



National Telecommunications and Information Administration

Broadband Technology Opportunities Program
Evaluation Study

Order Number D10PD18645



Case Study Report

University of Arkansas System

Comprehensive Community Infrastructure

Submitted March 11, 2014

ASR Analytics, LLC
1389 Canterbury Way
Potomac, MD 20854

Federal TIN: 20-1204680
DUNS: 15-108-3305
GSA Schedule #: GS-10F-0062R

Submitted to:

Shelita Saint-Louis, Contracting Officer
Cassandra Sterba, Contract Specialist
Acquisition Services Directorate
National Business Center
Department of the Interior

Table of Contents

- Executive Summary 1
- Section 1. Introduction 6
- Section 2. Impacts..... 12
 - 2.1 Healthcare 12
 - 2.2 Education and Training 17
 - 2.3 Workforce and Economic Development..... 19
 - 2.4 Digital Literacy..... 20
- Section 3. Grant Implementation 22
 - 3.1 Implementation 22
 - 3.2 Open Access Policies 24
 - 3.3 Results 24
 - 3.4 Sustainability 26
 - 3.5 Successful Tools, Techniques, and Strategies 26
- Section 4. Conclusions..... 28
 - 4.1 Improve Access to Unserved and Underserved Areas of the Country 28
 - 4.2 Broadband Education, Awareness, Training, Access, Equipment, and Support 29
 - 4.3 Public Safety Agencies 29
 - 4.4 Demand for Broadband, Economic Growth, and Job Creation..... 29
- Section 5. Next Steps for the Evaluation Study 31
- Notes..... 32
- Glossary..... 43
- Bibliography 45

List of Tables

Table 1. Community Anchor Institutions Located in the Service Area	4
Table 2. Number of Broadband Providers Available in Arkansas	6
Table 3. Arkansas Healthcare Institutions by Taxonomy Group	13

List of Figures

Figure 1. Maximum Speed Ranges Available for the Service Area Population	7
Figure 2. CAI Subscribers by Connection Speed	8
Figure 3. Map of CAIs in the Service Area	8
Figure 4. Direct Jobs Created by Arkansas e-Link	20

Executive Summary

About BTOP

The American Recovery and Reinvestment Act of 2009 (Recovery Act) appropriated \$4.4 billion in federal funding to the National Telecommunications and Information Administration (NTIA) to implement the Broadband Technology Opportunities Program (BTOP) in order to spur job creation, stimulate economic growth, and increase access to broadband services.¹ BTOP projects are intended to support increased broadband access and adoption, provide broadband training and support through community organizations, and stimulate the demand for broadband. NTIA distributed grant funding to 233 projects, benefiting all 50 states, 5 territories, and the District of Columbia. The types of projects BTOP funded include Public Computer Centers (PCC), Sustainable Broadband Adoption (SBA), and Comprehensive Community Infrastructure (CCI). CCI projects deploy new or improved broadband Internet facilities to connect households, businesses, and community anchor institutions (CAI) such as schools, libraries, hospitals, and public safety facilities.² CCI projects funded by BTOP are predominantly middle mile projects, although a small number of last mile projects were awarded.³

Comprehensive Community Infrastructure projects deploy new or improved broadband Internet facilities to connect households, businesses, and community anchor institutions such as schools, libraries, hospitals, and public safety facilities.

About the Evaluation Study

This case study report is one of twelve case studies performed by ASR Analytics, LLC (ASR) on CCI projects. It is part of a larger mixed-methods evaluation of the social and economic impacts of the BTOP program.

The purpose of this case study is to:⁴

- Identify how the grantee maximized the impact of the BTOP investment.
- Identify successful techniques, tools, materials, and strategies used to implement the project.
- Identify any best practices, and gather evidence from third parties, such as consumers and anchor institutions, as to the impact of the project in the community.

The information presented in this report intends to capture the social and economic impacts of the grant, and is not an evaluation of UAS, its partners, or its subgrantees.

This case study is primarily qualitative. Social and economic impacts are categorized by the five focus areas described in *Interim Report 1*, with the addition of the Government Services focus area.⁵ Section 2 includes the presentation of these impacts by focus area.

The evaluation study team collected information to evaluate the social and economic impact of the University of Arkansas System's (UAS) Arkansas Healthcare, Higher Education, Public Safety, and Research Integrated Broadband Initiative (Arkansas e-Link) during field visits. From October 20 to October 24, 2013, the evaluation study team met with project partners and CAIs connected by the project. In total, the evaluation study team performed nineteen site visit interviews and focus groups. ASR transcribed these discussions and used this information, along with other information

and reports provided by the grantee, to supplement Quarterly Performance Progress Reports (PPR), Annual Performance Progress Reports (APR), and other publicly available information. The information presented here is intended to capture the social and economic impacts of the grant, and is not an evaluation of UAS, its partners, or its subgrantees.

About the Grantee



The University of Arkansas System (UAS), founded in 1871, has more than 66,000 students and 17,000 employees over 6 main campuses, a medical school, 2 law schools, and several community colleges. Since 1991, the university has operated a statewide broadband healthcare network, known as the Arkansas Telehealth Network (ATN), overseeing 483 hours of daily interactive video.⁶

On August 1, 2010, NTIA awarded UAS a BTOP CCI grant for \$102,131,393 to implement the Arkansas Healthcare, Higher Education, Public Safety, and Research Integrated Broadband Initiative, later renamed the Arkansas e-Link project by the grantee. University of Arkansas for Medical Sciences (UAMS) supported the project by pledging \$26,450,427 in matching funds. Altogether, the project invested a total of \$128,581,820 in Arkansas. As of June 30, 2013, project expenditures totaled \$107,568,396 (84 percent of total budget),⁷

The Arkansas e-Link project invested a total of \$128,581,820 across Arkansas, including \$102,131,393 in federal funds.



UAMS is Arkansas's only medical teaching facility, comprising five colleges, the UAMS hospital, and numerous clinics and health service providers. UAMS is a member of the Arkansas Telehealth Oversight and Management (ATOM) board and operator of ATN, the state's primary telehealth network. ATN links hospitals, healthcare providers, and public safety agencies statewide on a dedicated broadband network.



The Arkansas Research and Education Optical Network (ARE-ON) was a subrecipient of the grant. ARE-ON is the state's only publicly owned fiber-optic network serving research and higher education institutions. ARE-ON provides fiber connectivity to four-year colleges and universities and two-year community colleges in Arkansas.

UAS designated grant implementation activities to a team comprised of project managers employed by UAMS and representatives from ARE-ON. The UAMS team members oversaw all telehealth activities while ARE-ON, the project's subgrantee, was responsible for connecting higher education institutions to its network. Grant administrators refer to the UAMS and ARE-ON teams, and their respective projects, jointly. They renamed the grant project, including healthcare and education initiatives, Arkansas e-Link (e-Link) and refer to themselves as the e-Link Team.

Project Proposal and Status

The Arkansas e-Link project focused on improving telemedicine opportunities, extending fiber connections to higher education institutions, and upgrading existing higher education connections. UAS proposed the following, with results shown:

- The project's goal was to build 380 miles of new fiber and improve capacity of existing ATN and ARE-ON network infrastructure.⁸ Due to budgetary constraints, the e-Link team decided to

execute dark fiber IRUs where possible instead of constructing new fiber. As of June 30, 2013, ARE-ON constructed 49 miles of new fiber and leased 716 miles of fiber through IRUs. The network's 1,488 miles of existing fiber were enhanced by installing new equipment, including upgrades to twenty-three interconnection points.⁹

- Serve 474 CAIs, including 423 healthcare sites, 22 community colleges, 14 other institutions of higher education, 8 libraries, 1 public safety entity, and 6 government buildings.¹⁰ As of June 30, 2013, the Arkansas e-Link project directly connected 376 CAIs, including 366 healthcare institutions, 4 higher education institutions, and 6 other community support organizations.¹¹ An additional 44 sites received Interactive video (IAV) equipment funded by the grant, but no broadband service. These sites rely on existing connectivity or connectivity provided through other federal programs to access the network. In total, the grant served 420 integrated network sites, or locations capable of broadband delivery and transmission as of June 30, 2013.¹² The grantee expects to add thirty-eight more integrated network sites, including twenty-one higher education institutions and nine healthcare sites. This would total 458 CAIs. Deviation from the original goal of 474 is due to site closures.
- Provide IAV equipment and attachments to participating healthcare sites.¹³ As of October 2013, UAMS distributed 530 IAV units and 641 clinical assessment tools, including stethoscopes and probes that attach to the IAV equipment. The IAV units distributed through the project facilitate two-way video communications and accommodate the attachment of clinical assessment tools such as stethoscopes and blood pressure cuffs. While most of the IAV units were distributed to healthcare facilities, including primary care providers, hospitals, and mental health facilities, eight libraries received IAV units for teleconferencing activities.¹⁴ Most of these healthcare entities are located in rural areas.
- Provide computers to libraries and healthcare sites for public Internet access and, in the case of healthcare sites, to provide health education materials.¹⁵ As of October 2013, UAMS distributed 290 public access computers. Recipients included eight public libraries and library districts, and the remaining were healthcare sites such as local health departments.¹⁶

UAS accomplished the following from their proposed goals:

- Constructed forty-nine miles of new fiber
- Improved capacity of ATN and ARE-ON networks
- Provided broadband service and equipment to 420 CAIs
- Distributed 530 IAV units, 641 clinical assessment tools, and 290 public access computers

As shown in Table 1, almost all of the CAIs served as of June 30, 2013 are medical facilities (97 percent), followed by other community support facilities as the second most frequent CAI type (2 percent).¹⁷ The project proposed to connect 474 CAIs, including 423 medical facilities, 34 institutions of higher education, 8 libraries, 8 other community support institutions, and 1 public safety building.¹⁸

Table 1. Community Anchor Institutions Located in the Service Area

Type	Goal		Served by Grantee		Service Area
	#	%	#	%	#
Library	8	2%	0	0%	57
Medical/Healthcare	423	89%	366	97%	3,318
Public Safety	1	0%	0	0%	1,041
School (K-12)	0	0%	0	0%	1,270
University, College, or Other Postsecondary	34	8%	4	1%	83
Other Community Support	8	1%	6	2%	6
All	474		376		5,775

The e-Link project focused on expanding and integrating the existing ARE-ON and ATN networks. ARE-ON and ATN do not intend to provide wholesale broadband service or service to businesses and homes. Thus, no wholesaler or last mile agreements have been executed or are anticipated. Upgraded and new interconnection points and capacity enhancements are intended to encourage last mile providers to serve additional healthcare, education, and government CAIs on the expanded ARE-ON and ATN networks.

Major Outcomes and Impacts

Through interviews and data collection from a number of sources, the evaluation study team observed qualitative and quantitative outcomes and impacts of the project. The list below highlights these outcomes and impacts, with additional detail provided in Section 2.

- Network upgrades, new connections, and the distribution of IAV equipment and tools have broadened telemedicine opportunities for Arkansas’s healthcare providers. Increased use of telemedicine capabilities have reduced the need for patient and provider travel, resulting in cost savings for healthcare providers and other stakeholders. The grant implementation team and project stakeholders also reported that telemedicine capabilities have increased access to healthcare for rural communities and improved the range and quality of healthcare and mental health services provided across Arkansas.
- Public safety entities, including the Arkansas Trauma Network, Arkansas Department of Health, emergency medical service (EMS) agencies, and hospitals have improved the delivery of emergency response and disaster response services. Improvements to ATN have enhanced the speed and quality of interagency communications, enabling more efficient emergency and disaster response efforts. Interviewees provided evidence that the distribution of IAV equipment has enabled growth in the number of remote trauma consultations, which has resulted in faster and more effective patient care.
- The provision of IAV equipment among healthcare institutions has transformed the way continuing medical education (CME) is delivered in

Through BTOP, the project achieved the following community impacts:

- Increased opportunities for telemedicine applications
- Increased access to healthcare for rural Arkansas
- Improved the delivery of emergency medical care
- Drove growth in distance education and inter-institution collaboration at community colleges

Arkansas. Transmitting lectures and training sessions over ATN allows healthcare professionals to access CME content using IAV instead of traveling to central Arkansas for training. This allows healthcare professionals to maintain their licensure and certifications, or to expand their knowledge base, without leaving their place of work. Remote delivery of CME content reduces travel costs and minimizes the loss of staff time for training at healthcare institutions.

- The grant has improved broadband service for the state's two-year colleges. Community colleges have expanded their distance education and technical program offerings. They have used broadband connections to collaborate with other ARE-ON colleges and universities to offer four-year degree programs. These activities have increased access to higher education and vocational training for rural Arkansans. Institutions connected to ARE-ON now have access to Internet2. Access to research networks improves the colleges' ability to qualify for research grants that they otherwise may not be eligible to receive.

Conclusions

Without the BTOP grant, nearly 400 medical facilities would have limited or no IAV capabilities, reducing the quality and range of care they provide. Rural Arkansans would have limited access to specialist care in their hometowns and be forced to travel for doctor visits. Healthcare professionals would have to travel more to obtain CME training and would miss work, resulting in fewer patients seen and greater travel costs for employers. Components of the Arkansas Trauma Network, including transmission of patient imaging and test results, would operate at a much slower speed due to limited bandwidth, delaying patients' emergency care. Small two-year colleges would face higher recurring connectivity costs and receive slower connections than they receive through ARE-ON. They would be limited in their use of broadband-enabled classrooms, instructional content, learning tools, and expansion of their distance education programs.

The BTOP grant enabled the integration and expansion of two publicly owned networks throughout the state of Arkansas. The integrated network provides a scalable, robust platform from which state agencies can provide enhanced healthcare and educational services. The BTOP investment represents an economic opportunity for broadband service providers, small and large businesses, and the state's workforce. The infrastructure, coupled with the equipment and training, attempts to increase sustained adoption to realize the return on this investment. Although speed and pricing data are not available for all CAIs, several community colleges reported speed increases between 300 and 3,000 percent while paying less each month for the improved service.

Several community colleges reported speed increases between 300 and 3,000 percent while paying less each month for the improved service.

Section 1. Introduction

The goal of the project was to connect approximately 474 CAIs and to provide middle mile broadband connectivity across the state. UAS proposed to integrate and enhance the capabilities of two networks already in operation in Arkansas, ARE-ON and ATN.¹⁹ The Arkansas e-Link project increased the accessibility and affordability of broadband service among healthcare providers and higher education institutions by increasing the capacity and reach of the existing 5,600-mile network.²⁰ While the project's service area encompasses the entire state, it concentrated on forty-three economically distressed and underserved counties in Arkansas's Mississippi Delta region.

The American Community Survey (ACS) Five Year Summary for 2007 to 2011 shows that Arkansas has a population of almost 2.9 million. Seventy-eight percent of the service area residents are White, and 16 percent are African American.²¹ The majority of the service area residents (60 percent) have a household income of less than \$50,000 a year.²² The rural nature of the state leaves many Arkansans with limited access to adequate healthcare. Seventy-three of Arkansas's seventy-five counties are designated partially or entirely "medically underserved."²³ Of all states, Arkansas ranks forty-ninth in overall health.²⁴

Using publicly available data, the evaluation study team identified 5,775 CAIs in the service area, including 3,318 medical/healthcare facilities, 1,270 K-12 schools, 1,041 public safety institutions, 83 postsecondary institutions, 57 libraries and 6 other community support facilities. The twenty-three new or upgraded interconnection points provided through the grant, along with capacity enhancements, will support future connections to additional CAIs.

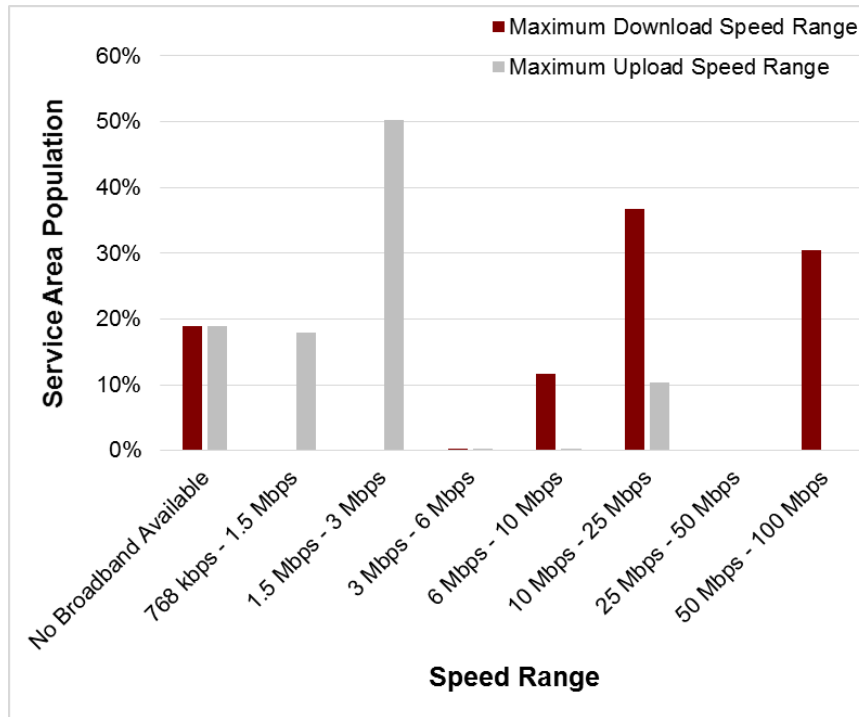
Table 2 shows the percentages of the populations in the service area by the number of broadband providers available according to data and speed thresholds defined by the National Broadband Map (NBM).²⁵ The largest portion of the service area population (45 percent) has access to two providers, but almost 19 percent of the service area population does not have access to any service providers. All provider statistics use the June 2011 release of the NBM and 2010 population data from GeoLytics.

