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Broadband Technology Opportunities Program Evaluation Study

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Case Study Report

Zayo Group

Comprehensive Community Infrastructure

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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 Zayo, 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 Zayo project during field visits. From July 30 to August 1, 2013, the evaluation study team met with representatives of Zayo and CAIs connected by the project. In total, the evaluation study team performed seven site visit interviews. 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 Zayo, its partners, or its subgrantees.

About the Grantee

Zayo Bandwidth is a division of the Zayo Group, LLC. The Zayo Group, founded in 2007, is a global provider of bandwidth infrastructure services, including dark fiber, IP transport, and carrier-neutral colocation. The network footprint stretches over 74,300 route miles, providing connectivity in and between major metropolitan areas on dense metro and intercity fiber assets.[6] The Zayo Group's network serves 271 markets in 7 countries.[7] Within the United States, the network serves forty-six states and Washington, D.C. The network reaches more than 11,740 buildings, including over 500 data centers, over 500 carrier points of presence (POP), and thousands of enterprise buildings.[8] Zayo Group is a private business that has primarily grown by acquisition. For example, in Indiana, Zayo acquired Indiana Fiber Works (IFW) in 2007 and assumed ownership of its legacy network.[9]

The Indiana Middle Mile Fiber for Schools, Communities, and Anchor Institutions project proposed investing a total of $35.8 million in Indiana, including $25.1 million federal funds. Zayo completed the project in January 2013 with $28.3 million in expenses.

On February 1, 2010, NTIA awarded Zayo Bandwidth a BTOP CCI grant for $25,140,315 to implement the Indiana Middle Mile Fiber for Schools, Communities, and Anchor Institutions project. Matching funds totaled $10.7 million, or 30 percent of the project budget.[10] Altogether, the project planned to invest a total of $35.8 million in Indiana. Zayo proposed $6.3 million in matching funds and an in-kind contribution of 481 miles of fiber valued at $4.4 million. Zayo completed the project 27 percent under budget on January 31, 2013 after spending $28,274,326.

On June 30, 2011, Zayo Bandwidth merged with its parent entity Zayo Group, and stands as a separate business unit. Zayo Group assumed all rights, duties, and obligations of Zayo Bandwidth. This change did not affect the goals of the grant, the staff involved, or the project timeline. In this report, the term "Zayo" refers to the Zayo Bandwidth division, with the understanding that its legal structure has changed since the grant award.

Project Proposal and Status

Through the BTOP grant, Zayo planned to connect twenty-one Ivy Tech Community College (Ivy Tech) campuses to the I-Light network, Indiana's existing state-owned, high-speed network for education and research. Ivy Tech is Indiana's largest higher education institution serving nearly 200,000 students, and is the largest singly accredited community college system in the United States.[11] Zayo proposed the following, with results shown:

- Deploy a 626-mile fiber-optic network to provide 1 Gbps to 10 Gbps connections to 21 Ivy Tech campuses. This new connection will improve capacity between these campuses and the forty-two colleges and universities already connected to the I-Light network to advance research, education, and economic opportunities throughout Indiana.[12] As of March 31, 2013, Zayo had constructed 645 miles of fiber, including 545 aerial miles and 100 underground miles, and connected 21 Ivy Tech campuses to the I-Light network.[13] Each Ivy Tech site connection is at least 1 Gbps with the option to increase bandwidth up to 10 Gbps.[14]
- Spur affordable broadband service to local consumers in more than 100 communities along the route, over 70 percent of which are in underserved areas, by allowing local Internet Service Providers (ISP) to connect to the project's open network.[15] As of March 31, 2013, Zayo had

signed twenty-nine agreements with twenty-seven providers and was negotiating agreements with sixteen wholesale or last mile providers.[16]

- Provide 413 interconnection points along the route on a wholesale basis, enabling last mile providers to serve an area with an estimated 480,000 households, 49,000 businesses, and almost 4,800 CAIs, including health centers, schools, public safety organizations, and government offices.[17] As of March 31, 2013, Zayo had installed 1,651 slack loops and 935 interconnection points.[18] There is a slack loop at each interconnection point. The number of businesses and residents connected by last mile providers is not publicly available. Section 3.2 of this report describes Zayo's approach to open access in more detail.
- Leverage broadband to stimulate economic development and bolster the state's career and technical education offerings.[19] Upgraded connectivity enabled Ivy Tech to establish new workforce training programs. In 2012, Ivy Tech introduced the two-year Manufacturing Production Operations (MRPO) program, which has seen steady enrollment growth. The online program focuses on the development of skills and knowledge in modern manufacturing processes and technologies necessary for students to gain employment in advanced manufacturing environments. Students completing the program earn a two-year Associate of Applied Science (AAS) degree.[20]

Zayo accomplished the following from their proposed goals:

- Installed 645 miles of fiber
- Installed 1,651 slack loops and 935 interconnection points
- Signed agreements with 29 providers
- Connected 21 Ivy Tech campuses to the I-Light network
- Ivy Tech has introduced new course offerings, supported by the new connectivity

In addition, the Zayo grant made it possible for three additional institutions of higher education, Franklin College, Oakland City University, and Manchester University, to obtain a direct connection to the I-Light network. Zayo did not directly connect any other institutions.

I-Light operates under a memorandum of understanding (MOU) defining the network's mission to connect higher education institutions exclusively. In 2012, lawmakers codified I-Light's MOU into law, specifying that I-Light can connect higher education institutions, but cannot connect K-12, commercial entities, or healthcare facilities. However, any non-higher education institution connected to I-Light before the legislative session received grandfathered service agreements.

Major Outcomes and Impacts

Social and economic impacts observed by the evaluation study team are highlighted below, with additional detail provided in Section 2.

- Ivy Tech has saved money by connecting to I-Light versus other broadband providers. Price and capacity data provided for twenty-one Ivy Tech campus locations show that the average cost per megabit decreased from $115.39 to $1.44. Before the grant, many Ivy Tech campuses did not have 1 Gbps connections because of budgetary restrictions. In rural areas of the state, campuses had limited options for connectivity. Across campus locations, a 1 Gbps connection to I-Light costs $1,500 per month. The total estimated monthly savings is $9,200 across campuses or $110,400 annually.[21] I-Light secures lower costs through a contract with the

Through BTOP, the project achieved the following impacts:

- Ivy Tech saves $110,400 annually in broadband costs
- Ivy Tech saves $640,000 annually in hardware costs
- Improved distance learning and teleconference capabilities for students and teachers
- Improved last mile residential service offerings

Indiana GigaPOP negotiated by bulk purchasing on behalf of its members. The Indiana GigaPOP is the single service provider to Internet2 in the state, also providing location-neutral pricing and no-cost engineering consulting services to members.[22]

- Ivy Tech is working to consolidate servers in its data center. Ivy Tech pays approximately $2,000 annually for each local file server at separate campus locations. The locations with limited connectivity before the grant would not have been able to connect to the centralized server without obtaining a direct connection to I-Light. The Ivy Tech Chief Technology Officer (CTO) estimates eliminating 400 servers through this effort, and thereby saving the cost associated with the power, maintenance, and general upkeep of 500 servers.[23] Ivy Tech estimates it costs approximately $1,600 to support each server, thus the consolidation could result in an estimated annual cost savings of $640,000.[24]
- The increased bandwidth provided because of the BTOP grant allows Ivy Tech campuses to conduct more distance learning and video conferencing. Professors can teach a course in one location, and distribute the course via videoconference to remote campus locations. This improves the breadth of courses available throughout the Ivy Tech system, including paralegal, human services education, and health IT training; enhances student degree options; and reduces the amount of travel required for students.
- The connection to the I-Light network enables Manchester University (MU) to extend its existing research programs to collaborate with other I-Light university and college members. Research includes collaborations with Purdue University, Ball State, Indiana State University, Butler University, and Grace College. Discipline-specific research occurs in Chemistry, Education, Pharmacy, and Physics. MU purchased teleconference equipment shortly after connecting to I-Light, which included one permanent and two mobile teleconferencing units for the two MU campuses.
- Connecting to the Zayo fiber enables the Utilities District of Western Indiana (UDWI) rural electric membership cooperative (REMC) to save $500 per month, decrease service interruptions, and improve services to members. Before connecting to fiber, UDWI needed thirty seconds to read an individual utility meter, and twelve hours to complete a full meter data collection. It now takes less than two seconds to read an individual meter and four hours to complete a full meter data collection. Reliable connectivity improves communication to substation equipment, enabling UDWI to better monitor, predict, and respond to outages. Connecting to the fiber also enabled UDWI customer service representatives to field more calls by freeing up phone lines.
- Connecting to the Zayo fiber network lowers the price paid for wholesale broadband transport. For example, Sitco, one of the largest fixed wireless Internet providers in Indiana, pays Zayo $1,550 per month for a 400 Mbps point-to-point circuit to one tower site. Other fiber providers charge $1,550 per month for 100 Mbps. Connecting to the Zayo fiber will enable Sitco to triple the speed of its lower-priced offerings without increasing the cost of service.

Conclusions

Without the BTOP grant, it is unlikely that the twenty-one Ivy Tech campuses would have been connected to the I-Light network because it was cost prohibitive. Students and faculty now have access to educational resources using broadband. The connections enhance learning by providing more bandwidth at an affordable price. The network connects classrooms at remote locations with video streaming and high-definition learning tools such as telepresence for collaborative workspace in classrooms, online meetings, and video collaboration. Researchers at different campuses now have the ability to exchange large data files. Ivy Tech has access to supercomputers and scientific data storage that can advance collaborative research across campuses and with other universities. The connection to I-Light enables online education and high-speed connectivity to accommodate the needs of students and faculty. The BTOP grant has enabled Zayo to connect other institutions to I-Light, including Franklin College, Oakland City University, and Manchester University.

In addition, the project expands the Zayo Indiana fiber network by approximately 30 percent.[25] Zayo implemented an open access network that made it possible for twenty-nine last mile providers to expand the availability of broadband service in Indiana, as of March 31, 2013. Zayo was also in negotiations with sixteen additional providers. Zayo implemented multiple interconnection points to give all last mile providers and network subscribers equitable and reliable access to the Internet. The increase in bandwidth enables users of both wired and wireless devices to expand their use of the Internet and wide area network connectivity. The BTOP grant enables last mile providers to connect institutions of higher education, K-12 schools, businesses, energy providers, and telecommunication providers to the fiber network. This includes access to Internet2 and National LambdaRail, enabling enhanced research between all levels of educational users. It also provides opportunities for users in rural areas to access the Internet with increased bandwidth.

