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Case Study Report

OSHEAN, Inc.

Comprehensive Community Infrastructure

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ASR Analytics, LLC
1389 Canterbury Way
Potomac, MD 20854

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Submitted to:

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

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Executive Summary

About BTOP

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

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

About the Evaluation Study

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

The purpose of this case study is to:⁴

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

The information presented in this report intends to capture the social and economic impacts of the grant, and is not an evaluation of OSHEAN, 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 OSHEAN project during field visits. From September 23 to September 26, 2013, the evaluation study team met with representatives of OSHEAN and CAIs connected by the project. In total, the evaluation study team performed ten 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 OSHEAN, its partners, or its subgrantees.

About the Grantee



OSHEAN has 117 members in Rhode Island and Massachusetts, including universities, hospitals, libraries, K-12 institutions, government agencies, and other nonprofit organizations. OSHEAN is active in the Rhode Island technology community, contributing expertise and resources to technological initiatives for the state and consortium members, including broadband projects, professional education, policy development, workforce expansion, and economic development.⁶

OSHEAN (formerly Ocean State Higher Education Economic Development and Administrative Network), founded in 1999, is a consortium of nonprofit organizations that seek to provide innovative Internet-based technology solutions to its members and the communities they serve.

OSHEAN completed the Beacon 2.0 project in October 2013 after spending a total of \$32,476,991 in Rhode Island and Bristol County, Massachusetts.

On September 1, 2010, NTIA awarded OSHEAN a BTOP CCI grant for \$21,739,183 to implement the Beacon 2.0 project.⁷ OSHEAN provided \$10,737,808 in matching funds from CAIs that signed letters of commitment to connect to the network and private companies, which represented over 30 percent of the total project cost.⁸ OSHEAN completed this project August 31, 2013 after spending a total of \$32,476,991 in Rhode Island and Bristol County, Massachusetts.⁹

Project Proposal and Status

Through the BTOP grant, OSHEAN planned to connect fourteen universities and community colleges, including the Community College of Rhode Island (CCRI), the New England Institute of Technology, the University of Rhode Island (URI), and the Naval War College (NWC). The project also planned to connect public safety institutions, including the Rhode Island State Police and the Narragansett Indian Tribal Police, to enable rapid data and video transfer. The project expands and upgrades OSHEAN's Beacon 1.0 612-mile fiber network initially built in Rhode Island.¹⁰ OSHEAN proposed the following, with results shown:

- Connect up to 50 CAIs with the capability to serve approximately 500 additional anchor institutions at speeds between 1 Gbps and 10 Gbps.¹¹ OSHEAN surpassed its target, connecting 115 CAIs to the Beacon 2.0 fiber network by August 31, 2013.¹²
- Construct 339 miles of new fiber and incorporate 90 miles of existing fiber to facilitate more affordable and accessible broadband service for up to 349,000 households and 8,000 businesses by enabling local Internet Service Providers (ISP) to utilize the project's open network.¹³ OSHEAN surpassed its mileage target, deploying 475 miles of new fiber and, after route modifications to accommodate additional CAIs, 432 upgraded miles.¹⁴ OSHEAN purchased twenty-year IRUs for the new fiber miles, constructed and owned by Cox Communications in Rhode Island, and Sidera Taunton Municipal Lighting Plant, and Lighttower in Massachusetts.

OSHEAN accomplished the following from their proposed goals:

- Installed 475 miles of new fiber and upgraded 432 miles of fiber
- Connected 115 CAIs
- Partnered with the Ocean State Libraries PCC grant and connected 14 libraries

The number of households and businesses connected by last mile providers is not publicly available.

- Leverage a PCC grant with subrecipient Ocean State Libraries (OSL) to provide broadband access and establish more than 600 computers to over 70 library branches in the state, including 10 mobile computer centers. OSHEAN directly connected fourteen OSL member libraries to the Beacon 2.0 network.¹⁵ OSHEAN provides Internet services to more than seventy OSL libraries through E-Rate funding.

Table 1 presents the distribution of the CAIs connected to the network by type of CAI.¹⁶ As shown the table, over half of the 115 CAIs connected by August 31, 2013 are educational institutions. The grantee connected fifteen healthcare providers, one public safety institution, and twenty-three government agencies categorized as other community support.¹⁷

Table 1. Community Anchor Institutions Located in Rhode Island and Massachusetts

Type	Served by Grantee		Total in Service Area
School (K-12)	44	38%	473
Library	14	12%	69
Medical/Healthcare	15	13%	1,607
Public Safety	1	1%	164
University, College, or Other Postsecondary	18	16%	46
Other Community Support	23	20%	23
All	115		2,382

Major Outcomes and Impacts

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

- Increased capacity and access to affordable bandwidth has facilitated the growth of CCRI's distance education program. CCRI reported that enrollment in the program increased by 112 percent within the last year. Without the enhanced broadband capacity, CCRI would not have been able to support the influx of students participating in distance education. Since connecting to Beacon 2.0, CCRI introduced a Homeland Security certificate program and established a Cisco Networking Academy.¹⁸
- NWC uses the connection to the Beacon 2.0 network to perform high-bandwidth graphic representations and visualization simulations with the Naval Postgraduate School in Monterey, California. NWC has implemented new, high definition 4K resolution displays to facilitate the real-time collaboration on research projects

Through BTOP, the project achieved the following community impacts:

- Increased distance learning opportunities
- Improved research and collaboration efforts
- Reduced data center costs for healthcare providers
- Improved interoperability for emergency management partners

across locations. Collaboration of this kind was not possible prior to obtaining increased bandwidth through Beacon 2.0.

- Connecting to the Beacon 2.0 network enabled the CharterCARE health system to consolidate two hospital IT infrastructures, merge administrative environments, use a single electronic medical record system, migrate to one data center, and decrease the number of software applications for clinical and financial systems. Operating one data center to support the two hospital facilities saved CharterCARE approximately \$500,000 by allowing them to close a second data center. CharterCARE was able to purchase one storage area network (SAN) for \$1 million to support the entire network, rather than purchasing two smaller SANs for \$800,000 each.
- The Providence Department of Public Safety uses the Beacon 2.0 network to provide connectivity to eight agency offices using a combination of OSHEAN fiber, its own fiber, and leased fiber from another carrier network. The connection available through Beacon 2.0 enables secure video conferencing that increases situational awareness and allows virtual face-to-face communication in the event of a crisis. The incident management system has greater reliability and capacity for communicating between departments and the public during an emergency event. Emergency and rescue services use this information to devise response strategies, such as determining the route for a fire truck to use in an emergency. Real time data sharing significantly improves response times. Prior to the Beacon 2.0 project, none of the Department of Public Safety facilities were connected to the network.
- Connecting to Beacon 2.0 allowed the Taunton Municipal Lighting Plant (TMLP) to increase its bandwidth and realize a significant cost savings. TMLP paid \$5,900 per month for 45 Mbps through its previous provider.¹⁹ Through OSHEAN, TMLP pays \$4,854 per month for 750 Mbps of Internet access, obtaining significantly more bandwidth and saving approximately \$1,046 per month or \$12,548 per year.²⁰ TMLP estimated that its existing fiber assets and connection to the Beacon 2.0 network reduce the time required to respond to outages by approximately 15 percent.
- Rhode Island College (RIC) is working with Brown University and the University of Rhode Island to establish a joint nursing facility, which will provide a second campus for RIC. The Beacon 2.0 network improves the feasibility of establishing the facility. The grant-funded network supports virtual circuits, which will allow RIC to operate the two campuses as one.

Conclusions

OSHEAN supported Recovery Act goals to increase access to broadband for CAIs. With the new fiber network, CAIs are beginning to transform their service delivery in the schools, libraries, healthcare facilities, and government buildings. OSHEAN is collaborating with state agencies and economic development organizations to help CAIs promote broadband adoption across their service areas.

Representatives from OSHEAN stated that it would not have been possible to build fiber throughout Rhode Island and Bristol County, Massachusetts to reach a comparable number of CAIs without the grant funds. Without the BTOP grant, it is unlikely that the 115 CAIs would have connected to the Beacon 2.0 network, as construction costs would have prohibited OSHEAN from building a network of comparable scope. Nearly all of the CAIs receive higher bandwidth at lower prices. The increase in bandwidth enables users of both wired and wireless devices, and the network to expand their use of broadband. Price and capacity data from CAIs interviewed show that the average price of broadband per megabit per month was reduced from about \$124 to \$4, while the average capacity increased by over 2,200 percent.

Community anchor institutions interviewed by the evaluation study reported that the average price of broadband per megabit per month dropped from about \$124 to \$4, while the average capacity increased by over 2,200 percent.

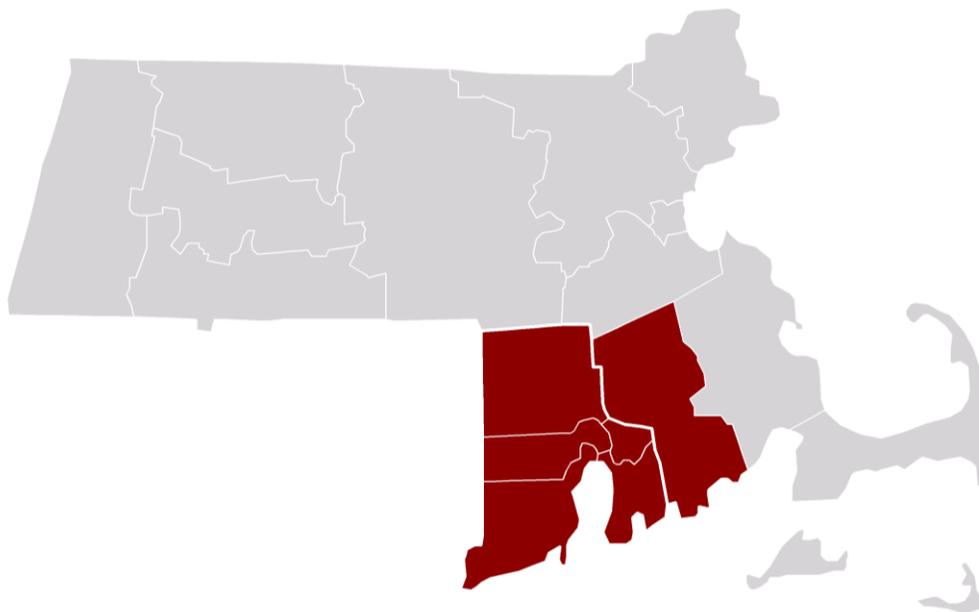
OSHEAN designed the Beacon 2.0 network with multiple interconnection points to give last mile providers the opportunity to expand broadband service in both states. OSHEAN is currently

negotiating agreements with third party providers and has secured one contract that will expand services to businesses and residences in both states.