Table 2. Number of Broadband Providers Available in Arkansas

Number of Providers	Service Area Population
0	18.95%
1	33.13%
2	44.57%
3	3.32%
4	0.03%

Figure 1 shows the percentages of the service area population with respect to the fastest download and upload speed range available to them.²⁶ According to the NBM, there are twenty-seven broadband providers in the service area. Four of the service area providers deliver service in the fastest download speed ranges of at least 50 Mbps. Maximum available download speeds range from 3 Mbps to 1 Gbps, while maximum upload speeds range from 768 kbps to 1 Gbps.

Figure 1. Maximum Speed Ranges Available for the Service Area Population



Less than half of the service area households subscribe to broadband. Federal Communications Commission (FCC) data from June 2012 show that 48 percent of the service area households subscribe to an Internet service that has at least 768 kbps download speeds and 200 kbps upload speeds.²⁷

Figure 2 presents a summary of CAI subscriptions at different speed tiers since the Arkansas e-Link project first served an institution in the second quarter of 2012.²⁸ Service (subscriptions) did not begin until the second quarter of 2012. As of June 30, 2013, most subscribers had service at the 1.5 Mbps speed tier. These 291 subscribers are primarily healthcare institutions, which access the fiber network through secure T1 connections. The second largest group of CAIs, seventy-seven, subscribe to service at the 10 Mbps range. In addition, seven CAIs receive 100 Mbps connections and one CAI receives a 1 Gbps connection.

Figure 2. CAI Subscribers by Connection Speed

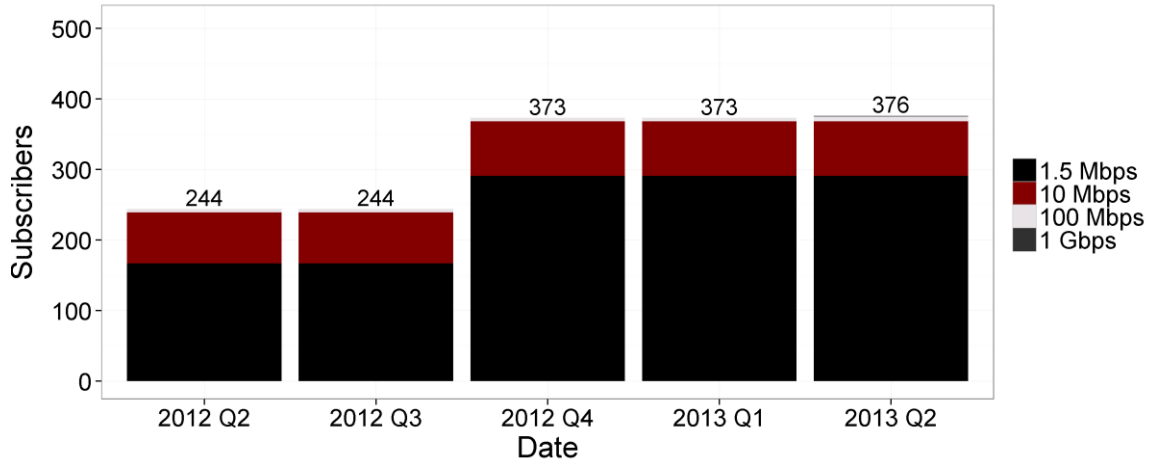
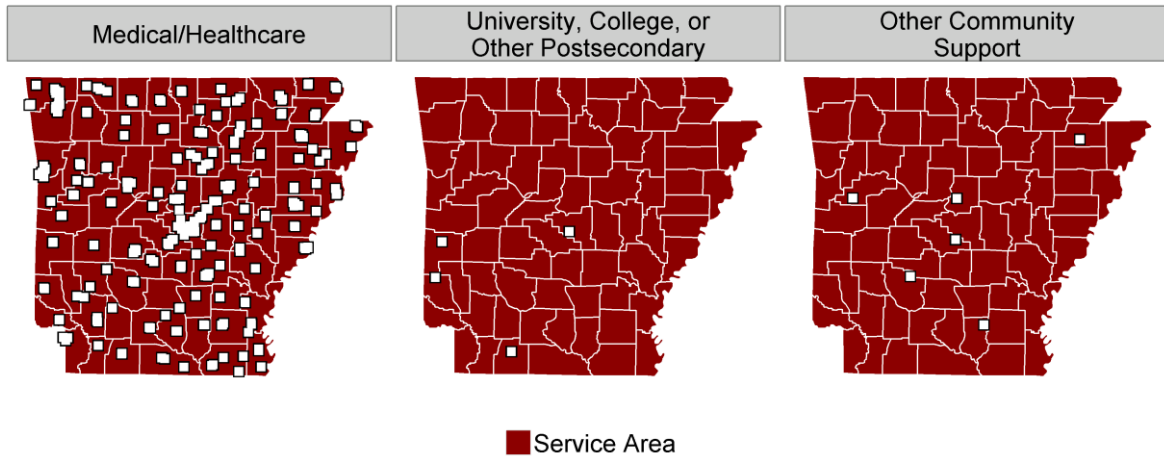


Figure 3 displays maps of the Arkansas e-Link service area and the locations of the CAIs served as of June 30, 2013.²⁹

Figure 3. Map of CAIs in the Service Area



The evaluation study team met with program staff and project partners. These interviews helped the team understand the grantee’s approach to project implementation and the strategies used to create demand for the broadband service. Additional interviews with key CAIs and partners throughout Arkansas focused on describing the impact on CAIs in relation to several factors, including the quality of service of the upgraded network, especially speed, reliability, flexibility, and cost. The analysis in this report focuses on outcomes and impacts to CAIs. Interviews conducted include the following:

- Healthcare
 - The **Arkansas Trauma Network and Arkansas Trauma Communications Center (ATCC)** use ATN for interoperable communications between public safety and emergency medical service (EMS) entities statewide. Established in 2011, the ATCC directs EMS calls for major and moderate traumas and coordinates all inter-facility patient transfers in the state. ATCC serves approximately sixty patients per day—60 percent are EMS calls and 40 percent are patient transfers.³⁰ The Trauma Network has benefitted from capacity and connection speed improvements made to ATN and from the increased number of IAV units in hospitals used

for trauma consultations. The IAV units enable remote consultations with trauma experts, reducing the time it takes to determine the best course of treatment and a suitable transfer plan for the patient.

- **Arkansas Department of Health (ADH)** oversees ninety-four local health units throughout the state and manages all health advancement, health protection, and public health initiatives in the state.³¹ The provision of IAV equipment to local health units was the primary benefit of the e-Link initiative for ADH. ADH now has improved communication capabilities with local health units. After receiving IAV equipment, local health units engage in more direct communication with other local health units, rather than working through ADH's main office.³²
- The **Greater Delta Alliance for Health (GDAH)** is a consortium of eight hospitals that serves a nineteen-county service area in southeastern Arkansas.³³ The evaluation study team met with representatives from four of the member hospitals: **Ashley County Medical Center (ACMC)**, **Chicot Memorial Medical Center (CMMC)**, **Delta Memorial Hospital (DMH)**, and **DeWitt Hospital and Hospital and Nursing Home (DHNH)**. GDAH hospitals received connectivity and IAV equipment and attachments through the grant. Hospitals use the IAV units for telemedicine and continuing medical education (CME) activities. Connecting to ATN through the Arkansas e-Link initiative allowed DMH and DHNH to remove T1 lines they had been using, eliminating a \$1,600 per month cost.³⁴
- **Howard Memorial Hospital (HMH)** is a small critical access hospital serving rural Howard County and parts of neighboring Hempstead and Pike Counties. HMH received two IAV units and a connection to ATN for its facility. HMH's telemedicine capabilities have increased access to medical specialists for patients in the HMH service area.³⁵
- **Boston Mountain Rural Health Center (BMRHC)** is a network of nine community health clinics providing medical and dental services to a five county service area.³⁶ BMRHC receives funding through the Health Resources and Service Administration (HRSA), an agency of the United States Department of Health and Human Services, to provide uncompensated care for impoverished and uninsured patients.³⁷ BMRHC received \$514,000 worth of IAV equipment and connected seven of its sites through the Arkansas e-Link grant.³⁸ The remaining two sites were not operational at the time that connectivity was provided.
- **Mainline Health Systems (Mainline)** is a nonprofit network of medical and dental clinics serving four counties in southeastern Arkansas.³⁹ Mainline Health has six medical clinics and two dental clinics. Mainline Health receives funding through HRSA to serve uninsured and underinsured patients and to offer financial assistance for qualifying patients. Mainline received IAV equipment and had four sites connected to ATN through the grant-funded project.⁴⁰ Mainline is using its telemedicine capabilities to increase access to specialty medical care for its patients and to deliver CME to employees.⁴¹
- **Health Resources of Arkansas (HRA)** provides mental and behavioral health services in a twenty-two county service area. HRA has more than thirty facilities, all connected by T1 lines operational before the grant period.⁴² Before the e-Link initiative, HRA had six IAV units, placed in four counties.⁴³ Through the e-Link initiative, HRA received an additional fourteen IAV units, and now have twenty units in fifteen counties.⁴⁴
- **Birch Tree Communities (Birch Tree)** is a nonprofit mental healthcare provider that offers clinical, rehabilitation, and support services through therapy sessions, intervention support, residential services, and medication and illness management. Approximately 70 percent of Birch Tree patients are referrals from hospitals and require twenty-four-hour care.⁴⁵ Birch Tree has fourteen facilities and was connected to the ATN through the e-Link initiative.⁴⁶ Prior to the grant, Birch Tree had implemented telemedicine using fourteen existing IAV units.⁴⁷ Arkansas e-Link provided two more IAV units.⁴⁸
- **Mid-South Health Systems (Mid-South)** is a nonprofit mental healthcare provider serving thirteen counties in eastern Arkansas.⁴⁹ Mid-South provides adult outpatient diagnoses and treatment, childhood and adolescent therapy and treatment, community support systems for those with serious mental illnesses, and support for individuals with developmental

disabilities. Mid-South has twelve campuses and sixteen T1 connections to ATN through the Arkansas e-Link initiative.⁵⁰ It also received IAV equipment.

- The **HomeCare Association of Arkansas** is a nonprofit organization that represents the home healthcare agencies in Arkansas. The HomeCare Association provides lobbying services and interacts with Medicare and Medicaid on behalf of member agencies for billing purposes.⁵¹ The HomeCare Association received IAV units through the project to distribute among member agencies for use in patients' homes. The Arkansas e-Link project did not provide connectivity for these units, which rely on existing connections or wireless cards provided by the agencies for connectivity. Thirteen member agencies received IAV equipment for home health monitoring.⁵²
- **Arkansas Aging Initiative (AAI)** is a program implemented through UAMS. AAI has eight main facilities throughout the state called Centers on Aging.⁵³ AAI focuses on researching aging and age-related conditions and delivering educational programming. The e-Link project connected the Centers on Aging to ATN and they received IAV equipment. Seven of the eight centers have two connections to ATN and the remaining center has one.⁵⁴
- Higher Education
 - **University of Arkansas Community College at Morrilton (UACCM)** serves nearly 2,300 students through associate degrees and career-focused technical training programs.⁵⁵ Before the grant, UACCM received a 30 Mbps connection through AT&T. The Arkansas e-Link project connected UACCM to ARE-ON, which provides a 120 Mbps commodity Internet connection and a 1 Gbps connection to Internet2.⁵⁶
 - **Cossatot Community College of the University of Arkansas (CCCUA)** is a two-year institution with campuses in De Queen, Ashdown, and Nashville. CCCUA serves nearly 1,600 students and offers associate degrees, technical certificates, and certificates of proficiency.⁵⁷ CCCUA is a large provider of distance education and holds two national awards for excellence in distance education programming. Before the grant, CCCUA connectivity relied on T1 lines. CCCUA connected to ARE-ON through e-Link and now has a 100 Mbps fiber connection.⁵⁸
 - **Phillips Community College of the University of Arkansas (PCCUA)** serves more than 2,000 students at campuses in Helena-West Helena, DeWitt, and Stuttgart.⁵⁹ PCCUA offers programs for traditional and non-traditional college students including college-level credit programs, continuing education, and workforce training. Before connecting to ARE-ON, PCCUA had a 10 Mbps connection.⁶⁰ The e-Link project connected PCCUA to ARE-ON, through which they receive a 100 Mbps fiber connection.
 - **Southern Arkansas Community College (SouthArk)** is a two-year institution serving approximately 1,700 students at two campuses.⁶¹ SouthArk offers two-year degrees for students planning to transfer to a four-year institution, career and technical training, and continuing education programs. Prior to the Arkansas e-Link initiative, SouthArk leased circuits from two different providers, receiving a 20 Mbps Internet connection for its two campuses.⁶² After the e-Link project, SouthArk receives a 100 Mbps Internet connection through ARE-ON.

The evaluation study team also met with the following groups that provided information on the social and economic impacts of the grant, although they did not directly receive broadband service or equipment because of it.

- **UAMS Center for Distance Health (CDH)** supports research and programming aimed at improving access to healthcare across Arkansas. CDH partners with the e-Link team to develop telemedicine applications for delivering healthcare services and CME over ATN to facilities in medically underserved areas. Enhancements to ATN capacity and the distribution of IAV equipment throughout the state have expanded the use of CDH programs and will accommodate the development of new telemedicine applications.
- **UAMS Center for Rural Health (Rural Health)** leverages academic and clinical resources to aid rural healthcare facilities throughout the state. Rural Health activities include providing

remote consultation and teaching opportunities via interactive video and providing resources to strengthen local hospitals' capabilities. As an entity within UAMS, Rural Health had adequate connectivity itself prior to the grant project. For Rural Health, the key benefit of the project lies in the connectivity and equipment received by its rural healthcare partners, enhancing their capabilities for clear two-way communications.

- The **Arkansas Association for Two-Year Colleges (AATYC)** is a nonprofit organization that serves all twenty-two two-year colleges in Arkansas and their students through lobbying initiatives, professional development opportunities, and inter-college partnerships.⁶³ Connecting to ARE-ON has greatly reduced the cost of connecting to the Internet for higher education institutions. ARE-ON's Executive Director estimated that some colleges and universities were paying as much as \$200 per megabit per month for Internet service before connecting to ARE-ON.⁶⁴ After connecting to ARE-ON, these institutions pay only \$10 per megabit per month. This represents a \$19,000 savings per month for a 100 Mbps connection. ARE-ON hopes to reduce the cost per megabit down to \$5 in the future.

Section 2 provides a summary of the outcomes and impacts the evaluation study team observed.

Section 2. Impacts

This section describes the outcomes and impacts of the e-Link project in relation to the five focus areas described in *Interim Report 1*, with the addition of the Government Services focus area.⁶⁵ These outcomes and impacts focus on understanding the effect on CAIs. The primary areas of impact were in Healthcare and Education and Training, which aligns with the primary goals of expanding the state's ATN and ARE-ON networks. While the Arkansas e-Link initiative distributed computers to library systems for public access, the evaluation study team did not visit or interview any library participants and therefore collected no impacts in the Quality of Life focus area. The evaluation study team did not collect any impacts in the Government Service focus area as state and local government uses of grant-funded connections were primarily healthcare-related.

One significant goal of the project was to provide IAV equipment for telemedicine activities. Sites that already had connectivity through other telemedicine programs, such as the FCC Rural Health Care Pilot Program, only received IAV equipment through the project. Remaining sites received both equipment and a secure T1 connection to ATN. While ARE-ON and ATN operate on the same physical infrastructure, they operate on different wavelengths, keeping the networks independent of one another. ATN is used for the transmission of healthcare-related traffic only, as required by HIPAA. Non-healthcare CAIs received fiber connections and are able to access the public Internet, as well as education and research networks such as Internet2.

2.1 Healthcare

This focus area includes activities intended to increase elements of the provision and administration of healthcare services, including health information technology, e-Care, electronic health records (EHR), telehealth, and mobile health. Impacts in the Healthcare focus area include broadband-enabled activities aimed at improving personal health or that of someone else. This definition includes not only sophisticated tasks, such as viewing medical records online, but also more common activities that might not involve a medical provider at all. Healthcare impacts might be observed at primary care physicians' offices, hospitals, or in areas served by nurse practitioners.

When assessing impacts it is important to understand the characteristics and composition of healthcare providers within the service area. As of June 30, 2013, the Arkansas e-Link project connected 366 healthcare institutions. Table 3 identifies the taxonomy groups of these connected institutions and the taxonomy groups of all healthcare institutions in Arkansas according to the National Plan and Provider Enumeration System (NPPES).⁶⁶ Sites that received equipment through the grant but rely on other sources of connectivity are not included in the table. The majority of the healthcare institutions connected by UAMS fall in the agency and ambulatory health care facilities taxonomy groups, representing 81 percent of medical connected facilities. The project connected sixty-six hospitals throughout Arkansas, representing more than 25 percent of all hospitals in the state.

Table 3. Arkansas Healthcare Institutions by Taxonomy Group

Taxonomy Group	Served by Grantee	Rest in Arkansas
Agency	133	1,051
Ambulatory Health Care Facilities	165	985
Hospital Units	0	77
Hospitals	66	260
Managed Care Organizations	0	55
Nursing & Custodial Care Facilities	0	468
Residential Treatment Facilities	1	56
All	366	2,952

This section summarizes the activities observed by the evaluation study team during site visits. The literature review presented in *Interim Report 1* provides evidence that these activities and situations lead to economic and social impacts. This report lists these impacts from the literature along with the evaluation study team’s observational evidence supporting either the realization of impacts or their potential to occur.