Zayo implemented an open access network that made it possible for twenty-nine last mile providers to expand the availability of broadband service in Indiana.

Section 1. Introduction

Zayo's goal was to directly connect twenty-one Ivy Tech Community College campuses to the I-Light network, Indiana's existing high-speed network for education and research, and to spur affordable broadband service by allowing local ISPs to connect to the project's open network across an eighteen-county area within Indiana. As shown in Figure 1, according to its grant application, Zayo serves the following counties: Allen, Bartholomew, Dearborn, Delaware, Elkhart, Fayette, Grant, Howard, Jefferson, Kosciusko, Lake, LaPorte, Madison, Monroe, Porter, Sullivan, Vanderburgh, and White. The evaluation study team identified connected CAIs in five additional counties: Gibson, Johnson, Marion, Tippecanoe, and Wabash. Throughout the rest of this report, references to the service area indicate the entire twenty-three county area shaded in the figure below. The fiber route, shown in black, includes route changes made by Zayo as of December 31, 2012.[26]

Figure 1. Zayo BTOP Service Area Map

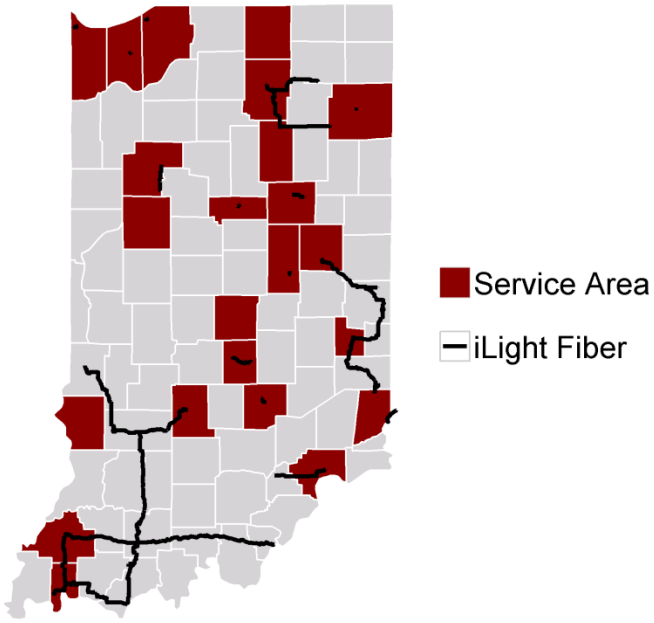


Table 1 presents current I-Light member institutions.[27]

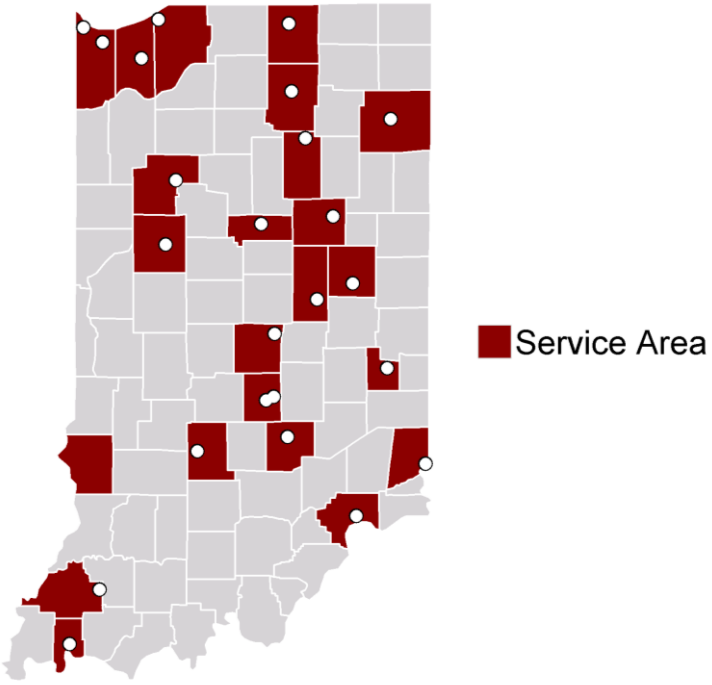
Table 1. I-Light Member Institutions

I-Light Member Institutions		
Anderson University	Indiana University	North Putnam Family Health Care
Ball State University	Indiana Wesleyan University	Schergen's Learning Center
Butler University	Ivy Tech Community College	State of Indiana
Calumet College of Saint Joseph	Lawrence County Community Learning Center	St. Joseph College
Depauw University	Manchester College	St. Mary's College
Earlham College	Martin County Community Learning Center	St. Mary of the Woods College
Franklin College	Martin County Courts	Taylor University
Goshen College	Martin University	Trine University
Grace College	Oakland City University	University of Evansville
Hanover College	Private Academic Library Network of Indiana	University of Indianapolis
Huntington University	Purdue University	University of Notre Dame
Indiana Department of Health	Purdue University County Extension Service	Valparaiso University
Indiana Institute of Technology Ft. Wayne	Putnam County Hospital	Vincennes University
Independent Colleges of Indiana	Family Medicine of Cloverdale	Wabash College
Indiana State University		

The American Community Survey (ACS) Five Year Summary for 2007 to 2011 shows that the service area's population of 3,618,134 represents about 56 percent of the population of Indiana.[28] According to the project's fact sheet, Zayo's network will enable last mile providers to reach about 480,000 households, 49,000 businesses, and 4,800 CAIs.[29] The service area has a higher population of Hispanic or Latino residents relative to the rest of Indiana, 8 percent as compared to 3 percent.[30] The income distribution, age distribution, and educational achievement in the service area are similar to the rest of Indiana.[31] Both the service area's unemployment rate (9.5 percent) and poverty rate (15.5 percent) are slightly higher than in the rest of Indiana.[32]

Figure 2 displays a map of Zayo's service area and the locations of the CAIs connected. I-Light purchased a ten-year Indefeasible Right of Use (IRU) for two strands of fiber to connect each Ivy Tech campus. The grant-funded dark fiber is limited only by equipment, which can run 10 Mbps to 100 Gbps.[33] I-Light provides each campus with 1 Gbps to 10 Gbps of Internet service. Zayo connected seventeen institutions by April 2012 and completed connections to all twenty-one Ivy Tech campuses by January 2013.

Figure 2. Locations of Connected Educational Institutions



According to the National Broadband Map (NBM), forty-one broadband providers offered service in the service area. Table 2 shows that 78 percent of service area residents had access to three or fewer broadband providers, compared to 89 percent of residents in the rest of Indiana.[34] All provider statistics use the June 2011 release of the NBM and 2010 population data from GeoLytics.

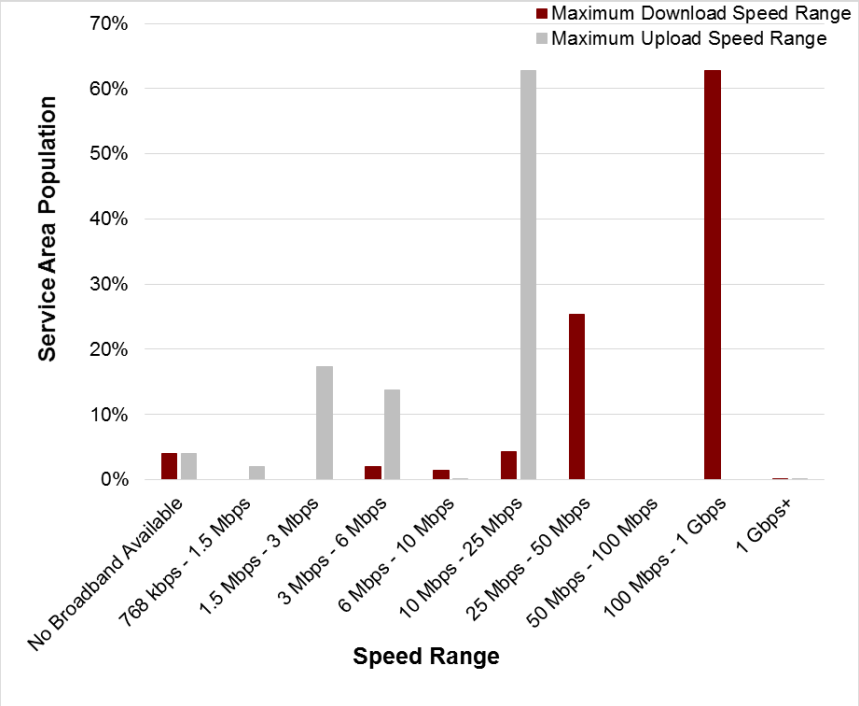
Table 2. Number of Broadband Providers Available in Indiana

Number of Providers	Service Area	Rest of Indiana
0	4.06%	10.22%
1	23.30%	28.19%
2	20.94%	32.38%
3	29.63%	18.21%
4	18.01%	6.99%
5	3.61%	1.58%
6	0.45%	2.22%
7	0.00%	0.21%

Figure 3 shows the percentages of the service area population with respect to the fastest download and upload speed range available to them.[35] The majority of the service area population had 100 Mbps to 1 Gbps download speeds available to them (63 percent) and 10 Mbps to 25 Mbps upload speeds (63 percent). Maximum download speeds range from 3 Mbps to 1 Gbps, and maximum upload speeds range from 768 kbps to 1 Gbps. Approximately 31 percent of the Indiana population outside of the service area had access to a maximum download speed of 25 Mbps or lower, compared to 8 percent of the service area population.[36] Eighty-five percent of the population of the

rest of Indiana is limited to 100 Mbps or lower as compared to 37 percent of the service area population.[37]

Figure 3. Maximum Speed Ranges Available for the Service Area Population



Federal Communications Commission (FCC) data from June 2012 show that 63 percent of the service area population subscribes to an Internet service that has at least 768 kbps download speeds and 200 kbps upload speeds.[38] Approximately 55 percent of the state's population subscribes to an Internet service with the same minimum thresholds.[39]

The evaluation study team met with Zayo staff, project partners, CAIs, and economic development professionals. These interviews helped the team understand the grantee's approach to project implementation, the strategies used to create demand for the broadband service, and the impacts on CAIs in terms of several factors, including the quality of service of the upgraded network, especially speed, reliability, and cost. The analysis in this report focuses on outcomes and impacts to CAIs. Interviews conducted include the following:

- Higher Education
  - The **Ivy Tech Community College** (Ivy Tech) serves more than 200,000 students per year at 31 locations throughout Indiana.[40] The college offers career and technical education and is the state's largest workforce training provider, awarding 20,000 certifications and delivering one million hours of training annually.[41] Ivy Tech is the largest provider of online courses in Indiana, and one of the largest online community college course providers in the country. Before receiving the grant-funded connection to I-Light, several Ivy Tech campuses operated at or near network capacity, limiting the ability of students and staff to perform basic online tasks. Without the grant, Ivy Tech would not have had the budget to connect the twenty-one campuses to the I-Light network. A 1 Gbps connection to I-Light costs each campus $1,500 per month. The total estimated monthly savings for all campuses is $9,200 per month, or $110,400 annually.[42]
  - **Manchester University** (MU) offers more than 55 areas of undergraduate study, 2 master's degree programs, and a professional doctoral program to 1,400 students.[43] The independent liberal arts school is located in North Manchester, Indiana. A four-year professional Doctor of

Pharmacy program is offered at a second campus in Fort Wayne, Indiana. In July 2012, Manchester College became Manchester University, and in August 2012, enrolled the first class in the College of Pharmacy. Before the grant, MU was a customer of I-Light, but not directly connected to the network. MU had a 100 Mbps Internet connection, for which they paid approximately $3,000 per month. MU determined that its connection was operating at full capacity and that they were in need of increased bandwidth. MU connected to I-Light approximately two years ago and pays slightly more than $3,000 per month for a 1 Gbps I-Light connection and a 350 Mbps Internet connection. The university also has a 1 Gbps I-Light connection between the North Manchester and Fort Wayne campuses. Without the grant, MU could not have obtained comparable capacity or a direct connection to I-Light, as the cost of last mile construction was beyond the scope of MU's budget.

