



# **National Telecommunications and Information Administration**

Broadband Technology Opportunities Program  
Evaluation Study

Order Number D10PD18645



## **Case Study Report**

### **Mid-Atlantic Broadband Cooperative**

#### **Comprehensive Community Infrastructure**

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# Executive Summary

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## About BTOP

The American Recovery and Reinvestment Act of 2009 (Recovery Act) appropriated \$4.4 billion in federal funding to the National Telecommunications and Information Administration (NTIA) to implement the Broadband Technology Opportunities Program (BTOP) in order to spur job creation, stimulate economic growth, and increase access to broadband services.<sup>1</sup> 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.<sup>2</sup> CCI projects funded by BTOP are predominantly middle mile projects, although a small number of last mile projects were awarded.<sup>3</sup>

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:<sup>4</sup>

- 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 MBC, 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.<sup>5</sup> 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 Mid-Atlantic Broadband Communities Corporation (MBC) project during field visits. From July 29 to August 1, 2013, the evaluation study team met with representatives of MBC and community anchor institutions (CAI) connected by the project. In addition, the team held two phone interviews on August 14 and August 28, 2013. In total, the evaluation study team performed fourteen interviews and focus

groups. ASR transcribed these discussions and used this information, along with other information and reports provided by the grantee, to supplement Quarterly Performance Progress Reports (PPR), Annual Performance Progress Reports (APR), and other publicly available information. The information presented here is intended to capture the social and economic impacts of the grant, and is not an evaluation of MBC, its partners, or its subgrantees.

## About the Grantee



Mid-Atlantic Broadband Cooperative was founded in 2004 with the mission of providing telecommunications solutions for isolated rural communities in southern Virginia.<sup>6</sup> As a cooperative of local telecommunications providers, MBC undertook the design, construction, and operation of a carrier-class fiber-optic network stretching across southern Virginia. In 2012, MBC shifted to a nonprofit model and officially became known as the Mid-Atlantic Broadband Communities Corporation (MBC).

On February 1, 2010, NTIA awarded MBC a BTOP CCI grant for \$16,044,290 to implement the Middle Mile Expansion for Southern Virginia (Southern Virginia project). In addition, MBC supplied \$4,011,073 in matching funds, for a total project budget of \$20,055,363. MBC used grant funds to expand its existing fiber network to reach K-12 schools, community institutions, and industrial parks in seventeen counties and five cities in southern Virginia.

The Southern Virginia project invested a total of \$20,055,363 in southern Virginia, including \$16,044,290 in federal funds.

In addition to this grant, which focused on southern Virginia, MBC also received a \$10,023,247 CCI BTOP grant to address similar broadband needs in eastern Virginia. The 174 miles of fiber installed as of September 30, 2103 through the Middle Mile Expansion for Eastern Virginia (Eastern Virginia project) expanded on the new portions of the network added by the Southern Virginia project and helped complete a ring to enhance the network's mesh architecture.<sup>7</sup> The Eastern Virginia grant is not the focus of this report, which will primarily discuss the implementation and impacts of the Southern Virginia grant. However, due to the interdependent nature of the two grants, some overlap may occur when discussing activities and impacts.

## Project Proposal and Status

MBC's primary goals were to connect K-12 schools and to provide middle mile broadband connectivity in its service area, comprising of seventeen counties and five independent cities. MBC proposed the following, with results shown:<sup>8</sup>

- Build over 465 miles of new fiber-optic cabling. MBC changed this goal to 428 miles, net of additions and deletions, due to route modifications, school districts declining fiber to their schools, or school closures. The award period was extended to accommodate modifications to the construction and route plan. MBC deployed all 423 miles of new fiber as of March 2013.<sup>9</sup>
- Connect 121 schools serving 58,000 students to the MBC network. MBC connected 101 K-12 schools and 2 higher education institutions as of March 2013.<sup>10</sup> MBC fell short of its goal for two reasons. Some schools closed or consolidated during the award period. Other schools were satisfied with their current service provider or had existing service contracts.

- Improve connection speeds to schools from 1.5 Mbps to at least 10 Mbps, with a goal of 100 Mbps. Schools connected through the grant are offered connections between 10 and 100 Mbps; most have 50 Mbps connections.<sup>11</sup>
- Generate affordable broadband access through an open access network model that encourages competition among incumbent and new providers. As of March 2013, MBC had fifty-two signed agreements with six last mile providers.<sup>12</sup> The evaluation study team received information from multiple CAIs suggesting that obtaining Internet service from a provider using the MBC network allowed customers to acquire greater bandwidth than they had been receiving at a lower cost than they had been paying.
- Improve network capacity and survivability. While some of the network expansion involved building spurs off existing routes, other portions connected existing fiber to form rings. MBC built a mesh architecture, creating alternate routes in case of fiber cuts or localized power failure. In addition, MBC made equipment upgrades to augment capacity and to improve the network’s ability to navigate the mesh architecture efficiently. MBC installed four new Infinera systems and upgraded two existing systems, which help traffic seek the fastest route through the mesh architecture.<sup>13</sup> The Infinera routing systems and increased number of path options work together to make the network more robust and resilient.

MBC accomplished the following from its proposed goals:

- Installed 423 miles of fiber
- Connected 101 K-12 schools and 2 higher education institutions
- 52 signed agreements with 6 last mile providers
- Improved network capacity and survivability

As shown in Table 1, the majority of CAIs connected at the time of the site visit are educational institutions (87 percent), followed by governmental community support organizations as the second-most frequent CAI type (7 percent).<sup>14</sup> Nongovernmental community support organizations and libraries account for the small remainder of CAIs connected. The evaluation study team is unable to quantify the total number of “Other Community Support” institutions in the service area due to data limitations. For this reason, “N/A” is included in these fields. All connected CAIs have speeds between 10 Mbps and 100 Mbps.

**Table 1. Community Anchor Institutions Located in the Service Area**

Type	Served by Grantee	Others in Service Area
Library	3	10
Medical/Healthcare	0	846
Other Community Support (Government)	8	N/A
Other Community Support (Nongovernmental)	4	N/A
Public Safety	0	150
School (K-12)	101	189
University, College, or Other Postsecondary	3	15
<b>All</b>	<b>119</b>	<b>1,198</b>

There is a substantial opportunity to leverage the MBC infrastructure in southern Virginia beyond the scope of the original set of CAIs proposed in the grant application. MBC has incurred the fixed cost of laying the middle mile fiber network. However, there are additional fixed and operating costs associated with building last mile connections. In sparsely populated areas, demand may not be great enough for providers to profit, or to recoup their costs. This remains the greatest obstacle for connecting additional customers to the MBC network.<sup>15</sup>

## 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 grant. The list below highlights these outcomes and impacts, with additional detail provided in Section 2.

- More than a hundred K-12 facilities connected through the grant now have the bandwidth and connectivity needed to provide students with broadband-enabled education activities. Most have implemented one-to-one computing programs, giving students hands-on technology experience and individualized learning experiences. Parents and teachers witnessed an overall improvement in students' performance and reported that students were more engaged in schoolwork after the deployment of additional technology in the schools.<sup>16</sup> Before the MBC connection, teachers were able to use Internet-based resources for instruction but often declined to do so because of slow connections. Since connecting to MBC, teachers are now more likely to use laptops, tablets, IP-based educational programming, online research databases, and other digital learning tools in their classrooms.
- One of the impacts most commonly described by representatives of school districts is improved network reliability and functionality during the Standards of Learning (SOL) test, Virginia's statewide standardized exam for public K-12 students. Most SOL testing is computer-based. Network administrators reported no outages and the online testing process functioned properly for teachers and students. In addition, capacity is now sufficient to accommodate traffic not directly related to testing during statewide standardized testing.
- Expansion of fiber infrastructure into rural areas has spurred economic growth in southern Virginia. Fiber is crucial for day-to-day operations in many industries, and the grant-funded network expansion contributed to the relocation or expansion of several firms in southern Virginia. Growing industries include advanced manufacturing and data center operations.<sup>17</sup> The project also connected a GigaPark, a broadband-ready industrial and technology campus.<sup>18</sup>
- Interviewees provided evidence that the BTOP grant contributed to the indirect creation of nearly 2,200 jobs.<sup>19</sup> The project itself created nearly fifty full-time jobs, including project management, administrative, and engineering positions.<sup>20</sup> For some service area businesses, the benefits of the grant did not result in the creation of new positions, but helped preserve the positions of existing employees.
- MBC's open access network has generated competition among providers, resulting in larger markets and lower prices for customers. Some previously unserved and underserved communities now have broadband access as providers have used the MBC network to reach areas they previously did not serve.<sup>21</sup> In addition, all interviewees told the evaluation study team that their recurring Internet service costs had dropped significantly once they connected to MBC's network, although specific cost savings are not available for all institutions. Most interviewees stated that their organization has greater bandwidth than before they connected to MBC's network, in addition to the lower cost. One customer reported that since connecting to MBC, their bandwidth has increased by 50 percent at 40 percent of the cost of the original bandwidth.<sup>22</sup>