- **Patients save time and money through reduced transportation, telephone calls, and face-to-face visit requirements.**⁶⁷
 - The Antenatal and Neonatal Guidelines, Education and Learning System (ANGELS) program is an obstetric consultative service provided by UAMS with support from ADH. Launched in 2003, ANGELS gives women with high-risk pregnancies in rural Arkansas access to expert obstetricians and neonatologists through IAV consultations.⁶⁸ This service allows pregnant women to have access to expert care in their hometown clinics, even if they are not well enough to travel, or do not have the means to do so. Reducing the need to travel has decreased the number of missed doctor visits by women with high-risk pregnancies, resulting in better birth outcomes.⁶⁹ The ANGELS program helps smaller rural healthcare providers deliver improved preventative care. Identifying maternal-fetal health concerns early on enables doctors and families to prepare for and monitor those conditions during pregnancy, through childbirth, and infancy. Fetal diagnoses allow doctors to treat babies immediately once they are born. While the ANGELS program existed prior to the Arkansas e-Link project, the IAV equipment distributed through the program gives ANGELS connectivity to a greater number of providers throughout the state. Enhanced capacity on ATN has also contributed to an expanded use of IAV through ANGELS.⁷⁰ ANGELS delivered 5,221 telemedicine sessions in 2012 compared to approximately 3,800 in 2011.⁷¹
 - Telemedicine activities increase healthcare access in rural areas by eliminating the need to travel.⁷² Consultations via IAV may occur on a regular basis or as follow-up basis after a physical visit. Grant stakeholders have observed increased patient compliance and fewer missed visits among telemedicine patients versus traditional setting patients.⁷³ Attending regular doctor visits and adhering to a treatment regimen more easily stabilizes health conditions and makes them easier and cheaper to manage.
 - Many primary care clinics the evaluation team visited have implemented specialist care via IAV after receiving their equipment through Arkansas e-Link. BMRHC partners with Baptist Health’s Arkansas Cardiology program to deliver remote cardiology consultations to patients using IAV.⁷⁴ Mainline also recently began providing cardiac care through telepresence. While some Mainline sites have cardiologists on-site, IAV units are used to deliver cardiology consultations for other sites. In the first two months of the program, twenty patients participated in IAV cardiac evaluations at Mainline.⁷⁵ CDH has implemented a program to provide cervical cancer screenings and biopsies via telemedicine for women in rural areas.

This eliminates the need to travel to Little Rock in the case of benign biopsies.⁷⁶ Other telemedicine programs include a remote speech therapy pilot at ACMC and a remote physical therapy rehabilitation service at HMM. Many of the rural health clinics and hospitals interviewed expressed interest in using their new telemedicine capabilities to add more specialty care services.⁷⁷

- Birch Tree provides transportation for its patients, as many of them are not licensed to drive or do not have the resources to travel. Because of this service, Birch Tree faces fuel costs of more than \$400,000 per year. Telemedicine capabilities have reduced travel costs for Birch Tree by reducing the need to transport patients and staff among sites.⁷⁸
- Prior to Arkansas e-Link, HRA employed five to six child psychiatrists who spent the majority of their workday traveling from site-to-site to see patients. Because of the e-Link project, they have a single child psychiatrist who sees patients via IAV. HA was also able to expand its service area by five additional counties.⁷⁹ As a result, HRA incurs fewer travel costs while serving a larger geographic area.
- Arkansas e-Link has allowed Mid-South to implement telemedicine practices at twelve of its sixteen sites.⁸⁰ Telemedicine activities have significantly increased access to mental and behavioral healthcare for Mid-South's service area, a rural, impoverished region that has had difficulty attracting doctors. Using IAV to conduct patient sessions gives doctors more time to see patients since they do not have to travel. Eliminating the need for patient travel minimizes the number of missed appointments and instances of discontinued care.⁸¹
- CDH is piloting a program to leverage telemedicine capabilities in prisons by implementing IAV evaluations for specialty practice areas, including cardiology and ophthalmology. The program will reduce costs for the prison by eliminating the need to transport inmates to Little Rock for visits to specialists' offices.⁸²
- In March 2013, a major oil spill occurred after a pipeline ruptured in Mayflower. ADH used telemedicine capabilities to deliver health assessments to affected citizens following the spill. The most common complaint was difficulty breathing, so ADH ordered IAV consultations with pulmonary physicians. Approximately thirty health assessments were delivered using IAV equipment at local health units.⁸³
- **Broadband enables providers to improve the range of health services offered.**⁸⁴
 - The Arkansas Stroke Assistance through Virtual Emergency Support (AR SAVES) program provides remote consultations for emergency room (ER) patients exhibiting stroke symptoms. Through ATN, AR SAVES links forty hospitals to neurologists at UAMS and at St. Edward Mercy Medical Center in Fort Smith, twenty-four hours a day.⁸⁵ The neurologist can evaluate the patient and determine whether it is safe to administer tPA, a blood clot-busting drug. Administering the drug as soon as possible minimizes the side effects of stroke. The window of time for administering the drug is often missed when patients at a rural hospital must be transported to a larger facility that is equipped to evaluate stroke victims. AR SAVES reduces the need for transfers and allows patients to receive tPA in a shorter time. As a result, the chances of recovery are significantly improved, as is quality of life post-stroke. While the AR SAVES program existed prior to the Arkansas e-Link initiative, enhancements to ATN and the distribution of IAV units among hospitals enabled the AR SAVES program to grow. In fiscal year 2010, just prior to the BTOP award, AR SAVES performed 205 consultations and delivered 41 doses of tPA.⁸⁶ As the project neared completion in fiscal year 2013, 594 patients were seen through AR SAVES and 151 doses of tPA were administered.⁸⁷ In addition, the average time to administer tPA decreased by approximately twenty minutes during the award period.⁸⁸
 - Telemedicine services have been leveraged to provide other emergency consultation services. A popular application of emergency telemedicine in Arkansas is hand trauma consultation, as hand injuries are a common occupational hazard in agricultural, food processing, and manufacturing jobs that are prevalent in the state. Using IAV and clinical attachments, which include a small camera, an ER nurse or physician can assist a remote hand specialist evaluate the patient's injury. The specialist can determine the best course of action for the patient, possibly saving the patients hand or fingers and preserving quality of

life. This could also eliminate a very costly transport to an out-of-state facility when it is not needed.

- Baptist Health's main site in Little Rock uses ATN for its eICU (intensive care unit) program. The eICU program allows staff at Baptist Health to remotely monitor ICU patients in rural hospitals that may be understaffed or not have expertise in the area of the patient's needs. The program will link Baptist Health to fifteen to sixteen rural hospitals, including ACMC.⁸⁹
- Increased bandwidth on ATN has allowed ANGELS to expand its Angel Eye program. Angel Eye promotes bonding between mothers and infants in neonatal intensive care units (NICU) by allowing the parents to monitor their baby twenty-four hours a day through a camera. The Angel Eye program existed prior to the Arkansas e-Link program and the grant did not provide funding for Angel Eye equipment, however, capacity improvements allowed ATN to accommodate additional Angel Eye cameras.⁹⁰
- Some sites that received equipment through Arkansas e-Link, including HMH, are partnering with the Arkansas Children's Hospital to provide emergency burn consultations. The Children's Hospital houses the only burn center in the state, so consultations are provided for burn victims of any age. ATN, which arranges the consultations and any resulting transfers, is considering creating virtual consultation rooms dedicated for burns.⁹¹
- **Broadband access also enables providers to rapidly share patient information with other healthcare providers.**⁹²
 - The Trauma Network and ATCC allow for interoperability between emergency response entities, allowing private EMS agencies and government agencies to communicate easily. Interagency collaboration helps to reduce trauma response times, to facilitate hospital transfers, and leads to more effective disaster response efforts.⁹³ The ATCC dashboard categorizes the capabilities and capacities of the state's hospitals according to sixteen categories.⁹⁴ The dashboard allows ATCC staff to quickly see which hospitals provide needed services and if they have available capacity. The ATCC coordinates the patient's transport to the admitting facility based on this information. The dashboard can be used on a stationary ATCC computer or a mobile device.
 - The Trauma Image Repository (TIR) is a resource for sharing trauma patients' records and imaging during a transfer. Patients are banded with a unique trauma number that appears on their files and acts as an identifier to protect patients' privacy in accordance with HIPAA. When a patient is transferred, their files travel through ATN to a server housed at UAMS. The facility receiving the transferred patient retrieves the files from the TIR server. After ten hours, the files are permanently deleted from the server. BTOP has significantly improved speeds for file transfers by improving ATN's capacity. Before the grant, it could take as long as forty-five minutes to transfer large data files, and sometimes patients arrived at the transfer facility before their images were transmitted. Now, the maximum transfer time for a large file is approximately ten to fifteen minutes. ATCC estimates that more than 200 images pass through the TIR each day.⁹⁵
 - The Health Information Exchange (HIE) Council and ADH are working together to create a patient information database that would centralize patient records and make them accessible to healthcare providers across the state on ATN. Greater EHR sharing could reduce administrative and clinical costs, and improve patient care by enabling integrated treatment approaches across disciplines. EHR sharing could also help facilitate the detection of infectious disease outbreaks and helps to reduce drug interactions.⁹⁶
- **Patients obtain improved ongoing care.**⁹⁷
 - The use of telemedicine units enables patients of the HomeCare Association member agencies to receive real-time monitoring and care. During home visits, nurses can use software and clinical attachments to measure, input, and track patients' vital statistics. Between visits, nurses and physicians can meet with patients for IAV evaluations. Remote monitoring allows nurses and physicians to adjust medications or treatments to stabilize patients' conditions, which prevents larger problems and unnecessary ER visits.⁹⁸

- **Access to provider websites and online medical records reduces the occurrence of duplicative paperwork and tests.**⁹⁹
 - The reliability of the TIR ensures that patient tests or imaging will not have to be duplicated when the patient is transferred. The patient information database proposed by the HIE Council would serve a similar function for non-trauma patients.¹⁰⁰ Eliminating duplicative tests minimizes delayed care and excessive radiation exposure associated with re-imaging.¹⁰¹
- **Broadband connectivity can improve the effectiveness of health promotion and disease prevention programs.**¹⁰²
 - ADH has connectivity to all ninety-four local health units in the state. There is also connectivity among the local health units. ADH relies on these connections to communicate with local health units to ensure uniformity in patient care and to track trends in diagnoses, which are critical components of containing the spread of infectious diseases. ADH has set aside one IAV unit in its building that specifically manages tuberculosis evaluations. If a local health unit receives a patient with tuberculosis symptoms, it can reach the tuberculosis unit directly to notify ADH and receive direction from specialists.¹⁰³ ADH is also piloting an HIV Specialty Care Program through which specialists evaluate HIV patients remotely. Like other telemedicine programs, eliminating the need to travel to central Arkansas has minimized the number of missed appointments. During the IAV consultation, they ensure patients are adhering to their treatment regimens. These factors improve patient compliance, resulting in improved health outcomes and quality of life for HIV patients.¹⁰⁴
- **The availability of online resources simplifies how patients obtain health information, improves the quality of information obtained, and provides the option to remain anonymous.**¹⁰⁵
 - UAMS Center for Rural Health is leveraging the public access computers distributed to local health units by developing a computer application that will provide health education information for pregnant women in waiting rooms of local clinics. The images and voiceovers in the modules are reflective of the local communities. Content is repetitive, an important feature for maximizing information retention.¹⁰⁶ The application is designed to increase health education and awareness among pregnant women to improve health outcomes for both the mother and infant.
 - CCCUA converted training materials for insurance assisters to an online format. Insurance assisters are responsible for helping patients navigate changes resulting from the Affordable Care Act (ACA). Insurance assisters in Arkansas received training from the web-based training modules developed by CCCUA. The bandwidth intensive material relied on ARE-ON for transport in both the development and deployment stages¹⁰⁷.
- **Access to online health information enhances patients' ability to seek care, select a provider, and choose treatment options, improving outcomes for physical and mental illness.**¹⁰⁸
 - AAI uses telepresence capabilities to present educational material about geriatric health through its Geriatric Grand Rounds program. AAI's eight Centers on Aging use the IAV equipment to educate healthcare professionals and older adults or adult children acting as caregivers about the treatment and management of conditions associated with aging, such as Alzheimer's disease. Sessions average approximately 150 patients.¹⁰⁹
- **Patients are able to obtain more accurate prescriptions in a shorter amount of time.**¹¹⁰
 - Birch Tree has an on-site pharmacist at its main site in Benton who uses teleconference capabilities for consultations with patients at other sites. The pharmacist can adjust the patient's drug regimen without Birch Tree having to transport the patient to their local pharmacy. This reduces travel costs for Birch Tree and enables the patient to receive their new prescription more rapidly.¹¹¹
- **Broadband improves communication efficiencies, resulting in improved patient-provider relationships.**¹¹²

- BMRHC, which serves many non-English speakers, has only one interpreter to serve all of its sites. It will begin using IAV to provide translation services for non-English speakers during their medical appointments.¹¹³

2.2 Education and Training

Impacts within the Education and Training focus area are measured as changes to elements of educational content distribution and instruction. These impacts occur at K-12 institutions, community colleges, four-year institutions, universities, and other education providers. This focus area includes how the broadband Internet connections help the educational CAIs to perform activities that lead to helping students earn a certificate or diploma or receive training that is recognized as valuable for career advancement. Examples of certificates or diplomas include community college degrees, four-year college degrees, advanced degrees, high school diplomas, general equivalency degrees, certifications in advanced software technologies such as network engineering, and other licenses or certifications that reflect knowledge of a particular subject at a level that would typically be taught at an educational institution.

Through ARE-ON, the Arkansas e-Link project focused on extending fiber connectivity to the state's two-year colleges. AATYC, which also had representation on the grant's governing body, worked with ARE-ON to facilitate connections to community colleges. As of June 30, 2013, four higher education institutions received connections through the project, including two community colleges, one public four-year university, and one private two-year institution.¹¹⁴ Four last mile providers serve the colleges connected through the grant.¹¹⁵ The e-Link team plans to connect an additional eighteen higher education institutions before the award period ends.¹¹⁶ The Arkansas e-Link project did not serve K-12 schools.

This section summarizes the activities observed by the evaluation study team during site visits. The literature review presented in *Interim Report 1* provides evidence that these activities and situations lead to economic and social impacts. This report lists these impacts from the literature along with the evaluation study team's observational evidence supporting either the realization of impacts or their potential to occur.

- **Distance learning opportunities allow schools to broaden the variety of courses offered. They also represent an educational resource for nontraditional or disabled students, or those living in geographically remote or poor areas.**¹¹⁷
 - Connecting to ARE-ON has been associated with increased use of video instruction and expansion of online course offerings at community colleges.¹¹⁸ SouthArk, for example, has obtained approval from the State of Arkansas to award associate's degrees through programs that are delivered entirely online via Blackboard, the school's learning management system (LMS). All other SouthArk degree programs are more than 50 percent web-based.¹¹⁹ CCCUA, the first community college in Arkansas to offer online classes, is a large provider of distance education. Administration at CCCUA estimated that over half of all instruction is delivered online. It plans to add new audiovisual classrooms to accommodate growth in online programming that will result from its connection to ARE-ON.¹²⁰
 - Since obtaining greater bandwidth through fiber connections, community colleges have engaged in greater collaboration with other institutions. UACCM created an online program to help students in associate of applied science programs transition to bachelor of applied science programs through the University of Arkansas at Fort Smith (UA Fort Smith). The program is open to students at UACCM and other community colleges with which UACCM has agreements. SouthArk is partnering with the University of Arkansas at Monticello (UA Monticello) to deliver bachelor's degree programs via video. PCCUA provides computer and Internet access and exam proctoring for online enrollees at UA Monticello, UA Fort Smith, and the University of Arkansas's (UA) main campus in Fayetteville. These collaborative programs will allow more two-year graduates to obtain bachelor's degrees through distance education.