- Last Mile Providers
  - **I-Light**, created and funded by the Indiana General Assembly in 1999, is the state's high-speed fiber-optic network for the research and education community. The I-Light network connects members with national educational and research networks, Internet2, and the National LambdaRail, an advanced research network.[44] I-Light provides members with a range of support resources including service desk, engineering, external connections, network design, and GlobalNOC services. I-Light operates under an MOU defining the network's mission to connect higher education institutions exclusively. In 2012, lawmakers codified I-Light's MOU into law, specifying that I-Light can connect higher education institutions, but cannot connect K-12, commercial entities, or healthcare facilities. However, any non-higher education institution connected to I-Light before the legislative session received grandfathered service agreements. I-Light directly connects Indiana colleges and universities with speeds from 1 Gbps to 10 Gbps with the ability to provide larger, on-demand wavelengths as necessary.
  - **Sitco**, headquartered in Evansville, Indiana, is a fixed wireless ISP serving Indiana and Illinois. Sitco also offers colocation, data connectivity, data backup and recovery, hosted Voice over Internet Protocol (VoIP), and virtual server and desktop services. Sitco provides maintenance service for Zayo in Evansville, hosts Zayo within its Evansville data center, and resells Zayo's circuits.
- Utilities Cooperative
  - **Utilities District of Western Indiana** (UDWI), a Touchstone Energy Cooperative, is a member of the Hoosier Energy Power Network serving over 19,000 meters in Indiana.[45] Zayo paid UDWI to increase utility pole heights and connect aerial fiber to the co-op's poles. Before the grant, UDWI only had access to wireless Internet service. UDWI pays $1,080 per month for 3 Mbps phone and Internet services through AT&T and $1,280 per month for 10 Mbps service through Zayo. Connecting via fiber significantly improved the reliability of service at UDWI's facilities. UDWI maintained its service agreement with its wireless provider, but transferred the bandwidth to support the phone system. This eliminated the need to purchase an additional T1 line for phone expansion, saving an estimated $500 per month.

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

- **Lincolnland Economic Development Corporation** (LEDC) engages in planning, marketing, and developing the Spencer County, Indiana economy. Formed to attract new business and retain existing investments in Spencer County, LEDC assists in business growth and relocation.[46] Zayo obtained information from LEDC about broadband and local economic conditions.

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

Section 2. Impacts

This section describes the impacts of the Zayo project in terms of the focus areas described in *Interim Report 1*, with the addition of the Government Services focus area.[47] These outcomes and impacts focus on understanding the effect on CAIs and service area communities. The CAIs began to expand services to meet the broadband and information needs of their customers after connecting to the fiber network. The Zayo project increased the demand for bandwidth at these locations rather than increase broadband adoption. Because the Zayo grant focused exclusively on directly connecting higher education institutions, the impacts primarily relate to Education and Training, and Workforce and Economic Development.

2.1 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, 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.

Zayo connected twenty-one Ivy Tech Community College campuses. Ivy Tech, one of two public, two-year institutions in the State of Indiana, serves over 200,000 students.[48] Although not originally within the scope of the project, the grant also connected Franklin College, Oakland City University, and Manchester University. There are 132 additional institutions of higher education located within Indiana. Students enrolled at the twenty-four locations connected to I-Light through the grant account for about 29 percent of Indiana's higher education student population.[49] More than 57 percent of students enrolled at campuses connected through the grant are female and approximately 31 percent are minorities.[50] This is comparable to the total Indiana student population where 57 percent are female and 28 percent are minorities.[51]

Connecting to the Internet via I-Light generates cost savings for Ivy Tech. Table 3 presents the estimated cost savings by campus. The total estimated monthly savings is $9,200 across campuses or $110,400 annually.[52] Price and capacity data provided for twenty-one Ivy Tech campuses show that the average cost per megabit decreased from $115.39 to $1.44. I-Light is able to obtain lower cost Internet access because of bulk purchasing on behalf of members and a contract for Internet through the GigaPOP. The GigaPOP goes out for bid for Internet access annually to ensure they obtain the lowest rates. I-Light pays for commodity Internet on behalf of its members and then charges members for use. Members are not charged for traffic between Indiana schools or over research and education networks, nor does this traffic count towards members' commodity Internet consumption. As a result, members achieve cost savings. For no additional cost, the Ivy Tech IT Headquarters, located on the Fairbanks campus, increased bandwidth to 10 Gbps from a combination of 150 Mbps OPT-E-MAN, switched Ethernet service, and 1 Gbps GigaMAN, dedicated, fiber-optic, point-to-point Ethernet transport service.[53] Before the grant, many campuses did not have 1 Gbps connections because of budgetary restrictions. In rural areas of the state, campuses had limited options for connectivity. Some Ivy Tech locations with 1 Gbps of connectivity did not increase speeds through connecting to the network but were able to realize cost savings. Ivy Tech campuses already paying $1,500 per month for a 1 Gbps fiber connection

benefitted from access to I-Light member services and resources, including the option to increase capacity on demand. Across campus locations, a 1 Gbps connection to I-Light costs $1,500 per month.

Table 3. Ivy Tech Campus Bandwidth Increases and Cost Savings

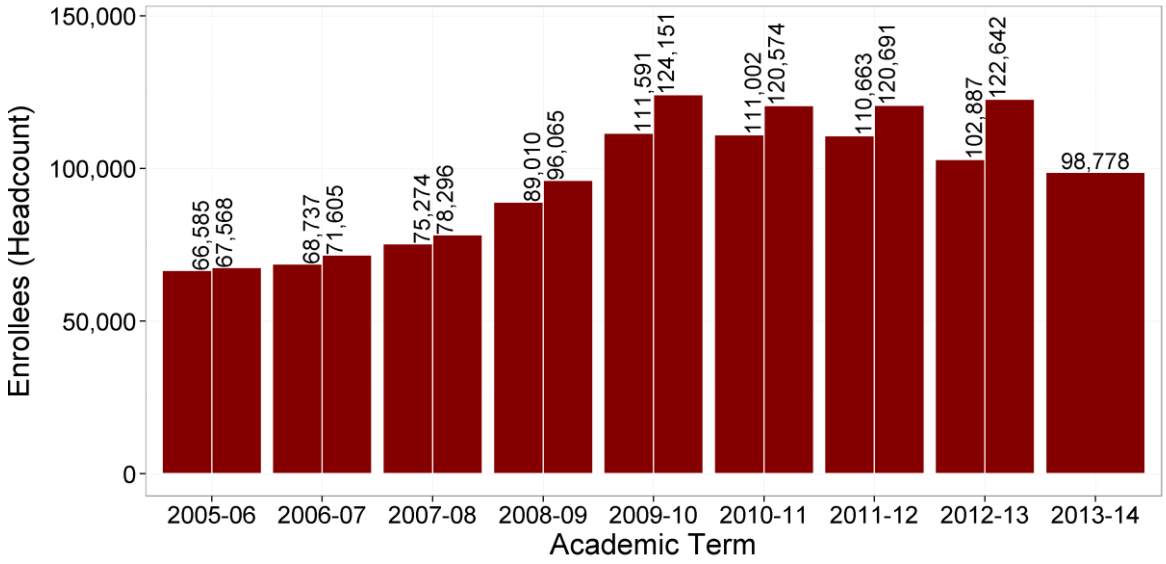
Campus	Previous Speed	Previous Connection	Previous Price	Current Speed	Current Price	Speed Increase	Savings/ Month
Anderson	1 Gbps	Fiber	$1,500	1 Gbps	$1,500	0%	$0
Bloomington	1 Gbps	Fiber	$1,500	1 Gbps	$1,500	0%	$0
Columbus	1 Gbps	Fiber	$1,500	1 Gbps	$1,500	0%	$0
Connersville	45 Mbps	DS-3	$2,500	1 Gbps	$1,500	2,122%	$1,000
East Chicago	45 Mbps	DS-3	$2,500	1 Gbps	$1,500	2,122%	$1,000
Evansville	45 Mbps	DS-3	$2,500	1 Gbps	$1,500	2,122%	$1,000
Fairbanks (IT HQ)	1.15 Gbps	OPT-E-MAN + GigaMAN	$2,500	10 Gbps	$2,500	770%	$0
Franklin	3 Mbps	T1 (2)	$2,200	1 Gbps	$1,500	33,233%	$700
Ft. Wayne	1 Gbps	Fiber	$2,000	1 Gbps	$1,500	0%	$500
Gary	1 Gbps	Fiber	$1,500	1 Gbps	$1,500	0%	$0
Kokomo	1 Gbps	Fiber	$1,500	1 Gbps	$1,500	0%	$0
Lafayette	1 Gbps	Fiber	$1,500	1 Gbps	$1,500	0%	$0
Lawrenceburg	45 Mbps	DS-3	$2,500	1 Gbps	$1,500	2,122%	$1,000
Madison	45 Mbps	DS-3	$2,500	1 Gbps	$1,500	2,122%	$1,000
Marion	1 Gbps	Fiber	$1,500	1 Gbps	$1,500	0%	$0
Michigan City	45 Mbps	DS-3	$2,500	1 Gbps	$1,500	2,122%	$1,000
Monticello	3 Mbps	T1 (2)	$2,200	1 Gbps	$1,500	33,233%	$700
Muncie (1)	1 Gbps	Fiber	$1,500	1 Gbps	$1,500	0%	$0
Muncie (2)	1 Gbps	Fiber	$1,500	1 Gbps	$1,500	0%	$0
New Elkhart	10 Mbps	Microwave (one-time cost)	$0	1 Gbps	$1,500	9,900%	-$1,500
Valparaiso	45 Mbps	DS-3	$2,500	1 Gbps	$1,500	2,122%	$1,000
Warsaw	6 Mbps	T1 (4)	$3,300	1 Gbps	$1,500	16,566%	$1,800

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.[54]**

- The Associate Vice President of Academic Online Programs at Ivy Tech reported that additional network capacity helps to support increasing student enrollment. Since the 2010-2011 academic year, Ivy Tech's enrollment began to stabilize across campuses. Figure 4 presents Ivy Tech enrollment aggregated across campuses.[55] Enrollment increased significantly following the recession between the 2007-2008 and 2009-2010 academic years. Since then, enrollment plateaued for two years. Enrollment estimates show a decrease for the 2013-2014 academic year; however, spring numbers are not yet final.