Section 1. Introduction

OSHEAN connected 115 CAIs within Rhode Island and Massachusetts to the BEACON 2.0 fiber network, offering service speeds between 1 Gbps and 10 Gbps. As shown in Figure 1, OSHEAN serves all of Rhode Island and Bristol County, Massachusetts. All references made to the service area throughout this report refer to all five counties of Rhode Island and Bristol County, Massachusetts.²¹

Figure 1. OSHEAN Service Area Map



The American Community Survey (ACS) Five Year Summary for 2007 to 2011 shows that nearly 85 percent of the service area residents are White. Twenty-one percent of the service area population speaks a language other than English. The highest level of educational attainment for 45 percent of the service area residents over the age of twenty-five is a high school diploma or less. About 45 percent of the service area population has a household income of less than \$50,000 per year.²²

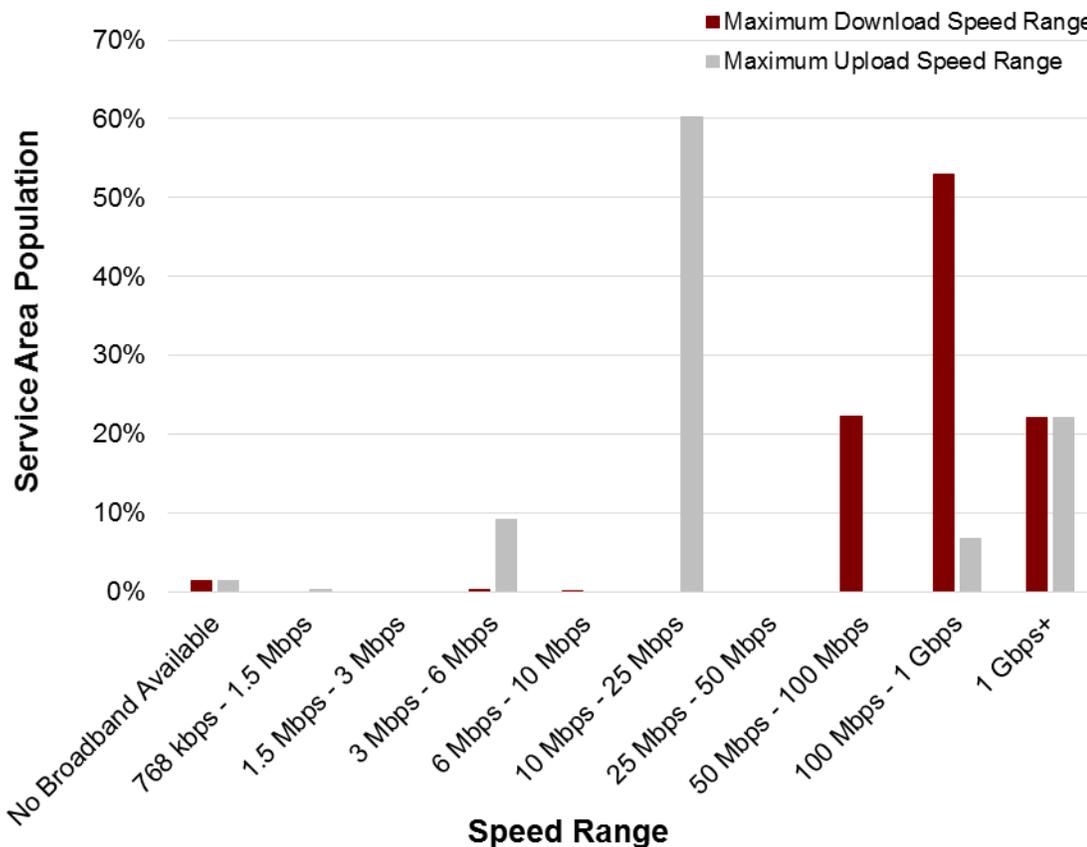
Table 2 shows the number of broadband service providers available to the service area population according to data and speed thresholds defined by the National Broadband Map (NBM).²³ A small portion of the service area population (1.4 percent) does not have access to a broadband provider. The majority of service area residents, about 73 percent, have access to two or three service providers. All provider statistics use the June 2011 release of the NBM and 2010 population data from GeoLytics.

Table 2. Number of Broadband Providers Available in the Service Area

Number of Providers	Service Area	Rest of MA
0	1.39%	1.38%
1	5.99%	6.24%
2	41.02%	35.91%
3	31.59%	39.63%
4	7.40%	16.34%
5	12.47%	0.47%
6	0.14%	0.04%

Figure 2 shows the percentages of the service area population with respect to the fastest download and upload speed range available to them.²⁴ According to the NBM, there are fifteen broadband providers in the service area. Maximum download speeds available to household subscribers range from 3 Mbps to 1 Gbps, while maximum upload speeds range from 768 kbps to 1 Gbps.

Figure 2. Maximum Speed Ranges Available for the Service Area Population

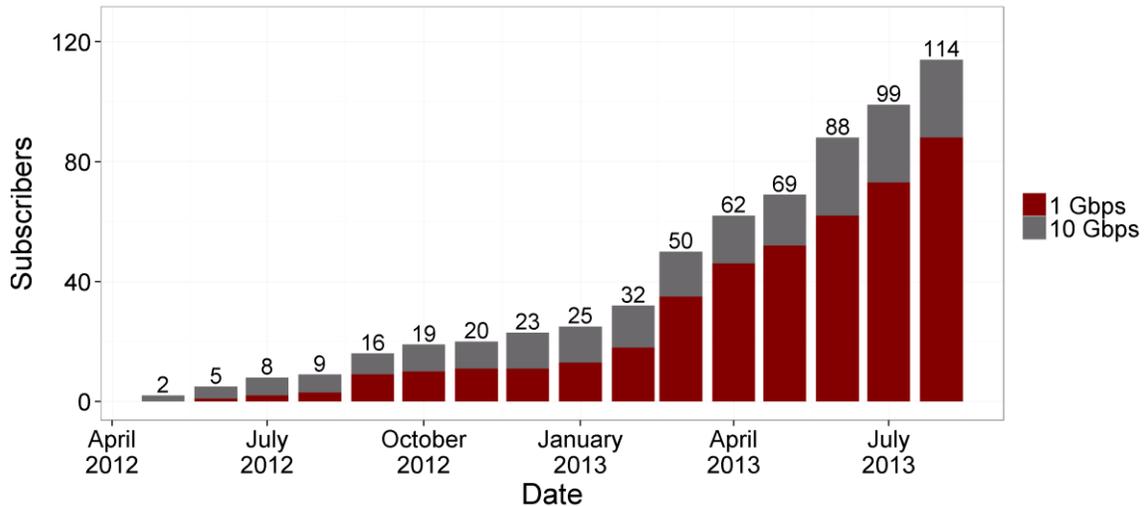


Federal Communications Commission (FCC) data from June 2012 show that 75 percent of service area households subscribe to an Internet service that has at least 768 kbps download speeds and 200 kbps upload speeds.²⁵

Figure 3 presents the connection speeds of CAIs connected to the Beacon 2.0 network through the BTOP-funded grant.²⁶ The first two subscribers received service in May 2012. The largest single-

month increase in subscriptions occurred in March 2013 when seventeen CAIs began receiving service. OSHEAN lit the connection for 115 CAIs subscribed to broadband through OSHEAN by August 31, 2013. OSHEAN plans to connect one additional facility, the OSHEAN operations center, located in Warwick, Rhode Island with 1 Gbps of improved access.²⁷

Figure 3. Subscription Speeds at Connected Community Anchor Institutions



OSHEAN's objective is to decrease costs for member institutions by recruiting additional members and distributing fixed costs over a larger customer base, thereby reducing prices. OSHEAN charges members separately for two distinct services:

- Transport to connect members to Beacon 2.0, Internet2, and other OSHEAN members
- The amount of commodity or Internet bandwidth used

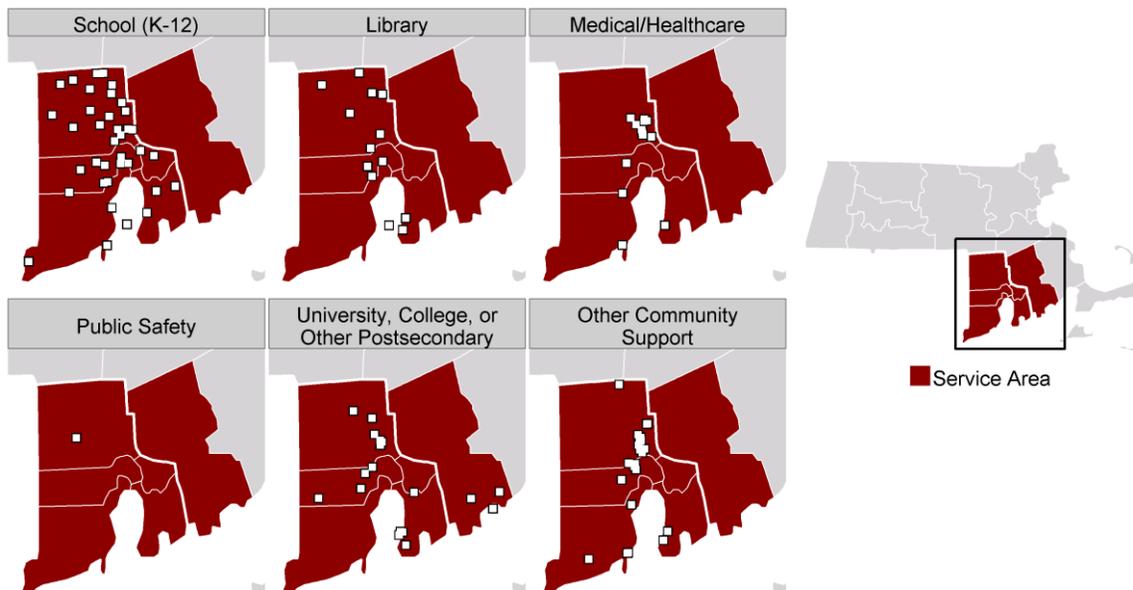
Since completing the Beacon 2.0 project, OSHEAN has been able to reduce annual costs for commodity bandwidth for members. The average price of broadband per megabit per month decreased from about \$124 to \$4, while the average speed increased by over 2,200 percent. Table 3 presents OSHEAN commodity Internet rates before and after implementing the BTOP project.²⁸ Additionally, the 2014 rates include a burst rate policy, which allows members' usage to peak above subscription levels at no additional cost, and unmetered Internet2 usage. OSHEAN did not provide transport service prior to the BTOP-funded project.

Table 3. OSHEAN Internet Service Pricing Before and After BTOP

Speed	Annual Cost 2012 (Pre-BTOP)	Annual Cost 2014 (Post-BTOP)	Annual Cost Savings
25 Mbps	\$93,125	\$7,500	\$85,625
50 Mbps	\$129,750	\$15,000	\$114,750
100 Mbps	\$174,750	\$25,000	\$149,750
250 Mbps	\$247,250	\$40,000	\$207,250
500 Mbps	\$272,250	\$60,000	\$212,250
1000 Mbps	\$322,250	\$100,000	\$222,250
2000 Mbps	N/A	\$175,000	N/A
3000 Mbps	N/A	\$250,000	N/A
4000 Mbps	N/A	\$325,000	N/A
5000 Mbps	N/A	\$400,000	N/A

Figure 4 presents the grant's service area and the locations of connected CAIs.²⁹ Excluding public safety institutions, several CAIs of each type were connected in or around the Providence area. Within Bristol County, Massachusetts, only higher education CAIs were connected through the grant.