- Increased bandwidth will accommodate collaboration among departments within colleges. For example, at UACCM, collaborative learning activities will partner drafting students with interior design students, and engineering students with architecture students. These projects are intended to simulate real word job experiences in the design industry.
- UAMS Rural Health offers a series of CME lectures and training courses for healthcare professionals. Lecture series and interactive training content are delivered over ATN via the IAV units. Healthcare professionals in rural Arkansas now have access to presentations by experts with whom they would not likely interact otherwise. Most of the healthcare organizations connected through the grant would not have been able to access the lectures or online content before the grant because they require a significant amount of bandwidth. Rural Health also provides self-guided training through an LMS called LearnOnDemand.org, which is free for healthcare professionals in ZIP Codes supported by the grant and available for a reduced cost elsewhere in the state.
- Remote CME content enables healthcare professionals across the state to maintain licensure or obtain accreditation without leaving the workplace. ADH, BMRHC, and AAI were among organizations interviewed that use the grant-funded IAV units to access CME content. CME activities reported by these organizations include lecture series, live interactive training sessions, and Senior Medicare Patrol training for fraud detection. Participants include physicians, nurses, and pharmacists.
- **Broadband gives teachers a wide range of media through which to facilitate lessons. The integration of technology into classroom activities creates the opportunity for interactive and personalized educational experiences for students.**¹²¹
 - Technical training programs delivered at community colleges, such as industrial equipment maintenance, automotive servicing, and petroleum technology, are increasingly reliant on broadband. Connections to ARE-ON support technical programs and have resulted in expansion of programming at some sites. After connecting to ARE-ON, SouthArk is building a new facility to support allied health programs. The facility will feature a full mock-up of a surgical suit. The use of these simulator tools would not have been possible without the increased bandwidth provided through the grant.¹²² UACCM is constructing a facility to hold workforce training for new or existing businesses. The facility will be IAV-equipped to accommodate virtual lecture and will house the Workforce Center where technical training programs will be delivered. UACCM administration credited their connection to ARE-ON with driving the development of the Workforce Center.¹²³
 - Before connecting to ARE-ON, instructors at CCCUA were limited in their use of audiovisual classrooms. The classrooms were equipped with tools that often went unused due to bandwidth limitations. After connecting to ARE-ON, capacity is sufficient to support the use of these tools. CCCUA is leveraging the new connection by implementing LifeSize, a live-streaming application for students who are unable to attend class, and purchasing ten E-Beam interactive whiteboard units. These tools will make learning experiences for distance education students more interactive and enable students enrolled in traditional classes to participate in lectures when extenuating circumstances such as illness or inclement weather make it difficult for them to attend.
- **Research has shown that computer use among students leads to improved academic performance, greater levels of educational attainment, improved school enrollment and graduation rates, and increased earning potential for students.**¹²⁴
 - Instructors and administrators interviewed at PCCUA reported that passing rates in their online courses exceed those of their traditional classroom courses. They attribute the difference in the increased levels of communication facilitated by the online course format.¹²⁵
- **School administrations leverage broadband infrastructure to carry out internal operations. Broadband represents a rapid, reliable channel of communication to improve interactions among administrators, teachers, parents, and students.**¹²⁶
 - CCCUA transitioned to VoIP telephony to connect its three campuses before connecting to ARE-ON. Using its old Internet connection, the network was frequently at capacity and

administrative calls could not be completed. Faculty would often rely on their personal mobile phones as a primary means of communication. After connecting to ARE-ON, the VoIP system's functionality significantly improved and service interruptions are no longer an issue.¹²⁷

- **Organizations may realize cost savings by conducting staff training activities online rather than using hardcopy training materials or hosting in-person training sessions.**¹²⁸
 - Rural Health's CME Director reported that over 1,800 hours of lectures were delivered via IAV from July 2012 to July 2013, representing a potential cost savings of \$80,000 or more in mileage alone.¹²⁹ Savings associated with not missing work and not missing patient appointments are not included in this figure.
 - AAI estimated that using telehealth network for a single CME training activity involving fifty to sixty participants saved an aggregate travel distance of 2,200 miles, equating to approximately \$1,000 in travel reimbursements.¹³⁰
 - Since receiving equipment through Arkansas e-Link, Birch Tree's Training Director delivers internal training using the IAV units. This eliminates the need for trainers or trainees to travel and for Birch Tree to reimburse employees for travel costs. In the past 3 years, over 300 staff members have participated in training via IAV.¹³¹

2.3 Workforce and Economic Development

Impacts within the Workforce and Economic Development focus area can occur through activities intended to increase overall employment of the target population, or to assist employed members of that population in finding jobs that offer increased salaries, better benefits, or a more attractive career path, including self-employment. This focus area also includes activities to attract new businesses to locate along the fiber path or to expand the economic activity of existing businesses connected to the network. While this focus area primarily describes jobs, it also includes other economic impacts such as wages, property values, and the number of firms in a region.

This section summarizes the activities observed by the evaluation study team during site visits. The literature review presented in *Interim Report 1* provides evidence that these activities and situations lead to economic and social impacts. This report lists these impacts from the literature along with the evaluation study team's observational evidence supporting either the realization of impacts or their potential to occur.

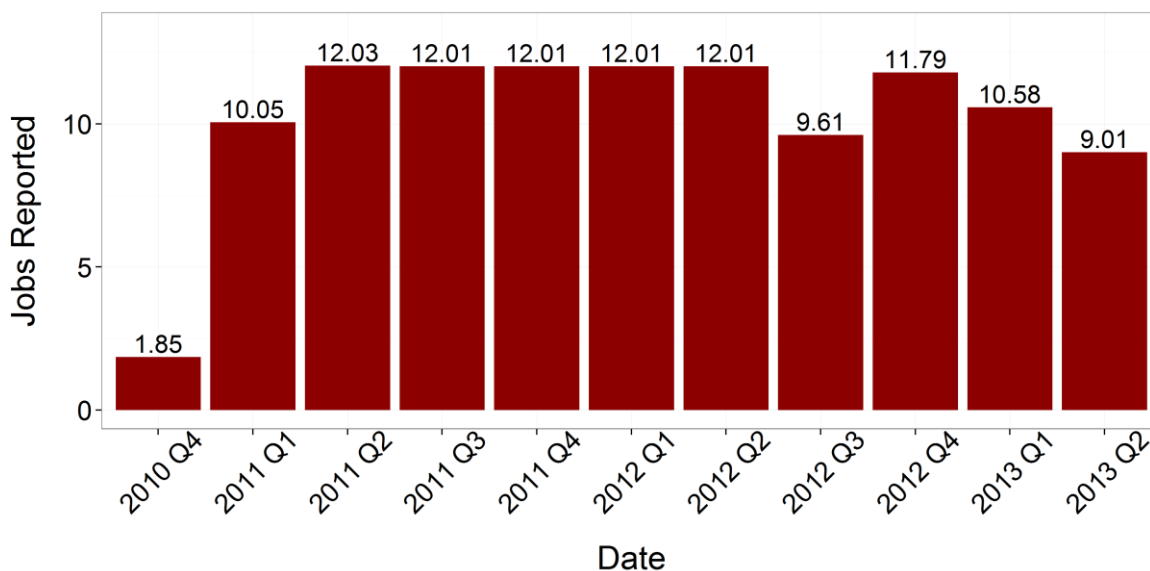
- **Access to computers with broadband connectivity enables additional employment options and increased earning potential for workers.**¹³²
 - Greater bandwidth obtained through the Arkansas e-Link project has made more online job training possible.¹³³ Community colleges have increased the number of online job training offerings, making it easier for workers to renew or obtain certifications and raise their earning potential.¹³⁴ One example is the Arkansas Rural Nursing Education Consortium (ARNEC), which offers an online RN program specifically for licensed practical nurse. Instructors deliver the courses via video on weekday evenings and students complete clinical training on weekends. This arrangement allows a licensed practical nurse to continue working full-time while they work toward an RN degree. Participating community colleges interviewed include CCCUA, South Ark, and UACCM.
 - DeWitt Hospital and Nursing Home partner with PCCUA to deliver training to employees at the hospital.¹³⁵ This allows employees to obtain and renew certifications on-site, during or after their shift, increasing the likelihood that employees will maintain proper licensure or advance their credentials.
- **Workforce and Economic Development activities supported by broadband infrastructure strengthen job and population growth.**¹³⁶
 - Arkansas's community colleges serve their communities and local economies by creating a skilled, competent workforce. SouthArk interacts with local chambers of commerce to identify

workforce needs and offers training to meet those needs.¹³⁷ El Dorado, served by SouthArk’s West Campus, is home to several chemical and oil refineries. These corporations have a large number of baby boomer employees that will be retiring in the near future. Refinery positions are highly technology-dependent. SouthArk’s process technology degree and certificate programs rely heavily on its grant-funded fiber connection. SouthArk hopes the connection to ARE-ON will accommodate expansion of these types of programs in order to meet the staffing needs of the local economy and retain graduates in the area.

- **Broadband access improves the ability of rural communities to compete for low- and high-end service jobs, the area of highest economic growth.**¹³⁸
 - Arkansas e-Link stakeholders view technology as a means for attracting high tech industry to the state. AATYC and ARE-ON leadership focus on leveraging fiber connections to reduce brain drain in Arkansas, translating education outcomes into economic impacts. In addition to creating a highly skilled workforce, community college administrators believe academic programs will support the use of new equipment and applications, boosting enrollment rates and classroom interactivity. They expect these improvements to result in more two-year students transferring to four-year programs.¹³⁹ This may lead to higher-paying employment opportunities for graduates. Project stakeholders hope that creating a highly skilled, highly educated workforce in the state will attract new industry to rural Arkansas, where construction and operating costs are low relative to urbanized areas.¹⁴⁰

As required by the Recovery Act, UAMS reported the number of jobs created quarterly as a direct result of the project. As shown in Figure 4, UAMS funded twelve full-time equivalent positions during five consecutive quarts from the second quarter of 2011 through the second quarter of 2012.¹⁴¹ These positions include a program director, a team of program managers, a principal investigator, and administrative employees. It is important to note that this includes only direct jobs created, and does not include indirect or induced job creation.¹⁴²

Figure 4. Direct Jobs Created by Arkansas e-Link



2.4 Digital Literacy

This focus area is fundamental to all of the others. “Digital Literacy” defines a set of skills and abilities that enable an individual to interact with the digital aspects of culture, and to maintain a digital identity. In the National Broadband Plan, the FCC defines digital literacy as “the skills needed to use information and communications technology to find, evaluate, create, and

communicate information."¹⁴³ Impacts within this focus area include the attainment of skills needed to obtain an education, search for employment, learn job-related skills, accessing government information, and more.¹⁴⁴

End users served through the grant gained Digital Literacy skills indirectly through using computers for field-specific purposes. Community colleges are making increased use of online capabilities because of their fiber connections. UACCM has implemented online requirements for both teachers and students. Instructors are required to post class content on the school's LMS for student accessibility. UACCM is also phasing in a general education curriculum requirement that mandates each student complete at least one online course.¹⁴⁵

In response to the growing use of online applications, community colleges are offering formal and informal Digital Literacy support. PCCUA offers a station at new student orientations to introduce students to the school's e-mail system and Blackboard LMS. Orientation workers introduce students to essential Blackboard features, including the student grades, advising, invoice, and transcript tabs. PCCUA also holds an introductory workshop for first-time online students. The workshop serves approximately seventy-five online students per semester.¹⁴⁶ Students learn how to use Blackboard's online course functions including discussion boards, quizzes, and assignments upload. For distance students who cannot attend the workshop, instructions are posted online.

In some cases, organizations that received connectivity through the grant are leveraging their connections to address the lack of home broadband access in the areas they serve. Community colleges are improving public access by increasing capacity and range of wireless networks and expanding open lab hours.¹⁴⁷ SouthArk is upgrading its wireless network by deploying new equipment to support increased wireless demand associated with mobile devices. UACCM has invested \$300,000 in wireless network upgrades.¹⁴⁸ CCCUA plans to offer computer labs dedicated to online classwork for students with poor or no home Internet access.¹⁴⁹ As a part of the patient treatment plan, Birch Tree allows its members to use IAV units to communicate with friends at other Birch Tree facilities or other mental health facilities with teleconferencing capabilities. Members gain proficiency using the basic functions of the IAV units through repeated interaction with their doctors during telemedicine sessions.¹⁵⁰

Section 3. Grant Implementation

This section presents the Arkansas e-Link team's strategy to maximize the social and economic impacts of the BTOP grant. The following subsections describe the Arkansas e-Link team's implementation strategies; the Arkansas e-Link team's approach to open access; major results of the Arkansas e-Link team's implementation strategy; an overview of sustainability efforts; and successful tools, techniques, and strategies identified during interviews with the grantee.

3.1 Implementation

Before the grant, UAMS formed a coalition with other healthcare providers in the state to form ATOM, the governing body responsible for oversight of ATN. ATOM received funding through the FCC Rural Health Care Pilot Program to deploy the beginning of a statewide telehealth system. The pilot program established the ATN as a piece of critical infrastructure that was leveraged with ARE-ON, which serves the state-supported two-year and four-year institutions, to extend the reach of high-speed broadband to rural areas of the state through the BTOP grant.

The University of Arkansas System brought together UAMS and ARE-ON to perform grant implementation functions. Together, these two entities formed the public partnership known as the Arkansas e-Link Initiative. The e-Link team procured dark fiber IRUs and constructed new fiber, mostly in the form of lateral drops and connections, to consolidate two state-owned networks, ATN and ARE-ON.

The Arkansas e-Link project involves the implementation of five main components:

1. Acquisition of existing fiber assets via indefeasible rights of use (IRU) agreements and construction of new, redundant backbone fiber paths
2. IRU acquisition and construction of new and upgraded laterals to support direct connections to ARE-ON and ATN member institutions
3. Construction of field colocation facilities that support third-party interconnection and serve as host locations for upgraded core networking equipment for UAMS and ARE-ON
4. Delivery of enhanced broadband services to ARE-ON and ATN member institutions and Internet access over the infrastructure
5. Distribution of equipment to healthcare providers and public libraries to support telehealth and education activities

The grant-funded construction and IRU acquisitions allowed for the construction of a ringed middle mile architecture by connecting segments in the northern and southern parts of the state. The network was designed and deployed to provide physical redundancy by creating diverse fiber paths. The network has a peering agreement with Louisiana Optical Network Initiative (LONI) hosted by Louisiana State University. The e-Link network has access to Internet2 through interconnections in Kansas City, Missouri, and Houston via Dallas, Texas, with the potential to connect in Memphis in the future. The network also has peering agreements with the Lonestar Education And Research Network (LEARN) of Texas, OneNet of Oklahoma, the Great Plains Network of Kansas City, Southern Crossroads (SoX) of Atlanta, and Ritter Communications, Inc., a private provider in Arkansas.

The enhanced connectivity facilitates interconnectivity between the state's two-year and four-year institutions through fiber links, allowing distance education and research collaboration. Public safety and public health agencies leverage the network to realize improved continuity of emergency systems through Arkansas's hospital disaster preparedness network, trauma network, and Little Rock's emergency medical service. IAV equipment and public-use computers placed in public

libraries and healthcare facilities promote participation in health and distance education and support groups.

The existing ATOM and ARE-ON boards govern the Arkansas e-Link project. The ATOM board comprises representatives from healthcare providers, most of whom participated in the FCC Rural Health Care Pilot Project. UAMS, as the state's only academic medical center, is a member of the ATOM board, provides leadership in grant administration, and manages the telehealth initiatives throughout the state. The ARE-ON board consists of the presidents and chancellors of the state's higher education institutions. Representative members meet to discuss the direction and progress of the state's current broadband efforts.

The project team identified early on in the grant proposal development that the most viable business model would involve the acquisition of fiber assets in the form of existing dark fiber IRUs as opposed to constructing and maintaining new fiber runs. Upon National Telecommunications and Information Administration (NTIA) approval to acquire fiber IRUs, the Arkansas e-Link team issued a request for proposal (RFP) to solicit bids from private providers seeking to sell IRUs for their fiber assets. The e-Link team identified nearly thirty routes statewide that were potential targets for IRUs. From these thirty routes, IRUs for seventeen were incorporated into the network design. The grant team purchased twenty-year dark fiber IRUs for approximately \$27,000 per mile. At 716 miles of leased fiber, this represents more than \$19 million invested in IRU providers. This was less than the amount projected for the e-Link team to build, own, and maintain new fiber.

In order to meet their IRU obligations, all four providers are required to make investments to upgrade their existing assets to meet the terms and performance specifications of the IRU agreements. The e-Link team provided collocation space in their field huts at cost to the IRU providers to complete segments of the BTOP network. Outside of these investments, ARE-ON's representative stated that three of four of the providers have been able to use the money received from IRU sales to reach new markets where they were regional providers, and provide services into a select number of cities in their region.

The e-Link network provides a scalable Ethernet service over a hub and spoke network design. The network initially delivers 20 Gbps over the middle mile backbone and can scale up incrementally to a maximum of 4,400 Gbps using 100 Gbps wave technology to strategically located regional hub sites. This design provides city-to-city runs for cost-effective transport that tie together interconnection hub locations at community colleges and four-year universities. The network provides thirty-six new or upgraded hubs that house ARE-ON and ATN networking equipment and support third-party provider interconnection and Internet access. The Ethernet technology and fiber architecture deployed along the middle mile supports a range of solutions offered by third-party ISPs, including multiprotocol label switching (MPLS) clouds, wireless, fiber, and other geographically accessible broadband technologies.

The availability of these strategically located hubs is intended to attract multiple third party ISPs to interconnect with the e-Link middle mile. These providers offer CAIs, businesses, and households throughout the state with cost-effective access to multiple providers offering affordable services over the network. These network hubs serve as collocation facilities from which UAMS provides secure, segregated connectivity and telehealth services to ATN member organizations and CAIs in order to facilitate compliance with HIPAA regulations. ARE-ON leverages the network infrastructure to provide improved connectivity to its two-year and four-year institutions over the network.

The technology deployed over the optical network allows ARE-ON and ATN to operate independent networks over the same infrastructure. ARE-ON owns and operates its optical and router networking equipment and services separate from that which ATN owns and maintains. ATOM operates its network over wavelengths provisioned by ARE-ON. ATN owns its router networking equipment and is responsible for performing engineering and maintenance. This virtual separation on a common physical infrastructure allows each entity to act independently and supports cooperative maintenance and operation efforts when necessary.

3.2 Open Access Policies

CCI projects funded by BTOP are predominantly middle mile projects, although a small number of last mile projects were awarded. These grants intended to improve available broadband capabilities for CAIs, to facilitate the development of last mile services in unserved and underserved areas, and to promote economic growth. This investment through the BTOP grant is intended to “lay the foundation for the ultimate provision of reasonably priced end-user broadband services” through open and nondiscriminatory interconnection strategies to enable last mile providers to have open access to the network.¹⁵¹

There is considerable debate on the impact of open access policies on the competitiveness of the broadband market.¹⁵² Open access is implemented through a wide variety of strategies. “These can range from commercial or voluntary arrangements, between communication operators and third-parties, through to regulatory intervention aimed at promoting certain policy objectives, such as expanding broadband availability, increasing competition, or promoting investment that may otherwise not be economic, such as in the case of enabling the establishment and treatment of shared facilities.”¹⁵³ The impact of open access will be dependent upon how well the practices and policies help to reduce the time, cost, and difficulty for last mile providers to interconnect to the network.¹⁵⁴ The impact also depends on how well the policy mechanisms ensure competitive pricing for wholesale services in the event of the presence of a middle mile provider that may also be a last mile provider.¹⁵⁵

ARE-ON infrastructure and hub locations form the network backbone on which both ATN and ARE-ON reside. The hub locations serve as colocation sites to facilitate connectivity to higher education and healthcare member institutions. The higher education network and all ARE-ON members are on one set of wavelengths with their own routers and other networking equipment. The ATN network has its own dedicated wavelengths, provisioned and managed by ARE-ON, to connect their sites. UAMS maintains its own core networking equipment and manages its network traffic, except for the waves, independently of ARE-ON’s equipment. Each organization has its own design and engineering staffs to maintain and operate their respective networks, which is possible due to the optical infrastructure.