Figure 4. Ivy Tech Enrollment

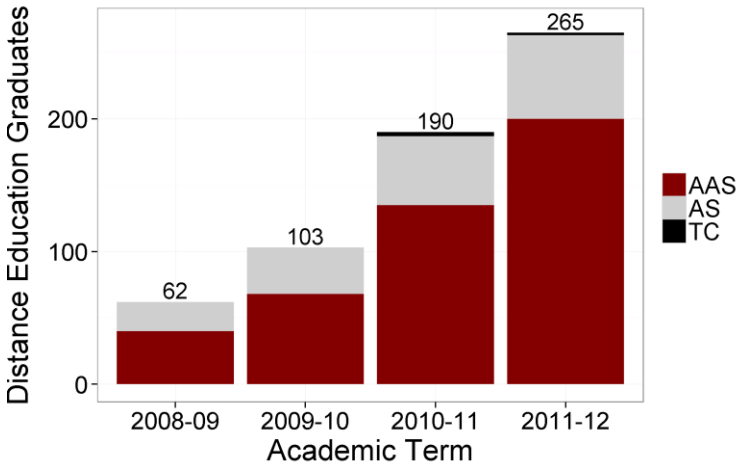


- Improved connectivity enables the extension of educational programs to additional Ivy Tech campus locations, furthering students' degree options. Sufficient bandwidth enables professors to teach a course in one location, and distribute the course via Internet to additional campus locations. This improves the breadth of courses available throughout the Ivy Tech system, enhancing student degree options, and reduces the amount of travel required for students. Ivy Tech offers several programs "at a distance" to serve remote locations. These locations could not individually offer the full suite of Ivy Tech programs because of limited student populations. Such scenarios were the stimulus for Ivy Tech to introduce distance learning fifteen years ago to ensure that the distance to campus locations would not deter participation in students' educational program of choice. Distance learning allows Ivy Tech to combine cohorts of students, ensuring there is sufficient demand to support the provision of particular programs. Students are able to engage in courses at local campuses instead of commuting significant distances, saving students' time and money. Without the capacity obtained through the BTOP grant, the rural campuses would likely not be able to offer degree programs such as paralegal or human services education. Many programs would only be available at the Indianapolis campus, which supports the largest cohort of students.
- Connectivity to the I-Light network helps to ensure reliable access to a wider range of courses and degree options to support a growing student population. By connecting twenty-one additional campuses to the I-Light network, the grant helped to ensure that regardless of students' location, all had access to the same quality of service. The increased bandwidth facilitates rural campuses' ability to conduct distance learning, and allows classrooms to use video conferencing, which was previously not feasible. Additionally, improved connectivity enhances the stability and viability of online testing programs and courses that require Internet resources. Improving the availability of programs enhances the number of students able to achieve degrees or certifications. The total number of degrees awarded at campuses

that received grant-funded upgrades more than doubled between 2008-2009 and 2011-2012.[56] Based on the recent growth in degrees awarded, the expansion of course and degree options, and improvements in the quality of technological resources, it is likely that Ivy Tech campuses connected by the Zayo BTOP grant will continue to realize growth in degrees conferred.

- Before the grant, Ivy Tech Connersville obtained connectivity through the Richmond campus. The Connersville campus had limited ability to run applications and use web-based services. For example, they could run one two-way video conference, which often interfered with e-mail service. Now, the campus is able to operate video conferencing, IP telephone, and other applications simultaneously.
- Upgraded connectivity strengthens the breadth of the distance education program. Ivy Tech offers approximately 350 online classes and 12 online degree programs. In 2013, Ivy Tech reported more than 32,000 students were enrolled in online classes.[57] Online students interact with their classmates and learn from the same instructors who teach classes on campus.
- Ivy Tech reported that the upgraded network capacity provided by the Zayo BTOP grant will support continued growth in the successful completion of distance education degrees. Figure 5 presents Ivy Tech degrees and certificates conferred to distance education students.[58] The number of distance education degrees and certificates awarded has increased steadily since the 2008-2009 academic year. The most common type of degree awarded via distance education is an Associate of Applied Science (AAS), followed by Associate of Science (AS). Relatively few Technical Certificates (TC) are awarded via distance education.

Figure 5. Ivy Tech Distance Education Degrees and Certificates Awarded



- Connection to I-Light enabled MU to expand its course offerings through collaboration with other institutions. MU collaborates with other independent colleges in Indiana, sharing resources and classes. MU indicated that before obtaining the direct connection to I-Light, capacity limited resource sharing with other institutions. MU is engaged in an initiative to share faculty resources with other regional schools. The institutions have discussed sharing Peace Studies courses using video conferencing and online class systems. In this case, MU would offer courses on-site, while students from other institutions would remain at their local campus and connect via video.
- Faculty members in the MU College of Pharmacy often engage in shared research with Purdue and Butler. Research is important for faculty development at the College of Pharmacy. It was not possible to engage in shared research before the I-Light connection. MU purchased teleconference equipment shortly after connecting to I-Light, which included one permanent and two mobile teleconferencing units for the two campuses.

- MU intends to establish an online education program. The program is currently in the incubation stage as MU evaluates the channels through which I-Light can facilitate the program's implementation and growth. MU currently has a limited number of classrooms available to support online education and will likely need to invest in space and equipment. MU will likely make the General Education courses available online; however, administrators have not discussed additional programs that will be included. MU's online education program would be available to domestic and international students. Without the I-Light connection, increasing online educational opportunities would not have been a possibility.

- **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.[59] The use of digital tools enabled by broadband can also save teachers time, allowing them to devote more effort to instruction.[60]**
  - Enhanced connectivity enables Ivy Tech instructors to incorporate multimedia applications into on-site and online classes that previously would have been inaccessible because of bandwidth constraints. Instructors stream videos using services such as Netflix to supplement course material. Before the grant, instructors at campus locations with limited bandwidth did not have the option to incorporate multimedia materials into course instruction. For example, streaming videos was not feasible at campuses operating on T1 connections.
  - Clinical space is often a challenge for health programs. Ivy Tech is working with the State Board of Nursing and other accrediting agencies to develop a program with simulation manikins to complete a portion of clinical time. Ivy Tech conducts training simulations with the manikins that can be shared across locations. As faculty develops new simulations, the network enables the content to be shared with other campuses. With the upgraded connection, students at all campus locations can engage in simulations despite clinical space limitations.
  - Ivy Tech is offering new bandwidth-intensive health IT training. The program incorporates video, audio, and simulation content into training materials. Training content is disseminated to smaller sites that previously did not have the capacity to support such applications. Much of the multimedia-based course content could not have been implemented without the additional capacity supplied through the I-Light connection.
  - The grant-funded connection to I-Light enables Ivy Tech to share software licenses so that programs can be accessed at all relevant campus locations. Limited connectivity prohibited floating licenses, requiring Ivy Tech to install them on several physical machines. Installing expensive software packages on PCs was not cost effective for smaller campuses. For the software packages for which the option is viable, floating licenses enable all students to access the programs, regardless of campus location. Ivy Tech is investigating strategies to extend remote access to additional programs such as AutoCAD and Pro/ENGINEER. This would help to increase program dissemination and reduce costs. Ivy Tech would like to virtualize the program, allowing students to access AutoCAD from their homes. This would also save Ivy Tech of having to purchase the program for smaller locations with limited student demand. Ivy Tech intends to employ this strategy across academic programs, enabling students to complete or engage in assignments and activities from any location.
  - In the past, Ivy Tech offered Cisco certifications, including Cisco Certified Networking Associate (CCNA) and Cisco Certified Networking Professional (CCNP) at multiple campus locations, requiring Ivy Tech to purchase identical equipment for each facility. Ivy Tech has since relocated the equipment to the data center. Increased bandwidth enables students to access the equipment from any area in the state. The CTO stated that this system has generated a significant cost savings for the institution and for students. Previously, students at smaller campuses commuted to campuses that housed the equipment to complete the relevant training.
  - Ivy Tech is implementing an e-book program for twenty-two classes in the fall 2013 semester where all course material will be provided in a digital format. Ivy Tech reported that it was not

feasible to implement an e-book program before obtaining improved network capacity. Ivy Tech intends to use its grant-funded connection to I-Light to expand this service to additional courses in coming semesters. E-books are a more affordable alternative to traditional textbooks. For example, the cost of the textbook for Ivy Tech course Math 136 is about $178. About 3,000 students per semester take this course. Ivy Tech is implementing the e-book program in this course this semester. The e-book includes a homework simulator and costs about $106. Each of the approximately 3,000 enrolled students saves about $70 with the e-book, for an overall savings of $210,000 per semester. Additionally, many faculty favor e-books as they often include digital homework simulators. As Ivy Tech expands the program to additional courses, e-book prices will likely decrease.