Through BTOP, the project achieved the following community impacts:

- New one-to-one computing programs in schools
- Relocation and expansion of several firms in southern Virginia
- Indirect creation of nearly 2,200 jobs

## Conclusions

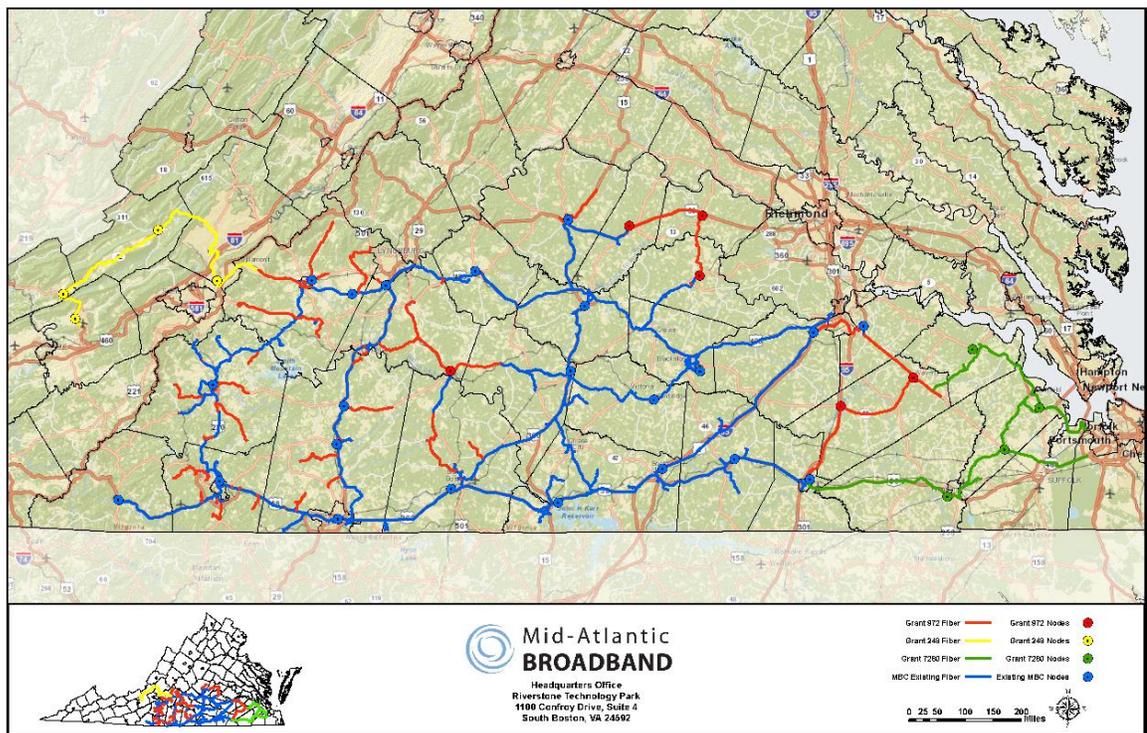
Without the BTOP grant, many K-12 schools in southern Virginia would continue to rely on T1 lines or microwave transmissions for Internet access. Network capacity would be constricted and connection speeds much slower. Utilization would likely approach total capacity on a regular basis, particularly during SOL testing. In the case of schools using microwave Internet access, transmissions would be susceptible to inclement weather and outages would be common. SOL testing conducted online would continue to be a challenging process, as teachers and students would experience problems with poor connection speeds, capacity overloads, and occasional outages. Lack of fiber infrastructure in rural areas make these economically distressed communities undesirable locations for companies to expand or relocate to, resulting in fewer employment opportunities and shrinking tax bases.<sup>23</sup>

Community anchor institutions interviewed by the evaluation study team reported that the grant project significantly improved the speed, reliability, and affordability of their broadband connections.

# Section 1. Introduction

MBC's primary goals were to connect K-12 schools and to provide middle mile broadband connectivity in its service area, comprising seventeen counties and five independent cities. Figure 1 below shows MBC's network, with expansions colored to signify which grant funded the construction. The red portions represent fiber lines constructed under this grant, the Southern Virginia project. Green represents the Eastern Virginia project, which was complemented by the Southern Virginia project. MBC constructed the yellow portions through a BTOP grant awarded to the Virginia Tech Foundation. Blue signifies existing MBC fiber. All fiber constitutes a single network owned and operated by MBC. As shown in the map, the area served by the Southern Virginia project (red) includes the counties of Amelia, Bedford, Buckingham, Campbell, Charlotte, Chesterfield, Cumberland, Dinwiddie, Franklin, Greenville, Halifax, Henry, Lunenburg, Pittsylvania, Powhatan, Prince George, and Sussex, and the cities of Bedford, Emporia, Lynchburg, Martinsville, and Petersburg.<sup>24</sup>

Figure 1. MBC Service Area Map



The project targets communities that are unserved or underserved by broadband service. The greatest obstacles to expanding broadband to consumers, businesses, and public institutions in these rural markets are the lack of affordable high-capacity backhaul and high-capacity access to the Internet.

As of December 2012, the counties and independent cities included in the grant application had an average unemployment rate of 6.9 percent, compared to a statewide unemployment rate of 5.9 percent.<sup>25</sup> Three of the counties and three cities had unemployment rates greater than 10 percent. The American Community Survey (ACS) Five Year Summary for 2007 to 2011 shows that 70 percent of the residents of both the service area and the rest of the State of Virginia are White. A higher portion of service area residents are African American (26 percent), when compared to the rest of Virginia (19 percent).<sup>26</sup> Approximately 49 percent of the service area residents have a household

income of less than \$50,000 a year compared to just 39 percent of the rest of the state’s population.<sup>27</sup> Using publicly available data, the evaluation study team identified 1,317 CAIs in the service area, including 13 libraries, 846 medical/healthcare facilities, 150 public safety institutions, 290 K-12 schools, and 18 higher education institutions.<sup>28</sup>

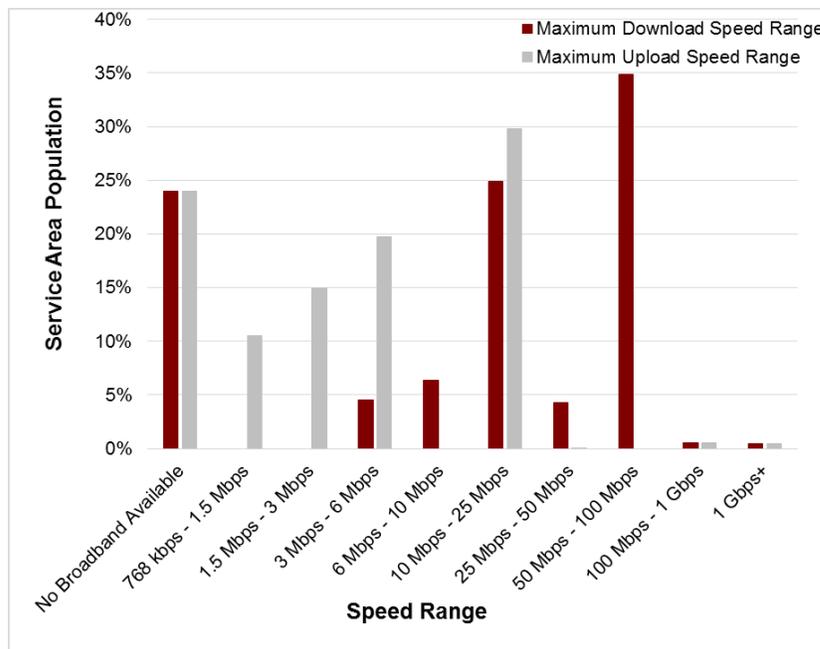
Table 2 shows the percentages of the populations in the service area and the rest of Virginia by the number of broadband providers available according to data and speed thresholds defined by the National Broadband Map (NBM).<sup>29</sup> In 2011, a much larger proportion of the service area population did not have access to any broadband providers compared to the rest of Virginia, 24 percent versus 11 percent. More than 20 percent of service area residents had access to only one provider, compared to 19 percent of residents in the rest of Virginia. 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 Virginia**

Number of Providers	Service Area	Rest of Virginia
0	24.02%	11.46%
1	20.41%	18.93%
2	28.18%	36.80%
3	26.92%	31.79%
4	0.47%	0.97%
5	0.00%	0.03%
6	0.00%	0.01%

Figure 2 shows the percentages of the service area population with respect to the fastest download and upload speed range available to them.<sup>30</sup> According to the NBM, eleven broadband providers offered service somewhere in the service area. Maximum download speeds ranged from 3 Mbps to 1 Gbps, while maximum upload speeds ranged from 768 kbps to 1 Gbps.