Figure 4. Locations of Connected Community Anchor Institutions



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

- Healthcare
 - **CharterCARE Health Partners** (CharterCARE) is a community-based health system that operates two hospitals, a nursing home, a public health clinic, laboratory, and homecare services. In 2010, CharterCARE began an affiliation of two organizations within the network, Roger Williams Medical Center and Our Lady of Fatima Hospital. Both hospitals were members of OSHEAN, sharing a 4 Gbps connection through Beacon 1.0. For the same annual price of \$60,000, CharterCARE purchased a redundant, path-diverse 10 Gbps connection to the Beacon 2.0 network.³⁰ In addition to participating in OSHEAN's collaborative and educational programs for members, CharterCARE obtained a connection to OSHEAN's Safe Harbor disaster recovery site and a connection to the Insurance Value Added Network Services (IVANS) network for Medicare processing.³¹
- Higher Education
 - The **Community College of Rhode Island (CCRI)** is the largest degree-granting, two-year, public college in New England.³² CCRI has been a member since OSHEAN's formation. CCRI uses OSHEAN for network interconnectivity between campuses, and for connection to the Internet, Internet2, Northeast Research and Education Network (NEREN), Northern Crossroads (NoX), and OSHEAN's internal member peering network. The Beacon 2.0 project enabled CCRI to increase WAN connectivity between CCRI campuses from 3 Gbps to 20 Gbps.³³ The aggregate 20 Gbps of bandwidth can be subdivided and reallocated as needed to any end location on the CCRI WAN. OSHEAN's network peering service reduces CCRI's demand for Internet bandwidth. CCRI also increased Internet access from 100 Mbps to 500 Mbps with 250 Mbps bursting capability at no additional cost. This allows CCRI's bandwidth use to peak up to 750 Mbps without incurring an additional charge. CCRI increased its physical connection to OSHEAN from 100 Mbps to 1 Gbps, ensuring the necessary physical infrastructure is available to upgrade the present 500 Mbps Internet bandwidth to 1 Gbps when necessary.³⁴ Additionally, CCRI established a new circuit to the state's data center, presently at 1 Gbps, with the capacity to increase to 10 Gbps, to support replication and business continuity.³⁵ CCRI increased bandwidth to its Lincoln campus from 1 Gbps to 10 Gbps to support the construction of on-site business continuity operations. Operations will require replication of data and recovery in the event of Warwick unavailability. CCRI serves as an OSHEAN network hub at both the Newport and Knight campuses.
 - **Rhode Island College (RIC)**, located in Providence, serves approximately 9,000 students.³⁶ RIC's mission focuses on serving first generation college students. Offering high quality, reliable technology is an important aspect of providing service to its student population. RIC has been a member of OSHEAN since its formation. Unlike other CAIs, OSHEAN self-funded the lateral construction and equipment installation to directly connect RIC to the Beacon 2.0 network. RIC subscribes to OSHEAN's Cumulus Video Commons service and participates in OSHEAN's member training programs, CIO forum, and networking events.
 - The **United States Naval War College (NWC)** is one of three Navy higher education institutions. NWC offers a one-year, resident program that graduates about 600 students per year, and a distance program that graduates about 1,000 students per year.³⁷ Since its inception in 1884, more than 24,000 U.S. military and international officers and senior federal service civilian executives have graduated from NWC.³⁸ The U.S. Naval War College is a professional school, and its primary academic missions include Professional Military Education (PME) and Joint Professional Military Education (JPME). The institution serves primarily mid-level to senior Navy officers who earn Master's degrees for completion of the curriculum. NWC purchased an aggregate 10 Gbps connection through OSHEAN, an upgrade from their previous 1 Gbps connection.³⁹
- Government Agencies
 - The **Rhode Island Division of Information Technology (Division of IT)** implements IT tools and solutions to support the delivery of government services. The governor of Rhode Island appointed the CIO of the Division of IT as chair of the Broadband Advisory Committee, responsible for providing recommendations for the organizations best suited to provide BTOP services to the state. The Division of IT purchased an aggregate 10 Gbps connection for

\$60,000 per year through OSHEAN.⁴⁰ The Division of IT divides the bandwidth among more than ten of its sites connected to the network.

- The **Providence Department of Public Safety** states its mission is to ensure the safety and well-being of all citizens within the city of Providence. The Department coordinates the efforts of Fire Department, Police Department, Communications Department, and the Emergency Management Agency & Office of Homeland Security.⁴¹ The Department provides connectivity to these facilities using a combination of OSHEAN fiber, its own fiber, and leased fiber from another carrier. Prior to the Beacon 2.0 project, none of the Department of Public Safety facilities were connected to the Beacon network. Connection to the Beacon 2.0 network enables the Department of Public Safety to adopt systems and applications to increase productivity and generate cost savings for the agencies under its umbrella. The fiber connectivity improves the reliability of communication among public safety entities.
- **Municipal Electric Provider**
 - The **Taunton Municipal Lighting Plant (TMLP)** is wholly owned by the City of Taunton in Massachusetts, but operates independently by an elected board of commissioners. TMLP has provided electric service for more than 100 years. TMLP's service territory is roughly 100 square miles and encompasses Taunton, Raynham, Berkley, and portions of the surrounding towns of Lakeville and Dighton. Outside of Taunton, much of the service territory is rural. TMLP has provided Internet services for about fifteen years. Within their service territory, TMLP offers Internet-based services to residential customers and secondary education institutions including the Taunton school system, Bristol-Plymouth High School, Bristol County Agricultural High School, and Coyle Cassidy High School. TMLP also serves large industrial parks. As an OSHEAN member, TMLP purchases Internet access services. TMLP pays \$4,854.37 per month for 750 Mbps of both Internet and Internet2 service, as compared to \$5,900 per month for 45 Mbps through their previous provider.⁴² OSHEAN completed a fiber swap agreement with TMLP to complete the network build in Taunton.
- **Network Support Service Provider**
 - **Atrion** has twenty-five years of experience in providing IT services and solutions. The company has worked with OSHEAN for almost fifteen years. Atrion provided network operations support to OSHEAN before the BTOP-funded project. Atrion agreed to provide a financial commitment to collaborate with OSHEAN on the Beacon 2.0 project. OSHEAN issued an RFP for support services for Beacon 2.0, and selected Atrion based on their prior experience and competitive pricing. Atrion operates OSHEAN's toll free support number and provides twenty-four-hour network support services.

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

- The **Rhode Island Economic Development Corporation (RIEDC)** works with public, private, and nonprofit organizations to promote sustainable economic growth within the state. The Broadband Program Director of RIEDC served on the governor's Broadband Advisory Committee. The committee selected RIEDC to apply for and implement the Rhode Island's State Broadband Initiative (SBI) mapping grant funded through NTIA. Within RIEDC, Broadband Rhode Island (BBRI) is responsible for implementing the SBI project. With OSHEAN, RIEDC established the Broadband Trifecta, which included all three BTOP grants awarded to Rhode Island.

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 OSHEAN project in terms of the five focus areas described in *Interim Report 1*, with the addition of the Government Services focus area.⁴³ These outcomes and impacts focus on understanding the effect on CAIs. Digital Literacy is not a focus of CCI grants and the evaluation study team did not note significant Digital Literacy impacts outside of the outcomes and impacts related to the other focus areas.

The grantee provided qualitative information supporting the assertion that nearly all CAIs participating in the grant received increased or comparable bandwidth at lower cost through the Beacon 2.0 project.

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, high school diplomas, general equivalency degrees, certifications in advanced software technologies such as network engineering, and other licenses or certifications that reflect knowledge of a particular subject at a level that would typically be taught at an educational institution.

When assessing impacts it is important to understand the characteristics and composition of education providers within the service area. Table 4 identifies the school level of all public schools in Rhode Island and Bristol County, Massachusetts.⁴⁴ It was not cost effective for OSHEAN to build to every K-12 school; however, it was able to build into a core building within each school district. By providing a high-speed connection to a core building, OSHEAN enabled districts to connect other facilities to the OSHEAN network for Internet access. This strategy resulted in OSHEAN connecting more high schools than primary and middle schools combined.

Table 4. Rhode Island and Massachusetts Public Schools (K-12) by School Level

School Level	Served by Grantee	Others in Service Area
Primary	1	276
Middle	8	81
High	25	58
Other	0	7
Undefined	10	7
All	44	429

OSHEAN connected schools that serve nearly 28,000 students of the nearly 225,000 public school students in the service area.⁴⁵ Nearly 4,400 of these students are minorities and more than 7,500 qualify for free or reduced lunch. Connected schools employ more than 2,200 full-time equivalent teachers.

OSHEAN connected eighteen of the forty-six postsecondary institutions in its service area.⁴⁶ Connected postsecondary institutions serve over 85,000 enrollees, nearly 27,000 of which are minorities. These institutions serve 64 percent of the total number of postsecondary students and 61 percent postsecondary minority students in the service area.⁴⁷

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.**⁴⁸
 - Increased capacity and access to affordable bandwidth through Beacon 2.0 has facilitated the growth of CCRI's distance education program. CCRI reported that enrollment in the program increased by 112 percent within the last year. Without the enhanced broadband capacity, CCRI would not have been able to support the increase in students participating in distance education. CCRI does not yet offer full degree programs via distance education, although many degree programs offer hybrid instruction options. CCRI is working towards developing the distance education program to remotely offer Associate degree programs.
 - Bandwidth provided through Beacon 2.0 improves NWC's ability to support its distance education program. Through NWC's College of Distance Education, students may either attend seminars at selected military bases throughout the United States or complete requirements via web-based or correspondence course programs. In the last four years, the distance education program's non-resident student population increased from just over 3,000 to 26,676.⁴⁹ Non-resident students receive access to Navy Internet-based facilities, including the Navy Knowledge Online learning system, a portal with information, courses, and resources for career management, learning, and personal development. Prior to connecting to Beacon 2.0, NWC was limited by bandwidth capacity and a network with a single point of failure. Operating with a single point of failure meant that an outage could interfere with the delivery of online content to distance students.
- **The use of digital tools enabled by broadband can save teachers time, allowing them to devote more effort to instruction.**⁵⁰ **Broadband also 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.**⁵¹
 - To prepare to accommodate trends in technology use among younger generations of students, NWC uses Beacon 2.0 connectivity to integrate technology into classroom instruction. For example, NWC established an iPad program for students to read course material digitally, rather than purchase or print thousands of pages. Integrating wireless connectivity, iPads, and similar technologies into coursework changes faculty members' approach to instruction. Portable devices enable students to research course content as the lecture occurs. Although such scenarios require greater faculty preparation, the use of such technologies facilitates students' engagement and participation in course instruction.
 - The Beacon 2.0 network enabled CCRI to adopt advanced technologies to enhance its nursing and health science programs. New healthcare programs will leverage data transfers between CCRI, hospitals, and clinics where nursing students conduct fieldwork. CCRI recently established a Simulation Center to support the nursing and other health science programs. The center uses the Beacon 2.0 network to incorporate hands-on technologies and bandwidth-intensive applications, enhancing students' learning experience. CCRI has established simulation labs on each campus, offering a variety of simulation mannequins, which mimic human physiology to provide an interactive learning experience.⁵² The program enables students to practice reacting to unexpected situations in healthcare delivery and uses cameras to allow students to review and analyze their responses.