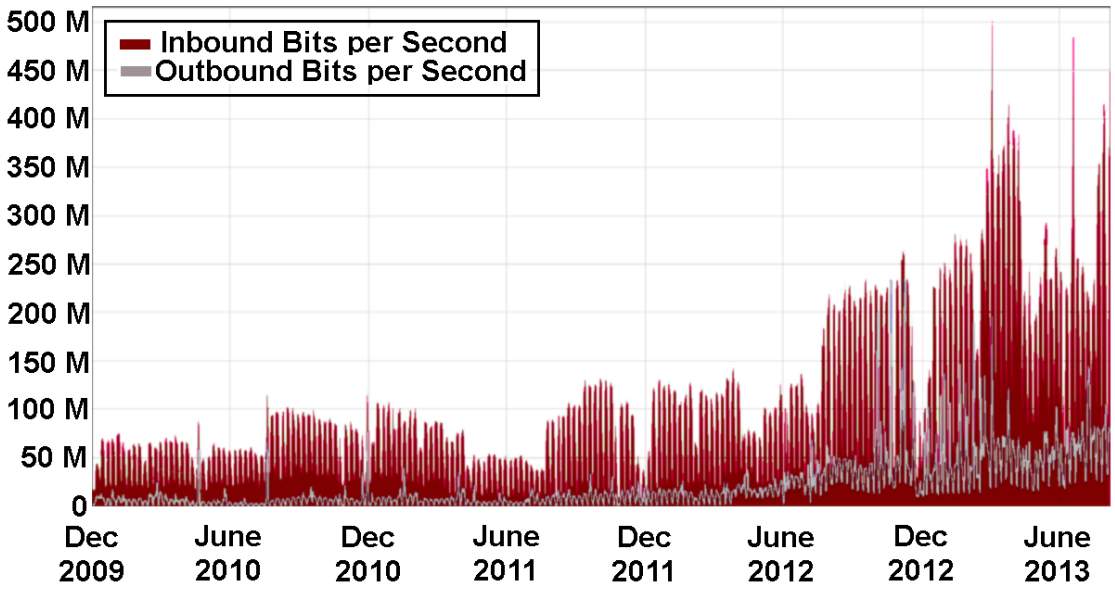
- Ivy Tech offers two courses, Political Science 101 and English 112, which do not use textbooks. Instead, the courses use free downloads of open resources. Additionally, other courses use free downloads of open resources, saving students a significant amount of money. Before upgrading bandwidth, Ivy Tech could not have offered such options. Ivy Tech intends to prepare faculty to offer more textbook-free courses to reduce the economic burden on students.

- **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.**[61]
  - Strengthening I-Light improves the educational landscape for Indiana. I-Light has enabled a community forum for information sharing. In addition to providing more bandwidth than most Indiana colleges and universities could otherwise afford, the network provides a variety of other capabilities such as connecting classrooms at distant locations with high quality video streaming and allowing researchers at any location to exchange large digital data files and access supercomputers and scientific data storage facilities. It makes possible multi-campus collaborative research projects and enables the use of high definition learning tools. In addition, I-Light works to facilitate collaboration between members. I-Light hosts member meetings, and consistently talks to members about their needs. I-Light assists in facilitating discussion between network members to address issues such as collaboration and data sharing. Connection to the I-Light network enables Ivy Tech campuses to share resources in the digital library collections throughout the system and access Research and Education library collections at other colleges and universities in the network.
  - Since connecting to the I-Light network, MU has extended research programs to collaborate with other I-Light members. Many MU faculty members involve students in research across several academic domains. In addition, MU collaborates with Purdue University, Ball State University, Indiana State University, Butler University, and Grace College to support research efforts. Collaborative research efforts that leverage I-Light include those within Chemistry, Education, Pharmacy, and Physics.
  - Ivy Tech has an institution-wide policy requiring all faculty members to use Blackboard learning management systems (LMS), a virtual learning platform and course management system. Before obtaining the upgraded connectivity, it would not have been possible to implement this policy, as some aspects of Blackboard are bandwidth-intensive. Multiple people attempting to view video content simultaneously would saturate connections almost immediately at some locations. Operating a single, institution-wide LMS helps to facilitate collaboration and improve productivity.
  - Ivy Tech is in the beginning stages of establishing a collaborative arrangement with Indiana State and Ball State University related to LMS. The institutions operate similar technology infrastructure systems, such as Banner and Blackboard, and are interested in leveraging collective knowledge and resources to improve their ability to service student populations. Ivy Tech staff does not think it would be possible to engage in this collaboration if it did not have the technological capabilities provided through the grant.
  - Within the Ivy Tech administrative offices, staff members use video conferencing. I-Light improved the implementation of this service. Ivy Tech believes there are many additional opportunities for video conferencing that the institution has yet to adopt. Before obtaining

increased capacity through the grant, there was an antiquated video conferencing system in place, which often malfunctioned. Ivy Tech would like to enhance the provisioning of video conference services, an endeavor that was previously outside the scope of the budget and technical capabilities.

- I-Light connectivity is beneficial because it allows Ivy Tech to increase the bandwidth to locations as necessary. I-Light offers Ivy Tech capacity of 1 to 10 Gbps. Based on network usage data, Ivy Tech anticipates that the 1 Gbps connections will support the institutions connected by the grant for the foreseeable future. Ivy Tech monitors network usage using a system that triggers an alarm if utilization passes 80 percent. The alarm has not sounded for any campus operating on a 1 Gbps connection. The IT department works in concert with academic staff to ensure the feasibility of any bandwidth intensive activity. Figure 6 presents bandwidth consumption aggregated across Ivy Tech campuses, which increased substantially between June 2011 and June 2013 as Zayo connected additional campuses to the I-Light network.[62]

Figure 6. Ivy Tech Bandwidth Consumption



- Connecting to I-Light permits Ivy Tech to implement applications and services to enhance operational efficiencies. Connection to Internet2 enables Ivy Tech to use Amazon cloud services. The Internet2 connection to Amazon will enable the back office to implement new initiatives using the cloud services. Supporting nearly 200,000 students and almost 8,000 faculty and staff generates a significant amount of data.[63] Ivy Tech is also working with Amazon to support data warehousing and analytics. This would not be feasible without a connection to Internet2.
- Ivy Tech uses Banner Document Management System (BDMS). Before the grant, some locations struggled to use the system because their connections prohibited them from uploading larger files. Network utilization reached 100 percent, which slowed down bandwidth and limited the Internet-based activity at these locations. The enhanced capacity through I-Light alleviated this issue.
- Network reliability improves operations. In the past, if a building or campus lost connectivity, Ivy Tech would send an e-mail to notify administrators, faculty, and staff that a particular campus would be unreachable for an extended period. The Director of the White County Instructional Center at the Lafayette campus indicated a notable difference in speed and markedly fewer outages, which has a direct effect on education.

2.2 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 and broadband helps to reduce unemployment by enabling job seekers to engage in training programs, facilitating job seekers' ability to search and apply for open positions online, and reducing geographic limitations associated with employment search.[64] Capabilities help to improve job matches by broadening the range of open positions obtainable by job seekers. Consequently, improved job matches increase employee productivity.[65]**
  - Ivy Tech's workforce training programs benefit local businesses by generating a qualified pool of applicants. Ivy Tech offers a wide range of academic and workforce training programs for students. One element of Ivy Tech's mission as a statewide community college system is helping Indiana's businesses improve the quality and competitiveness of their workforce and stimulate economic development throughout the state. Connecting additional campuses to the I-Light network through the Zayo BTOP grant enables Ivy Tech to enhance academic and workforce training programs at additional campus locations by enabling the incorporation of new applications and increasing the provision of digital learning opportunities. For example, upgraded connectivity has allowed Ivy Tech to establish new workforce training programs. In 2012, Ivy Tech introduced the two-year Manufacturing Production and Operations (MRPO) program, and has observed steady enrollment growth. The online program develops the skills and knowledge of modern manufacturing processes and technologies necessary for employment in advanced manufacturing environments. Students completing the program earn a two-year Associate of Applied Science (AAS) degree.[66]
  - Ivy Tech offers training programs that facilitate relationships between students and potential employers. Enhanced connectivity increases the feasibility of collaboration between employer and student, better preparing students to enter a position with the employer upon graduation. For example, in Warsaw, Indiana, there is a large concentration of orthopedic manufacturing facilities producing orthopedic products. Campuses in the area work closely with manufacturers to provide relevant job training and educational programs. Ivy Tech Corporate College recently developed an Orthopedic Quality Standards and Technical Skills Certificate Program in partnership with OrthoWorx. The curriculum trains the industry's workforce with technical skills related to orthopedic quality standards. The Ivy Tech Orthopedic and Advanced Manufacturing Training Center (OAMTC) located in Warsaw hosts the courses. Orthopedic device industry professionals provide classroom instruction.[67]
  - Ivy Tech Corporate College has a relationship with Cummins Engines in Columbus, Indiana, which has a significant operation in China. Ivy Tech has sent staff to China to facilitate a distance learning relationship. The feasibility of distance education enabled this relationship to expand to other higher education institutions within the same province in China.
  - Ivy Tech nursing courses provide students skills for medical charting through collaborations with local hospitals. This enables graduates of the nursing program to enter a position with

competence in the particular charting applications of the hospital of employment. Students use a virtual private network (VPN) to access medical charts at hospitals.

- MU now offers online interviews and internships. Students can work remotely from the Manchester campus if employers agree to the arrangement. Students use Skype to conduct web-based interviews. MU students completed approximately one dozen online interviews and three internships during the 2012-2013 academic year.[68] MU also conducts interviews with potential students, faculty, and staff using Internet-based tools.

- **Workforce and Economic Development activities supported by broadband infrastructure strengthen job and population growth.[69]**
  - Through its relationship with Zayo, Sitco introduced new services and increased revenues, resulting in the company's expansion. Before working with Zayo, Sitco was exclusively a wireless ISP and data center company. Collaboration with Zayo enabled Sitco to expand its range of service offerings to include the following:
    - Sitco colocates Zayo and other carriers in its data center and serves as a cross-connect point for third party providers. Zayo's presence in the colocation facility increases the number of agreements with third party providers, which increased revenue for Sitco.
    - Sitco signed a multi-year agreement to provide maintenance service for Zayo in the Evansville, Indiana area. According to the contract, Sitco installs microwave dishes and fiber endpoint equipment, and provides maintenance for about thirty carrier towers for approximately $60,000 per year.
    - Sitco uses Zayo to obtain point-to-point transport circuits to some of the towers for its wireless business. The grant also creates an opportunity for Sitco to resell Zayo circuits for revenue.
  - As a result of the service expansion, Sitco brought on additional staff and created three new business units to support cross-connects, fiber resale, contractual tower work, and contractual maintenance and monitoring work. Sitco reported hiring several additional employees to support the provision of services to Zayo. The president reported that the project has been a valuable educational experience, and employees' skill sets have improved.