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



Broadband subscription rates are also lower in the service area than across the state. Federal Communications Commission (FCC) data from June 2012 show that 55 percent of the service area population subscribes to an Internet service that has at least 768 kbps download speeds and 200 kbps upload speeds.<sup>31</sup> Nearly 70 percent of the rest of the state's population subscribes to an Internet service with the same minimum thresholds.<sup>32</sup>

Figure 3 presents a summary of CAI subscriptions since MBC first connected an institution in the third quarter of 2011.<sup>33</sup> The grantee reports that for each quarter where there are subscriptions, the general offering given to CAIs is 10 to 100 Mbps. They go on to explain that most schools have 50 Mbps service.<sup>34</sup> MBC did not report connection speeds in detail.

**Figure 3. CAIs Connected by Connection Speed**

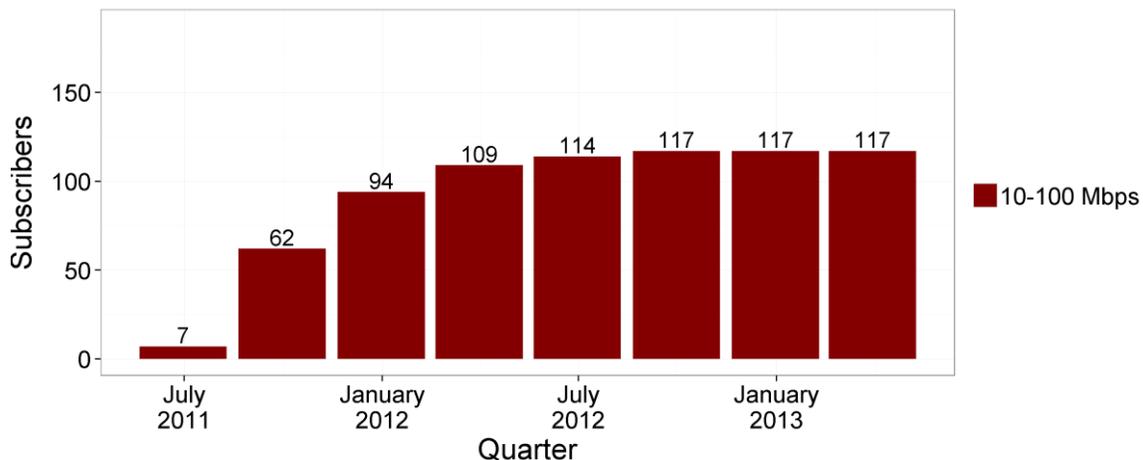
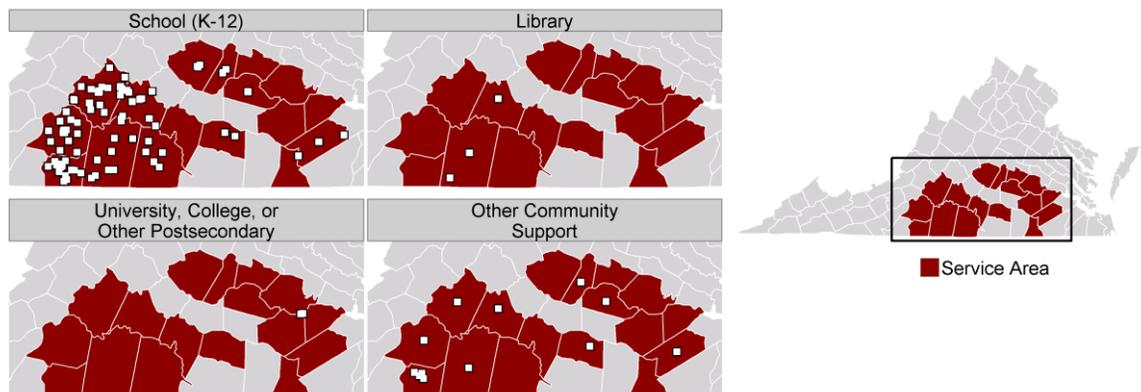


Figure 4 displays a map of MBC's service area and the locations of the CAIs connected. The CAIs connected were predominantly K-12 schools, mostly located in the western portion of the service area. MBC made connections to 101 K-12 education sites as of March 2013.<sup>35</sup> Two higher education sites were connected, both belonging to Virginia State University, a historically black college. Three libraries, one in Campbell County and two in Pittsylvania County, and twelve other community organizations complete the list of CAIs connected through the project.

**Figure 4. Map of CAIs in the Service Area**



The evaluation study team met with MBC staff, project partners, economic development specialists, and civic and government leaders. 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 southern Virginia focused on describing the impact on CAIs in terms of 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:

- **Last Mile Providers**
  - **GCR Company** (GCR) is a local information technology service provider in southern Virginia. GCR offers Internet service, network engineering and equipment, and technical support to business and residential customers. GCR functioned in multiple roles on the grant project. GCR provided some initial consulting for the BTOP-funded MBC network expansion and eventually performed equipment installation, network engineering, and testing services. GCR also uses the MBC network to provide last mile broadband service.
  - **Shentel** is a telecommunications provider in the southeastern United States offering voice, video, and data communications services through multiple operating subsidiaries. Historically, Shentel served the northern Shenandoah Valley in Virginia, but acquisitions within the past five years have expanded Shentel's market to include all of southern and southwestern Virginia, as well as portions of West Virginia and Maryland. Shentel uses the MBC network operationally to service points of presence for its cable TV and broadband markets in southern and southwestern Virginia and to reach an alternative peering point in Atlanta. In addition, Shentel uses the MBC network to augment its own 2,656-mile fiber network to provide last mile Internet service in remote areas it could not previously reach.<sup>36</sup> Four of Shentel's circuits on the MBC network serve school districts connected through the BTOP grant.<sup>37</sup>
- **Business Subscriber**
  - **ICF International** (ICF) is a Northern Virginia-based multinational consulting firm offering professional services to clients in the public and private sectors. As part of a major telephony upgrade, ICF constructed a new data and call center in Martinsville, Virginia for handling market research and customer service operations. ICF primarily manages government contracts so the ability to exchange large quantities of data rapidly and securely with clients is required. In addition, as an international corporation, ICF has offices, call centers, and data centers throughout the United States and abroad, necessitating a rapid, dependable form of intra-firm communication. ICF's site selection committee chose the new facility's location largely due to MBC's fiber network. MBC's open access model allows ICF to receive Internet service through its preferred providers, AT&T and Level 3 Communications.
- **School Districts**
  - **Henry County Public Schools** (HCPS) is the public school district serving Henry County. HCPS operates fourteen schools including two high schools, two middle schools, and ten elementary schools, as well as a regional alternative learning program and preschool programs at all elementary schools. Altogether, the district serves over 7,000 students.<sup>38</sup> HCPS uses technology to enhance instructional activities and foster innovation, and currently has a student-to-computer ratio of two-to-one, surpassing the state requirement of five-to-one. One-to-one technology initiatives in the district include the provision of iPads for all students in grades three through six and the implementation of a technology-based curriculum at Magna Vista High School through the nonprofit New Tech Network, which will provide each student with a MacBook Pro. HCPS uses digital technologies to streamline administrative activities where possible, and for communication with parents through a web-based parent portal. The HCPS administrative office and schools receive fiber-based broadband service through GCR on the MBC network. Previously, HCPS schools relied on wireless microwave technology for Internet access.
  - **Pittsylvania County Schools** (PCS) is the public school district serving Pittsylvania County. PCS operates twenty schools including four high schools, four middle schools, ten elementary schools, an alternative school, and a career and technical center. Enrollment in the 2012-13 school year was 9,311.<sup>39</sup> PCS uses digital technologies for both administrative and instruction purposes. The student information, accounting, cafeteria payment, and heating and cooling systems all rely on Internet connectivity to function. All classrooms are equipped with SMART

Boards or digital projectors and most schools have iPad and laptop carts that can be checked out for classroom use. In addition, the county subscribes to United Streaming to provide schools with IP-based educational television programming. PCS receives Internet service on the MBC network using GCR and the *nDanville* fiber network as its last mile providers. Prior to the fiber connections, PCS schools received wireless Internet access from the main office via microwave technology.

