other than the telephone company) that provides point-to-point communications service on a common carrier basis. For example, point-to-point services are used to connect points on the telephone network that normally cannot be connected using standard wire line or fiber optic due to terrain features.

State Network
A telecommunications network which, to some extent, is administered or owned by a state government. Many state networks are, in form, little more than a set of contracts held by the state with commercial telecommunications service providers to provide interconnection between broadband networks that can then be accessed by state agencies and other qualified entities in order to develop low-cost broadband data, voice, or video transmission capabilities. In function, State Networks allow "seamless" telecommunications between state and other public entities which have access to the network as though the state owned and operated the network facilities.

Switched Line / Circuit
A communications channel that is not permanent in nature, but is connected through a switching device of some kind. This allows multiple computers or users on a network to have access to the circuit when it is not being used elsewhere.

T1
T1 refers to a digital transmission service capable of transmitting 1.544 Mbps. It is the general term for a digital carrier available for high volume voice, data, or compressed video traffic. T1 is a standard for transmission that is accepted in North America.

Telco
Telephone Company. Generally, this refers to the company providing local telephone service. See also: "CLEC", "ILEC".

Universal Service
The financial support mechanisms that constitute a universal fund which helps to compensate telephone companies or other communications entities for providing access to telecommunications services at reasonable and affordable rates throughout the country, including rural, insular, and high cost areas, and to public institutions. Companies, not consumers, are required by law to contribute to the Universal Service Fund. The law does not prohibit companies from passing this charge on to customers.

Universal Service Administrative Company (USAC)
A private, not for profit corporation that is responsible for providing every state and territory in the United States with access to affordable telecommunications services through the Universal Service Fund under the direction of the Federal Communications Commission. USAC administers four programs: the High Cost Program, the Low Income Program, the Rural Health Care Program, and the Schools and Libraries Program.

Wide Area Network (WAN)
A data network that is used to interconnect a company's remote data sites, or widely-dispersed computer equipment.

NOTES

[1] It concludes that those outside of population centers are particularly likely to "not be served by market forces" alone.

[2] Points of Presence of POPs are the physical connections where the local service provider joins a long distance carrier. Proximity to a POP can reduce mileage sensitive charges for accessing long distance service or data transmission.

[3] The Standard Industrial Classification (SIC) is the statistical classification standard developed by the U.S. Department of Commerce underlying most economic and statistical series. In this report we generally use four digit codes which classify industries at the product level. The SIC system is being replaced by the North American Industrial Classification System (NIACS). Since we were interested in industry trends over the 1990s we used the SIC system.

[4] The CLEANCBP program is used primarily to estimate employment in sectors where total employment is not reported or suppressed in the *County Business Patterns* data. This model was developed by Andrew Isserman and Oleg Smirnoff, University of West Virginia.

[5] Location quotients are used as indicators of the region's relative specialization in particular industries. Mathematically, it is a ratio of ratios: the ratio of specialization variables Xr and Xn (employment in industry X in the region and the nation, respectively) to reference variables Yr and Yn (eg., total employment in the region and nation, respectively). If the location quotient (LQ) result for an industry is greater than 1, this means that the region is more specialized in that industry than the nation and likely to export some of the industry's product. If equal to 1, then the industry in the region and in the nation are equivalent in terms of specialization suggesting that the region is self-sufficient. If the location quotient is less than 1, then the industry is less specialized in the region than in the nation suggesting that the region is a net importer of the industry's products.

[6] Shift-share analysis calculates three "effects" of change in regional employment as follows (for example for 1988-1996):

- National Growth Effect (N): the impact of total national employment change on the region in selected industry. For example for 1988-1996.

  N = RegionIndustryJobs88 * Growth rate of U.S. Jobs 88-96

- Industrial Mix Effect (M): reflects the extent to which employment in the selected industry in the region is growing faster or slower than the same industry nationally.