- **New or enhanced connectivity benefits businesses by enabling the use of applications and processes that increase productivity and efficiency.[70]**
  - Connecting to the Zayo fiber enabled UDWI to realize cost savings and improve network speed and reliability. Before Zayo's fiber build, UDWI relied on wireless Internet service, which weather frequently disrupted. UDWI supplemented the wireless connection with a 3 Mbps connection from AT&T. Connecting via fiber significantly enhanced the reliability of service at UDWI, helping to prevent service interruptions. UDWI pays $1,080 per month for 3 Mbps phone and Internet services through AT&T and $1,280 per month for 10 Mbps service through Zayo. UDWI maintained its service agreement with AT&T, but transitioned the bandwidth to support the phone system. Before upgrading, UDWI shared bandwidth to support the phone system and internal Internet-based applications and activities. Bandwidth obtained through the Zayo connection prevented UDWI from having to purchase an additional T1 line to implement a phone system expansion, saving $500 per month. The savings generated through the Zayo service contract will allow UDWI to allocate funds to more productive channels.
  - Using the Zayo connection to reallocate bandwidth from the AT&T connection to support the phone system expansion enabled UDWI to save time when conducting mass calls. In the past, it would require two to three days to complete calls to customers informing them of an impending service disconnection. They are now able to accomplish the same task in an afternoon. UDWI is looking into leveraging the increased capacity to adopt a VoIP phone system.
  - Improved network connectivity enables UDWI to realize a substantial improvement in meter reading capabilities. Before connecting to fiber, employees required twelve hours to complete a full meter data collection and thirty seconds to read an individual meter. It now

takes four hours to complete a full meter data collection, and less than two seconds to read an individual meter. UDWI is using the same system to read the meters, although it is now operating on an improved connection.

- Improved network connectivity enhanced UDWI's ability to respond to storm-related outages. Connecting to the fiber enabled UDWI customer service representatives to field more calls by freeing up phone lines. UDWI is able to reinstate communications to key areas and provide faster responses to affected consumers. During severe weather, customers and public safety agencies often attempt to contact UDWI for service. Reducing the time required to complete meter data collection enables UDWI to confirm meter status more quickly and accurately during storms. Reliable connectivity improves communication to substation equipment, enabling UDWI to better monitor, predict, and respond to outages.
- UDWI intends to use improved connectivity to adopt additional programs and applications to enhance operational efficiency. UDWI is working to leverage the improved connectivity to increase the level of automation in the field by acquiring additional pieces of equipment that can communicate back and forth with the office. For example, mechanisms to minimize disruptions associated with outages include substation reclosers to close a circuit breaker automatically after it opens improperly, and regulators to control voltage. Upgraded connectivity provides enough bandwidth to connect the UDWI office to Supervisory Control and Data Acquisition (SCADA) equipment in its substations. Currently, UDWI has fifteen of eighteen substation sites connected and communicating with such tools. They recently entered an agreement to purchase equipment to monitor voltage and fault. UDWI reported that most of its switches enable the use of alternate feeds. UDWI is working with a company to integrate automated equipment that could be controlled from the office to replace manually operated switches. During the last storm, the switches saved about 4,000 customer hours of outages. UDWI estimated they could save additional hours with an automated system controlled at the office. UDWI anticipates improving customer service by improving its ability to get customers back on sooner.
- The improved connectivity enables UDWI to achieve redundancy for its systems. It is virtualizing systems, and moving systems off-site. Currently, its main billing and accounting systems are housed in Georgia. This would not be possible if they did not have adequate connectivity on-site.
- Connection to I-Light helped to facilitate Ivy Tech's transition towards a standardized telephone system. Ivy Tech campuses, divided into fourteen distinct regions, opted for different phone systems based on the preferences of senior administrators. Ivy Tech will standardize the systems and adopt a Session Initiation Protocol (SIP) trunking system, which the CTO anticipates will save a significant amount of money. Currently, the Fairbanks location supports 132 phone lines, shared across 2 buildings. Ivy Tech pays for the 132 lines to support simultaneous phone calls during class registration periods. Although the 132 lines are used approximately 6 weeks per year, it is more cost-effective to pay for the additional lines than incur the cost of deactivating and reactivating lines multiple times per year. SIP trunking will allow Ivy Tech to maintain a minimum number of hard lines, and use the Internet for additional demand.
- The new connectivity allowed Ivy Tech to consolidate its servers in its data center. Before the grant, bandwidth was insufficient to connect to the data center, thus the locations had to store files locally. Enhanced connectivity enables these locations to connect to the data center and ensure files are backed up, improving the security of data. Ivy Tech pays approximately $2,000 annually for each local file server at separate campus locations. Locations with limited connectivity before the grant would not have been able to connect to the centralized server without obtaining a direct connection to I-Light. The Ivy Tech CTO estimates eliminating 400 servers through this effort, and thereby saving the cost associated with the power, maintenance, and general upkeep of 500 servers.[71] Ivy Tech estimates it costs approximately $1,600 to support each server, thus the consolidation could result in an estimated annual cost savings of $640,000.[72] The I-Light connection improved the functionality of MU's internal systems. I-Light enables MU's two campuses to serve as

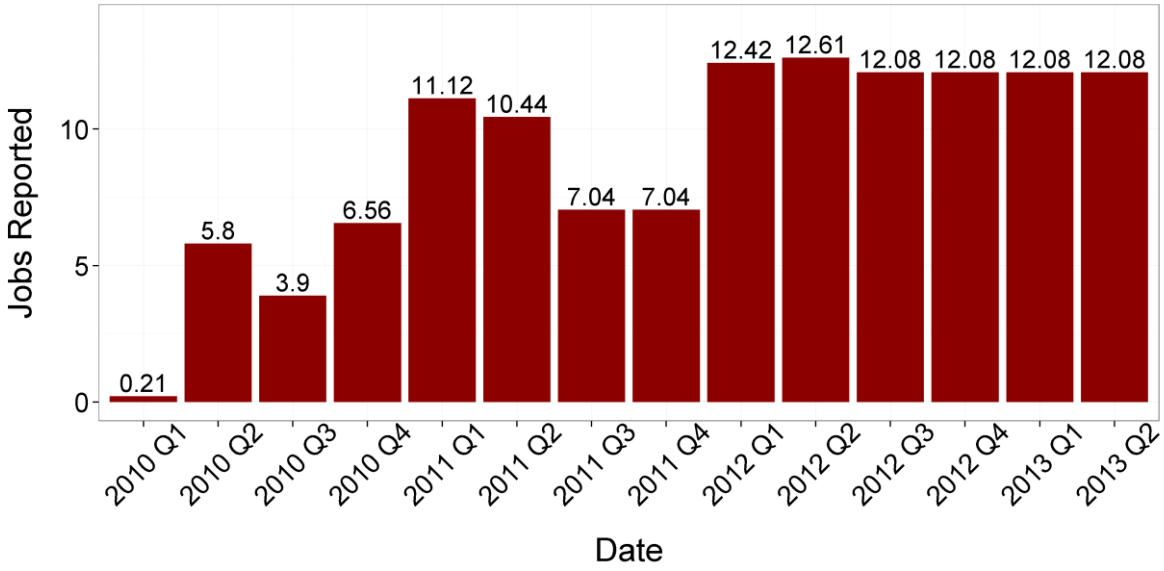
disaster recovery sites for each other. Each campus now serves as the backup server for the other. MU provides redundant servers across campuses, providing for high availability.

- **Broadband access allows businesses to enhance marketing strategies by growing or establishing a web presence, increasing the frequency of customer interaction, and thereby increasing customer bases.[73]**
  - Connecting to Zayo's fiber network improves the speed and reliability of the UDWI website and the bill payment processor for web payments. Additionally, UDWI recently introduced an online storefront on its website, selling a wide range of energy efficient products.[74] Customers had the option to pay bills online before the upgraded connection, however, the site's connection was often subject to disruption. UDWI is working to provide meter data on its website, allowing customers to access usage information. Before connecting to Zayo fiber, UDWI was unable to transmit data of this scope, which generates a data point per customer, per hour. UDWI is also working to expand paperless communications. They intend to examine different payment and notification options. UDWI is in the process of implementing a text messaging communication service. Fiber connectivity also provides the speed necessary for UDWI to host a web-based outage map.
- **The availability of infrastructure in a community enables firms reliant on broadband services to relocate or open additional locations. Local businesses are able to obtain improved access to inputs and markets.[75]**
  - Connecting to the Zayo fiber network enables Sitco to improve its last mile residential service offerings and grow its customer base. Sitco reported that before Zayo, four fiber carriers operated in the area. Zayo's presence lowered the price point for transport services. For example, Sitco pays Zayo $1,550 per month for a 400 Mbps point-to-point circuit to one tower site. Other fiber providers charged $1,550 per month for 100 Mbps**.** Sitco intends to improve wireless Internet service to current customers by increasing the speed and quality of service. Connecting to the Zayo fiber will allow Sitco to improve the speed tiers available to consumers without increasing prices. Currently, Sitco customers can purchase four different service packages, ranging in price from $39 to $69 per month, with each speed tier costing an addition $10 per month. Sitco will triple the speeds of the three lowest tier packages without raising the price. Sitco will double the speed of the fastest package to 3 Mbps. Eventually, Sitco intends to leverage the fiber to increase speeds up to 7 Mbps.
  - The Zayo fiber build enables Sitco to expand its service offerings to include fiber to the home services. In economically feasible locations, Sitco intends to use the Zayo fiber to build out to residences and capitalize on unrealized potential in rural markets. Sitco has a VoIP service and contracts with dish providers to offer a triple play package. Without the grant-funded fiber build out, offering such services would not be feasible. To support fiber to the home services, Sitco anticipates hiring additional employees. Sitco is in the process of becoming a competitive local exchange carrier (CLEC), which will enable them to obtain access to pole space and other facilities. Specifically, they are becoming a non-facilities based CLEC, which means they will not have caged space in the incumbent local exchange carrier (ILEC) as they have facilities on-site.
- **Broadband connectivity enables increased telework opportunities.[76] Broadband access to facilitate such capabilities is especially significant to economic growth in geographically remote areas.[77]**
  - Telework arrangements can help organizations recruit new employees with hard-to-find skill sets, or retain current employees who move because of spouse relocation or other life changes. Access to reliable connectivity expands Ivy Tech's pool of qualified applicants. The Associate Vice President of Online Academic Programs estimated that about 20 percent of Ivy Tech faculty members are located out-of-state. This would not have been possible prior to the BTOP grant. The grant enabled a more stable network and technology platforms. Ivy Tech is now able to conduct nationwide searches for faculty to teach online courses, whereas before this was not possible. Connectivity enhances business operations, which helps administrators and faculty complete work more efficiently. Ivy Tech employs a number

of administrative staff members who do not work on-site. Service limitations are no longer an impending activity to deter faculty from joining Ivy Tech.