- Economic Development Organizations
  - The evaluation study team interviewed economic development organizations that serve the southern Virginian region directly. The evaluation study team also interviewed economic development organizations that serve eastern Virginia. The Southern Virginia network had a direct impact on the reliability of the Eastern Virginia project by extending access to Internet peering points in Northern Virginia and Atlanta and added redundancy to the network in case of fiber cuts. Many of the economic development initiatives in eastern Virginia would be limited in the type of broadband services available without the presence and interconnection to the Southern Virginia project's network.
  - Economic development organizations serving southern Virginia
    - **Southern Virginia Regional Alliance (SVRA)** is a regional marketing and economic development organization representing Halifax, Henry, Patrick, and Pittsylvania Counties, and the cities of Danville and Martinsville. SVRA focuses on marketing the region and its industrial parks to established companies that intend to relocate or expand. Target markets include aerospace engineering, plastic and polymer manufacturing, food and beverage processing, and data center operations. SVRA leverages the availability of MBC fiber as a major selling point when marketing the area to companies.
  - Economic development organizations serving eastern Virginia
    - The **Isle of Wight County Department of Economic Development** is responsible for marketing the county and its four industrial parks to expanding or relocating companies. A part of the Hampton Roads area, the rural county's residents desire amenities akin to those of a more metropolitan environment, including fiber telecommunications. Large employers in the county include Smithfield Foods, existing prior to the award period, and Safco, a manufacturer of office furniture, and Green Mountain Coffee, which constructed new facilities during the award period. In addition, International Paper, which discontinued operations at its Franklin mill in 2009, is repurposing the facility to manufacture fluff used in healthcare and absorbent products. Isle of Wight County was not included in the Southern Virginia project's service area; rather, it was a part of the Eastern Virginia project's service area. However, the Southern Virginia project was designed to improve the reliability of the eastern Virginia network by extending both networks to a mesh network providing continuous Internet service even in the event of fiber cuts. Additionally, the interconnection provides access to the Equinix Internet service in Northern Virginia. Thus, the southern Virginia network had a direct impact to the economic development activities in Isle of Wight, as well as Surry County. The complementary nature of the two grants indicates that the Southern Virginia project contributed to the impacts and outcomes observed in Isle of Wight County.
    - The **Mecklenburg County Department of Economic Development** is responsible for marketing the county to companies interested in opening new facilities in the area. Mecklenburg County is a very rural county with a transitioning economy that has historical roots in textiles and traditional manufacturing. The availability of MBC fiber in Mecklenburg County makes the area marketable to companies that require broadband connectivity. The county has nine business and industrial parks that are a part of MBC's GigaPark initiative (described in Section 2.2). The MBC network has helped the area attract and retain operational facilities for large companies including Microsoft and Hewlett-Packard. With the Microsoft data center, the Southern Virginia project provided an additional route to Internet peering points in Northern Virginia, Charlotte, and Atlanta. The redundancy helps to ensure the network performance needed for the Microsoft data center. This would not have been possible without the Southern Virginia project.

- Other
  - **Surry County** is a very rural county in southern Virginia. It is unique in that there are no providers offering service in the county to any entity other than the school district, which received service in July 2013, just weeks before the site visit. The evaluation study team met with representatives from the **Surry County Administrators Office; Surry County Public Schools; Surry County Department of Community Planning and Economic Development; Windsor Mill**, a local manufacturer of interior and exterior wood trim and molding; and **S. Wallace Edwards and Sons**, a meatpacking company. The BTOP-funded project extended the MBC network to Surry County where local schools previously received a 45 Mbps connection through Verizon. On the MBC network, they now have a 50 Mbps connection using GCR as a last mile provider and pay one-third the cost they paid to Verizon. Other community institutions, residents, and businesses, however, have not been able to receive broadband service because of a lack of providers in the area. They hope to connect to MBC in the future as discussed in Section 4.4.

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

# Section 2. Impacts

This section describes the outcomes and impacts of the MBC project in terms of the five focus areas described in *Interim Report 1*, with the addition of the Government Services focus area.<sup>40</sup> These outcomes and impacts focus on understanding the effect on CAIs. As the CAIs deployed the Internet connectivity through the MBC network, each CAI began to expand its services to meet the information needs of its customers. Many of the CAIs participating in the grant were already broadband users, but at much lower bandwidths. The MBC project provided additional supply to meet the demand for bandwidth among these existing users and extended middle mile fiber infrastructure into remote areas to reach new subscribers. While MBC focused on connecting educational institutions, the evaluation study team also discussed outcomes and impacts related to Workforce and Economic Development. The interviewees did not discuss significant outcomes and impacts in the Quality of Life/Civic Engagement, Digital Literacy, Healthcare, and Government Services focus areas, although some institutions may lease circuits on the MBC network.

## 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 recognized as valuable for career advancement. Examples of certificates or diplomas include community college degrees, four-year college degrees, advanced degrees, general equivalency degrees, certifications in advanced software technologies such as network engineering, and other licenses or certifications that reflect knowledge of a particular subject at a level that would typically be taught at an educational institution.

When assessing impacts it is important to understand the characteristics and composition of education providers within the service area. Table 3 identifies all public schools in the service area.<sup>41</sup> MBC connected more primary schools than any other level, sixty-five, more than half of all schools connected (64 percent). Additionally, MBC connected only public schools, connecting to more than 40 percent of the public schools in the service area.

**Table 3. Virginia Public Schools (K-12) by School Level**

School Level	Served by Grantee	Others in Service Area
Primary	65	35
Middle	14	16
High	14	29
Other	4	74
Undefined	4	N/A
<b>All</b>	<b>101</b>	<b>150</b>

MBC connected schools that serve nearly 44,500 students, 38 percent of all primary and secondary school students in the service area. More than 12,000 of these students are minorities and represent nearly 23 percent of the minority primary and secondary students in the service area. More than 21,500 of the service area’s students qualify for free lunch. MBC connected schools employ 2,600 full-time equivalent teachers, 37 percent of all teachers in the area. MBC also connects to two postsecondary locations through Virginia State University, a historically black college.<sup>42</sup>