  M = RegionIndustryJobs88 *
  ((National growth rate of jobs in selected industry 88-96) – (Growth rate of U.S. Jobs 88-96))

- Regional Shares Effect (R): the impact of any changes in the region's share of national employment in the selected industry.

  R = RegionIndustryJobs88 *
  ((Regional growth rate of jobs in selected industry 88-96) – (National growth rate of jobs in selected industry 88-96))

[7] High-speed lines were defined very conservatively in this study as 128 kbps for residential service and 256 kbps for business service.

[8] Distressed counties have a 3-year average unemployment rate that is at least 1.5 times the U.S. average of 4.9 percent; have a per capita market income that is less than two-third (67 percent) of the U.S. average of $21,141 and have a poverty rate that is at least 1.5 times the U.S. average of 13.1 percent or have two times the poverty rate and qualify on one other indicator. (Appalachian Regional Commission, County Economic Status in the Appalachian Region, FY 2001.)

[9] The FCC's use of the "high-speed" designation is problematic because it does not identify whether the service is broadly available to the public, such as the affordable DSL service, or a more exclusive service, such as a single T1 line, but in the case of the Appalachian region is it easy to see that high-speed services are not pervasive.

[10] With FCC approval that a state has met Section 271 requirements (the competition checklist), the BOCs are allowed to enter into long distance voice and inter-LATA data transport services.
[11] High Cost Methodology Order, FCC 99-306.
[12] On a related note, our case study visits illustrated the typical problem with wireless phone services in rural regions: the license holders for rural service areas are under no obligation to provide service throughout their licensed area. Consequently, only the larger towns or cities in a county might have cell phone service, leaving other communities without the ability to even attract a provider since the license is already taken.
[13] Mueller, M. (1997). Universal service: Interconnection, competition and monopoly in the making of American telecommunications. Cambridge, MA: MIT Press.
[14] We purposefully refer to USF programs in this section as "federal universal service" programs to avoid confusion with state-level universal service programs discussed in a later section.
[15] In addition to the high-cost and the E-Rate programs, the federal Universal Service Fund supports low-income programs (i.e., Lifeline and Linkup) geared to increase access to basic telephone service.
[16] The federal high-cost program disburses the USF to eligible local exchange carriers, but a large number of these eligible carriers have service territories ("study areas") spanning both Appalachian and non-Appalachian counties. Available data from the FCC do not allow us to identify the proportion of universal service support directed to Appalachian and non-Appalachian counties in each state.
[17] For example, BellSouth in Mississippi received a USF payment in excess of $100 million in 2000, and the company spent the money not only for rate-reduction purposes but also for various infrastructure upgrade projects. Subsequently, BellSouth's telecommunications infrastructure in Mississippi was improved enough to allow the state government (the Mississippi Department of Information Technology Services) to build a statewide ATM network, which would benefit the state network users (i.e., the state government agencies, local governments, schools, libraries, and universities) by offering greater bandwidth and lower telecommunications costs. Personal interviews with Gary Rawson (the Mississippi Department of Information Technology Services), Aug. 3, 2001; Randy Tew (the Mississippi Public Utilities Staff), Aug. 3, 2001.
[18] 1996 Telecommunications Act § 254(f).
19 All of these states do receive some high cost funding and support for low-income programs, but these six states are the ones with positive net inflows of funding.
[20] These are often called Section 271 proceedings, referring to the portion of the Telecommunications Act that establishes the procedures for ascertaining the attainment of a competitive threshold in the state.
[21] COVANET reduces voice long-distance service by 32-52 percent, T1 Frame Relay by 20-28 percent in comparison to pre-2000. COVANET also reduces ATM rates by 15 percent from the rates the state government received under the Net.Work.Virginia. deal. (Net.Work.Virgini. is a consortium lead by Verizon and Sprint and provides advanced telecommunications services at discount prices to Virginia's public and private entities. Since the creation of COVANET, the state government encouraged state agencies and schools to switch from Net.Work.Virginia. to COVANET.) See, Carter, L. & Davidson, B. (2000, May 10). Covanet. Presentation given at the Customer Summit, Virginia Department of Information Technology. [Online]. Available: http://www.dit.state.va.us/telco/covanet/
[22] Maryland, New York, South Carolina, and West Virginia.
[23] A legal ambiguity remains with regard to the access to Net.Work.Maryland by private businesses. The Task Force on High Speed Networks strongly recommends such access. See, Task Force on High Speed Networks. (1999, December 31). Report to the Maryland General Assembly. [Online]. Available: http://www.techmd.state.md.us/Technology/TFHSN/leg-report.pdf
[24] These three models should not be considered mutually exclusive. The State of New York, for example, employs both resource sharing and anchor tenancy models for the creation of its state telecommunications network.
[25] In 2000, the Mississippi's federal high-cost support was the highest in the nation.
[26] The PUC originally sought a full structural separation of Verizon into two independent companies. See, Global Telephone Order (1999, September 30).
[27] http://tracs.syr.edu/tracfbi/findings/geoData/tables/topoper90.html. Nearby Itawamba County ranked 6th with 41.6 percent. Noxubee was not on this list.
[28] Amory Federal Manager John Clingan (who lives in Smithville) called the company an "asset to the community."