As required by the Recovery Act, Zayo reported the number of jobs created quarterly as a direct result of the project. As shown in Figure 7, Zayo funded an average of nine full-time equivalent (FTE) positions during the fourteen consecutive quarters beginning quarter one of 2010.[78] The largest number of jobs funded in a quarter thus far is 12.6, which occurred during the second quarter of 2012.[79] It is important to note that this only includes direct jobs created, and does not include indirect or induced job creation.

Figure 7. Direct Jobs Created by Zayo



2.3 Government Services

One of the five core purposes established by the Recovery Act was to "improve access to, and use of, broadband service by public safety agencies." [80] The Government Services focus area identifies how broadband improves services provided by government organizations to the public and includes both the provision and administration of public safety activities. Examples of public safety agencies include law enforcement agencies, fire departments, and emergency medical services (EMS). Some potential government service impacts include enhanced government efficiency, improved ability to save lives and reduce injuries, prevention of criminal activity, and improved information sharing between citizens and public safety entities.

UDWI anticipates improved connectivity will enhance its ability to address power outages. UDWI provides service to fire stations, volunteer fire departments, a regional airport in Bloomington, several schools, and government contractors through the Crane Naval Base. UDWI explained that during severe storms, fire departments and schools serve as emergency shelters. UDWI's emergency response plan ensures shelter locations are the first to get power in the event of an outage. An automated switching scheme, enabled by improved connectivity, will help to provide service. Most shelters are located in more dense areas where an alternate feed is generally available.

Section 3. Grant Implementation

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

3.1 Implementation

Zayo, a privately held company, is a global provider of fiber-based bandwidth infrastructure solutions. Services provided by Zayo include dark fiber, synchronous optical networking (SONET), Ethernet, IP services, and carrier-neutral colocation and interconnection. The company operates as a middle mile provider. The Zayo middle mile network provides bandwidth that is available to carriers, last mile providers, anchor institutions, and businesses. Zayo directly connects organizations if the option is financially viable for both Zayo and the customer.

Zayo purchased Indiana Fiber Works, LLC (IFW) October 2, 2007, enabling Zayo to leverage a dark fiber and conduit network and provide greater latitude for business in the market as a provider of dark fiber in Indiana. IFW, founded in 1998, provides services to private networks, wholesale, and retail communication networks. Through the purchase, Zayo acquired more than 2,000 route miles of fiber. IFW is now a subsidiary of Zayo Bandwidth.

Zayo established a partnership with I-Light to apply for the BTOP grant. I-Light's goals for expansion of its fiber backbone coincided with the goals of the BTOP grant. I-Light served several of Ivy Tech's core campuses before the grant and recognized their bandwidth and funding constraints. As a state-funded institution, connectivity options for rural campuses were often cost prohibitive for Ivy Tech. Ivy Tech selected the list of twenty-one campuses to connect to the network. I-Light and Zayo examined the local populations surrounding the campuses to determine if they met the grant's requirements for unserved or underserved and also evaluated business opportunities within those areas. I-Light was aware of the areas of the state that were challenging to serve, and was able to leverage the grant to reach these regions.

Zayo made a limited number of changes to its initial network route design. Zayo met with state representatives, mayors, and community leaders before the build out to generate public support for the project. Several mayors requested minor route alterations to reach specific locations within their communities, which Zayo accommodated if feasible. Zayo indicated that although it would have been preferable to make slight alterations to the network route to avoid negotiating with pole-owning utilities, obtaining the approval for the corresponding adjustments to the Environmental Assessment would have jeopardized Zayo's ability to complete the project on schedule.

The Zayo project deployed a 645-mile fiber-optic network, adding to its existing 2,750-mile network across the state of Indiana. Zayo provided 481 miles of fiber from its existing network as an in-kind contribution. Zayo constructed the network using a combination of aerial and underground fiber. The company spent approximately $54,263.56 per construction of each new mile.[81] The BTOP project expanded the Zayo Indiana fiber network by approximately 30 percent.

I-Light specified the feasible distance of Ivy Tech campuses from interconnection points. Campuses that exceeded the distance limitations required amplifiers. For example, the Warsaw campus is located outside the distance limitation of the closest I-Light POP. However, the route towards Ivy Tech Warsaw is near Manchester University. I-Light established an agreement that enabled Manchester University to host amplification equipment. I-Light paid Zayo to construct a short lateral to Manchester University, and, as a result, Ivy Tech Warsaw obtained a direct

connection. The agreement resulted in an additional point of interconnection on the I-Light network and the establishment of a small fiber ring in northern Indiana.

The twenty-one Ivy Tech campuses each receive two strands of fiber to connect to the I-Light network. I-Light provides each of the newly connected campuses, with the exception of IT headquarters, with 1 Gbps with the ability to increase bandwidth up to 10 Gbps. Seventeen campuses connect via NxT1 or DS3, and four sites are connected via Gigabit Ethernet connections.

Network management for I-Light is provided by the Global Research Network Operations Center (GRNOC) at Indiana University, a premier provider of highly responsive network coordination, engineering, monitoring, and installation services that support the advancement of research and education networking. The GRNOC provides continuous support for advanced research networks across the country.

High-count single mode fiber is deployed in rings and linear spurs from Zayo's existing network infrastructure. Over the network, Zayo is able to deliver Ethernet, Private Line, Wavelength, Dark Fiber, and Dedicated Internet Access services using dense wavelength division multiplexing (DWDM) and SONET technologies to enable 1.5 Mbps to 10 Gbps services to communities along the fiber route. A last mile provider or end user can also request that Zayo extend fiber from a standard interconnection point to their building. The extension is dependent on the distance and complexity of the build.[82]

Pricing is set on an individual basis for customers who want to purchase fiber. Zayo set its rates comparable to market prices for services such as Ethernet, IP, wavelengths, and dark fiber. Customers who purchase larger amounts of fiber often receive better per mile rates than those that purchase few. Customers who lease point to point rather than purchase an entire ring pay a higher price per mile than customers who purchased rings. A maintenance component is included in all direct fiber pricing. Dark fiber is sold in a protected configuration with one data and one protection strand. There are typically two components to dark fiber pricing, a lease or IRU and maintenance and operation. Leases and IRUs may be paid as a monthly fee or pre-paid, and is stated as a per-fiber-mile rate. Maintenance and operation is stated per-route-mile. The price is not dependent on the number of strands and the mileage, but merely the mileage.

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 are 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.[83]

There is considerable debate on the impact of open access policies on the competiveness of the broadband market.[84] 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."[85] 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.[86] 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.[87]

Zayo established an open access network that aligns with its wholesale strategy. The Zayo BTOP project opened more opportunities for ISPs to connect CAIs, businesses, and residences in Indiana. The open access model has provided the smaller, local telecommunications companies the opportunity to expand their networks by taking advantage of lower wholesale broadband costs.

As part of its open access strategy, Zayo prioritized multiple interconnection points. The build along the network route includes 1,651 slack loops, 935 interconnection points, which is more than the 413 projected in the baseline report, and 5 colocation facilities. In terms of design, a slack loop was created every 2,000 feet to enable ISPs to connect to the fiber. The slack line is not stationary and offers flexibility in terms of the location of the point of connection, which saves ISPs the cost of having to build to an interconnection point located out of reach. Zayo has joint-use pole agreements, which enables them to move slack loops to accommodate new customers. Companies often bring their fiber to the pole to connect to Zayo.

Zayo offers customers the autonomy to place interconnection points, slack loops, or hand holes near hospitals, schools, municipal buildings, major intersections, and large industrial facilities. This creates many opportunities for wireless ISPs to connect to the fiber. This also helps to encourage competitive pricing by ISPs to serve facilities located near a splice point. All ISPs that purchase fiber in the area operate from the same interconnection point to connect directly to a facility.

Zayo's network build created opportunity for Sitco and other last mile providers to expand their commercial customer base in the Evansville area. Zayo built to Ivy Tech and the University of Southern Indiana (USI), presenting an opportunity for other last mile providers serving the area to build off the Zayo fiber to reach potential customers. The route Zayo selected opens substantial geographic territory for low-cost builds to properties, and the provision of faster speeds. Businesses within a reasonable build distance from Zayo fiber include Vectran, Deaconess Hospital, and Berry Plastics. Without Zayo, Sitco would not have been able to pursue relationships with these potential customers. In some cases, Sitco could have considered providing service, but it would require expensive licensed microwave equipment. Utility companies and hospitals, mission critical organizations, are not as likely to rely upon licensed wireless equipment that is less reliable and potentially slower. Similarly, there is opportunity for Sitco to leverage Zayo's fiber near the end of the route at USI and deliver service to ethanol manufacturing plants in the area.

Zayo reported that there was immediate interest in fiber from the tower companies. Present day cell and data usage requires a substantial amount of capacity. Connecting to the Zayo backbone allows cell companies to access the bandwidth necessary to support their customer base.

3.3 Results

There were three major results of the Zayo project observed by the evaluation study team:

- Ivy Tech campuses obtained direct connectivity to I-Light, Indiana's research and education network, improving internal operations and enhancing educational programming. Connecting to the I-Light network allows Ivy Tech to enhance its distance education program and facilitates Ivy Tech's ability to collaborate with other higher education institutions on the network. Increased capacity enables new learning initiatives and the use of high definition learning tools. Through its connection to I-Light, Ivy Tech obtained increased capacity at competitive prices. I-Light purchases Internet service through the Indiana GigaPOP, which aggregates demand to achieve lower rates. Without the grant, Ivy Tech could not have obtained direct connectivity for these twenty-one campuses due to budgetary limitations.
- As of March 31, 2013, Zayo had twenty-nine agreements with broadband last mile or wholesale providers and was in negotiation with an additional sixteen.[88] Zayo implemented more than 2,000 interconnection points, offering last mile providers and network subscribers equitable and reliable access to the Internet. Last mile providers have the opportunity to expand their network and connect more CAIs, businesses, and residences while providing broadband services at

lower prices. Data on the number of homes and businesses served by these last mile providers are not publicly available.

- The CAIs connected to the Zayo fiber network through the grant are now able to provide faster and more reliable Internet access to meet the growing information needs of the public and their customers. Before the grant, many Ivy Tech campuses did not have 1 Gbps connections because of budgetary restrictions. In rural areas of the state, campuses had limited options for connectivity. The grant enabled Ivy Tech to obtain 1 Gbps connections for twenty campuses, and a 10 Gbps connection for its IT headquarters, increasing the average capacity across campuses by nearly 5,000 percent.[89] As the CAIs continue to use the new broadband connections, it is expected that larger impacts will emerge.