- Increased bandwidth available through Beacon 2.0 enables CCRI to support additional academic programs and enhancements to existing programs. Since connecting to Beacon 2.0, CCRI introduced certificate programs in Emergency/Disaster Management and Homeland Security.⁵³ Since 2012, CCRI has awarded five Emergency/Disaster Management Certificates to students completing the program.⁵⁴ To complement the new academic program, the Director of Networking and Telecommunications for Information Technology is working to establish a Homeland Security Task Force, comprising professionals from Homeland Security and higher education. The Task Force will use the network to develop and maintain a national incident response system. Additionally, increased capacity supports students' ability to earn Cisco certifications through CCRI's Cisco Academy. Connection to Beacon 2.0 enables CCRI to increase capacity as necessary to support increased bandwidth demands generated by program implementation and enhancements.
- With enhanced network capacity, CCRI faculty members have the option to incorporate technology and multimedia content into classroom instruction, establishing a more interactive learning environment. Before access to the upgraded connection, faculty members were often reluctant to integrate technology into the classroom, as traffic from such activities would have strained network capacity. The network upgrade enables faculty to incorporate digital content, and allows students to access media materials to complete assignments. CCRI reports observing an increase in the use of video conferencing, resource sharing, teaching, and collaboration with faculty at other institutions.
- The workstations available in RIC's on-campus computer labs offer applications and software that most students do not have at home, such as Spartan, Maple, GraphPad, ArcView, SPSS, and SAS. RIC intends to evaluate using the Beacon 2.0 network to provide Desktop as a Service (DaaS), allowing students to access these programs outside of campus computer labs. RIC offers two walk-in computer labs with 100 computers and several smaller, instructional labs.
- The New England Institute of Technology (NEIT) obtained new 1 Gbps connections for both of its campuses through the Beacon 2.0 project.⁵⁵ NEIT used the network's capabilities to implement a new video service based on the Kaltura Video platform, a cloud-based online application that allows students and faculty to publish, upload, record, create screen capture movies, manage videos, and organize and distribute information. During the spring 2013 semester, 43 faculty members uploaded 457 videos.⁵⁶
- **Research has shown that computer use among students leads to improved academic performance, greater levels of educational attainment, improved school enrollment and graduation rates, and increased earning potential for students.**⁵⁷
 - To meet students' bandwidth demands, RIC used Beacon 2.0 capabilities to support a separate dedicated network for the residence halls, allowing for faster file downloads and uploads, faster web browsing, and smoother video and audio streaming. RIC has a contract with Apogee, an on-campus residential network provider, to provide broadband services to the residence halls, which house about 1,250 students. RIC indicated it could not have established this arrangement without the Beacon 2.0 connection. Since connecting to the Beacon 2.0 network, Apogee provides students in residence halls with 5 Mbps of bandwidth each, significantly increasing available bandwidth. The affordability of service through OSHEAN allows RIC to avoid charging students a technology fee. Apogee conducts student satisfaction surveys twice per year and found that RIC students report 80 to 90 percent satisfaction with network services.
- **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.**⁵⁸
 - Before connecting to Beacon 2.0, limited bandwidth prevented NWC from collaborating with its sister institutions. For example, the Naval Academy Preparatory School (NAPS) is located in Newport, Rhode Island. Connectivity through Beacon 2.0 enabled NWC to partner with the Naval Academy to build a Virtual Private Network (VPN) from NAPS to connect to the Naval Academy network, facilitating collaboration. Before connecting to Beacon 2.0, this endeavor

would not have been feasible. NWC also uses the Beacon 2.0 connection to perform high-bandwidth graphic representations and visualization simulations with the Naval Postgraduate School in Monterey, California. NWC implemented new 4K display technology to facilitate the real-time collaboration on research projects across locations. Collaboration of this kind was not possible prior to obtaining increased capacity through Beacon 2.0, as it was not possible for NWC to purchase more than 1 Gbps of transport from a local provider.

- NWC seeks to increase collaboration, resource sharing, and application use across the twenty-three degree-granting Department of Defense institutions. For example, the Naval Postgraduate School implemented an application used for configuration control management. The school will create a port for NWC, enabling the two institutions to share the application across the network. NWC is also working to establish a virtual desktop application that can be distributed to the Academy and Postgraduate School across the network, rather than operating three separate instances of the virtual desktop infrastructure. This strategy would generate a cost savings for the institutions.
- Connecting to the Beacon 2.0 fiber enables TMLP to offer affordable, high-capacity broadband to public schools with limited budgets. With the transition to Internet-based solutions, schools are demanding greater bandwidth. For example, TMLP provides Internet service to the Taunton school system and reported quadrupling the bandwidth provided to Taunton schools in the last two years. Enhanced capacity through Beacon 2.0 allows the local school system to offer disabled or sick students remote access in order to participate in classroom assignments from home. The Taunton school system used WAN technology and a TMLP IP-based solution to adopt an IP-based private branch exchange system, eliminating about 400 to 500 plain old telephone service (POTS) lines supporting the school system and saving a significant amount of money for the school system.
- The Beacon 2.0 peering capabilities facilitate CCRI's research and other collaborative endeavors. For example, CCRI is located near Kent County Hospital and has conducted preliminary discussions to establish a collaborative environment with the nursing program. CCRI could establish a virtual circuit to any specialist facility that has a peering connection with the hospital. CCRI would be able to directly connect to specialists and stay on net. OSHEAN membership enables CCRI to accomplish this at no cost.
- The Beacon 2.0 network enabled CCRI to allocate a portion of its network to support IP voice service between campuses for no additional cost. All voice traffic to CCRI campuses converges on the OSHEAN network, eliminating the need for separate, redundant T1 circuits.⁵⁹ Before connecting to Beacon 2.0, bandwidth constraints at CCRI interfered with the quality of voice service. The quality, capacity, and affordability of the Beacon 2.0 network allow all campuses to have access to high quality voice services.
- CCRI is using the Beacon 2.0 network to improve operations. For example, a new system will monitor projectors at all four campuses to increase uptime, to improve maintenance, and to ensure support staff is available for each classroom. CCRI is also implementing a program that would control computer workstations, allowing faculty demonstrations and presentations to appear on all computer monitors in the classroom. CCRI would not have attempted to implement such projects before connecting to the Beacon 2.0 network, as they did not have adequate bandwidth to support the endeavors.
- RIC will work with Brown University and URI to establish a joint nursing facility using the Beacon 2.0 network. The network-supported virtual circuits will allow RIC to operate the nursing campus as part of the main campus. Without Beacon 2.0 connectivity, RIC would have had to purchase a point-to-point circuit from a commercial provider to support the facility.
- Salve Regina University received a new 1 Gbps connection through the Beacon 2.0 project.⁶⁰ During the spring 2013 semester, Salve Regina used the network's capabilities to adopt a Canvas Learning Management System (LMS) to facilitate collaboration and communication among faculty and students.⁶¹ The web-based LMS supports weekly instructional modules, group discussions, multimedia sharing, assignment submission procedures, and grading functionalities.

- o Increased capacity supplied through the Beacon 2.0 network improves CCRI's ability to support the use of personal devices on campus. CCRI increased its bandwidth from 100 Mbps to 500 Mbps with 250 Mbps of burst capabilities, which helps to accommodate growing mobile and personal device use. CCRI's bandwidth consumption can peak at 750 Mbps without incurring any additional charge. CCRI observed an increase in Internet traffic from 100 Mbps to nearly 400 Mbps.⁶² CCRI anticipates continued increase in traffic as it evaluates student wireless utilization and adjusts the present rate limiting to accommodate the increased mobile demand.⁶³ Without the Beacon 2.0 upgrade, CCRI would not have been able to support the current level of wireless use.

2.2 Healthcare

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

When assessing impacts it is important to understand the characteristics and composition of healthcare service providers within the service area.⁶⁴ Table 5 identifies the taxonomy groups of these connected institutions and the taxonomy groups of all healthcare institutions in the service area and the rest of Massachusetts according to the National Plan and Provider Enumeration System (NPPES).⁶⁵ OSHEAN connected fifteen healthcare institutions by June 30, 2013.⁶⁶ OSHEAN connected more hospitals (nine) than any other type of healthcare institution.

Table 5. Rhode Island and Massachusetts Healthcare Institutions by Taxonomy Group

Taxonomy Group	Served by Grantee	Others in Service Area
Agency	1	570
Ambulatory Health Care Facilities	3	450
Hospital Units	0	6
Hospitals	9	66
Managed Care Organizations	0	16
Nursing & Custodial Care Facilities	0	273
Residential Treatment Facilities	0	211
Other	2	0
All	15	1,592

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.

- **Broadband connectivity enables providers to adopt new technologies and practices that enhance productivity, achieving outcomes such as improved appointment and treatment scheduling and more complete medical records at lower costs.**⁶⁷
 - Connecting to the Beacon 2.0 network enabled CharterCARE to merge the information technology (IT) infrastructures of its two primary hospitals, Roger Williams and Fatima Hospital. The network provides reliable, redundant, and diverse path connectivity between facilities to support the consolidation of IT environments. As a result, CharterCARE now uses a single electronic medical record system, operates one data center, and maintains one software application for clinical and financial systems, yielding CharterCARE significant cost savings. Merging the IT environments enabled CharterCARE to close the Fatima data center and operate a single data center to support the two hospitals. This endeavor saved CharterCARE approximately \$500,000, as the Fatima data center required a new generator if it were to remain in operation. Additionally, CharterCARE was able to purchase one storage area network (SAN) for \$1 million to support the entire network, rather than purchasing two smaller SANs for \$800,000 each.
 - Without Beacon 2.0, budget constraints would have kept CharterCARE from obtaining an equivalent amount of bandwidth or a comparable range of network services. CharterCARE needed to supply the two hospitals and several community-based locations with Internet service and connectivity to CharterCARE member facilities. For connectivity to Beacon 1.0, each CharterCARE hospital facility paid OSHEAN \$30,000 per year, or a combined total of \$60,000 annually.⁶⁸ Since connecting to Beacon 2.0, CharterCARE obtained 10 Gbps redundant, path-diverse connectivity and a 10 Gbps connection to OSHEAN's Safe Harbor facility in Springfield, Massachusetts for disaster recovery at a cost of \$60,000 per year.⁶⁹ A commercial vendor, unable to provide a 10 Gbps connection, offered a diverse-entry, 4 Gbps connection for \$142,380 per year.⁷⁰ Had OSHEAN not completed the Beacon 2.0 project, CharterCARE would have spent an additional \$82,380 per year for 40 percent of its current bandwidth allocation.
 - CharterCARE's strategic initiatives include increasing the number of physicians on staff by acquiring additional provider groups and using OSHEAN's circuit provisions to connect these facilities to the Beacon 2.0 network. As of September 23, 2013, CharterCARE had seven interconnection points and was establishing an eighth to support a primary care practice in Cranston, Rhode Island.
 - The bandwidth provided through Beacon 2.0 has helped to improve CharterCARE's performance in clinical integration and patient care. Before Beacon 2.0 connectivity, limited bandwidth prevented CharterCARE from sharing large data files, such as magnetic resonance imaging (MRI) files, among facilities. Test results and images, including MRIs and X-rays, can be shared instantly across facilities, reducing staff and patient travel. Additionally, CharterCARE will leverage increased bandwidth to form a central repository of radiology images from each hospital's individual picture archiving and communication system. Medical staff will be able to access all images instantaneously in either CharterCARE location.
 - The bandwidth provided via Beacon 2.0 enabled CharterCARE to improve internal systems. Beacon 2.0 bandwidth allows CharterCARE to store hardcopy files in an off-site data center and access an electronic version instantly from any CharterCARE location. CharterCARE has the functionality to scan hardcopy files, such as physician notes, into the electronic medical records. Without the Beacon 2.0 connection, CharterCARE would have had to maintain a scanned repository on site, and transfer images to other facilities overnight.
 - Connection to the Beacon 2.0 network enabled CharterCARE to shift all back office departments to one location, thereby improving staff efficiency and coordination. Rather than having to gain competency in two distinct systems, all CharterCARE staff learn one system implemented across locations. This integrated network system facilitates the sharing of staff across CharterCARE facilities. It would not have been possible to share personnel resources as efficiently if CharterCARE had to maintain two separate IT environments.
- **Patients obtain improved ongoing care.**⁷¹

- CharterCARE reported that establishing a single medical record system shared across all facilities improves patient care. A single system ensures that regardless of the facility at which a patient arrives, all hospital staff have access to the same records. Physicians and specialists with full credential privileges are able to log into the hospital system to see the full history of a patient's care. Accessing a single system saves staff time, limits the redundancy of test implementation, and improves the quality of care delivered.
- The Beacon 2.0 network capabilities support CCRI's dental health clinic. The clinic offers an annual program, Mission of Mercy, to provide dental services to residents without dental health insurance. CCRI is able to take digital X-rays on-site and transmit files to local dentists that provide advanced procedures. This service requires the ability to transfer large files across the network.
- **Broadband enables providers to improve the range of health services offered.**⁷²
 - Connection to the network enables CharterCARE to implement new applications, such as teleconferencing, telemedicine, and, in the future, virtual intensive care unit (ICU) services. CharterCARE explained that inpatient volumes are declining, and sharing staff across facilities is a cost-effective response to reduced resource needs. The ability to share pertinent data such as records and radiology results among locations facilitates the sharing of staff.