The optical technology supports the open access architecture of the network. ARE-ON and ATN will use part of the total network capacity. The additional capacity enabled by the optical infrastructure makes ample bandwidth available for public Internet access and wavelength allocations by third-party providers wishing to connect at any of the network’s thirty-four middle mile interconnection points. Other than dark fiber that ARE-ON provides to its member institutions, selling dark fiber is not part of the grant business model.

An important distinction between ARE-ON and the ATN is that ARE-ON provides Internet access and the telehealth network does not allow traffic over the public Internet. Internet access through ARE-ON is in furtherance of the research and education missions of the state-supported two-year and four-year institutions. Patient privacy issues and HIPAA require ATN member institutions to ensure the secure transmission of patient medical information. ATN member institutions wishing to have Internet access are required to subscribe to a private third-party provider or maintain existing Internet service in addition to their connection to the telehealth network.

As of November 1, 2013, ARE-ON did not have any executed agreements with third-party providers to provide last mile services over the grant-funded network. Since the project’s business mode does not involve selling dark fiber, no wholesale providers have executed agreements.

3.3 Results

The evaluation study team observed five major results of the Arkansas e-Link project:

- The Arkansas e-Link project deployed a scalable fiber-based network infrastructure that provides increased broadband speed to a wider number of member institutions and CAIs. These levels of speed and reliability were not possible using the older technologies and equipment that served these sites. In the short term, many sites will continue to use their T1 lines because of a lack of last mile broadband providers available to serve rural areas. In the longer term, the implementation of the fiber-based technology will support significant increases in bandwidth at CAIs. Some CAIs report current connection speeds as low as 768 kbps. This enables new uses of broadband technology that were unattainable before. Section 2, above, provides descriptions of early impacts that the evaluation study team observed.
- The Arkansas e-Link project provides middle mile connectivity at lower prices than before the construction of the network. While the impact on pricing in the last mile provider market is not yet well defined, ARE-ON reported that one of its providers in the southern part of the state has begun to offer competitive pricing on services that ARE-ON currently provides to its member institutions.
- The Arkansas e-Link project facilitated the cost-effective expansion and increased reliability of two underutilized public networks dedicated to research and education (ARE-ON) and healthcare and public safety (ATN). The e-Link team purchased IRUs from private providers to complete rings along the network backbone, which provides route diversity and redundancy. Network laterals also facilitated new and enhanced connections to member sites and CAIs that have expressed a need for increased bandwidth to provide critical services in remote areas of the state. Fiber-optic cable makes up the middle mile portion of the network, which provides a high level of reliability and high bandwidth capacity. The increased reliability of the network provides CAIs and last mile providers with a more stable platform to implement new systems using broadband technologies, and encourages the sustained adoption and use of broadband in areas where reliability is critical, such as emergency response. The increased reliability also increases the likelihood that technology will be integrated into everyday operations. This is a key aspect of implementing a successful telemedicine infrastructure to reach medically underserved areas of the state.
- The BTOP-funded project provided IAV equipment and training to physical and mental health care providers, and to home healthcare providers. Public use computers were also provided to healthcare facilities and libraries on an as-needed basis. The ability to make this equipment available along with technical support increases the potential of sustained adoption of the broadband-based technologies activities that ARE-ON and UAMS have initiated in the fields of healthcare, public safety, research, and education.
- New and upgraded network colocation facilities serve as secure, reliable interconnection points to host ARE-ON and ATN optical equipment that makes enhanced connectivity and access to broadband services and commodity Internet to members and CAIs possible. These interconnection points also serve as third-party points of interconnection along the network route allowing for increased opportunities for third-party providers to reach unserved and underserved areas of the state. Three of the four IRU providers made investments to upgrade the infrastructure acquired through their IRU agreement with the e-Link project. These providers reported that they reinvested the revenue generated from the sale of IRUs into expanding their infrastructure to enlarge their service area.

The longer-term impact of the Arkansas e-Link project will depend on several factors related to the results listed above:

- The impact of open access will be dependent upon how well the practices and policies help to reduce the time, cost, and ease for last mile providers to interconnect to the network.¹⁵⁶ The use of the newly available broadband capacity will depend on the creativity and investment of local economic actors. Over the short-term, ARE-ON has identified how one of its member institutions, Southern Arkansas University Tech (SAU Tech) in Camden, Arkansas, is leveraging the enhanced connectivity to drive economic impacts. SAU Tech trains existing staff and potential new hires for defense contractors in the area. The benefits of the connectivity between the SAU Tech campus and these employers are key economic components for the area and

would not be possible without BTOP. The extent to which relationships like these can be established and maintained will determine the extent to which social and economic impacts of the grant will be realized.

- The Arkansas e-Link project represented a significant federal and state-funded capital investment to expand opportunities for private investment. The network provides opportunities for private service providers to expand their own facilities and fiber plant to areas previously not reached by these providers. This has resulted in existing providers growing their presence within their territories. Over the long term, the open access policies implemented by the e-Link team and the return on initial investments by private providers will determine the extent to which multiple providers compete in the state marketplace, either by connecting to the grant-funded middle mile or by continuing to expand their respective service area footprints.
- The e-Link team must maintain the reliability of the network and quality of services over time. At present, the network is fully managed and monitored on a 24x7x365 basis. ARE-ON and UAMS staff members have experience in managing their respective portions of the network. They are familiar with the resources needed to support the enhanced network, as well as the needs of their customers, whose familiarity and comfort level with the technology vary widely. The team's past success suggests that future network maintenance is well within its capabilities. Continued quality service delivery will ensure sustained adoption and the development and adoption of increasingly sophisticated, bandwidth-intensive applications.

3.4 Sustainability

The first step to ensuring the network's sustainability beyond the grant term is to ensure the availability of affordable access to infrastructure. The e-Link team informed the evaluation study team that it will actively pursue extension of its existing twenty-year IRU agreements beyond the initial twenty-year term to ensure long-term access to network infrastructure. According to the e-Link team, long-term sustainability will depend in large part on the adoption and use of the network by ARE-ON and ATN member institutions. To support grant and ongoing operations, UAMS accountants process billing for broadband services and telehealth services. UAMS provides a 24/7 customer care hotline to schedule and troubleshoot IAV connections as part of network management. ARE-ON will provide accounting oversight to the proposed fiber connectivity to the state's two-year colleges. Both UAMS and ARE-ON are state-supported institutions that exist within the University of Arkansas System. As such, they have access to resources that facilitate grant administration and ongoing network operations and customer support. As part of its operational model beyond the grant period, the e-Link team will make colocation space available for third-party providers, as space is available.

The sustainability of the Arkansas e-Link project will also depend, in part, on the successful recruitment of last mile providers to the network. ARE-ON and ATN do not plan to provide broadband service for the purpose of home or business access. Rather, third-party providers can interconnect to use the grant-funded middle mile infrastructure to offer last mile services to homes and businesses. The e-Link team has not executed any service agreements with any last mile providers as of November 1, 2013. The grant facilitated private investment in the form of IRU purchases by the grant team from private providers. These IRUs made it possible for the e-Link team to reach key areas of the state. These IRU purchases and accompanying maintenance agreements are an ongoing revenue source and an opportunity for the private providers to make investments to expand their network to reach unserved and underserved CAIs.

3.5 Successful Tools, Techniques, and Strategies

This subsection describes successful techniques, tools, and strategies identified by the grantee and interviewees. Successes and challenges described in earlier sections are not repeated here.

- Oversight during the construction phase was critical. Engineers were required to travel frequently to provide adequate project oversight. To ensure consistent communication between the e-Link team officials in Little Rock and engineers in the field, the e-Link team held weekly status meetings by video and phone between their engineering team and engineering consultants to address issues and monitor progress. They also provided oversight to ensure that the prefabricated concrete buildings that house colocation facilities were manufactured to specifications and delivered on time.
- The e-Link team strategically located colocation and interconnection facilities on two-year and four-year college campuses that are ARE-ON members. This facilitated land acquisition and access needed for construction and operations.
- Each colocation facility was engineered and built to Telcordia carrier-quality standards to ensure a high-level of reliability and security. The first set of rack space in each structure is dedicated to colocation equipment. This provides easy access for third-party providers and minimizes the possibility of unauthorized access to core network equipment in other racks.
- To educate users of the value of the connectivity and services that the grant would provide, UAMS prepared and distributed statistics about cost savings, return on investment, and transportation savings. UAMS partnered with the South Central Telehealth Resource Center to provide training to familiarize healthcare providers with the IAV unit. The e-Link team held regional educational meetings at the two-year colleges that were open to the public.
- UAMS originally planned to deploy all of its telehealth IAV units to member healthcare institutions simultaneously. Due to delays in the original construction schedule, deployment of the telemedicine units to healthcare facilities without sufficient bandwidth was delayed. As an alternative, UAMS identified sites that already had sufficient bandwidth prior to BTOP that would support the use of IAVs and provided them with the equipment. This allowed UAMS to begin delivering telemedicine equipment and refining training methods and materials while healthcare providers became familiar with the equipment and were able to provide telemedicine services to their patients.
- ATOM's and ARE-ON's existing relationships with their member institutions drew support for the grant proposal. During the course of the grant, the e-Link team members remained engaged with their respective member institutions to communicate the details and benefits of the project. The e-Link team held regional seminars targeting community and civic leaders, business leaders, educators, physicians, hospital administrators, and other healthcare providers. This ongoing outreach activity has helped build and maintain relationships and trust among the e-Link team and CAIs.
- The e-Link team cited delays surrounding the required environmental assessment (EA). The team was not familiar with the requirements and resources needed to perform an EA. As a result, the budget for an EA and personnel required to do it were not included in the original grant proposal. The e-Link team subcontracted the environmental assessment to ICF International. The environmental assessment was conducted during the first six months of the grant period, which was not anticipated by the grant team. Their strategy to delegate the environmental assessment to an experienced firm was identified by the e-Link team as a successful strategy for project.

Section 4. Conclusions

The American Recovery and Reinvestment Act of 2009 (Recovery Act) instructed NTIA to implement BTOP to promote five core purposes:¹⁵⁷

1. Provide access to broadband service to consumers residing in unserved areas of the country.
2. Provide improved access to broadband service to consumers residing in underserved areas of the country.
3. Provide broadband education, awareness, training, access, equipment, and support to:
 - a. Schools, libraries, medical and healthcare providers, community colleges and other institutions of higher learning, and other community support organizations.
 - b. Organizations and agencies that provide outreach, access, equipment, and support services to facilitate greater use of broadband services by vulnerable populations (e.g., low-income, unemployed, seniors).
 - c. Job-creating strategic facilities located in state- or federally designated economic development zones.
4. Improve access to, and use of, broadband service by public safety agencies.
5. Stimulate the demand for broadband, economic growth, and job creation.

This section summarizes how the Arkansas e-Link team's implementation of BTOP has encouraged the fulfillment of the Recovery Act's goals. The Arkansas e-Link team supported Recovery Act goals to improve access in unserved and underserved areas. With these connections, CAIs are beginning to leverage access to high-speed broadband and equipment to develop and expand their services for healthcare and higher education.

4.1 Improve Access to Unserved and Underserved Areas of the Country

The first two goals of the Recovery Act encourage improved access for unserved and underserved areas:

- Provide access to broadband service to consumers residing in unserved areas of the country.
- Provide improved access to broadband service to consumers residing in underserved areas of the country.

According to the December 2012 release of the National Broadband Map, almost 19 percent of the service area population does not have access to a broadband service provider. The Arkansas e-Link project increased the accessibility and affordability of broadband service among healthcare providers and higher education institutions by extending and improving the capacity of the pre-existing 5,600-mile fiber network.¹⁵⁸ The project concentrated on forty-three economically distressed and underserved counties in Arkansas's Mississippi Delta region. The expanded reach of the e-Link network facilitates accessible interconnection by last mile providers that serve regions throughout the state, thereby allowing the grant to support broadband access in every county in Arkansas.

By providing high-speed connectivity to all of the state's seventy-five counties, of which seventy-three are considered medically underserved, UAMS is able to provide enhanced telemedicine services to remote areas of the state. The Arkansas e-Link team is also collaborating with training organizations to support the deployment and sustained use of the IAV equipment provided to ATN member institutions and CAIs through the grant. The Arkansas e-Link project also provided IAV

equipment and public-use computers to libraries to support the healthcare and education goals of the grant.

4.2 Broadband Education, Awareness, Training, Access, Equipment, and Support

Most closely aligned with PCC and SBA grants, the next Recovery Act goal is for grantees to provide broadband education, awareness, training, access, equipment, and support to:

1. Schools, libraries, medical and healthcare providers, community colleges and other institutions of higher learning, and other community support organizations.
2. Organizations and agencies that provide outreach, access, equipment, and support services to facilitate greater use of broadband services by vulnerable populations (e.g., low-income, unemployed, seniors).
3. Job-creating strategic facilities located in state- or federally designated economic development zones.

The libraries, medical and healthcare providers, two-year colleges, four-year universities, other institutes of higher learning, and other community support organizations comprising the integrated network's 420 CAIs, received ongoing education on the social and economic benefits of broadband and IAV equipment, as well as organization-specific information on the costs and benefits of supporting the grant. These activities helped increase the awareness of the e-Link project and the benefits of broadband technology for organizations and individuals throughout the state.

The increase in the number of telehealth providers supported through the BTOP grant brought about a partnership between UAMS and the South Central Telehealth Resource Center to provide IAV equipment training to healthcare CAIs. Funding for this training was provided outside of the grant and was in addition to the training developed and provided by UAMS.

4.3 Public Safety Agencies

The fourth goal of the Recovery Act is to improve access to, and use of, broadband service by public safety agencies. The Arkansas e-Link network provided enhanced connectivity to public health agencies to support the expansion of critical health services such as stroke assistance and neonatal care, disaster recovery, and trauma communications. The deployment of the enhanced network connectivity has allowed CAIs in remote areas of the state to leverage the broadband-enabled services, resources, and expertise offered by the state Department of Health, the University of Arkansas for Medical Sciences, and other larger hospitals, such as Baptist Health.

4.4 Demand for Broadband, Economic Growth, and Job Creation

The final Recovery Act goal is to stimulate the demand for broadband, economic growth, and job creation. The implementation of the Arkansas e-Link project represents a significant federal and state-funded capital investment that has enabled expanded healthcare and educational services to CAIs across the state. The network design and technology deployed also support interconnection by private service providers so that they may affordably expand their own facilities in order to offer higher quality, lower cost service to additional CAIs in unserved or underserved areas of the state.

The integrated network is expected to stimulate the demand for broadband, economic growth, and job creation. The integrated network deployment is in its early stages and there is very little information available on changes in organizational conditions before and after grant implementation. The grant proposal cited a study that stated teleconferencing helps hospitals

realize at least \$145,000 in yearly savings.¹⁵⁹ The grant proposal also references an unnamed study that found that without telehealth, 94 percent of patients would travel 70 miles or more for medical care, 84 percent miss one day of work, and 74 percent spend \$75 to \$150 on additional family expenses. With telemedicine consultations, 92 percent of patients saved \$32 in fuel costs, 84 percent saved \$100 in wages, and 74 percent saved \$75 to \$150 in family expenses per visit, a total savings of up to \$282 per visit.¹⁶⁰ The grant application also states that broadband access in educational settings could directly affect and ultimately lower the cost of college: online educational opportunities cost less than traditional classroom meetings due to lower costs of parking and utilities.¹⁶¹

Section 5. Next Steps for the Evaluation Study

In early 2014, ASR will deliver *Interim Report 2* to NTIA. This report will include a summary of the site visits to twelve CCI projects. It will also include a summary of the second round of site visits to the fifteen PCC and SBA grants.

For the CCI projects, *Interim Report 2* will summarize the activities underway by twelve CCI grantees and the social and economic impacts of these projects. For the PCC and SBA projects, *Interim Report 2* will provide an update to and refinement of the analysis presented in *Interim Report 1*.

In September 2014, ASR will deliver a *Final Report* that quantitatively and qualitatively assesses the economic and social impact of BTOP grants (including CCI, PCC, and SBA grants). The centerpiece of the *Final Report* will be an assessment of how and to what extent BTOP grant awards have achieved economic and social benefits in areas served by the grantees. To the extent that such information is available, ASR will use results from studies performed by the grantees to round out the conclusions presented.

Notes

¹ National Telecommunications and Information Administration, *Broadband Technology Opportunities Program (BTOP) 16th Quarterly Program Status Report*, 2013, http://www.ntia.doc.gov/files/ntia/publications/ntia_btop_16th_quarterly_report.pdf.

² National Telecommunications and Information Administration, "About," *BroadbandUSA: Connecting America's Communities* (Washington, DC, June 11, 2012), <http://www2.ntia.doc.gov/about>.

³ The Notice of Funds Availability (NOFA) includes the following definitions:

- Last mile project – any infrastructure project the predominant purpose of which is to provide broadband service to end users or enduser devices (including households, businesses, community anchor institutions, public safety entities, and critical community facilities).
- Middle mile project – a broadband infrastructure project that does not predominantly provide broadband service to end users or to end-user devices, and may include interoffice transport, backhaul, Internet connectivity, or special access.

National Telecommunications and Information Administration, "Broadband Initiatives Program; Broadband Technology Opportunities Program Notice" (Washington, D.C., 2009), http://www.ntia.doc.gov/files/ntia/publications/fr_bbnofa_090709.pdf.

⁴ National Telecommunications and Information Administration, "Statement of Work for Broadband Technology Opportunities Program (BTOP) Evaluation Study," July 26, 2010, 6.

⁵ ASR Analytics, *Progress towards BTOP Goals: Interim Report on PCC and SBA Case Studies, Broadband Technology Opportunities Program Evaluation Study (Order Number D10PD18645)* (Potomac, MD, 2012), <http://www.ntia.doc.gov/report/2012/progress-towards-btop-goals-interim-report-pcc-and-sba-case-studies>.