[29] A majority of these students are Black and are poor; approximately 87 percent are on the school lunch program.
[30] The T1 connection costs $667 per month at the main library, but the library pays only 10% of the cost, or $67, to the provider (BellSouth).
[31] The GTPDD serves Choctaw, Clay, Lowndes, Noxubee, Oktibbeha, Webster, and Winston counties.
[32] COVANET is modeled after Net.Work.Virginia, and aims at reducing telecommunications cost by aggregating demand. The connectivity ranges between 56 kpbs (dial-up access) to 622 Mbps (OC-12). As a state network, COVANET's eligible users are limited to state and local governments, public schools, state universities and colleges, and other public entities.

[33] The local loop portion of the network service also uses non-distance sensitive pricing, making the service affordable to users who are distant from telephone central offices. Installation and annual running costs for different connection speeds as of 2001 are as follows: DS-1 (1.5 Mbps), $500/$12,000; DS-3 (45 Mbps), $1,000/$53,124; and OC-3 (155 Mbps), $2,000/$133,716.

[34]For more information, visit http://www.dba.state.va.us/financing/crd/program.asp?PROGRAM_ID=68
[35] Virginia Employment Commission, Local Area Unemployment Statistics, June 2001. <http://www.vec.state.va.us/pdf/lausclf.pdf>
[36] Users in the City of Bristol, which is an independent city and does not officially belong to Washington County, have access to the backbone network of American Electric Power.
[37] BVUB has several potential competitors to provide advanced telecommunications in the region, including Sprint, and two CLECs, KMC and Adelphia. Mr. Brown reported that the project has already generated competition. Adelphia currently leases fiber capacity from BVUB and recently finished a construction of its own $17 million fiber system that runs through northeast Tennessee and southwest and central Virginia. Mr. Brown also said that cable providers Charter Communications and Comcast are expanding cable modem services into Bristol. BVUB currently operates 9 POPs throughout its OC-12 (622 Mbps) fiber loops. The utility's headquarters will be relocated shortly to a site where a Multimedia-Services Access Point (MSAP) has been installed. BVUB is also building an environmentally controlled Network Operations Center in the new facility. However, BVUB has stopped further backbone expansion because of a pending lawsuit.

[38] The University of Virginia's College at Wise, Emory & Henry Collage, Old Dominion University, Radford University, University of Virginia, George Mason University, Virginia Polytechnic Institute and State University, and College for Older Adults.
[39] SWVTC's membership numbers over 100 large and small businesses, educational institutions, local governments, and individuals. It has one part-time employee, and a 21-seat board of directors with representatives from many technology using or producing firms. Its principal fundraising event is an annual Technology Expo, described as a regional "power summit" on technology and economic development issues.

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