2.3 Workforce and Economic Development

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

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

- **New or enhanced connectivity benefits businesses by enabling the use of applications and processes that increase productivity and efficiency.**⁷³
 - Increased capacity available through the Beacon 2.0 network improves TMLP's ability to respond to service outages. With the connection to Beacon 2.0, TMLP established a robust, scalable, and fault tolerant system, helping to ensure facilities are better protected. TMLP projected that the connection to Beacon 2.0 resulted in a 15 percent improvement in TMLP's response time.⁷⁴ TMLP also uses the Beacon 2.0 network to support an emergency outage system that logs and automatically distributes incoming calls to the transmission and distribution department to prioritize incidents. Over a fiber connection, equipment signals to TMLP the conditions of different locations across the service area. Heightened awareness enables TMLP to offer more reliable service to customers.
 - With the increased bandwidth through Beacon 2.0, TMLP is implementing demand-based services that enable more efficient energy delivery to customers. Communicating with customers via smart meters allows TMLP to idle large-scale energy consuming equipment when it is not needed. TMLP estimated this can save customers about 20 to 30 percent on their energy bills. TMLP currently provides this service to a small number of large commercial customers. When feasible, TMLP intends to offer the service to all customers, which would reduce energy consumption and utility bills.

- Atrion hired three additional employees and provided professional development services to ensure staff could effectively support the Beacon 2.0 project.⁷⁵ Prior to the Beacon 2.0 project, Atrion did not have a support team dedicated exclusively to servicing OSHEAN's network. Ten to fifteen Atrion employees now support the Beacon 2.0 project in some capacity, while three employees are dedicated exclusively to support OSHEAN. Over two years, Atrion trained eighteen employees in new technologies including Cisco Prime Optical, Cisco Carrier Packet Transport (CPT), and Cisco Dense Wavelength Division Multiplexing (DWDM).⁷⁶
- RIC intends to leverage the Beacon 2.0 network to adopt a more robust business continuity platform on Internet2. Prior to the network upgrade, bandwidth and reliability limitations prevented RIC from implementing a business continuity system that supported remote sites or facilities with remote access.
- CCRI uses OSHEAN's hosted services to shift internal systems off campus, thereby reducing capital and operational costs. OSHEAN's hosted services enabled CCRI to meet Payment Card Industry compliance requirements and transition credit card handling systems off campus. Before obtaining Beacon 2.0 connectivity, CCRI maintained the payment systems supporting the campus bookstore, tuition, and fee payments on campus. CCRI has also recently shifted the student e-mail system off campus.
- **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.⁷⁷ Workforce and Economic Development activities supported by broadband infrastructure strengthen job and population growth.⁷⁸**
 - Access to lower cost, higher capacity bandwidth through Beacon 2.0 improves TMLP's ability to compete with other ISPs operating within its service area. TMLP paid \$5,900 per month for 45 Mbps through their previous provider.⁷⁹ Through OSHEAN, TMLP pays \$4,854 per month for 750 Mbps of both Internet and Internet2, saving approximately \$12,548 per year.⁸⁰
 - TMLP is using its connection to Beacon 2.0 to expand the availability of Internet-based customer resources. Prior to connecting to the grant-funded network, TMLP could not adequately support online customer services. TMLP uses Tele-Works service to offer online bill payments options and an improved, web-based customer service call center. TMLP intends to increase web-based communications. Without the increased bandwidth, TMLP would not be able to accomplish these goals.
- **Broadband connectivity enables increased telework opportunities.⁸¹ Broadband access to facilitate such capabilities is especially significant to economic growth in geographically remote areas.⁸²**
 - NWC's connection to the Beacon 2.0 network facilitates the school's ability to accommodate requirements for the Telework Act of 2010 to support telecommuting federal employees. Robust connectivity to the NWC campus is paramount to employees' ability to telecommute. The Beacon 2.0 network provides NWC with a dual-homed connection. Peering arrangements with OSHEAN and regional ISPs keep all network traffic local. Traffic from telecommuting faculty members via a commercial connection travels to a peering point, then to OSHEAN, and connects to the NWC campus. The arrangement allows NWC to use its Internet2 connection on Beacon 2.0, minimizing its demand for more expensive connectivity. This, coupled with OSHEAN's efforts to reduce bandwidth costs, helps to minimize the price for NWC.

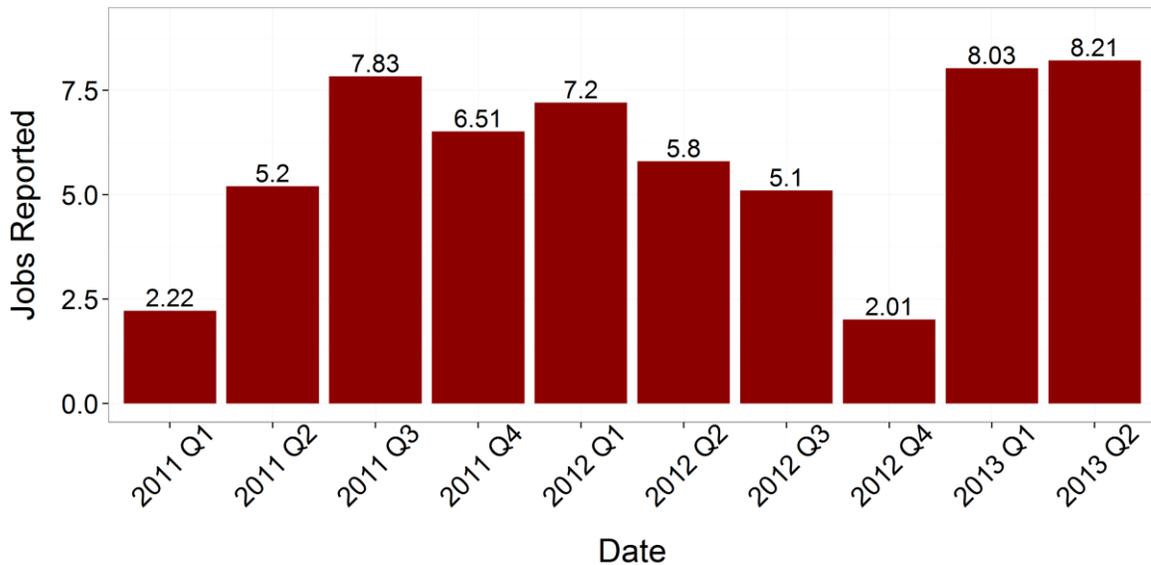
As required by the Recovery Act, OSHEAN reported the number of jobs created quarterly as a direct result of the project. Figure 5 shows the number of direct jobs created by OSHEAN over the grant period.⁸³ OSHEAN's highest periods of job creation were the first and second quarters of 2013 when OSHEAN funded over eight jobs.⁸⁴ Over the preceding eight quarters, OSHEAN funded an average of slightly more than five jobs. OSHEAN reported jobs that reflect the following initiatives:

- Hourly labor for fiber installation, splicing testing from fiber providers with Indefeasible Right of Use (IRU)
- Hourly labor for equipment installation and configuration
- Hourly labor for OSHEAN project consultants (Project Manager, Field Manager)

- Hourly labor for BTOP legal efforts
- Hourly in-kind hours for OSHEAN employees designated as part of the project (Network Engineer, Program Manager, Contracts Specialist)

OSHEAN’s job figures do not include time allocated to managerial, sales, or other professional work from fiber and equipment vendors. It is important to note that these figures only include direct jobs created, and do not include indirect or induced job creation.

Figure 5. Direct Jobs Created by OSHEAN



2.4 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.”⁸⁵ 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.

OSHEAN connected one police department in the service area.⁸⁶ 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.

- **The use of broadband at all levels of government allows government entities to deliver services more efficiently. Intranet systems enable the secure and rapid exchange of information among government agencies. Governments are also able to store and safeguard massive quantities of data. By streamlining in-house operations with the use of broadband-supported tools, governments realize greater internal efficiency and productivity.**⁸⁷

- The secure connection available through Beacon 2.0 enables secure video conferencing between the Department of Public Safety Commissioner, the Chief of Police, the Chief of the Fire Department, and other parties, allowing for face-to-face communication in the event of a crisis. This helps to save time and alleviates the need to travel under potentially dangerous conditions.
- The Providence Department of Public Safety uses its Emergency Operations Center (EOC), which obtained a fiber connection through the BEACON 2.0 project, to provide training programs. The police department recently implemented a new scheduling software system and trained the department using the EOC. More than 500 participants completed this training program.
- Rhode Island's state crime lab is located on the URI campus and was formerly using a T1 connection to provide services. Now the lab is able to directly connect to the Beacon 2.0 fiber network and has experienced operational efficiencies.
- **Broadband improves the relationship between governments and their constituents. Diffusion of online information engages citizens and enhances transparency of government agencies.⁸⁸ Online tools allow government entities to offer better customer service and support.⁸⁹**
 - Rhode Island Division of IT agencies use the Beacon 2.0 network to support their websites, improving the response time and reliability of service. The Division of IT purchased a 10 Gbps aggregate connection for \$60,000 per year, and divides bandwidth among more than ten sites connected to the network. It would not be possible for the Division of IT to purchase an equivalent number of circuits to provide connectivity for additional agencies through a commercial provider for a comparable price. The Division of IT has received positive feedback from both constituents and agencies about the websites' service improvements and reported that the number of calls reporting a disruption in transaction processes has decreased significantly.
 - The Rhode Island Secretary of State, supported by the Division of IT, collaborated with the state Board of Elections to enhance its website, www.sos.ri.gov, to offer tools for voters including polling location look up, sample ballot review, absentee ballot status, and options to review and edit voter registration information. In an assessment of all states' election-related websites, the Pew Charitable Trusts awarded Rhode Island a perfect score.⁹⁰ The website recorded that 300,000 pages were viewed in the 7 days leading up to the November 2012 presidential election.⁹¹
- **Public safety entities, including police, fire, and emergency medical personnel, can reduce response times and improve the quality of services they provide with the use of broadband-supported applications and equipment.⁹² Law enforcement, investigative, and intelligence agencies may also use broadband for preventative purposes. Security and surveillance activities enabled by broadband, such as those that use global positioning system (GPS) technologies, reduce costs, counteract crime and acts of terror, save lives, and avoid injuries.⁹³**
 - TMLP uses the Beacon 2.0 fiber network to enhance video surveillance presence within its service area. For example, State Route 44, the evacuation route for the local nuclear power plant, uses video to manage traffic. Local schools use video cameras for after-hours surveillance. TMLP reported that connection to the Beacon 2.0 network improved the functionality of existing surveillance systems.
 - The Beacon 2.0 connection enables CCRI to improve campus security systems. A recently installed security system enables CCRI to send live video to police and state troopers as they are en route to respond to a situation, improving awareness of the incident and its location. The network's bandwidth enables the implementation of the surveillance system, and will enable staff at any CCRI location to view the cameras at the other campuses. CCRI also implemented a system to replace keys for access to campus facilities.
 - The Providence Department of Public Safety uses its connection to the Beacon 2.0 network to access a port camera system along the Narragansett Bay. Raytheon hosts the system,

which communicates with the Department of Public Safety and the Department of Environmental Management. The cameras monitor liquefied natural gas tankers or carriers transporting other dangerous cargo.