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.**<sup>43</sup>
  - Henry County Schools is a large provider of adult education and general equivalency degree (GED) classes. Some classes are administered online, including the GED exam. Increased capacity acquired through the BTOP-funded project has resulted in more online training activities and allowed one Henry County school to apply to become an official GED testing site.<sup>44</sup>
  - Faster speeds and greater bandwidth obtained through the grant-funded network have resulted in more online learning initiatives in Pittsylvania County Schools. The county has implemented online courses for special education students and nursing students in the county's vocational program.<sup>45</sup>
  - Many teachers in Surry County Schools use the schools' network for continuing education courses. Many are enrolled in online classes to obtain professional certifications or additional degrees, but do not have reliable broadband connectivity available to them at home to support their education. The schools' Internet connection enables teachers to enroll in online continuing education programs to which they would not have access without their schools' BTOP-funded connection.
- **The use of digital tools enabled by broadband can save teachers time, allowing them to devote more effort to instruction.**<sup>46</sup>
  - Henry County Schools, which previously relied on wireless microwave technology for Internet access, has implemented several technology-focused initiatives after acquiring fiber connectivity. Each teacher in the county receives his or her own laptop for planning and instructional purposes. Teachers have the flexibility to research and plan lessons from home. Each school has its own selection of video-on-demand educational programming, available through the school's intranet. The greater bandwidth of the MBC network ensures that content downloads relatively quickly, preventing lengthy wait times for teachers and students.
  - Pittsylvania County Schools provide software to teachers that enables them to create computer-based exams. The software gives students experience with computer-based test taking and saves teachers time by automating grading. Prior to the grant, limited broadband capacity resulted in slowed network traffic when an entire class of students used computers simultaneously. After connecting to MBC through the BTOP grant, bandwidth is now adequate to support online testing.
- **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.**<sup>47</sup>
  - Henry County Schools provides all students in grades three through six with iPads, which were purchased through a separate \$500,000 grant in 2010.<sup>48</sup> Textbooks for third through sixth grade are purchased in digital format and loaded on to students' iPads. Other grades have access to iPad carts that can be checked out by teachers for classroom use and iPad café tables in libraries. One of the most commonly used iPad applications in Henry County Schools is Accelerated Reader, a progress-monitoring reading comprehension program. Students check out and read books on the iPad, which they also use to complete comprehension tests after they finish reading. The reliability and speed of schools' connections to the MBC network ensure that iPad learning activities function smoothly and without interruption. The success of the iPad program in lower grades has led Henry County Schools to implement a Bring Your Own Technology (BYOT) program in its high schools in the 2013-2014 school year. On BYOT

days, students will have the flexibility to bring a device such as a laptop, tablet, or smartphone from home or to check out a school-owned device to use for instructional purposes.

- In Pittsylvania County Schools (PCS), many elementary and middle schools were equipped with iPad carts prior to the site visit, and four more carts have been distributed for the 2013-14 school year. There are also laptop carts in every school except one, totaling 600 laptops in the county as a whole. Greater bandwidth obtained through MBC supports the use of laptops for classroom instruction and for SOL testing, the statewide standardized exam.
- Isle of Wight County Schools implemented an iPad program in its high schools during the 2012-13 school year. Each high school student received an iPad and the entire curriculum was rewritten to integrate the devices into instruction. The iPads hold students' textbooks in digital format, eliminating the need to purchase more expensive, printed books. They also give students more research capabilities. The MBC network provides the network capacity necessary to support the simultaneous use of students' devices.
- All PCS institutions have access to an IP-based television system that offers approximately eight educational channels, including the Public Broadcasting Service (PBS). In addition, the school district has a subscription to United Streaming Services through which teachers can stream additional content during lessons. Nearly 99 percent of classrooms in the district are equipped with either a digital projector or a SMART Board, and televisions. Some schools have purchased licenses for additional educational resources, research databases, or software to take advantage of the fiber connectivity. PCS schools' connection to the MBC network provides the bandwidth necessary to support these applications. Bandwidth was not adequate prior to the grant.
- **Research has shown that computer use among students leads to improved academic performance and greater levels of educational attainment.**<sup>49</sup>
  - In Henry County, responses to a survey administered to parents stated that students seemed more engaged in their education when learning on their iPad or other digital device than compared to traditional learning methods.<sup>50</sup> Teachers have reiterated this statement. In addition, computer-based lessons and exams have been successful for credit-recovery courses in the county's alternative school. The alternative school staff has expressed that their students, who previously had trouble succeeding in a traditional school environment, frequently out-perform their classmates when returning to their regular schools. Schools also use technology to accommodate students with physical or cognitive disabilities who have exhibited greater progress when using digital tools.
  - PCS is attempting to use technology to boost standardized test scores. SOL math test scores in the county were relatively low last year, so the 2013-14 school year will focus on using technology to support math curricula.<sup>51</sup>
- **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.**<sup>52</sup>
  - PCS uses a parent portal and online learning management system to track students' attendance and progress. Parents can check the portal to receive individualized feedback about their students and to monitor their academic performance, including grades and assigned homework. Parents can also sign up for phone, e-mail, or text message alerts from the school system and their child's school. Through the MBC network, PCS now has the connection speeds to support access and use of these online applications, which are hosted remotely.
  - Fiber connections in Henry County extend to all schools that have connectivity back to the central board office. The student data system, library systems, and reading programs are in the cloud, eliminating the need to purchase servers for each school, which would have been necessary without the connection to MBC.
  - In Pittsylvania County, fiber connectivity has helped schools streamline their individual administrative activities. Student information systems and schools' cafeteria payment systems are computer-based. This simplifies record keeping for school administrations and enables

parents to make online payments from home on their students' cafeteria accounts. Many schools have IP-based heating and cooling systems, allowing maintenance staff to make adjustments remotely. This capability helps the district manage energy use and costs.

- For school districts, one of the most noticeable outcomes of connecting to the MBC network is the reliability and functionality of the network during SOL testing.<sup>53</sup> Representatives of Henry County Schools and Pittsylvania County Schools, as well as representatives of GCR and Shentel, emphasized that the connections to the MBC network have drastically improved testing operations. The schools have not experienced any outages during SOL testing. In addition, schools that were previously approaching 100 percent capacity during testing now have additional bandwidth to accommodate Internet traffic not related to testing. Representatives of the school districts remarked that the reliability and speed of the network has made test time less stressful for both teachers and students.

## 2.2 Workforce and Economic Development

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

In 2008, before the BTOP grant was awarded, MBC expanded its network to reach sixty business and technology parks across the state.<sup>54</sup> A marketing campaign rebranded them "GigaParks," a nod to the high capacity of the 800-mile network that serves them. As of August 2013, MBC served sixty-five GigaParks across southern Virginia.<sup>55</sup> Thirty-eight GigaParks are in the BTOP grant's service area, one of which was connected through the grant-funded project.<sup>56</sup>

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.

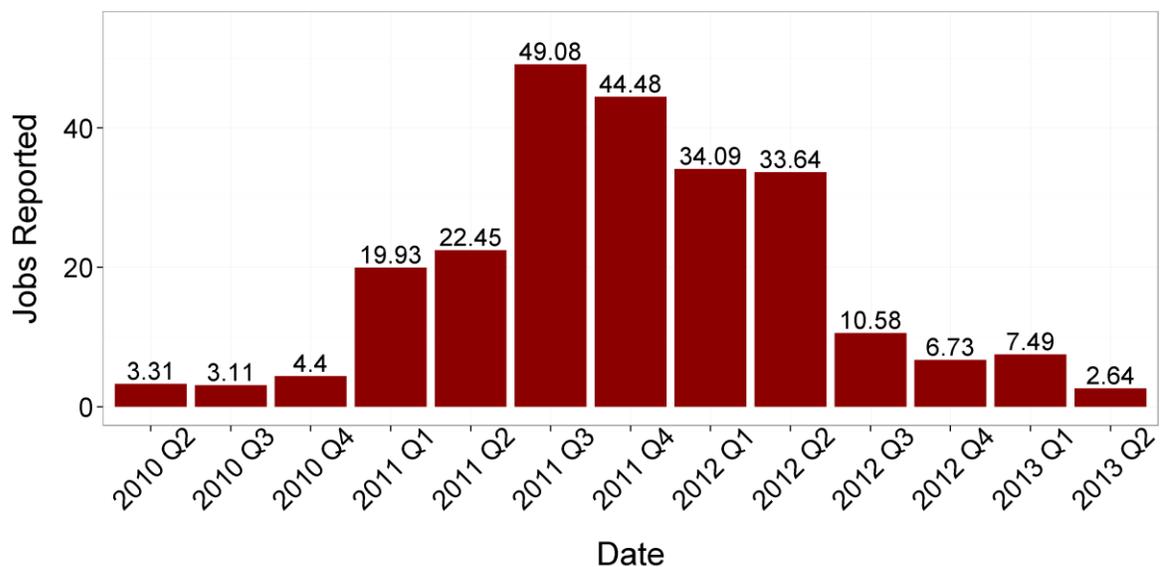
- **The availability of infrastructure in a community enables firms reliant on broadband services to relocate or open additional locations. Local businesses are able to obtain improved access to inputs and markets.<sup>57</sup>**
  - ICF recently opened a new facility in Martinsville. Broadband connectivity is crucial for ICF, which handles mostly government contracts involving significant quantities of data that must be transported and processed securely. Additionally, as an international company, ICF must have a high-quality connection to facilitate smooth communications with offices across the country and world. During the grant period, ICF commenced a major telephony upgrade involving the construction of a new call center for managing market research and customer service operations. ICF chose to build its new center in the Martinsville Patriot Center GigaPark largely due to MBC's fiber network. ICF's business needs go beyond broadband access alone. Its leadership team expressed that network reliability should near 100 percent. The high degree of reliability offered by the MBC network factored heavily in the decision to locate in Martinsville.
  - Shentel uses the MBC network to provide last mile broadband service in rural markets where it did not previously have a presence. A representative of Shentel remarked that MBC's network reliability and wholesale pricing are significantly better than those of incumbent middle mile carriers. The lower prices MBC offered to Shentel result in lower retail prices for its customers, making Internet access available and affordable in rural markets.