⁶ National Telecommunications and Information Administration, "The Arkansas Healthcare, Higher Education, Public Safety, & Research Integrated Broadband Initiative Project Fact Sheet," December 03, 2013, http://www2.ntia.doc.gov/files/grantees/fact_sheet_-_university_of_arkansas.pdf.

⁷ National Telecommunications and Information Administration, "Post-Award Monitoring (PAM) Database 2013-09-12" (Washington, DC: Distributed by National Telecommunications and Information Administration, 2013).

⁸ National Telecommunications and Information Administration, "The Arkansas Healthcare, Higher Education, Public Safety, & Research Integrated Broadband Initiative Project Fact Sheet."

⁹ University of Arkansas for Medical Sciences, *Arkansas Healthcare, Higher Education, Public Safety, & Research Integrated Broadband Initiative Third Quarter Performance Progress Report, 2013*, 2013.

¹⁰ National Telecommunications and Information Administration, "The Arkansas Healthcare, Higher Education, Public Safety, & Research Integrated Broadband Initiative Project Fact Sheet."

¹¹ National Telecommunications and Information Administration, "Post-Award Monitoring (PAM) Database 2013-09-12."

¹² National Telecommunications and Information Administration, "Post-Award Monitoring (PAM) Database 2013-09-12."

¹³ University of Arkansas for Medical Sciences, “Arkansas Healthcare, Higher Education, Public Safety, & Research Integrated Broadband Initiative Application, Part 1,” March 26, 2010, http://www2.ntia.doc.gov/files/grantees/universityofarkansas_infrastructure_application_part1.pdf.

¹⁴ e-Link Team, “Interview with Author” (Little Rock, AR, October 21, 2013).

Representative of University of Arkansas for Medical Sciences, “E-Mail Communication,” October 31, 2013.

¹⁵ University of Arkansas for Medical Sciences, “Arkansas Healthcare, Higher Education, Public Safety, & Research Integrated Broadband Initiative Application, Part 1.”

¹⁶ e-Link Team, “Interview with Author.”

¹⁷ Institute of Museum and Library Services, “Public Libraries in the United States Survey (FY2011)” (Washington, DC, June 2013), http://www.ims.gov/research/public_libraries_in_the_united_states_survey.aspx; Centers for Medicare & Medicaid Studies, “National Plan and Provider Enumeration System (NPPES)” (Washington, DC, July 2013), http://nppes.viva-it.com/NPI_Files.html; United States Fire Administration, “National Fire Department Census Database”, August 8, 2013, <http://apps.usfa.fema.gov/census/>; United States Department of Justice. Office of Justice Programs. Bureau of Justice Statistics, “Census of State and Local Law Enforcement Agencies (CSLLEA), 2008,” *Directory of Law Enforcement Agencies Series* (Ann Arbor, MI: Inter-university Consortium for Political and Social Research, August 3, 2011); National Center for Education Statistics, “Elementary/Secondary Information System (ELSi)” (Washington, DC, August 15, 2013), <https://nces.ed.gov/ccd/elsi/>; National Center for Education Statistics, “Integrated Postsecondary Education Data System (IPEDS)” (Washington, DC, August 15, 2013), <https://nces.ed.gov/ipeds/>; National Telecommunications and Information Administration, “Post-Award Monitoring (PAM) Database 2013-09-12.”

¹⁸ National Telecommunications and Information Administration, *University of Arkansas System The Arkansas Healthcare, Higher Education, Public Safety, & Research Integrated Broadband Initiative Project Fact Sheet, BroadbandUSA: Connecting America’s Communities* (Washington, DC, August 2010), http://www2.ntia.doc.gov/files/grantees/fact_sheet_-_university_of_arkansas.pdf.

¹⁹ National Telecommunications and Information Administration, “The Arkansas Healthcare, Higher Education, Public Safety, & Research Integrated Broadband Initiative Project Fact Sheet.”

²⁰ National Telecommunications and Information Administration, “The Arkansas Healthcare, Higher Education, Public Safety, & Research Integrated Broadband Initiative Project Fact Sheet.”

²¹ United States Census Bureau, “2007-2011 ACS 5-Year Summary File,” *American Community Survey* (Washington, DC, December 06, 2012), http://www.census.gov/acs/www/data_documentation/2011_release/.

²² United States Census Bureau, “2007-2011 ACS 5-Year Summary File.”

²³ Arkansas Department of Health, “Arkansas Medically Underserved Areas (MUA),” December 03, 2013, <http://www.healthy.arkansas.gov/programsServices/hometownHealth/Documents/MedicallyUnderserved.pdf>.

²⁴ United Health Foundation, “United States Overview: 2012,” *America’s Health Rankings*, December 03, 2013, <http://www.americashealthrankings.org/Rankings>.

²⁵ National Telecommunications and Information Administration, “State Broadband Initiative June 30, 2011” (Washington, D.C.: United States Department of Commerce, 2011), <http://www2.ntia.doc.gov/Jun-2011-datasets>.

- ²⁶ National Telecommunications and Information Administration, “State Broadband Initiative June 30, 2011.”
- ²⁷ FCC Form 477 data includes information at the census tract level on the population that subscribes to broadband using the following speed thresholds: at least 768 kbps download speed and at least 200 kbps upload speed. Because of this limitation, ASR is not able to filter for subscribers with download speeds of at least 3 Mbps and upload speeds of at least 768 kbps.
- ²⁸ National Telecommunications and Information Administration, “Post-Award Monitoring (PAM) Database 2013-09-12.”
- ²⁹ National Telecommunications and Information Administration, “Post-Award Monitoring (PAM) Database 2013-09-12.”
- ³⁰ Representatives of Arkansas Trauma Network, “Interview with Author” (Little Rock, AR, October 21, 2013).
- ³¹ Arkansas Department of Health, “About ADH,” 2014, <http://www.healthy.arkansas.gov/aboutADH/Pages/default.aspx>.
- ³² Representatives of Arkansas Department of Health, “Interview with Author” (Little Rock, AR, October 22, 2013).
- ³³ Greater Delta Alliance for Health, “Greater Delta Alliance for Health, Inc.,” 2014, <http://gdaharkansas.org/home>.
- ³⁴ Representatives of the Greater Delta Alliance for Health, “Video Interview with Author,” October 21, 2013.
- ³⁵ Representatives of Howard Memorial Hospital, “Interview with Author” (Nashville, AR, October 23, 2013).
- ³⁶ Representative of Boston Mountain Rural Health, “Interview with Author” (Marshall, AR, October 22, 2013).
- ³⁷ Representative of Boston Mountain Rural Health, “Interview with Author.”
- ³⁸ Representative of Boston Mountain Rural Health, “Interview with Author.”
- ³⁹ Mainline Health Systems, “About Us,” 2014, <http://www.mainlinehealth.net/AboutUs/tabid/16089/Default.aspx>.
- ⁴⁰ Representatives of Mainline Health Systems, “Phone Interview with Author,” October 25, 2013.
- ⁴¹ Representatives of Mainline Health Systems, “Phone Interview with Author.”
- ⁴² Representatives of Health Resources of Arkansas, “Interview with Author” (Little Rock, AR, October 21, 2013).
- ⁴³ Representatives of Health Resources of Arkansas, “Interview with Author.”
- ⁴⁴ Representatives of Health Resources of Arkansas, “Interview with Author.”
- ⁴⁵ Representative of Birch Tree Communities, “Interview with Author” (Benton, AR, October 23, 2013).
- ⁴⁶ Representative of Birch Tree Communities, “Interview with Author.”
- ⁴⁷ Representative of Birch Tree Communities, “Interview with Author.”
- ⁴⁸ Representative of Birch Tree Communities, “Interview with Author.”
- ⁴⁹ Mid-South Health Systems, “About Us,” October 15, 2013, <http://www.mshs.org/view/about-us>.

- ⁵⁰ University of Arkansas for Medical Sciences, "Sites Listed by County," October 15, 2013, <http://www.arkansaselink.com/sites-listed-by-county/>.
- ⁵¹ HomeCare Association of Arkansas, "History and Objectives," 2014, <http://www.homecareassociationarkansas.org/history-and-objectives>.
- ⁵² Representative of HomeCare Association of Arkansas, "Interview with Author" (Little Rock, AR, October 21, 2013).
- ⁵³ University of Arkansas for Medical Sciences, "Arkansas Aging Initiative," 2014, <http://aging.uams.edu/?id=4605&sid=6>.
- ⁵⁴ University of Arkansas for Medical Sciences, "Sites Listed by County."
- ⁵⁵ University of Arkansas Community College at Morrilton, "About UACCM," October 15, 2013, http://www.uaccm.edu/About_UACCM/About_UACCM.htm.
- ⁵⁶ Representatives of the University of Arkansas Community College at Morrilton, "Interview with Author" (Morrilton, AR, October 22, 2013).
- ⁵⁷ Cossatot Community College of the University of Arkansas, "UA Cossatot Has Another Record Enrollment," October 15, 2013, <http://www.cccua.edu/news/2013/09/08/ua-cossatot-has-another-record-enrollment>.
- ⁵⁸ Representatives of Cossatot Community College of the University of Arkansas, "Interview with Author" (De Queen, AR, October 23, 2013).
- ⁵⁹ Arkansas Department of Higher Education, "Arkansas Colleges, Universities See Decrease in Headcount, Increase in FTE," September 23, 2013, <http://www.adhe.edu/newsroom/Pages/PrelimFall13Enrollment.aspx>.
- ⁶⁰ Representatives of Phillips Community College of the University of Arkansas, "Interview with Author" (Helena, AR, October 24, 2013).
- ⁶¹ Representative of Southern Arkansas Community College, "Phone Interview with Author," October 25, 2013.
- ⁶² Representative of Southern Arkansas Community College, "Phone Interview with Author."
- ⁶³ Arkansas Association of Two-Year Colleges, "AATYC Mission," 2013, <http://www.aatyc.org/about-us/mission.html>.
- ⁶⁴ e-Link Team, "Interview with Author."
- ⁶⁵ ASR Analytics, *Progress towards BTOP Goals: Interim Report on PCC and SBA Case Studies*.
- ⁶⁶ Centers for Medicare & Medicaid Studies, "National Plan and Provider Enumeration System (NPPES)"; National Uniform Claim Committee, *Health Care Provider Taxonomy*, July 2013, http://www.nucc.org/index.php?option=com_content&view=article&id=14&Itemid=125.
- The evaluation study team used background information to determine the taxonomy groups in which grantee-connected healthcare institutions fall based on the taxonomy system in National Uniform Claim Committee, *Health Care Provider Taxonomy*. This is the same taxonomy used in Centers for Medicare & Medicaid Studies, "National Plan and Provider Enumeration System (NPPES)."
- ⁶⁷ Cheryl A. Moyer, "Online Patient-Provider Communication: How Will It Fit?," *The Electronic Journal of Communication* 17, no. 3 & 4 (2007), <http://www.cios.org/EJCPUBLIC/017/3/01732.HTML>.
- Digital Impact Group, "The Economic Impact of Digital Exclusion" 19104, no. 215 (2010).
- ⁶⁸ Representatives of Arkansas Trauma Network, "Interview with Author."

⁶⁹ e-Link Team and Representatives of UAMS Center for Distance Health, "Interview with Author" (Little Rock, AR, October 22, 2013).

University of Arkansas for Medical Sciences, *ANGELS 2011 Annual Report* (Little Rock, AR, 2012), <http://angels.uams.edu/files/2010/12/Angels-Annual-report-2011.pdf>.

University of Arkansas for Medical Sciences, *ANGELS 2012 Annual Report* (Little Rock, AR, 2013), <http://angels.uams.edu/files/2010/12/Angels-Annual-report-2012.pdf>.

⁷⁰ e-Link Team and Representatives of UAMS Center for Distance Health, "Interview with Author."

⁷¹ University of Arkansas for Medical Sciences, *ANGELS 2011 Annual Report*.

University of Arkansas for Medical Sciences, *ANGELS 2012 Annual Report*.

⁷² e-Link Team and Representatives of UAMS Center for Distance Health, "Interview with Author."

⁷³ e-Link Team and Representatives of UAMS Center for Distance Health, "Interview with Author."

⁷⁴ Representative of Boston Mountain Rural Health, "Interview with Author."

⁷⁵ Representatives of Mainline Health Systems, "Phone Interview with Author."

⁷⁶ e-Link Team and Representatives of UAMS Center for Distance Health, "Interview with Author."

⁷⁷ Representatives of Howard Memorial Hospital, "Interview with Author."

Representatives of Mainline Health Systems, "Phone Interview with Author."

Representative of Boston Mountain Rural Health, "Interview with Author."

⁷⁸ Representative of Birch Tree Communities, "Interview with Author."

⁷⁹ Representatives of Health Resources of Arkansas, "Interview with Author."

⁸⁰ Representative of Mid-South Health Systems, "Phone Interview with Author," October 24, 2013.

⁸¹ Representative of Mid-South Health Systems, "Phone Interview with Author."

⁸² e-Link Team and Representatives of UAMS Center for Distance Health, "Interview with Author."

⁸³ Representatives of Arkansas Department of Health, "Interview with Author."

⁸⁴ The South Dakota Bureau of Information and Telecommunications, "Broadband Benefits for Rural Areas," February 01, 2011, <http://broadband.sd.gov/Benefits-Rural.aspx>.

⁸⁵ University of Arkansas for Medical Sciences, "AR SAVES: 40 Statewide AR SAVES Partners Can Provide Timely, Life-Saving Treatment," October 24, 2013.

⁸⁶ University of Arkansas for Medical Sciences, *AR SAVES 2009 Annual Report* (Little Rock, AR, 2009), <http://arsaves.uams.edu/files/2012/07/2009-report.pdf>.

University of Arkansas for Medical Sciences, *AR SAVES 2011 Annual Report* (Little Rock, AR, 2011), <http://arsaves.uams.edu/files/2012/07/2010-report.pdf>.

UAMS did not issue a 2010 annual report. To generate FY 2010 statistics, data were collected from the 2009 and 2011 reports.

⁸⁷ University of Arkansas for Medical Sciences, *AR SAVES Annual Report 2012* (Little Rock, AR, 2012), <http://arsaves.uams.edu/files/2012/03/AR-SAVES-Annual-Report-2012.pdf>.

University of Arkansas for Medical Sciences, *AR SAVES 2013 Annual Report* (Little Rock, AR, 2013), <http://arsaves.uams.edu/files/2012/03/2013-Annual-Report.pdf>.

⁸⁸ University of Arkansas for Medical Sciences, *AR SAVES Annual Report 2012*.

University of Arkansas for Medical Sciences, *AR SAVES 2013 Annual Report*.

- ⁸⁹ Representatives of the Greater Delta Alliance for Health, “Video Interview with Author.”
- ⁹⁰ e-Link Team and Representatives of UAMS Center for Distance Health, “Interview with Author.”
- ⁹¹ Representatives of Arkansas Trauma Network, “Interview with Author.”
- ⁹² HealthIT.gov, “Benefits of Health IT,” August 28, 2012, <http://www.healthit.gov/patients-families/health-it-makes-health-care-convenient>.
- ⁹³ Representatives of Arkansas Trauma Network, “Interview with Author.”
- ⁹⁴ Representatives of Arkansas Trauma Network, “Interview with Author.”
- ⁹⁵ Representatives of Arkansas Trauma Network, “Interview with Author.”
- ⁹⁶ Representatives of Arkansas Department of Health, “Interview with Author.”
- ⁹⁷ HealthIT.gov, “Benefits of Health IT.”
- ⁹⁸ Representative of HomeCare Association of Arkansas, “Interview with Author.”
- ⁹⁹ HealthIT.gov, “Benefits of Health IT.”
- ¹⁰⁰ Representatives of Arkansas Department of Health, “Interview with Author.”
- ¹⁰¹ Representatives of Arkansas Trauma Network, “Interview with Author.”
- ¹⁰² Broadband for America, “Health Care” (Washington, DC, 2011), <http://www.broadbandforamerica.com/benefits/healthcare>.
Moyer, “Online Patient-Provider Communication: How Will It Fit?”
- ¹⁰³ Representatives of Arkansas Department of Health, “Interview with Author.”
- ¹⁰⁴ Representatives of Arkansas Department of Health, “Interview with Author.”
- ¹⁰⁵ Ingrida Lulis and Pam Mason, “Paradigm Shift: The New World of Hearing Health Care Delivery,” *The ASHA Leader*, July 31, 2012, <http://www.asha.org/Publications/leader/2012/120731/Paradigm-Shift--The-New-World-of-Hearing-Health-Care-Delivery.htm>.
- ¹⁰⁶ Representative of UAMS Center for Rural Health, “Interview with Author” (Little Rock, AR, October 21, 2013).
- ¹⁰⁷ Representatives of Cossatot Community College of the University of Arkansas, “Interview with Author.”
- ¹⁰⁸ David McDaid and A-La Park, *Online Health: Untangling the Web* (London, UK: The British United Provident Association, January 04, 2011), http://www.bupa.com.au/staticfiles/Bupa/HealthAndWellness/MediaFiles/PDF/LSE_Report_Online_Health.pdf.
- Yi Yvonne Zhou et al., “Improved Quality at Kaiser Permanente through E-Mail between Physicians and Patients,” *Health Affairs* 29, no. 7 (July 2010): 1370–1375, doi:10.1377/hlthaff.2010.0048.
- George Lauer, “Seniors Who Use Internet Could Reap Health Benefits, Studies Show,” December 01, 2009, <http://www.ihealthbeat.org/features/2009/seniors-who-use-internet-could-reap-health-benefits-studies-show.aspx>.
- Casey B. White et al., “A Content Analysis of E-Mail Communication between Patients and Their Providers: Patients Get the Message.,” *Journal of the American Medical Informatics Association* 11, no. 4 (2005): 260–7, doi:10.1197/jamia.M1445.
- ¹⁰⁹ Representatives of the Arkansas Aging Initiative, “Phone Interview with Author,” October 25, 2013.