- **Communication supported by broadband allows for greater information sharing between public safety entities and citizens.⁹⁴ Citizens can file reports for public safety services online. Public safety entities can issue warnings and alerts for citizens through online channels.⁹⁵**
 - The EOC houses a studio to conduct press conferences with television and radio news channels, helping to ensure accurate information is released to the public. Media representatives are able to remain within this facility during emergencies to ensure information is immediately disseminated to the public as it is released.
 - The Department of Public Safety uses the Beacon 2.0 network to operate an incident management system that logs and distributes incoming calls. The connection to the network helps to ensure citizens are able to communicate with officials and obtain accurate information.
- **Broadband connectivity helps to preserve continuity of government operations in the wake of disasters or epidemics.⁹⁶**
 - Prior to the Beacon 2.0 project, the EOC operated with limited capacity. The EOC houses representatives from all relevant city government departments, such as the police and fire departments, to direct city services during emergencies. The center relies on Beacon 2.0 connectivity to communicate with human services, utility companies, Rhode Island Emergency Management Agency (RIEMA) and the Federal Emergency Management Agency (FEMA), and facilitates the dissemination of information to the public. Combining all parties in the same facility provides a faster, more reliable connection, improved coordination, accuracy of information, and response time.
 - The Providence Department of Public Safety reported that the EOC has proven invaluable during severe weather emergencies. The EOC uses the Beacon 2.0 network to communicate with the Department of Public Works (DPW) office, which was connected to fiber through the grant. Connecting to fiber improved the DPW's ability to deploy resources. The DPW office is able to communicate with trucks and vendors in the field in real time, improving awareness of blockages and resources in the field. For example, an internal map analyzes Global Positioning System (GPS) data from trucks and reports the time elapsed since a plow last serviced a particular street. Emergency and rescue services use this information to devise response strategies, such as determining the route to send a fire truck. Real time data sharing was not possible before obtaining the fiber connection.

2.5 Quality of Life/Civic Engagement

The Quality of Life/Civic Engagement focus area includes activities that create stronger and more integrated communities through broadband. Impacts within this focus area are measures of broadband capacity for local institutions that provide public access and training in technology, such as libraries and other community centers.⁹⁷ These institutions provide support for individuals to participate in activities that benefit their communities and society, access information about government, participate in communities and civic associations, engage in education and training, seek employment, and establish or support small businesses. For some residents, this public access provides their only means of Internet connectivity. For others, it provides a place to seek assistance, to learn, and to share ideas and information with others. Support of public broadband access is therefore a means of enhancing the civic commons and the quality of life in the community. There is growing evidence that while libraries are beginning to offer more services to support quality of life and civic engagement, over 75 percent of public libraries are falling behind in having adequate broadband speeds to meet the needs of the public.⁹⁸

When assessing impacts it is important to understand the characteristics and composition of civic organizations within the service area. OSHEAN connected fourteen of the sixty-nine libraries in its

service area.⁹⁹ Table 6 identifies the locations of all libraries in the service area.¹⁰⁰ The Institute of Museum and Library Services (IMLS) determines locales based on the proximity of libraries to urban centers and their location in Census-designated rural territories.¹⁰¹ Nearly two-thirds of the connected libraries are located in suburbs.

Table 6. Rhode Island and Massachusetts Libraries by Locale

Locale	Served by Grantee	Others in Service Area
City	3	4
Suburb	9	38
Town	0	2
Rural	1	11
Undefined	1	0
All	14	55

For connected libraries, the average number of computers and computer sessions are more than three times the averages for other libraries in the service area; average total visits two and a half times larger; and average number of librarians and average number of patrons are twice as large.¹⁰²

OSHEAN received a BTOP Round 1 PCC grant to provide computers and training in more than seventy library branches that are members of the Ocean State Libraries (OSL) network. OSL is a subrecipient of the PCC grant. The libraries targeted by the PCC grant all receive IP service from OSHEAN via an E-Rate-funded bid process. The Rhode Island Department of Education (RIDE) bids separately for transport and IP services. OSHEAN does not provide transport services to any OSL library locations. OSHEAN will bid to provide transport services to the fourteen libraries connected to the Beacon 2.0 network when RIDE’s current contract expires. OSHEAN selected the fourteen locations to connect based on cost and geography. OSHEAN hopes to provide faster and more cost effective communications between the libraries and other OSHEAN members.¹⁰³

In 2007, OSL introduced EZone, a platform for patrons to download books, music, and videos.¹⁰⁴ OSL has observed increased patron use of the portal to download eBooks and audio books. In 2013, OSL expects 12 percent of all visitors to have used EZone, as compared to 1 percent of all library patrons using EZone in 2007.¹⁰⁵ Additionally, digital checkouts as a percentage of physical checkouts have increased from 0.25 percent in 2007 to 6 – 8 percent in 2013.¹⁰⁶ Beacon 2.0 network capabilities will help to support the continued growth of the EZone system.

RIEDC works with CAIs across the state to provide digital literacy training. RIEDC implemented the Broadband RI (BBRI) initiative to increase the availability and use of broadband. BBRI stakeholders emphasize using the OSHEAN Beacon 2.0 network to help increase the number of residents using broadband, thereby improving the economic development and quality of life within the state.¹⁰⁷ RIEDC’s BBRI initiative conducts a train-the-trainer program with Rhode Island CAIs to expand the provision of digital literacy education. OSHEAN assists RIEDC in promoting digital literacy training services. RIEDC provided digital literacy training to some of the CAIs connected to the Beacon 2.0 network.

Section 3. Grant Implementation

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

3.1 Implementation

OSHEAN is a nonprofit consortium of universities, hospitals, government agencies, and other nonprofit organizations dedicated to providing innovative Internet-based technology solutions for its member institutions and the communities they serve.¹⁰⁸ OSHEAN was founded in 1999 through collaboration with Rhode Island Network for Educational Technology (RINET), Brown University, and URI.¹⁰⁹ The merger with RINET expanded the types of nonprofits that could be served by OSHEAN, including K-12 schools, government agencies, and healthcare providers. OSHEAN seeks to develop network expertise among its member organizations and to create an environment that encourages collaboration through shared resources and information.¹¹⁰ OSHEAN is governed by a board of directors that consists of representatives from its member institutions.

Prior to the Beacon 2.0 project, OSHEAN operated the Beacon 1.0 network, which grew to a multi-gigabit capacity network. OSHEAN secured agreements with dark fiber providers and connected fourteen CAIs and thirty-five facilities at an average growth rate of 15 percent per year. OSHEAN's experience in running a Layer 3 fiber-based network, leasing dark fiber, and lighting dark fiber with the Beacon 1.0 network provided the basis for estimating the cost of the Beacon 2.0 network expansion and for performing the work to build it.

OSHEAN initially determined the network route based on the location of the CAIs that signed letters of commitment to connect to the network. CAIs participating in the Beacon 2.0 project contributed to the capital cost by paying for the laterals and equipment to connect to the network. CAIs paid \$40,000 to fund the lateral installation and construct a connection to the facilities.¹¹¹ The original network design was altered minimally in Rhode Island to enable Cox to leverage its existing pole rights for the network build. OSHEAN could not connect Block Island, included in the original proposal, because of unanticipated costs associated with its location. The modified network route included locations only on the mainland. OSHEAN leveraged existing staff resources to plan and design the network. The team includes engineers with prior network build experience who were responsible for designing and maintaining the Northeast Research and Education Network (NEREN) optical network that connects educational institutions in New England. Additional staff and consultants were hired to build the network.

OSHEAN leased 475 miles of newly constructed fiber to establish the Beacon 2.0 network that connects CAIs in all 5 counties in Rhode Island and Bristol County in Massachusetts. The Beacon 2.0 network provides a minimum of 1 Gbps up to 10 Gbps connectivity for CAIs and other organizations.¹¹² The network design included a 10 Gbps backbone upgrade and will offer broadband capacities scalable up to 100 Gbps.¹¹³

OSHEAN deployed DWDM optical multiplexing technology at the optical node locations to increase bandwidth over the existing fiber network, which includes Cogent 10 Gbps routers, Level3 10 Gbps routers, and Safe Harbor 10 Gbps router equipment. OSHEAN deployed Cisco 15454 packet transport equipment at the optical node sites and installed Cisco CPT50 platform equipment at all CAI sites for scaling and simplifying service delivery over the network. Atrion coordinated the collaborative effort with Cisco to acquire and distribute the technology used in the network build and provided and managed implementation services for the technology solution. OSHEAN also contracts with Atrion for network operations services, which are provided 24x7x365 and include enterprise

system support, environment monitoring, problem resolution, diagnostics, help desk support, equipment support, and on site repair. OSHEAN contracts with Cox to respond to and repair any physical fiber issues.

To expand the existing Beacon 1.0 network, OSHEAN opted to purchase IRUs to lease fiber constructed by project partners, rather than own and maintain the network fiber. OSHEAN did not want to assume liability for owning and maintaining the fiber. OSHEAN signed IRUs with Cox Communications, which owns and maintains the fiber in Rhode Island, and Sidera, which owns the fiber in Massachusetts. OSHEAN has a 20-year IRU lease on the fiber from both companies with 20 years of renewal options, and leasing for 48-strand fiber from Cox and for 24-strand fiber from Sidera.¹¹⁴ In addition, OSHEAN has an IRU with Lightower Fiber Networks to install forty-six fiber miles and TMLP to complete four fiber miles in Massachusetts. The use of IRUs for the procurement of fiber has resulted in cost and time savings for OSHEAN.

OSHEAN also completed fiber exchange agreements to finalize the network build.

- OSHEAN negotiated a fiber swap with TMLP, a consortium member, to complete the network build in Taunton. The agreement eliminated the need to lay fiber by Sidera in Taunton, decreasing costs for OSHEAN. The agreement also allowed TMLP to access fiber on the Beacon 2.0 network to provide services to schools located beyond its service territory. TMLP is working to develop a plan to utilize the Beacon 2.0 fiber to deliver service to CAIs along the route.
- OSHEAN engaged in a fiber-for-services exchange with URI, a member of the consortium connected to the Beacon 1.0 network. URI received grant funding to build fiber that coincided with the timing of the Beacon 2.0 network build. OSHEAN and URI met to leverage both projects to avoid overlap in building the networks. The agreement stipulated that URI would construct the network around its campus, which eliminated OSHEAN's need to lay fiber in this area. URI provided OSHEAN with an IRU to purchase strands on the Beacon 2.0 network. In exchange, OSHEAN provided URI with capacity to connect other URI campuses in Providence to the OSHEAN core network.
- OSHEAN arranged a fiber-for-services exchange with OpenCape in Massachusetts to use OpenCape's existing fiber on poles along the Beacon 2.0 network route. The arrangement stipulated that OSHEAN provide OpenCape with Internet services out of Providence in exchange for the use of fiber.

Before implementing the BTOP project, OSHEAN only provided connections through leased circuits or dark fiber agreements. OSHEAN now offers transport service over the BEACON 2.0 network, which costs less than leased circuit and fiber services. Previous dark fiber leases could range from \$1,000 to \$6,000 per month and required the member or OSHEAN to light and manage the equipment to provide a 1 Gbps connection. Beacon 2.0 service is lit and does not require members to provide or install the equipment to light the fiber. Table 9 presents OSHEAN transport service rates.