3.4 Sustainability

Zayo indicated that without the grant, it would not have been feasible to construct a network of similar scope. Zayo does not build speculatively, and I-Light would not have had the budget to support a comparable build. Now that construction is complete, Zayo does not anticipate any potential interference to the network's sustainability. Zayo will maintain ownership over its fiber and respond to maintenance issues as necessary. Replacing the fiber at the end of its lifespan is significantly less resource-intensive than the network's construction.

I-Light negotiated with Zayo to renew the lease on an existing IRU agreement and to purchase four additional fiber strands to enhance its backbone in the southern portion of the state. The combination of cost savings generated through renewing the backbone lease for an additional twenty years and the grant-funded fiber build out enabled I-Light to establish a reserve fund to eliminate its dependence on the State of Indiana for capital funding to upgrade the backbone, or acquire fiber or equipment. I-Light will use some of the funds that had been reserved for backbone leases to connect some of the campuses currently operating on leased circuits. I-Light will leverage the Zayo fiber network to create these connections and collaborate with other fiber providers as necessary. I-Light also intends to deploy additional services, including cloud-based service to members.

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.

- Zayo sought contractors within the regions of the network build, as it was more cost effective for local construction companies to work in their area of operation. Zayo divided the build into seven sections, broke out laterals to each campus, and had contractors bid on each section. Zayo awarded the contract to the lowest bid for each section. This generated a substantial cost savings for the project. Zayo ultimately finished the project 27 percent under budget.[90]
- Zayo noted that from a sales perspective, it was important to communicate with potential customers in the early stages of the project. Zayo found that wholesale customers understood the challenges associated with the build out, and therefore were willing to make purchases early and wait on delivery. However, CAIs generally preferred for the project to be complete before committing to service.[91]
- Zayo saved money by maintaining ownership over its fiber rather than leasing regionally. This successful strategy allowed Zayo to respond to the different needs of customers and to manage its own maintenance schedules, which translated into savings of time and money.
- Zayo established a marketing strategy to secure agreements with ISPs that included direct sales calls, networking with providers in the state, word-of-mouth, and exhibit booths at conferences to highlight BTOP and its importance as an economic and community-building stimulus project. Zayo placed signs near all major facilities to highlight available interconnection

points along the route of the fiber build. The company's website was also a source of information for ISPs interested in pursuing an agreement with Zayo. Zayo employs a full-time director of sales for Indiana. In addition, I-Light contributed to broadband awareness in Indiana through member meetings and outreach visits to campuses on its network.

Section 4. Conclusions

The Recovery Act instructed NTIA to implement BTOP to promote five core purposes:[92]

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 Zayo's implementation of BTOP has encouraged the fulfillment of the Recovery Act's goals, with the exception of the fourth goal because public safety was not a focus of the Zayo project. Zayo was not provided with subscriber information by last mile providers and is unable to track the type and number of CAIs connected to the network. The Zayo grant is a middle mile project that did not directly connect businesses and residences to the network.

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.

Zayo made the greatest impact in improving access by directly connecting twenty-one campuses of Ivy Tech and three additional higher education institutions. The benefits are significant as the sites are experiencing different gains in cost savings and network reliability from the new broadband connections. For Ivy Tech campuses located within unserved and underserved areas, there is a lack of cost effective broadband service. Before the upgrade, broadband was provided via T1 lines from the local ILEC. Purchasing additional T1 lines to support campus needs offered just an additional 1.5 Mbps per line and was often expensive when compared to newer broadband technologies.

Zayo's network routing establishes a fiber-based broadband infrastructure that offers interconnection points strategically along the route to facilitate future expansion of the network. With more than 2,000 interconnection points passing through Indiana cities and communities that include lateral and ring connections to the network, the Zayo BTOP grant provides residences and businesses in unserved and underserved areas the opportunity to access broadband through ISPs. Zayo's open network policy and strategic network design establishes an economically viable

opportunity for ISPs to expand their market size by offering broadband service to these communities.

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 Zayo grant focused on providing a middle mile broadband network and last mile connections to a select group of higher education CAIs. This included providing information to ISPs to increase the awareness of the benefits of connecting to the network. Zayo provides ongoing support to customers with whom they have agreements.

Zayo provided twenty-one Ivy Tech campuses, and three additional higher education campuses, with direct connectivity to the I-Light network. I-Light is able to provide increased bandwidth to connected institutions as needed. Each CAI may increase capacity to 10 Gbps upload and download speeds, although few had done this as of the site visit. I-Light subscribers also have access to the fully staffed GlobalNOC Service Desk, GlobalNOC network engineers, and other support services. In addition, to ensure members realize the maximum value of network connectivity, I-Light hosts member meetings and facilitates discussion surrounding issues such as collaboration and data sharing. I-Light is considering options to offer training session to recently connected institutions to demonstrate the network's capabilities in supporting education and internal operations.

4.3 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. All participating Ivy Tech campuses were broadband users, but many only had access to much lower bandwidths than provided through the grant. The Zayo project increased the demand for bandwidth with these existing users rather than increase broadband adoption, thereby increasing Ivy Tech's capabilities to establish workforce training programs that focus on manufacturing. However, it is too soon to observe direct impacts. There are no studies available that illustrate the effect of the Zayo project on growth in the service area counties.

- **Zayo**
  - The Zayo grant funded an average of nine FTE positions during the fourteen consecutive quarters beginning quarter one of 2010.[93] The largest number of jobs funded in a quarter was 12.6, for the second quarter of 2012.[94] It is important to note that this only includes direct jobs created, and does not include indirect or induced job creation.
- **I-Light**
  - Management of the I-Light network and GlobalNOC attract top talent among students, researchers, businesses, and industries. Experience and expertise in managing a network of this scope also helps to increase the ability of researchers to obtain grants and outside

funding. This can enhance the competitiveness of research institutions and generate growth opportunities and externalities for the communities providing support services for staff and programs. The development of an advanced communications infrastructure and intellectual capital helps to attract businesses and institutions that support economic growth and job creation.

- **UDWI**
  - Prior to Zayo building fiber to the area, a carrier owned fiber within the community although the company did not offer service along the route. Other providers offer connection options but there are problems with reliability. UDWI will leverage its fiber connection toward increasing the prevalence of paperless billing and providing customer metering data on its website. The decision to adopt paperless options is dependent on the customer base's ability and their willingness to use digital communication tools.
- **LEDC**
  - Zayo's grant-funded fiber build passes through Rockport, Indiana. Perry-Spencer Communications (PSC), one of the primary ISPs to the Rockport area, purchased a standard agreement for lit service with Zayo, which includes gigabit transport to the Chicago data center, and gigabit IP add-on from this data center. The service terminates on PSC's fiber in its Jasper data center. PSC has requested quotes from Zayo for dark fiber terminating in Rockport, but has not purchased an agreement to date. Current Internet service options in the Rockport, Indiana area are limited and may pose a deterrent to development of the community with sparse population and limited business investment. LEDC noted that Zayo's larger capacity infrastructure will support faster and more reliable service. LEDC believes that infrastructure with greater capacity would attract more of an industrial and business base to the area, helping to create jobs and increase revenue flow into the community. Projects that could benefit from the provision of last mile service over Zayo's recently constructed communications infrastructure could generate jobs and enhance economic development within the community.
    - LEDC is negotiating a $2.8 billion natural gas project with a New York-based firm. The project would require a minimum of 800 construction workers at professional trades and union scale wages for at least 3.5 years. LEDC indicated this is a substantial opportunity for the Rockport community. The project, after build-out, has committed to the State of Indiana to employ at least 200 full-time, on-site employees at an average annual income of more than $70,000. The Rockport construction site does not yet have a hardwired broadband connection.
    - The Ohio Valley Resources nitrogen fertilizer project will capitalize at more than $1.2 billion. The project will require a 1,200 construction workers, many of whom will be professional trade union employees, receiving the corresponding scale wages, per diems, and benefits. At completion, the project has committed to eighty full-time, on-site employees. The project will require expansion of professional service providers within Spencer County to support the plant's operations. LEDC reported industrial service providers within the county have started to hire additional staff, acquire additional certificates, and expand upon structures to accommodate the anticipated growth. To LEDC's knowledge, there is not yet a hardwired connection to the project site.
  - Rockport's geographic location attracts companies intending to pursue large-scale projects. The four-lane highway intersecting the community and connecting to Owensboro and Bowling Green, Kentucky is a favorable factor for future development. There are plans to continue the four-lane build-out of the road. The Interstate 67 Development Corporation and the Commonwealth of Kentucky champion the effort, intending to upgrade the road to achieve interstate status to attract new investments. However, large-scale development projects require access to reliable, high-speed Internet connectivity. Firms incentivized by Rockport's proximity to an interstate will likely require a reliable communications infrastructure. Businesses would likely be deterred by the current absence of hardwired, high-speed connectivity.

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.

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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

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Glossary

Acronym	Definition
AS	Associate of Science
AAS	Associate of Applied Science
ACS	American Community Survey
APR	Annual Performance Progress Report
ASR	ASR Analytics, LLC
BDMS	Banner Document Management System
BTOP	Broadband Technology Opportunities Program
CAI	Community Anchor Institution
CCI	Comprehensive Community Infrastructure
CCNA	Cisco Certified Network Associate
CCNP	Cisco Certified Network Professional
CLEC	Competitive Local Exchange Carrier
CTO	Chief Technology Officer
DWDM	Dense Wavelength Division Multiplexing
FCC	Federal Communications Commission
FTE	Full-time equivalent
GRNOC	Global Research Network Operations Center
IFW	Indiana Fiber Works
ILEC	Incumbent Local Exchange Carrier
IPEDS	Integrated Postsecondary Education Data System
IRU	Indefeasible Rights of Use
ISP	Internet Service Provider
LEDC	Lincolnland Economic Development Corporation
LMS	Learning Management System
MOU	Memorandum of Understanding
MRPO	Manufacturing Production Operations
MU	Manchester University
NBM	National Broadband Map
NTIA	National Telecommunications and Information Administration
OAMTC	Orthopedic and Advanced Manufacturing Training Center

Acronym	Definition
PCC	Public Computer Centers
POP	Point of Presence
PPR	Quarterly Performance Progress Report
PSC	Perry Spencer Communications
REMC	Rural electric membership cooperative
SBA	Sustainable Broadband Adoption
SCADA	Supervisory Control and Data Acquisition
SIP	Session Initiation Protocol
SONET	Synchronous Optical Networking
TC	Technical Certificate
UDWI	Utilities District of Western Indiana
USI	University of Southern Indiana
VoIP	Voice over Internet Protocol
VPN	Virtual Private Network

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