¹¹⁰ Broadband for America, “Health Care.”

¹¹¹ Representative of Birch Tree Communities, “Interview with Author.”

¹¹² Audiey C. Kao et al., “The Relationship Between Method of Physician Payment and Patient Trust,” *JAMA: The Journal of the American Medical Association* 280, no. 19 (November 18, 1998): 1708–1714, doi:10.1001/jama.280.19.1708.

Audiey C. Kao et al., “Patients’ Trust in Their Physicians: Effects of Choice, Continuity, and Payment Method,” *Journal of General Internal Medicine* 13, no. 10 (October 1998): 681–686, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1500897/>.

¹¹³ Representative of Boston Mountain Rural Health, “Interview with Author.”

¹¹⁴ National Telecommunications and Information Administration, “Post-Award Monitoring (PAM) Database 2013-09-12.”

¹¹⁵ e-Link Team, “Interview with Author.”

¹¹⁶ Representative of Arkansas Association of Two-Year Colleges and Representative of ARE-ON, “Interview with Author” (Little Rock, AR, October 21, 2013).

¹¹⁷ Scott M. Andes and Daniel D. Castro, *Opportunities and Innovations in the Mobile Broadband Economy*, *The Information Technology and Innovation Foundation*, 2010, <http://www.itif.org/files/2010-mobile-innovations.pdf>.

Communications Workers of America, *Speed Matters: Benefits of Broadband* (Washington, DC, 2009), http://files.cwa-union.org/speedmatters/CWA_Benefits_of_Broadbandr_2010.pdf.

Linda Ann Hulbert and Regina C. McBride, “Utilizing Videoconferencing in Library Education: A Team Teaching Approach,” *Journal of Education for Library and Information Science* 45, no. 1 (2004): 25–35, <http://www.jstor.org/stable/40323919>.

Carly Shuler, *Pockets of Potential: Using Mobile Technologies to Promote Children’s Learning* (New York, NY: The Joan Gans Cooney Center, January 2009), <http://joanganzcooneycenter.org/Reports-23.html>.

¹¹⁸ Representatives of Cossatot Community College of the University of Arkansas, “Interview with Author.”

Representatives of Phillips Community College of the University of Arkansas, “Interview with Author.”

Representative of Southern Arkansas Community College, “Phone Interview with Author.”

Representatives of the University of Arkansas Community College at Morrilton, “Interview with Author.”

¹¹⁹ Representative of Southern Arkansas Community College, “Phone Interview with Author.”

¹²⁰ Representatives of Cossatot Community College of the University of Arkansas, “Interview with Author.”

¹²¹ Ruth H. Moody and Michael P. Bobic, “Teaching the Net Generation without Leaving the Rest of Us Behind: How Technology in the Classroom Influences Student Composition,” *Politics & Policy* 39, no. 2 (April 29, 2011): 169–194, doi:10.1111/j.1747-1346.2011.00287.x.

¹²² Representative of Southern Arkansas Community College, “Phone Interview with Author.”

¹²³ Representatives of the University of Arkansas Community College at Morrilton, “Interview with Author.”

¹²⁴ British Educational Communications and Technology Agency, *Extending Opportunity: Final Report of the Minister's Taskforce on Home Access to Technology* (Coventry, UK, July 2008), <http://dera.ioe.ac.uk/8285/>.

Robert W. Fairlie, "The Effects of Home Computers on School Enrollment," *Working Paper*, September 2003, http://cjtc.ucsc.edu/docs/r_schoolcomp6.pdf.

Mizuko Ito et al., *Living and Learning with New Media Summary of Findings from the Digital Youth Project, The John D. and Catherine T. MacArthur Foundation Reports on Digital Media and Learning*, November 2008, <http://digitalyouth.ischool.berkeley.edu/files/report/digitalyouth-WhitePaper.pdf>.

Robert LaRose et al., *Closing the Rural Broadband Gap, Final Technical Report*, November 30, 2008, <https://www.msu.edu/~larose/ruralbb/>.

Barbara Means et al., *Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies* (Washington, DC: United States Department of Education, September 2010), <http://www2.ed.gov/rschstat/eval/tech/evidence-based-practices/finalreport.pdf>.

Juan Moran et al., "Technology and Reading Performance in the Middle-School Grades: A Meta-Analysis with Recommendations for Policy and Practice," *Journal of Literacy Research* 40, no. 1 (January 2008): 6–58, doi:10.1080/10862960802070483.

Don Passey et al., *The Motivational Effect of ICT on Pupils, RR523* (Lancaster, UK: University of Lancaster, April 2004), <https://www.education.gov.uk/publications/RSG/ICTSCH/Page1/RR523>.

Nancy Protheroe, "Technology and Student Achievement," *Principal*, November 2005, <http://www.naesp.org/resources/2/Principal/2005/N-Dp46.pdf>.

Shapley Research Associates and Texas Center for Educational Research, *Final Outcomes for a Four-Year Study (2004–05 to 2007–08), Evaluation of the Texas Technology Immersion Pilot (eTxTIP)*, January 2009, <http://www.tcer.org/research/etxtip/>.

Gil Valentine et al., *Children and Young People's Home Use of ICT for Educational Purposes: The Impact on Attainment at Key Stages 1-4, RB672*, August 2005, <https://www.education.gov.uk/publications/RSG/ParentsCarersandFamilies/Page12/RB672>.

Jörg Wittwer and Martin Senkbeil, "Is Students' Computer Use at Home Related to Their Mathematical Performance at School?," *Computers & Education* 50, no. 4 (May 2008): 1558–1571, doi:10.1016/j.compedu.2007.03.001.

Julius Genachowski, "Broadband: Our Enduring Engine for Prosperity and Opportunity," in *NARUC Conference* (Washington, DC, 2010), http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-296262A1.pdf.

Digital Impact Group, "The Economic Impact of Digital Exclusion."

Robert W. Fairlie et al., *Crossing the Divide: Immigrant Youth and Digital Disparity in California* (Santa Cruz, 2006), <http://cjtc.ucsc.edu/docs/digital.pdf>.

¹²⁵ Representatives of Phillips Community College of the University of Arkansas, "Interview with Author."

¹²⁶ The South Dakota Bureau of Information and Telecommunications, "Broadband Benefits for Rural Areas," February 01, 2011, <http://broadband.sd.gov/Benefits-Rural.aspx>.

¹²⁷ Representatives of Cossatot Community College of the University of Arkansas, "Interview with Author."

¹²⁸ IBM Learning Solutions, *IBM's Learning Transformation Story* (Somers, NY: IBM Global Services, June 2004), <http://www-304.ibm.com/easyaccess/fileservice?contentid=183268>.

Robert D. Atkinson and Daniel D. Castro, *Digital Quality of Life: Understanding the Personal and Social Benefits of the Information Technology Revolution* (Washington, DC: Information Technology and Information Foundation, October 01, 2008), <http://www.itif.org/files/DQOL.pdf>.

¹²⁹ Representative of UAMS Center for Rural Health, "Interview with Author."

¹³⁰ Representatives of the Arkansas Aging Initiative, "Phone Interview with Author."

¹³¹ Representative of Birch Tree Communities, "Interview with Author."

¹³² USDA Economic Research Service, "Rural Digital Economy: Online Activities," *Briefing Rooms*, August 13, 2009, <http://ers.usda.gov/Briefing/Telecom/demandservice.htm>.

¹³³ Representatives of Cossatot Community College of the University of Arkansas, "Interview with Author."

Representative of Southern Arkansas Community College, "Phone Interview with Author."

Representatives of the University of Arkansas Community College at Morrilton, "Interview with Author."

¹³⁴ Representative of UAMS Center for Rural Health, "Interview with Author."

Representatives of Cossatot Community College of the University of Arkansas, "Interview with Author."

Representative of Southern Arkansas Community College, "Phone Interview with Author."

Representatives of the University of Arkansas Community College at Morrilton, "Interview with Author."

¹³⁵ Representatives of the Greater Delta Alliance for Health, "Video Interview with Author."

¹³⁶ Peter Stenberg et al., *Broadband Internet's Value for Rural America, ERR-78* (United States Department of Agriculture Economic Research Service, August 2009), <http://www.ers.usda.gov/publications/err-economic-research-report/err78.aspx>.

Larry F. Darby, Joseph P. Jr. Fuhr, and Stephen B. Pociask, *The Internet Ecosystem: Employment Impacts of National Broadband Policy* (Washington, DC: The American Consumer Institute, January 28, 2010), <http://www.theamericanconsumer.org/wp-content/uploads/2010/01/aci-jobs-study-final1.pdf>.

¹³⁷ Representative of Southern Arkansas Community College, "Phone Interview with Author."

¹³⁸ USDA Economic Research Service, "Rural Digital Economy: Online Activities."

¹³⁹ Representative of Arkansas Association of Two-Year Colleges and Representative of ARE-ON, "Interview with Author."

¹⁴⁰ Representative of Arkansas Association of Two-Year Colleges and Representative of ARE-ON, "Interview with Author."

Representatives of Cossatot Community College of the University of Arkansas, "Interview with Author."

¹⁴¹ The Recovery Accountability and Transparency Board, "Recovery API," *Recovery.gov* (Washington, DC, March 20, 2013), <http://www.recovery.gov/FAQ/Developer/Pages/RecoveryAPI.aspx>.

¹⁴² Recovery.org provides the following guidance and example for calculating grant-funded jobs:

1. If a normal full-time schedule is 40 hours a week, multiply 40 hours x 52 weeks = 2,080 Total Hours per year.
2. Divide 2,080 Total Hours by 4 to equal 520 regular quarterly hours.

3. If two full-time employees each worked 520 hours (1,040 hours) for the quarter and another half-time employee worked 260 hours, the Total Hours for the three employees is 1300 (520 + 520 + 260 = 1300).
4. Divide 1300 by 520 to equal 2.5 Recovery funded jobs during that quarter.

For more information, visit <http://www.recovery.gov/News/featured/Pages/Calculator.aspx>

¹⁴³ Federal Communications Commission, *Connecting America: The National Broadband Plan*, 2010, <http://www.broadband.gov/plan/>.

¹⁴⁴ Julius Genachowski, "Remarks on Broadband Adoption," 2011, <http://www.fcc.gov/document/chairman-genachowski-broadband-adoption>.

¹⁴⁵ Representatives of the University of Arkansas Community College at Morrilton, "Interview with Author."

¹⁴⁶ Representatives of Phillips Community College of the University of Arkansas, "Interview with Author."

¹⁴⁷ Representatives of Cossatot Community College of the University of Arkansas, "Interview with Author."

Representatives of the University of Arkansas Community College at Morrilton, "Interview with Author."

Representative of Southern Arkansas Community College, "Phone Interview with Author."

¹⁴⁸ Representatives of the University of Arkansas Community College at Morrilton, "Interview with Author."

¹⁴⁹ Representatives of Cossatot Community College of the University of Arkansas, "Interview with Author."

¹⁵⁰ Representative of Birch Tree Communities, "Interview with Author."

¹⁵¹ National Telecommunications and Information Administration, "Broadband Technology Opportunities Program Notices" (Washington, DC, January 22, 2010), http://www.ntia.doc.gov/files/ntia/publications/fr_btopnofa_100115_0.pdf.

¹⁵² Jonathan E. Nuechterlein and Philip J. Weiser, *Digital Crossroads: American Telecommunications Policy in the Internet Age* (Cambridge, MA: The MIT Press, 2005).

¹⁵³ OECD, "Broadband Networks and Open Access," *OECD Digital Economy Papers* no. 218 (March 04, 2013).

¹⁵⁴ William H. Lehr, Marvin Sirbu, and Sharon Gillett, "Broadband Open Access : Lessons from Municipal Network Case Studies," 2008.

¹⁵⁵ Lehr, Sirbu, and Gillett, "Broadband Open Access : Lessons from Municipal Network Case Studies."

¹⁵⁶ Lehr, Sirbu, and Gillett, "Broadband Open Access : Lessons from Municipal Network Case Studies."

¹⁵⁷ Rural Utilities Service and National Telecommunications and Information Administration, "Broadband Initiatives Program & Broadband Technology Opportunities Program," *Federal Register* 74, no. 130 (July 09, 2009): 33104–34, <http://www.gpo.gov/fdsys/pkg/FR-2009-07-09/pdf/FR-2009-07-09.pdf>.

¹⁵⁸ National Telecommunications and Information Administration, "The Arkansas Healthcare, Higher Education, Public Safety, & Research Integrated Broadband Initiative Project Fact Sheet."

¹⁵⁹ University of Arkansas for Medical Sciences, “Arkansas Healthcare, Higher Education, Public Safety, & Research Integrated Broadband Initiative Application, Part 1.”

¹⁶⁰ University of Arkansas for Medical Sciences, “Arkansas Healthcare, Higher Education, Public Safety, & Research Integrated Broadband Initiative Application, Part 1.”

¹⁶¹ University of Arkansas for Medical Sciences, “Arkansas Healthcare, Higher Education, Public Safety, & Research Integrated Broadband Initiative Application, Part 1.”

Glossary

Acronym	Definition
AAI	Arkansas Aging Initiative
AATYC	Arkansas Association of Two-Year Colleges
ACA	Affordable Care Act
ACMC	Ashley County Medical Center
ACS	American Community Survey
ADH	Arkansas Department of Health
ANGELS	Antenatal and Neonatal Guidelines, Education, and Learning System
APR	Annual Performance Progress Report
ARE-ON	Arkansas Research and Education Optical Network
ARNEC	Arkansas Rural Nursing Consortium
AR SAVES	Arkansas Stroke Assistance through Virtual Emergency Support
ASR	ASR Analytics, LLC
ATCC	Arkansas Trauma Communications Center
ATN	Arkansas Telehealth Network
ATOM	Arkansas Telehealth Oversight and Management
BMRHC	Boston Mountain Rural Health Center
BTOP	Broadband Technology Opportunities Program
CAI	Community Anchor Institution
CCCUA	Cossatot Community College of the University of Arkansas
CCI	Comprehensive Community Infrastructure
CDH	University of Arkansas for Medical Sciences Center for Distance Health
CME	Continuing Medical Education
CMMC	Chicot Memorial Medical Center
DHNH	DeWitt Hospital and Nursing Home
DMH	Drew Memorial Hospital
EA	Environmental Assessment
EHR	Electronic Health Records
EMS	Emergency Medical Services
ER	Emergency Room
FCC	Federal Communications Commission
GDAH	Greater Delta Alliance for Health

Acronym	Definition
HIE	Health Information Exchange
HIPAA	Health Insurance Portability and Accountability Act
HMH	Howard Memorial Hospital
HRA	Health Resources of Arkansas
HRSA	Health Resources and Services Administration
IAV	Interactive Video
ICU	Intensive Care Unit
IRU	Indefeasible Rights of Use
LEARN	Lonestar Education And Research Network
LMS	Learning Management System
LONI	Louisiana Optical Network Initiative
MPLS	Multiprotocol Label Switching
NBM	National Broadband Map
NICU	Neonatal Intensive Care Unit
NPDES	National Plan and Provider Enumeration System
NTIA	National Telecommunications and Information Administration
PCC	Public Computer Centers
PCCUA	Phillips Community College of the University of Arkansas
PPR	Quarterly Performance Progress Report
RFP	Request for Proposal
SAU	Southern Arkansas University
SAU Tech	Southern Arkansas University Tech
SBA	Sustainable Broadband Adoption
SoX	Southern Crossroads
TIR	Trauma Image Repository
UA	University of Arkansas
UA Fort Smith	University of Arkansas at Fort Smith
UA Monticello	University of Arkansas at Monticello
UACCM	University of Arkansas Community College at Morrilton
UAMS	University of Arkansas for Medical Sciences
UAS	University of Arkansas System

Bibliography

- Andes, Scott M., and Daniel D. Castro. *Opportunities and Innovations in the Mobile Broadband Economy*. The Information Technology and Innovation Foundation, 2010. <http://www.itif.org/files/2010-mobile-innovations.pdf>.
- Arkansas Association of Two-Year Colleges. "AATYC Mission," 2013. <http://www.aatyc.org/about-us/mission.html>.
- Arkansas Department of Health. "About ADH," 2014. <http://www.healthy.arkansas.gov/aboutADH/Pages/default.aspx>.
- . "Arkansas Medically Underserved Areas (MUA)," December 03, 2013. <http://www.healthy.arkansas.gov/programsServices/hometownHealth/Documents/MedicallyUnderserved.pdf>.
- Arkansas Department of Higher Education. "Arkansas Colleges, Universities See Decrease in Headcount, Increase in FTE," September 23, 2013. <http://www.adhe.edu/newsroom/Pages/PrelimFall13Enrollment.aspx>.
- ASR Analytics. *Progress towards BTOP Goals: Interim Report on PCC and SBA Case Studies. Broadband Technology Opportunities Program Evaluation Study (Order Number D10PD18645)*. Potomac, MD, 2012. <http://www.ntia.doc.gov/report/2012/progress-towards-btop-goals-interim-report-pcc-and-sba-case-studies>.
- Atkinson, Robert D., and Daniel D. Castro. *Digital Quality of Life: Understanding the Personal and Social Benefits of the Information Technology Revolution*. Washington, DC: Information Technology and Information Foundation, October 01, 2008. <http://www.itif.org/files/DQOL.pdf>.
- British Educational Communications and Technology Agency. *Extending Opportunity: Final Report of the Minister's Taskforce on Home Access to Technology*. Coventry, UK, July 2008. <http://dera.ioe.ac.uk/8285/>.
- Broadband for America. "Health Care." Washington, DC, 2011. <http://www.broadbandforamerica.com/benefits/healthcare>.
- Centers for Medicare & Medicaid Studies. "National Plan and Provider Enumeration System (NPPES)." Washington, DC, July 2013. http://nppes.viva-it.com/NPI_Files.html.
- Communications Workers of America. *Speed Matters: Benefits of Broadband*. Washington, DC, 2009. http://files.cwa-union.org/speedmatters/CWA_Benefits_of_Broadbandr_2010.pdf.
- Cossatot Community College of the University of Arkansas. "UA Cossatot Has Another Record Enrollment," October 15, 2013. <http://www.cccua.edu/news/2013/09/08/ua-cossatot-has-another-record-enrollment>.
- Darby, Larry F., Joseph P. Jr. Fuhr, and Stephen B. Pociask. *The Internet Ecosystem: Employment Impacts of National Broadband Policy*. Washington, DC: The American Consumer Institute,

January 28, 2010. <http://www.theamericanconsumer.org/wp-content/uploads/2010/01/aci-jobs-study-final1.pdf>.