Table 7. OSHEAN Transport Service Rates

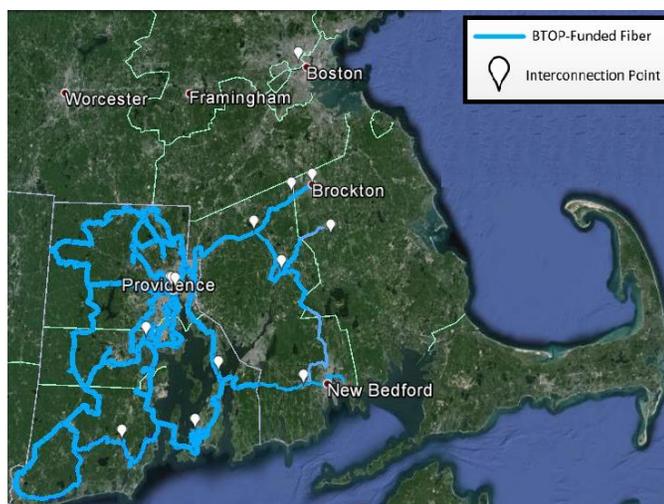
Transport	Number of Circuits Included	Annual Fee
100 Mbps	1 Circuit	\$6,000
250 Mbps	1 Circuit	\$9,000
500 Mbps	1 Circuit	\$12,000
1 Gbps	4 Circuits	\$24,000
10 Gbps	6 Circuits	\$60,000
20 Gbps	N/A	\$100,000

3.2 Open Access Policies

OSHEAN explained that while it abides by BTOP’s open access non-discrimination policies, the consortium’s charter to conduct business on behalf of nonprofits precludes providing services directly to businesses and residences. OSHEAN is now in discussions with last mile providers that provide these services and has secured an agreement with Last Mile Solutions LLC, a competitive local exchange carrier that will provide services to businesses and residences in Rhode Island and Massachusetts.

OSHEAN’s approach to open access focuses on providing interconnections in locations where providers can access the network. OSHEAN’s strategy is to build into common carrier locations. Network providers and customers may interconnect with the OSHEAN network at any of the fourteen points of interconnection. OSHEAN has also built slack loops along the backbone routes so that laterals can be installed to connect new facilities to the network. According to OSHEAN, they were already at most of these locations, which was necessary to provide Internet services for their members. OSHEAN purchases Internet services from ISPs to provide choices to their network members. Figure 6 presents a map of the Beacon 2.0 network, highlighting its fourteen points of interconnection.

Figure 6. Beacon 2.0 Network Map



3.3 Results

The evaluation study team observed two major results of the OSHEAN project:

- The Beacon 2.0 network provides broadband access at lower prices than before the expansion of the network. OSHEAN's objective is to decrease costs for member institutions by recruiting additional members and distributing fixed costs over a larger revenue base, thereby reducing prices. Completing infrastructure build with grant funds enabled OSHEAN to reduce the costs of leased circuits, dark fiber, and equipment, thereby reducing the price of transport and commodity for members. CAIs reported they would not be able to purchase a package of services comparable to what OSHEAN provides from commercial vendors at an equivalent price. Price and capacity data from CAIs interviewed show that the average price of broadband per megabit per month was reduced from about \$124 to \$4, while the average capacity increased by over 2,200 percent.
- CAIs connected to the Beacon 2.0 network benefit from access to OSHEAN's suite of member services. The Beacon 2.0 network offers a cost-effective solution for members that need to connect multiple facilities, enabling members to interconnect to any location on the network without accruing any circuit costs as long as the member is below its bandwidth capacity. In addition to connecting to the fiber network, members receive additional services that include Internet access, cloud computing, emergency notification, a disaster recovery facility, Internet content filtering solutions, leased circuits, managed network services, and technology solutions such as virtual desktop applications. OSHEAN reported that it could not have expanded its network to reach a service area of comparable size, enhanced its network capacity, or provided many of the services available over the network without the grant.

3.4 Sustainability

The sustainability of the OSHEAN project will depend on the number of additional CAIs that are brought onto the network and pay to connect to the fiber network and for Internet services. Members that are connected to the network have the option to purchase Internet service, which is part of OSHEAN's core revenue. In addition, the Beacon 2.0 network runs through every town and provides the backbone for future business with nonprofits and government agencies, as well as sells wholesale services to other last mile providers. The route was designed to lay fiber close to institutions such as city halls and K-12 schools where it would be more cost effective for CAIs to connect to the Beacon 2.0 network in the future. In addition, OSHEAN connected sixty more CAIs than initially planned. The expansion of the network provides an additional revenue stream that will contribute to the long-term sustainability of the network.

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.

- OSHEAN's preexisting relationship with Atrion, the network operator, facilitated collaboration on the Beacon 2.0 project, including completion of the grant application. In order to provide support for the network, Atrion and OSHEAN frequently met to establish processes, standardize procedures, and support issues including sparing, inventory management, and manufacturer support. Frequent coordination enables Atrion and OSHEAN to develop a comprehensive and affordable plan to provide support services for members that was preferable to those available from other providers.
- OSHEAN member organizations benefit from the opportunity to collaborate with other members in discussions of best practices and challenges.

- OSHEAN's business strategy and agreement with Cox Communications enabled the consortium to connect significantly more CAIs to the network than initially planned because of Cox's pricing structure, position as an existing provider, rights to utility poles, and adequate staffing to support the network build out in Rhode Island. OSHEAN worked with Cox as a transport circuit provider for some member CAIs before implementing the BTOP project.

Section 4. Conclusions

The American Recovery and Reinvestment Act of 2009 (Recovery Act) instructed NTIA to implement BTOP to promote five core purposes:¹¹⁵

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 OSHEAN's implementation of BTOP has encouraged the fulfillment of the Recovery Act's goals.

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.

Both the OSHEAN CCI and RIEDC mapping projects focus on expanding services for nonprofits and community-serving organizations. The projects' common goal is to improve Internet access for residents, help businesses and organizations obtain competitive pricing, and improve the ability of organizations to communicate with their constituents.

OSHEAN made the greatest impact in improving access by directly connecting 115 CAls. The lower cost of connecting to the Beacon 2.0 network allows nonprofit CAls to purchase more bandwidth than they could afford to otherwise. OSHEAN expects to connect additional nonprofits to the Beacon 2.0 network in the future.

OSHEAN's network routing establishes a fiber-based broadband infrastructure that offers interconnection points strategically along the route to facilitate future expansion of the network. There are fourteen interconnection points in Rhode Island and Massachusetts cities. OSHEAN'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. OSHEAN has secured an agreement with Last Mile Solutions, LLC and is negotiating with others to provide services over the network. The number of businesses and residents connected by local ISPs is not publicly available.

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 OSHEAN project focused on providing a middle mile broadband network and supported Recovery Act goals by increasing access to broadband for CAIs, particularly nonprofits. This included providing information to community members through public events and meetings, and increasing awareness of the benefits of broadband. The BTOP grant also provided equipment and support to institutions as part of the upgrades to broadband access at the CAIs. OSHEAN provides ongoing support to consortium members connected to the network. Each CAI may receive broadband connections between 1 Gbps and 10 Gbps. The CAIs connected to the Beacon 2.0 network have access to broadband and the Internet to meet the growing needs of their constituency. As the CAIs continue to learn how to leverage the new broadband connections, it is expected that larger impacts will emerge.

- Higher Education – educational institutions are increasing course offerings, providing greater bandwidth for students for personal electronic devices, and increasing use of videoconferencing for remote course offerings and distance learning. Instructors can use virtual, real time collaboration in courses and high-bandwidth graphic representations to enhance student learning.
- Healthcare – a healthcare provider used access to reliable, redundant connectivity to integrate the IT infrastructures used across facilities. This allows provider facilities to use a single electronic medical record system, decrease multiple applications for clinical and financial systems, and downsize to one data center thereby achieving cost savings.
- Government – public safety institutions can now communicate between facilities and organizations to better coordinate and deploy resources to serve the public, communicate in real time during an event improving situational awareness, use GPS in vehicles that assist with emergency responses and routes, and share data and resources between public safety departments.
- Municipal Electric – utility service organizations can implement demand-based services that create more efficient energy delivery, can communicate with customers through smart meters, and can decrease the amount of energy used by businesses through large equipment, thereby saving customers between 20 and 30 percent on their energy bills.

OSHEAN reported serving as the ISP for 98 percent of the K-12 schools in Rhode Island, although the transport circuits provided through a commercial vendor limit bandwidth at schools. OSHEAN does not currently provide K-12 schools with transport service. If the K-12 schools decide not to extend the current E-Rate agreement through the final option year, the contract for transport service will go to bid in late fall 2013. If OSHEAN wins the contract, it will begin providing service to K-12 schools July 1, 2014 and will increase the amount of bandwidth available to the participating locations. OSHEAN's goal is to offer K-12 schools decreased costs, or improve capacity for the same rate they currently pay. It was not cost effective for OSHEAN to build to every K-12 school; however, it was able to build into every school district. By providing a high-speed connection to at least the

core building of each district, OSHEAN enabled the districts to connect other facilities to the OSHEAN network for Internet access.

4.3 Public Safety Agencies

The fourth goal of the Recovery Act is to improve access to, and use of, broadband service by public safety agencies. As described in Section 2 of this report, the Beacon 2.0 network provided public safety institutions with greater bandwidth to deploy technology in a cost-effective manner. Agencies have more capabilities to serve the public much more effectively.

The Beacon 2.0 network provides connectivity to public safety facilities using a combination of OSHEAN fiber, fiber owned by the Providence Department of Public Safety, and leased fiber from other carriers.

The broadband infrastructure enables the public safety agencies to deploy services in a cost-effective manner. The public safety network is configured using a mesh design to connect the EOC, the E 9-1-1 Uniform Emergency Telephone System, the Rhode Island State Police, and other agencies. The connection to Beacon 2.0 provides redundancy and reliability.

4.4 Demand for Broadband, Economic Growth, and Job Creation

The final Recovery Act goal is to stimulate the demand for broadband, economic growth, and job creation.

OSHEAN funded eight jobs through the grant. Without the BTOP grant, OSHEAN believes it would not have been able to expand the Beacon 1.0 network. The grant enables OSHEAN to draw more nonprofits that need Internet and technological assistance into the consortium.

OSHEAN's operational strategy is designed to help keep bandwidth costs low to support the needs of nonprofits. OSHEAN reported that higher education institutions have ever-increasing demands for bandwidth to support new educational technology and student wireless use. Several higher education members, including Brown and URI, have subscribed to 10 Gbps service. While larger schools require significant capacity to support students and staff, they may not have the budget to support increasing bandwidth demands.

RIEDC is exploring opportunities related to the Route 195 interchange, a highway reroute that created open space for land development. RIEDC's goal is to ensure that the area becomes a broadband-rich environment. The route is located near an area referred to as the "Knowledge District," comprising Brown Medical School, Rhode Island Hospital, and several Lifespan organizations. Lifespan is an umbrella organization serving as a core research unit. Increasing capacity for the organizations within this district will help to support economic development by attracting other firms to the region. Though it is not possible to draw a direct correlation between the Beacon 2.0 network and economic development within the district, the schools and hospitals within the area leverage the infrastructure's capabilities.

Section 5. Next Steps for the Evaluation Study

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

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

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

Notes

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

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

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

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

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

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

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

⁶ OSHEAN, "Our Mission," 2010, <http://www.oshean.org/Page/View/AboutUs/>.

⁷ National Telecommunications and Information Administration, *OSHEAN Inc. BEACON 2.0 Project Fact Sheet, BroadbandUSA: Connecting America's Communities* (Washington, DC, September 2010), <http://www2.ntia.doc.gov/files/grantees/factsheetri-maosheaninc.pdf>.

⁸ OSHEAN, "OSHEAN Receives \$21.7M Federal Stimulus Grant to Put Schools, Hospitals & Libraries in Broadband Fast Land" (OSHEAN, 2010).

⁹ OSHEAN, "Beacon 2.0 Project Is Complete," 2013, <http://www.oshean.org/?page=Beacon2Launch>.

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

¹⁰ National Telecommunications and Information Administration, *OSHEAN Inc. BEACON 2.0 Project Fact Sheet*.