- Mecklenburg County economic developers in the county target advanced manufacturing, distribution, and data-intensive companies. Hewlett-Packard (HP) and Microsoft constructed and operate data center facilities in Clarksville. Microsoft has since expanded its campus twice, investing a total of \$1 billion in the facility. Grant-funded improvements to portions of the MBC network that reach an interconnection point in Washington, DC are of particular importance to the HP center, which focuses on federal government contract work.
- The Southern Virginia project connected MBC's Eastern Virginia project, which extends to Isle of Wight County, and to the rest of the MBC network. The Isle of Wight County Department of Economic Development leverages the MBC network to attract relocating or expanding businesses to the county's four industrial parks. Since the fiber build, Safco, an office furniture manufacturer, and Green Mountain Coffee Roasters have constructed facilities in Isle of Wight. International Paper, which ceased operations at its Franklin mill in 2009, is repurposing the mill to manufacture fluff for medical and absorbent products. These companies have invested a combined \$282 million in their Isle of Wight facilities.<sup>58</sup>
- **Workforce and Economic Development activities supported by broadband infrastructure strengthen job and population growth.**<sup>59</sup>
  - ICF's relocation to Martinsville created 539 permanent jobs.<sup>60</sup> Positions range from entry level to management.
  - The Mecklenburg County Department of Economic Development estimated that the HP data center employs between 100 and 150 permanent staff. Representatives also estimated that Microsoft has employed 250 to 450 temporary construction employees at any given time during its expansion in the past 3 years.<sup>61</sup>
  - The Isle of Wight County Department of Economic Development stated that Green Mountain Coffee has plans to employ 800 individuals by 2015.<sup>62</sup> In addition, Safco's expansion created 40 jobs and the reopening of the International Paper mill will create 200 jobs.<sup>63</sup>
- **New or enhanced connectivity benefits businesses by enabling the use of applications and processes that increase productivity and efficiency.**<sup>64</sup>
  - The southern Virginia economy was historically heavily manufacturing-based. In recent years, the popularity of automated manufacturing processes has made digital technologies increasingly important for these industries. All economic developers and representatives of private firms interviewed expressed that broadband was essential for new and existing companies in their area.
  - Economic development representatives from Mecklenburg County stressed that the MBC network has attracted new business development and has preserved existing area businesses. Before the MBC network was constructed, there was no fiber available in Mecklenburg County. Businesses often paid \$10,000 to \$20,000 per month for Internet access through a T1 line. Last mile providers in the area now offer broadband services through MBC at a much lower price, which allows businesses to lower their operating costs.
  - The high degree of reliability offered by MBC has enabled ICF to recently shift to 24/7 operations. The shift has resulted in the acquisition of new business contracts with local manufacturer Hooker Furniture and the City of Martinsville's emergency management agencies. ICF interviewees stated that they could not have acquired these contracts prior to transitioning to twenty-four hour operations. This represents an expansion into new markets for ICF, which typically manages federal government contracts.
- **Broadband access improves the ability of rural communities to compete for low- and high-end service jobs, the area of highest economic growth.**<sup>65</sup>
  - Henry County's relatively high unemployment rate of 13.9 percent in 2010 and proximity to several universities and community colleges were factors in ICF's decision to build its new facility.<sup>66</sup> ICF's initial hiring strategy was to acquire employees with a technology-intensive background, such as computer programming. Once they fill senior positions, ICF will begin recruiting junior-level employees that meet basic education and skill requirements. These employees will then undergo on-the-job training to acquire proficiency in the platforms or programming languages necessary for their work. ICF recruiters have built a relationship with

representatives of nearby universities and community colleges and carry out recruiting activities at these campuses.

As required by the Recovery Act, MBC reported the number of jobs created quarterly as a direct result of the project. Figure 5 below shows direct job creation over the award period.<sup>67</sup> For most of the award period, job creation was mostly associated with administrative activities. A rise in engineering, construction, and inspection activities spurred rapid job growth during the first through third quarters in 2011, peaking at just over 49 full-time equivalent workers.<sup>68</sup> More than 60 percent of the project's construction was completed during this time.<sup>69</sup> As the final construction phases were completed, the number of full-time positions began to fall, from the last quarter of 2011 until the last quarter of 2012 when the number of positions funded by the grant returned to pre-construction levels. It is important to note that this only includes direct jobs created, and does not include indirect or induced job creation.

**Figure 5. Direct Jobs Created by MBC**



Most of the interviewees did not report increases in job creation because of receiving improved broadband service, though some mentioned it might have saved some otherwise eliminated positions. Many respondents reported increases in operational efficiency of their CAI, but none supplied the evaluation study team with quantitative measures that could describe the extent of these gains.

## Section 3. Grant Implementation

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

### 3.1 Implementation

MBC is a nonprofit organization that serves as a wholesale open access network transport provider. MBC provides a carrier-class fiber-optic network that enables retail private sector last mile providers to serve the southern Virginia region.<sup>70</sup> Originally operating as an independent nonprofit cooperative, MBC sought to implement an open access fiber-optic telecommunication infrastructure to help transform the predominantly rural regional economy in southern Virginia.<sup>71</sup> As a broadband cooperative, telecommunication providers joined MBC as members to obtain middle mile services through the cooperative's broadband transport network. The members also had a voice in how MBC was managed. MBC was required under the cooperative model to use its income solely for paying expenses and to share any excess income with its members.<sup>72</sup> In 2012, MBC transitioned from a 501(c)(12) cooperative to a 501(c)(4) nonprofit corporation and became known as the Mid-Atlantic Broadband Communities Corporation. As a 501(c)(4), MBC is now organized to operate only to promote social welfare for the benefit of southern Virginia.<sup>73</sup> The nonprofit model allows MBC to serve any last mile provider without requiring the provider to become a cooperative member.

MBC's active customers range from large national corporations like Verizon and Level 3 Communications, to small wireless providers and competitive local exchange carriers (CLEC).<sup>74</sup> Last mile providers use the MBC network for a variety of services including optical transport services and equipment colocation services at six towers and more than thirty node sites.<sup>75</sup> MBC provisions either wavelength or Ethernet circuits over its synchronous optical network (SONET) infrastructure. This architecture ensures that when a telecommunication provider buys 100 Mbps of transport services, they have a dedicated 100 Mbps fiber optic conduit for their services.<sup>76</sup> The diversity in transport services offered allows MBC to accommodate large bandwidth transport needs as well as relatively smaller bandwidth needs.

MBC designed its broadband network infrastructure with a strategy to provide service that is highly reliable, scalable, and resilient. MBC has deployed Infinera network technologies to build a mesh network to enhance network reliability significantly. This upgrade was implemented at key points in the network where IP traffic comes in from interconnection points in the regional network. Infinera technology seeks out the shortest route for traffic on the mesh network. The mesh architecture allows MBC to keep the Internet traffic moving through alternate paths in the event of a fiber cut or other unplanned outage. The BTOP grant funding also enabled MBC to interconnect to a new \$6 million network built by the Virginia Tech Foundation from Blacksburg to Bedford. These connections also help to improve the network's reliability and resiliency. These enhancements have had a considerable impact on MBC's customers, many of whom require near 100 percent reliability for day-to-day operations.