Digital Impact Group. "The Economic Impact of Digital Exclusion" 19104, no. 215 (2010).

e-Link Team. "Interview with Author." Little Rock, AR, October 21, 2013.

e-Link Team, and Representatives of UAMS Center for Distance Health. "Interview with Author." Little Rock, AR, October 22, 2013.

Fairlie, Robert W. "The Effects of Home Computers on School Enrollment." *Working Paper*, September 2003. http://cjtc.ucsc.edu/docs/r_schoolcomp6.pdf.

Fairlie, Robert W., Rebecca A. London, Rachel Rosner, and Manuel Pastor. *Crossing the Divide: Immigrant Youth and Digital Disparity in California*. Santa Cruz, 2006. <http://cjtc.ucsc.edu/docs/digital.pdf>.

Federal Communications Commission. *Connecting America: The National Broadband Plan*, 2010. <http://www.broadband.gov/plan/>.

Genachowski, Julius. "Broadband: Our Enduring Engine for Prosperity and Opportunity." In *NARUC Conference*. Washington, DC, 2010. http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-296262A1.pdf.

———. "Remarks on Broadband Adoption," 2011. <http://www.fcc.gov/document/chairman-genachowski-broadband-adoption>.

Greater Delta Alliance for Health. "Greater Delta Alliance for Health, Inc.," 2014. <http://gdaharkansas.org/home>.

HealthIT.gov. "Benefits of Health IT," August 28, 2012. <http://www.healthit.gov/patients-families/health-it-makes-health-care-convenient>.

HomeCare Association of Arkansas. "History and Objectives," 2014. <http://www.homecareassociationarkansas.org/history-and-objectives>.

Hulbert, Linda Ann, and Regina C. McBride. "Utilizing Videoconferencing in Library Education: A Team Teaching Approach." *Journal of Education for Library and Information Science* 45, no. 1 (2004): 25–35. <http://www.jstor.org/stable/40323919>.

IBM Learning Solutions. *IBM's Learning Transformation Story*. Somers, NY: IBM Global Services, June 2004. <http://www-304.ibm.com/easyaccess/fileservice?contentid=183268>.

Institute of Museum and Library Services. "Public Libraries in the United States Survey (FY2011)." Washington, DC, June 2013. http://www.ims.gov/research/public_libraries_in_the_united_states_survey.aspx.

Ito, Mizuko, Heather Horst, Matteo Brittanit, Danah Boyd, Becky Herr-Stephenson, Patricia G. Lange, C.J. Pascoe, and Laura Robinson. *Living and Learning with New Media Summary of Findings from the Digital Youth Project. The John D. and Catherine T. MacArthur Foundation Reports on Digital Media and Learning*, November 2008. <http://digitalyouth.ischool.berkeley.edu/files/report/digitalyouth-WhitePaper.pdf>.

- Kao, Audiey C., Diane C. Green, Nancy A. Davis, Jeffrey P. Koplan, and Paul D. Cleary. "Patients' Trust in Their Physicians: Effects of Choice, Continuity, and Payment Method." *Journal of General Internal Medicine* 13, no. 10 (October 1998): 681–686.
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1500897/>.
- Kao, Audiey C., Diane C. Green, Alan M. Zaslavsky, Jeffrey P. Koplan, and Paul D. Cleary. "The Relationship Between Method of Physician Payment and Patient Trust." *JAMA: The Journal of the American Medical Association* 280, no. 19 (November 18, 1998): 1708–1714.
 doi:10.1001/jama.280.19.1708.
- LaRose, Robert, Jennifer L. Gregg, Sharon Stover, Joseph Straubhaar, and Nobuya Inagaki. *Closing the Rural Broadband Gap, Final Technical Report*, November 30, 2008.
<https://www.msu.edu/~larose/ruralbb/>.
- Lauer, George. "Seniors Who Use Internet Could Reap Health Benefits, Studies Show," December 01, 2009. <http://www.ihealthbeat.org/features/2009/seniors-who-use-internet-could-reap-health-benefits-studies-show.aspx>.
- Lehr, William H., Marvin Sirbu, and Sharon Gillett. "Broadband Open Access : Lessons from Municipal Network Case Studies," 2008.
- Lusis, Ingrida, and Pam Mason. "Paradigm Shift: The New World of Hearing Health Care Delivery." *The ASHA Leader*, July 31, 2012.
<http://www.asha.org/Publications/leader/2012/120731/Paradigm-Shift--The-New-World-of-Hearing-Health-Care-Delivery.htm>.
- Mainline Health Systems. "About Us," 2014.
<http://www.mainlinehealth.net/AboutUs/tabid/16089/Default.aspx>.
- McDaid, David, and A-La Park. *Online Health: Untangling the Web*. London, UK: The British United Provident Association, January 04, 2011.
http://www.bupa.com.au/staticfiles/Bupa/HealthAndWellness/MediaFiles/PDF/LSE_Report_Online_Health.pdf.
- Means, Barbara, Yukie Toyama, Robert Murphy, Marianne Bakia, and Karla Jones. *Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies*. Washington, DC: United States Department of Education, September 2010.
<http://www2.ed.gov/rschstat/eval/tech/evidence-based-practices/finalreport.pdf>.
- Mid-South Health Systems. "About Us," October 15, 2013. <http://www.mshs.org/view/about-us>.
- Moody, Ruth H., and Michael P. Bobic. "Teaching the Net Generation without Leaving the Rest of Us Behind: How Technology in the Classroom Influences Student Composition." *Politics & Policy* 39, no. 2 (April 29, 2011): 169–194. doi:10.1111/j.1747-1346.2011.00287.x.
- Moran, Juan, Richard Ferdig, P. David Pearson, James Wardrop, and Robert Blomeyer. "Technology and Reading Performance in the Middle-School Grades: A Meta-Analysis with Recommendations for Policy and Practice." *Journal of Literacy Research* 40, no. 1 (January 2008): 6–58. doi:10.1080/10862960802070483.
- Moyer, Cheryl A. "Online Patient-Provider Communication: How Will It Fit?" *The Electronic Journal of Communication* 17, no. 3 & 4 (2007). <http://www.cios.org/EJCPUBLIC/017/3/01732.HTML>.

- National Center for Education Statistics. "Elementary/Secondary Information System (ELSi)." Washington, DC, August 15, 2013. <https://nces.ed.gov/ccd/elsi/>.
- . "Integrated Postsecondary Education Data System (IPEDS)." Washington, DC, August 15, 2013. <https://nces.ed.gov/ipeds/>.
- National Telecommunications and Information Administration. "About." *BroadbandUSA: Connecting America's Communities*. Washington, DC, June 11, 2012. <http://www2.ntia.doc.gov/about>.
- . "Broadband Initiatives Program; Broadband Technology Opportunities Program Notice." Washington, D.C., 2009. http://www.ntia.doc.gov/files/ntia/publications/fr_bbnofa_090709.pdf.
- . *Broadband Technology Opportunities Program (BTOP) 16th Quarterly Program Status Report, 2013*. http://www.ntia.doc.gov/files/ntia/publications/ntia_btop_16th_quarterly_report.pdf.
- . "Broadband Technology Opportunities Program Notices." Washington, DC, January 22, 2010. http://www.ntia.doc.gov/files/ntia/publications/fr_btopnofa_100115_0.pdf.
- . "Post-Award Monitoring (PAM) Database 2013-09-12." Washington, DC: Distributed by National Telecommunications and Information Administration, 2013.
- . "State Broadband Initiative June 30, 2011." Washington, D.C.: United States Department of Commerce, 2011. <http://www2.ntia.doc.gov/Jun-2011-datasets>.
- . "Statement of Work for Broadband Technology Opportunities Program (BTOP) Evaluation Study," July 26, 2010.
- . "The Arkansas Healthcare, Higher Education, Public Safety, & Research Integrated Broadband Initiative Project Fact Sheet," December 03, 2013. http://www2.ntia.doc.gov/files/grantees/fact_sheet_-_university_of_arkansas.pdf.
- . *University of Arkansas System The Arkansas Healthcare, Higher Education, Public Safety, & Research Integrated Broadband Initiative Project Fact Sheet. BroadbandUSA: Connecting America's Communities*. Washington, DC, August 2010. http://www2.ntia.doc.gov/files/grantees/fact_sheet_-_university_of_arkansas.pdf.
- National Uniform Claim Committee. *Health Care Provider Taxonomy*, July 2013. http://www.nucc.org/index.php?option=com_content&view=article&id=14&Itemid=125.
- Nuechterlein, Jonathan E., and Philip J. Weiser. *Digital Crossroads: American Telecommunications Policy in the Internet Age*. Cambridge, MA: The MIT Press, 2005.
- OECD. "Broadband Networks and Open Access." *OECD Digital Economy Papers* no. 218 (March 04, 2013).
- Passey, Don, Colin Rogers, Joan Machell, and Gilly McHugh. *The Motivational Effect of ICT on Pupils. RR523*. Lancaster, UK: University of Lancaster, April 2004. <https://www.education.gov.uk/publications/RSG/ICTSCH/Page1/RR523>.
- Protheroe, Nancy. "Technology and Student Achievement." *Principal*, November 2005. <http://www.naesp.org/resources/2/Principal/2005/N-Dp46.pdf>.

Representative of Arkansas Association of Two-Year Colleges, and Representative of ARE-ON. "Interview with Author." Little Rock, AR, October 21, 2013.

Representative of Birch Tree Communities. "Interview with Author." Benton, AR, October 23, 2013.

Representative of Boston Mountain Rural Health. "Interview with Author." Marshall, AR, October 22, 2013.

Representative of HomeCare Association of Arkansas. "Interview with Author." Little Rock, AR, October 21, 2013.

Representative of Mid-South Health Systems. "Phone Interview with Author," October 24, 2013.

Representative of Southern Arkansas Community College. "Phone Interview with Author," October 25, 2013.

Representative of UAMS Center for Rural Health. "Interview with Author." Little Rock, AR, October 21, 2013.

Representative of University of Arkansas for Medical Sciences. "E-Mail Communication," October 31, 2013.

Representatives of Arkansas Department of Health. "Interview with Author." Little Rock, AR, October 22, 2013.

Representatives of Arkansas Trauma Network. "Interview with Author." Little Rock, AR, October 21, 2013.

Representatives of Cossatot Community College of the University of Arkansas. "Interview with Author." De Queen, AR, October 23, 2013.

Representatives of Health Resources of Arkansas. "Interview with Author." Little Rock, AR, October 21, 2013.

Representatives of Howard Memorial Hospital. "Interview with Author." Nashville, AR, October 23, 2013.

Representatives of Mainline Health Systems. "Phone Interview with Author," October 25, 2013.

Representatives of Phillips Community College of the University of Arkansas. "Interview with Author." Helena, AR, October 24, 2013.

Representatives of the Arkansas Aging Initiative. "Phone Interview with Author," October 25, 2013.

Representatives of the Greater Delta Alliance for Health. "Video Interview with Author," October 21, 2013.

Representatives of the University of Arkansas Community College at Morrilton. "Interview with Author." Morrilton, AR, October 22, 2013.

Rural Utilities Service, and National Telecommunications and Information Administration. "Broadband Initiatives Program & Broadband Technology Opportunities Program." *Federal*

Register 74, no. 130 (July 09, 2009): 33104–34. <http://www.gpo.gov/fdsys/pkg/FR-2009-07-09/pdf/FR-2009-07-09.pdf>.

Shapley Research Associates, and Texas Center for Educational Research. *Final Outcomes for a Four-Year Study (2004–05 to 2007–08). Evaluation of the Texas Technology Immersion Pilot (eTxTIP)*, January 2009. <http://www.tcer.org/research/etxtip/>.

Shuler, Carly. *Pockets of Potential: Using Mobile Technologies to Promote Children's Learning*. New York, NY: The Joan Gans Cooney Center, January 2009. <http://joanganzcooneycenter.org/Reports-23.html>.

Stenberg, Peter, Mitchell Morehart, Stephen Vogel, John Cromartie, Vince Breneman, and Dennis Brown. *Broadband Internet's Value for Rural America. ERR-78*. United States Department of Agriculture Economic Research Service, August 2009. <http://www.ers.usda.gov/publications/err-economic-research-report/err78.aspx>.

The Recovery Accountability and Transparency Board. "Recovery API." *Recovery.gov*. Washington, DC, March 20, 2013. <http://www.recovery.gov/FAQ/Developer/Pages/RecoveryAPI.aspx>.

The South Dakota Bureau of Information and Telecommunications. "Broadband Benefits for Rural Areas," February 01, 2011. <http://broadband.sd.gov/Benefits-Rural.aspx>.

———. "Broadband Benefits for Rural Areas," February 01, 2011. <http://broadband.sd.gov/Benefits-Rural.aspx>.

United Health Foundation. "United States Overview: 2012." *America's Health Rankings*, December 03, 2013. <http://www.americashealthrankings.org/Rankings>.

United States Census Bureau. "2007-2011 ACS 5-Year Summary File." *American Community Survey*. Washington, DC, December 06, 2012. http://www.census.gov/acs/www/data_documentation/2011_release/.

United States Department of Justice. Office of Justice Programs. Bureau of Justice Statistics. "Census of State and Local Law Enforcement Agencies (CSLLEA), 2008." *Directory of Law Enforcement Agencies Series*. Ann Arbor, MI: Inter-university Consortium for Political and Social Research, August 03, 2011. doi:10.3886/ICPSR27681.v1.

United States Fire Administration. "National Fire Department Census Database," August 08, 2013. <http://apps.usfa.fema.gov/census/>.

University of Arkansas Community College at Morrilton. "About UACCM," October 15, 2013. http://www.uaccm.edu/About_UACCM/About_UACCM.htm.

University of Arkansas for Medical Sciences. *ANGELS 2011 Annual Report*. Little Rock, AR, 2012. <http://angels.uams.edu/files/2010/12/Angels-Annual-report-2011.pdf>.

———. *ANGELS 2012 Annual Report*. Little Rock, AR, 2013. <http://angels.uams.edu/files/2010/12/Angels-Annual-report-2012.pdf>.

———. *AR SAVES 2009 Annual Report*. Little Rock, AR, 2009. <http://arsaves.uams.edu/files/2012/07/2009-report.pdf>.

- . *AR SAVES 2011 Annual Report*. Little Rock, AR, 2011.
<http://arsaves.uams.edu/files/2012/07/2010-report.pdf>.
- . *AR SAVES 2013 Annual Report*. Little Rock, AR, 2013.
<http://arsaves.uams.edu/files/2012/03/2013-Annual-Report.pdf>.
- . *AR SAVES Annual Report 2012*. Little Rock, AR, 2012.
<http://arsaves.uams.edu/files/2012/03/AR-SAVES-Annual-Report-2012.pdf>.
- . “AR SAVES: 40 Statewide AR SAVES Partners Can Provide Timely, Life-Saving Treatment,” October 24, 2013.
- . “Arkansas Aging Initiative,” 2014. <http://aging.uams.edu/?id=4605&sid=6>.
- . “Arkansas Healthcare, Higher Education, Public Safety, & Research Integrated Broadband Initiative Application, Part 1,” March 26, 2010.
http://www2.ntia.doc.gov/files/grantees/universityofarkansas_infrastructure_application_part1.pdf.
- . *Arkansas Healthcare, Higher Education, Public Safety, & Research Integrated Broadband Initiative Third Quarter Performance Progress Report, 2013*, 2013.
- . “Sites Listed by County,” October 15, 2013. <http://www.arkansaselink.com/sites-listed-by-county/>.
- USDA Economic Research Service. “Rural Digital Economy: Online Activities.” *Briefing Rooms*, August 13, 2009. <http://ers.usda.gov/Briefing/Telecom/demandservice.htm>.
- Valentine, Gil, Jackie Marsh, Charles Pattie, and BMRB. *Children and Young People’s Home Use of ICT for Educational Purposes: The Impact on Attainment at Key Stages 1-4. RB672*, August 2005.
<https://www.education.gov.uk/publications/RSG/Parentscarersandfamilies/Page12/RB672>.
- White, Casey B., Cheryl A. Moyer, David T. Stern, and Steven J. Katz. “A Content Analysis of E-Mail Communication between Patients and Their Providers: Patients Get the Message.” *Journal of the American Medical Informatics Association* 11, no. 4 (2005): 260–7.
doi:10.1197/jamia.M1445.
- Wittwer, Jörg, and Martin Senkbeil. “Is Students’ Computer Use at Home Related to Their Mathematical Performance at School?” *Computers & Education* 50, no. 4 (May 2008): 1558–1571. doi:10.1016/j.compedu.2007.03.001.
- Zhou, Yi Yvonne, Michael H. Kanter, Jian J. Wang, and Terhilda Garrido. “Improved Quality at Kaiser Permanente through E-Mail between Physicians and Patients.” *Health Affairs* 29, no. 7 (July 2010): 1370–1375. doi:10.1377/hlthaff.2010.0048.