¹¹ National Telecommunications and Information Administration, *OSHEAN Inc. BEACON 2.0 Project Fact Sheet*.

¹² OSHEAN, "OSHEAN BTOP Community Anchor Institutions," 2013.

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

Five of the 110 CAIs reported by OSHEAN were K-12 institutions, which represented more than one school in the public data, These five institutions reported by OSHEAN are counted as 10 institutions by ASR.

¹³ National Telecommunications and Information Administration, *OSHEAN Inc. BEACON 2.0 Project Fact Sheet*.

¹⁴ National Telecommunications and Information Administration, "Post-Award Monitoring (PAM) Database 2013-09-12."

¹⁵ Institute of Museum and Library Services, "Public Libraries in the United States Survey (FY2011)" (Washington, DC, June 2013), http://www.ims.gov/research/public_libraries_in_the_united_states_survey.aspx.

¹⁶ Centers for Medicare & Medicaid Studies, "National Plan and Provider Enumeration System (NPPES)" (Washington, DC, July 2013), http://nppes.viva-it.com/NPI_Files.html; National Center for Education Statistics, "Elementary/Secondary Information System (ELSi)" (Washington, DC, August 15, 2013), <https://nces.ed.gov/ccd/elsi/>; National Center for Education Statistics, "Integrated Postsecondary Education Data System (IPEDS)" (Washington, DC, August 15, 2013), <https://nces.ed.gov/ipeds/>; National Telecommunications and Information Administration, "Post-Award Monitoring (PAM) Database 2013-09-12" (Washington, DC: Distributed by National Telecommunications and Information Administration, 2013); United States Department of Justice. Office of Justice Programs. Bureau of Justice Statistics, "Census of State and Local Law Enforcement Agencies (CSLLEA), 2008," *Directory of Law Enforcement Agencies Series* (Ann Arbor, MI: Inter-university Consortium for Political and Social Research, August 03, 2011), doi:10.3886/ICPSR27681.v1; United States Fire Administration, "National Fire Department Census Database," August 08, 2013, <http://apps.usfa.fema.gov/census/>; OSHEAN, "OSHEAN BTOP Community Anchor Institutions."

¹⁷ There were several instances where connected institutions reported by OSHEAN could not be matched to a public data set: ten Schools (K-12), one Postsecondary, and one Library. These institutions were added to their respective service area and Rhode Island and Massachusetts totals. Ten of the connected Postsecondary institutions reported by OSHEAN are satellite campuses or locations. These Postsecondary institutions were added to the service area and Rhode Island and Massachusetts totals. Five of the connected Public Safety institutions reported by OSHEAN were not public safety institutions, but rather Providence Department of Public Safety offices and facilities. The evaluation study team reclassified these five institutions as Other Community Support.

¹⁸ For additional information, visit <https://www.netacad.com/>

¹⁹ Representative of Taunton Municipal Lighting Plant, "E-Mail Communication," November 01, 2013.

²⁰ Representative of Taunton Municipal Lighting Plant, "E-Mail Communication."

²¹ OSHEAN, "OSHEAN BTOP Grant Award," 2013, <http://www.oshean.org/Page/View/BTOP>.

²² United States Census Bureau, "2007-2011 ACS 5-Year Summary File," *American Community Survey* (Washington, DC, December 06, 2012), http://www.census.gov/acs/www/data_documentation/2011_release/.

²³ National Telecommunications and Information Administration, "State Broadband Initiative June 30, 2011" (Washington, D.C.: United States Department of Commerce, 2011), <http://www2.ntia.doc.gov/Jun-2011-datasets>.

²⁴ National Telecommunications and Information Administration, "State Broadband Initiative June 30, 2011."

²⁵ FCC Form 477 data includes information at the census tract level on the population that subscribes to broadband using the following speed thresholds: at least 768 kbps download speed

and at least 200 kbps upload speed. Because of this limitation, ASR is not able to filter for subscribers with download speeds of at least 3 Mbps and upload speeds of at least 768 kbps.

²⁶ OSHEAN, "OSHEAN BTOP Community Anchor Institutions."

²⁷ OSHEAN, "OSHEAN BTOP Community Anchor Institutions."

²⁸ Rob Gay, "E-Mail Communication," November 01, 2013.

²⁹ National Telecommunications and Information Administration, "Post-Award Monitoring (PAM) Database 2013-09-12."

³⁰ Representative of CharterCARE, "E-Mail Communication," November 11, 2013.

³¹ Representative of CharterCARE, "E-Mail Communication."

³² Community College of Rhode Island, "Our History - About CCRI," 2014, <http://www.ccri.edu/about/history.html>.

³³ Representative of the Community College of Rhode Island, "E-Mail Communication," October 03, 2013.

³⁴ Representative of the Community College of Rhode Island, "E-Mail Communication," October 03, 2013.

³⁵ Representative of the Community College of Rhode Island, "E-Mail Communication," October 03, 2013.

³⁶ Rhode Island College, "About RIC," 2013, <http://www.ric.edu/aboutric/>.

³⁷ U.S. Naval War College, "About," 2013, <http://www.usnwc.edu/About.aspx>.

³⁸ U.S. Naval War College, "About."

³⁹ OSHEAN, "OSHEAN BTOP Community Anchor Institutions."

⁴⁰ OSHEAN, "OSHEAN BTOP Community Anchor Institutions."

⁴¹ City of Providence, "Department of Public Safety Mission Statement," 2014, <http://www.providenceri.com/public-safety/mission-statement>.

⁴² Representative of Taunton Municipal Lighting Plant, "E-Mail Communication."

⁴³ ASR Analytics, *Progress towards BTOP Goals: Interim Report on PCC and SBA Case Studies*.

⁴⁴ Ten of the connected Schools (K-12 institutions) reported by OSHEAN could not be matched to the public data set. Eight are school district offices, one is a data center, and one is an administrative building. Characteristics are unavailable for these locations.

National Center for Education Statistics, "Elementary/Secondary Information System (ELSi)."

NCES provides definitions for the following school levels:

- Primary: lowest grade offered is in pre-kindergarten through third grade and highest grade offered is in pre-kindergarten through eighth grade
- Middle: lowest grade offered is in fourth through seventh grades and highest grade offered is in fourth through ninth grades
- High: lowest graded offered is in seventh through twelfth grades and highest grade offered is twelfth grade
- Other: grades offered do not follow the primary, middle, or high school level configurations, or the school does not have a grade system
- Undefined: missing value

⁴⁵ If any of the ten connected school district offices, the data center, or the administrative building pass service on to individual schools, this will underrepresent the actual number of students served.

National Center for Education Statistics, "Elementary/Secondary Information System (ELSi)."

⁴⁶ One of the connected Postsecondary institutions reported by OSHEAN could not be matched to the public data set. Ten of the connected Postsecondary institutions reported by OSHEAN are satellite campuses or locations. Characteristics are unavailable for locations that could not be matched to the public data set.

National Center for Education Statistics, "Integrated Postsecondary Education Data System (IPEDS)."

⁴⁷ National Center for Education Statistics, "Integrated Postsecondary Education Data System (IPEDS)."

⁴⁸ Scott M. Andes and Daniel D. Castro, *Opportunities and Innovations in the Mobile Broadband Economy*, The Information Technology and Innovation Foundation, 2010, <http://www.itif.org/files/2010-mobile-innovations.pdf>.

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

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

⁴⁹ U.S. Naval War College, "About."

⁵⁰ Jessica Briskin et al., "26B-K: Smart Apps: An Analysis of Educational Applications Available on Smartphones and the Implications for Mobile Learning (D&D)," in *Annual Meeting of the AECT Convention* (Hyatt Regency Orange County, Anaheim, CA: Association for Educational Communications and Technology, 2010), http://convention2.allacademic.com/one/aect/aect10/index.php?click_key=1&cmd=Multi+Search+Search+Load+Publication&publication_id=430393&PHPSESSID=jgkifdqag6qgtckajo0k657jc7.

⁵¹ Ruth H. Moody and Michael P. Bobic, "Teaching the Net Generation without Leaving the Rest of Us Behind: How Technology in the Classroom Influences Student Composition," *Politics & Policy* 39, no. 2 (April 29, 2011): 169–194, doi:10.1111/j.1747-1346.2011.00287.x.

⁵² Community College of Rhode Island, "About the Center," 2013, <http://www.ccri.edu/simulation/about.html>.

⁵³ Representative of the Community College of Rhode Island, "E-Mail Communication," October 07, 2013.

⁵⁴ Community College of Rhode Island, "Graduate Data," 2013, <http://www.ccri.edu/irpl/graduates.html>.

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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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- City, Small: Territory inside an urbanized area and inside a principal city with population less than 100,000
- Suburb, Large: Territory outside a principal city and inside an urbanized area with population of 250,000 or more
- Suburb, Midsize: Territory outside a principal city and inside an urbanized area with population less than 250,000 and greater than or equal to 100,000
- Suburb, Small: Territory outside a principal city and inside an urbanized area with population less than 100,000
- Town, Fringe: Territory inside an urban cluster that is less than or equal to 10 miles from an urbanized area
- Town, Distant: Territory inside an urban cluster that is more than 10 miles and less than or equal to 35 miles from an urbanized area
- Town, Remote: Territory inside an urban cluster that is more than 35 miles from an urbanized area
- Rural, Fringe: Census-defined rural territory that is less than or equal to 5 miles from an urbanized area, as well as rural territory that is less than or equal to 2.5 miles from an urban cluster
- Rural, Distant: Census-defined rural territory that is more than 5 miles but less than or equal to 25 miles from an urbanized area, as well as rural territory that is more than 2.5 miles but less than or equal to 10 miles from an urban cluster

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Glossary

Acronym	Definition
APR	Annual Performance Progress Report
ASR	ASR Analytics, LLC
BBRI	Broadband Rhode Island
BTOP	Broadband Technology Opportunities Program
CAI	Community Anchor Institution
CCI	Comprehensive Community Infrastructure
CCRI	Community College of Rhode Island
CEO	Chief Executive Officer
CIO	Chief Information Officer
CPT	Carrier Packet Transport
DaaS	Desktop as a Service
DPW	Department of Public Works
DWDM	Dense Wavelength Division Multiplexing
EHR	Electronic Health Record
EOC	Emergency Operations Center
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
GPS	Global Positioning System
ICU	Intensive Care Unit
IMLS	Institute of Museum and Library Services
IRU	Indefeasible Right Of Use
ISP	Internet Service Provider
IVANS	Insurance Value Added Network Services
JPME	Joint Professional Military Education
LAN	Local Area Network
LMS	Learning Management System
MRI	Magnetic Resonance Imaging
NAPS	Naval Academy Preparatory School
NBM	National Broadband Map
NEIT	New England Institute of Technology
NEREN	Northeast Research and Education Network

Acronym	Definition
NoX	Northern Crossroads
NPPEs	National Plan and Provider Enumeration System
NTIA	National Telecommunications and Information Administration
NWC	United States Naval War College
OSL	Ocean State Libraries
PCC	Public Computer Centers
PME	Professional Military Education
POTS	Plain Old Telephone Service
PPR	Quarterly Performance Progress Report
Recovery Act	American Recovery and Reinvestment Act of 2009
RFP	Request For Proposal
RIC	Rhode Island College
RIDE	Rhode Island Department of Education
RIEDC	Rhode Island Economic Development Corporation
RIEMA	Rhode Island Emergency Management Agency
RINET	Rhode Island Network for Educational Technology
SAN	Storage Area Network
SBA	Sustainable Broadband Adoption
SBI	State Broadband Initiative
TMLP	Taunton Municipal Lighting Plant
URI	University of Rhode Island
VPN	Virtual Private Network
WAN	Wide Area Network

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