One of MBC's goals was to improve the performance of the southern Virginia network by reaching several carrier-neutral interconnection points to ISPs outside of the region. This reduces the Internet access costs in MBC's service area and increases the number of carriers able to provide affordable service to CAIs. MBC's own network node facilities are designed to make the interconnection with telecommunication providers neutral, convenient, and well protected. The facilities are twelve-by-twenty-foot precast concrete structures with space for MBC equipment on one side and colocation space on the other side that other telecommunication providers can rent. Node facilities operate on a redundant power supply and MBC monitors and manages service twenty-four hours a day from its existing network operations center in South Boston, Virginia. Dual HVAC systems, substantial

grounding and environmental monitoring systems, and a low-emission emergency backup generator that operates on diesel fuel offer additional protection for node facilities. MBC initially planned to build four node facilities but was able to add two more for a total build of six node facilities with savings accrued through the project. The node facilities allow transport circuits as small as 10 Mbps, utilizing Ethernet over SONET technology.

## 3.2 Open Access Policies

CCI projects funded by BTOP are predominantly middle mile projects, although a small number of last mile projects were awarded. These grants intend to improve available broadband capabilities for CAIs, to facilitate the development of last mile services in unserved and underserved areas, and to promote economic growth. This investment through the BTOP grant is intended to “lay the foundation for the ultimate provision of reasonably priced end-user broadband services” through open and nondiscriminatory interconnection strategies to enable last mile providers to have open access to the network.<sup>77</sup>

There is considerable debate on the impact of open access policies on the competitiveness of the broadband market.<sup>78</sup> Open access is implemented through a wide variety of strategies. “These can range from commercial or voluntary arrangements, between communication operators and third-parties, through to regulatory intervention aimed at promoting certain policy objectives, such as expanding broadband availability, increasing competition, or promoting investment that may otherwise not be economic, such as in the case of enabling the establishment and treatment of shared facilities.”<sup>79</sup> The impact of open access will be dependent upon how well the practices and policies help to reduce the time, cost, and difficulty for last mile providers to interconnect to the network.<sup>80</sup> The impact also depends on how well the policy mechanisms ensure competitive pricing for wholesale services in the event of the presence of a middle mile provider that may also be a last mile provider.<sup>81</sup>

MBC has a well-established mission to provide an open access broadband network. The MBC website and other communication materials clearly state, “MBC operates an open access network that enables businesses to work with the communication provider of their choice to secure diverse network access.”<sup>82</sup> MBC’s open access philosophy was first developed when the cooperative was formed in 2004. As it built out the network, including expansions funded through BTOP, MBC leadership implemented strategies to provide a middle mile transport network, allowing private sector providers to build out last mile connections.

MBC does not compete directly with retail broadband ISPs in that it does not provide end user access or value-added services such as traffic shaping or scheduling. MBC works with CAIs to identify their Internet service needs, and then notifies a group of retail ISPs with requests for proposals. MBC has nearly ten years of experience operating and managing its own middle mile broadband network. The staff includes sixteen employees who worked on all phases of the project, including a separate department responsible for managing the BTOP grants.<sup>83</sup> MBC does not reject any carriers’ requests for interconnections as an open access provider and has active agreements with forty-five different telecommunication providers as of August 2013.<sup>84</sup>

MBC designed the network expansion with upgrades and scalability in mind. MBC acknowledges the importance of building a network that will facilitate ease of upgrades since many customers require rapid upgrades to accommodate growing demand. They are able to complete bandwidth upgrades remotely within approximately ten minutes.<sup>85</sup> MBC also placed handholes along the route to facilitate fast connections should future service be requested. Handholes are located near CAIs, cell towers, major intersections, and other locations MBC anticipated service opportunities would arise.

MBC implements the details of its open access policy through master service agreements with the carriers that use the network. It offers layer one transport services only and does not use any practices to block access, engage in packet-shaping, or restrict connectivity or bandwidth utilization.

The absence of MBC-provided value-added services eliminates the possibility for MBC to compete with its last mile providers, preserving the open access nature of the network.

Despite MBC's middle mile expansion, last mile providers have been reluctant to build into certain remote areas citing cost-ineffectiveness due to sparse population density. As a result, some communities remain underserved or unserved.

### 3.3 Results

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

- The project expanded MBC's middle mile infrastructure to reach rural areas. Prior to the grant, much of the area currently served by MBC had little to no end-user connectivity options. Those areas that did have Internet service available were frequently offered services inferior to fiber-based broadband, including wireless microwave service. Since MBC has incurred the middle mile construction costs, providers that were not willing to provide fiber services to these areas are beginning to offer fiber-based last mile services. Now, areas that were unserved or underserved before the project have access to broadband.
- The open access model followed by MBC has generated competition among area providers, effectively lowering prices for end-users. This includes both incumbent providers as well as new providers that came to the area after the middle mile build-out. Although most did not offer specific cost data, all of the organizations interviewed by the evaluation study team reported that their connectivity costs fell after connecting to the MBC network. In addition, the majority of these respondents stated that they also received higher bandwidth connections through MBC than through their incumbent provider.
- The network architecture and equipment implemented by MBC increased the network's reliability and survivability. The fiber routes constructed through the grant completed loops to connect existing infrastructure and to create a mesh network. The mesh layout gives traffic a number of different paths from node to node, which preserves continuity of operations in the event of an outage. To further improve speed and reliability, MBC purchased Infinera equipment for the network, which identifies the fastest route for traffic traveling through the mesh network.

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

- The impact of open access will be dependent upon how well the practices and policies help to reduce the time, cost, and ease for last mile providers to interconnect to the network.<sup>86</sup> Although the middle mile expansion funded through the grant has encouraged increased competition among providers in some regions, other areas, like Surry County, remain unserved. Even using MBC's middle mile infrastructure, it is still cost-prohibitive for providers to serve extremely sparsely populated areas. Local governments and MBC will continue to work together to demonstrate demand to providers in an effort to bring broadband services to unserved and underserved regions.
- The impact also depends on how well the policy mechanisms ensure competitive pricing for wholesale services.<sup>87</sup> MBC offers attractive rates for wholesale services to last mile providers. To the extent that MBC maintains this pricing structure, it should be able to increase the use of the expanded network and the social and economic benefits it provides, particularly among residential users, who were not reached through the grant project.
- MBC must maintain the reliability of the network over time. The network is monitored on twenty-four hour basis at MBC's network operations center, located in its office building. Many end users served on the MBC network require near 100 percent reliability, including government, education, and corporate subscribers. Network reliability is particularly important for continuing to attract businesses to Virginia's economic development zones. MBC's past experience and post-BTOP success indicates that future network maintenance is well within its capabilities.

### 3.4 Sustainability

MBC has initiated the following activities to support the sustainability of the project:

- Expanding its middle mile service to include broadband services to support carrying more wireless backhaul traffic to Internet exchange points.
- Expanding its colocation facilities with new points of presence in Richmond and Washington, D.C. to improve opportunities for last mile providers to serve customers.
- Opened an economic development office in the Silicon Valley area to encourage businesses to operate facilities in southern Virginia.
- Recently formed a 501(c)(3) charitable arm to leverage grant opportunities to support projects that have a social and educational impact in the region.

ASR will check in with MBC in the second quarter of 2014 to learn more about the sustainability of the project.

### 3.5 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.

- At BTOP conferences, MBC's CEO collaborated with representatives from other regional networks to consider how they might leverage an interconnection between the networks. As a result, MBC has expanded interconnections with the Telx network in Atlanta. While not funded by this grant, that connection was made possible through the relationships fostered between organizations participating in the BTOP program.
- MBC frequently completed random quality inspections at construction sites to ensure the construction was completed properly and on time. MBC's motto for the project was "Inspect what you expect." Five different contractors installed the fiber network. MBC developed a process to check the quality of the installation. This also allowed MBC to remedy any issues or deviation from the contract early on in the process before they developed into larger problems.
- MBC contacted schools individually during the engineering stage. This allowed MBC to obtain rights of way, determine where equipment could be housed, and resolve all engineering details prior to construction, which facilitated a smooth transition between the engineering and construction stages.
- MBC's Business Development Manager holds informational luncheons with potential customers to build its customer base. MBC often invites last mile providers in order to generate interest around the provision of end-user service in rural areas.
- The MBC team had to adjust to the heavy administrative workload connected to the implementation of a large federal grant. MBC hired three new employees as a result, as well as an additional employee who was not hired solely to help with grant administration but makes significant contributions to the project.
- MBC's project management team uses Geographic Information Systems (GIS) innovatively. GIS is used to support strategies to market the broadband service to customers. The GIS is used to query several databases to identify CAIs and businesses that are located within 1,000 feet of the fiber backbone. MBC then sends a postcard to the CAI or business. MBC starts its customer opportunity process to notify last mile providers that then respond to the customer. GIS is also used for route planning and engineering and to help with economic development initiatives.
- The geographic area affected by this project required MBC to acquire numerous land leases for easements, railroad crossing permits, and right of ways. MBC used an ongoing Memorandum of Understanding (MOU) with the Virginia Department of Transportation (VDOT) to obtain right of

way use through the project area. This allowed MBC to quickly and easily acquire permits in most cases. In addition, VDOT gave MBC unrestricted use of its controlled access roads for construction purposes in exchange for fiber access.<sup>88</sup>

- MBC developed a process to match opportunities for last mile providers to connect new service for end user entities. When prospective customers inform MBC that they would like service, they first work with MBC to identify their service needs. Next, MBC distributes a notice to all of the last mile providers that use the network that includes the needs of the customer as well as the wholesale price and non-recurring fee charged by MBC. Providers can then develop a quote for the customer and contact them directly to establish a service agreement. Once the customer chooses a provider, the provider notifies MBC of the contract and MBC and the provider sign an agreement as well. After any necessary construction is completed on the lateral connection, MBC turns on the service to the end user.

## Section 4. Conclusion

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The American Recovery and Reinvestment Act of 2009 (Recovery Act) instructed NTIA to implement BTOP to promote five core purposes:<sup>89</sup>

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 MBC's implementation of BTOP has encouraged the fulfillment of the Recovery Act's goals. MBC supported Recovery Act goals to improve access in unserved and underserved areas. With these connections, schools in rural areas have the reliable broadband service they need to give their students a competitive, modern education. The MBC expansion into remote areas is also transforming local economies, providing employment opportunities, and stimulating economic activity.

### 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.

As MBC launched its work to build the broadband infrastructure in southern Virginia, the region had a greater proportion of CAIs and individuals who lacked broadband access than the rest of the state. According to data from the June 2011 release of the NBM, more than 24 percent of the MBC service area residents do not have a broadband provider available to them. The service area has a higher concentration of individuals without a broadband provider available than the rest of the state, where more than 11 percent of the population do not have a broadband provider available.<sup>90</sup> Broadband subscribership rates are also lower in the service area than across the state. FCC data show that 55 percent of the service area population subscribes to an Internet service that has at least 768 kbps download speeds and 200 kbps upload speeds. Nearly 70 percent of the state population subscribes to an Internet service with at least the same minimum thresholds.<sup>91</sup>

The MBC network improved access to broadband in these underserved areas. First, MBC made the greatest impact in improving access in underserved areas in southern Virginia by directly connecting 119 CAIs. The benefits are significant as school districts, libraries, community colleges, and universities are experiencing different gains in cost savings and network reliability from the new broadband connections. In addition, these CAIs have been able to expand the range of services they offer. Schools, in particular, have pursued numerous technology initiatives and can now broaden the

range of courses they offer and the number of students they reach with the use of online and distance learning programs.

Demand is still unmet in many sparsely populated areas. Despite the middle mile expansion funded by the BTOP grant, potential subscribers are too dispersed geographically for providers to recoup construction and operating costs associated with making last mile connections. As a result, most providers are unwilling to invest the fixed cost of building to end users in these areas. Surry County, for example, has been unsuccessful in finding a provider for its area. As a result, it is pursuing the construction of a 350-foot wireless tower, which is a less reliable form of broadband access for its residents, but the only option that is feasible at this time.

The MBC network focuses on providing physical access to the middle mile network. The last mile providers add value by offering other broadband network services to CAIs based on their needs. MBC has made the last mile services more affordable by colocating network equipment with its ISP, Equinix, in Ashburn. This has created more competition in southern Virginia through this affordable access and drives down the costs for the CAIs connected through the grant.

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

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

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

Schools connected to the MBC network have begun to offer some digital literacy training because of their one-to-one computing programs. Parents who are not digitally literate have requested and participate in training events to become familiar with students' devices. In addition, technology training is offered, and sometimes required, for teachers. School districts have incorporated digital literacy training into their professional development programming to support teachers' use of technology in the classroom.

Now that K-12 schools are connected, MBC is focusing on using the network as a marketing feature for economic development in southern Virginia. MBC and its partners recognize that private industries' high demand for broadband connectivity make fiber availability and access essential for economic development prospects. MBC worked with local and regional economic developers to identify industrial and technology campuses to connect through its GigaPark initiative. MBC fiber currently reaches sixty-five GigaParks in southern Virginia, thirty-eight (58 percent) of which are in the grant service area.

## **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, MBC did not connect to any public safety entities. However, ICF was able to begin providing emergency management services to the City of Martinsville after connecting to MBC's network.

## 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. Many of the CAIs participating in the MBC grant were already broadband users, but at much lower bandwidths than after they connected to MBC. The MBC project increased demand for bandwidth with these existing users, rather than increase broadband adoption at CAIs that had no broadband connection. Many respondents reported increases in operational efficiency of their CAI. Henry County Schools, for example, would routinely approach 100 percent capacity during online SOL testing prior to connecting to MBC. After receiving increased bandwidth through MBC, network utilization during testing hovered around 50 percent capacity, allowing for additional traffic not related to testing.<sup>92</sup>

There are no studies available that illustrate the effect of the MBC project on economic growth in the service area. The availability of fiber in rural areas that were previously unserved or underserved, however, has opened up economic opportunities that would not have arisen otherwise. Rural Virginia is a desirable location for businesses to relocate or expand because land is available and relatively cheap, taxes are low, and the unemployment rate is relatively high. The availability of fiber in these areas makes them extremely marketable to site selection teams. Local economic developers and MBC's GigaPark team worked together to get these sites connected to the network to stimulate economic growth in southern Virginia. As mentioned throughout the report, the service area has seen the relocation and expansion of several firms, resulting in numerous job opportunities for local and regional workforces.

## Section 5. Next Steps

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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

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- 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.

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- Middle: lowest grade offered is in fourth through seventh grades and highest grade offered is in fourth through ninth grades
- High: lowest grade 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: there were four institutions connected by the grantee classified as K-12 schools for which there was no match in the public data set. Some of these institutions were career and technology centers and adult education centers.

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<sup>68</sup> Recovery.org provides the following guidance and example for calculating grant-funded jobs:

1. If a normal full-time schedule is 40 hours a week, multiply 40 hours x 52 weeks = 2,080 Total Hours per year.
2. Divide 2,080 Total Hours by 4 to equal 520 regular quarterly hours.
3. If two full-time employees each worked 520 hours (1,040 hours) for the quarter and another half-time employee worked 260 hours, the Total Hours for the three employees is 1300 (520 + 520 + 260 = 1300).
4. Divide 1300 by 520 to equal 2.5 Recovery funded jobs during that quarter.

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

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# Glossary

Acronym	Definition
APR	Annual Performance Progress Report
ASR	ASR Analytics, LLC
BTOP	Broadband Technology Opportunities Program
BYOT	Bring Your Own Technology
CAI	Community Anchor Institution
CCI	Comprehensive Community Infrastructure
CLEC	Competitive Local Exchange Carrier
EMS	Emergency Management Services
EPA	Environmental Protection Agency
FCC	Federal Communications Commission
GCR	GCR Company
GED	General Equivalency Degree
GIS	Geographic Information System
HCPS	Henry County Public Schools
HVAC	Heating, Ventilation, and Air Conditioning
ICF	ICF International, Inc.
IMLS	Institute of Museum and Library Services
MBC	Mid-Atlantic Broadband Communities Corporation
MOU	Memorandum of Understanding
NBM	National Broadband Map
NTIA	National Telecommunications and Information Administration
PBS	Public Broadcasting Service
PCC	Public Computer Centers
PCS	Pittsylvania County Schools
PPR	Quarterly Performance Progress Report
SBA	Sustainable Broadband Adoption
SOL	Standards of Learning
SONET	Synchronous Optical Network
STEM	Science, Technology, Engineering, and Mathematics
SVRA	Southern Virginia Regional Alliance
VDOT	Virginia Department of Transportation

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