Department of Economic and Community Development

Randy Boyd
Commissioner

Bill Haslam
Governor

July 19, 2016

Team Tennessee,

As I traveled across Tennessee in my first few months as TNECD commissioner last year and held town hall "listening" sessions, over half of each conversation focused on increasing broadband access.

After subsequent conversations with businesses, telecommunications industry stakeholders and legislators, we found there was general disagreement about Tennessee's broadband access and utilization needs.

We commissioned this report from leading consultants in the field to help answer four basic questions:

- What is the technical definition of broadband?
- How many Tennesseans do not have access to broadband?
- What is the cost of bringing broadband to Tennesseans that do not have it?
- What are best practices and lessons learned for promulgating broadband from around the country?

The consultants' study also included a robust, live assessment of Tennessee's broadband access. More than 23,000 Tennessee households and businesses participated in the assessment.

Businesses participating in the assessment said broadband enabled 43 percent of all net new jobs and 66 percent of revenues. In addition, 34 percent of businesses classified broadband as essential to selecting their location, and 56 percent noted that it was essential to remain in their location. Sixteen percent of economic development agencies reported that businesses frequently chose not to locate in an area due to insufficient broadband.

It is clear that broadband is critical to the economic future of Tennessee. Broadband already significantly contributes to Tennessee's economy. When a community lacks adequate access, economic opportunities are lost.

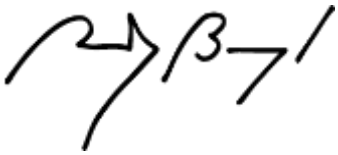
Attached are an executive summary and three reports provided by our consultants:

- *Internet Connectivity and Utilization* – Benchmarks current access and utilization.
- *eStrategy*– Outlines recommendations and options for increasing access and utilization.
- *Considerations and Best Practices for Statewide Broadband Initiatives* – Details best practices and lessons learned from other states' broadband initiatives.

This report is a starting point for meaningful conversations about broadband in our state. An internal working group will review the report and have discussions with stakeholders to develop potential solutions to close the gap on broadband access in Tennessee.

Not every option included in the report may be the answer for Tennessee, nor is there one simple solution. With the menu of options provided in the study, decision makers can begin a dialogue to find a win-win-win combination to ensure our communities have the broadband they need.

Warmest regards,



Randy Boyd
Commissioner

TNECD Broadband Initiative Summary

After leaders in all nine TNECD regions identified broadband as a crucial factor in the economic success of their communities, the Tennessee Department of Economic and Community Development (TNECD) commissioned a broadband study to assess the current state of broadband in Tennessee.

TNECD contracted with Strategic Networks Group and NEO Connect, global leaders in broadband consulting, to help answer specific questions about Tennessee's broadband access and recommend options for increasing access and utilization across the state. More than 23,000 Tennesseans and Tennessee businesses participated in the assessment.

In response, the consultants have provided a three-part report:

- *Internet Connectivity and Utilization:* benchmarks current access and utilization;
- *eStrategy: o*utlines recommendations and options for increasing access and utilization;
- *Considerations and Best Practices for Statewide Broadband Initiatives:* details best practices and lessons learned from other states' broadband initiatives.

In the attached reports, the consultants answered the four main questions posed by TNECD:

1. How should Tennessee define broadband?

According to the consultants, Tennessee should adopt the Federal Communication Commission's definition of broadband as 25 Mbps download speed and 3 Mbps upload speed.

Other findings by the consultants included:

- The most frequently cited barrier to increased household utilization of the Internet is the speed and reliability of the service. 68% of respondents cited this as a very important barrier, while 20% said it was somewhat important.
- Satisfaction correlates with the speed of the service. At 25 Mbps or greater, 71% of household users reported that their speeds were fast enough compared to only 48% at 10 Mbps or less.
- For businesses, utilization correlates with upload speeds. Businesses need at least 3 Mbps upload speed to be actively engaged.
- Demand for bandwidth has increased and will continue to increase dramatically in the coming years.

2. What are the penetration rates for broadband in terms of access and utilization?

According to data collected by the consultants, the FCC and other entities, 87% of households have access to broadband leaving 834,545 people without access.

Other findings by the consultants included:

- Existing broadband infrastructure is not fully utilized because 69% of businesses had speed tests below 25 mbps download speed and 76% of households had speed tests below 25 mbps download speed.
- Fiber connectivity is the most reliable, fastest and highly rated type of connectivity by a significant margin with cable and fixed wireless rated as the next best. DSL and mobile wireless performed at lower speeds with less reliability while satellite and dial-up had by far the poorest rated services. Over half (54%) of households are connected with these lower performing connectivity types (DSL, mobile wireless, satellite and dial-up).
- Areas with more service providers have higher speeds for both businesses and residents. For example, the average download speed for businesses with access to only one provider was 22.5 mbps while businesses with access to more than three providers averaged download speeds of 43.8 mbps.
- Almost 5% of assessment respondents reported no Internet at their home. Over half cited lack of availability as the cause with the second most frequent barrier as affordability. Only 2% said they did not need the Internet.

3. How much will it cost to ensure that all of our households are adequately connected?

In order to define the scope of the problem, the consultants conducted a cost estimate to build out Fiber to the Premise (FTTP), the gold standard in broadband technologies, to unserved or underserved households. The recommendation is not to have the state build out FTTP to each home. This number merely provides information about what it would take to build fiber to every home without broadband.

- Build out FTTP in areas without 10/1: $819,450,000 - $1,258,636,800
- Build out FTTP in areas without 25/3: $1,117,397,500 - $1,716,322,560

Other technologies can be used to provide 25/3 broadband from a fiber access point to a home. For example, fixed wireless can reduce the costs per home by $800-1,400.

- Build out fixed wireless in areas without 10/1: $360,547,000 - $996,420,800
- Build out fixed wireless in areas without 25/3: $491,654,900 - $1,358,755,360

4. What are the best practices and critical success factors from other states' broadband initiatives?

The consultants found the following best practices prevalent in other state s' broadband initiatives:

- Strong public leadership that champion broadband projects;
- State broadband office or similar entity;

- Effective partnerships;
- Public seed funding and grant programs to encourage investment and build out;
- Transparency;
- Proper planning and due diligence.

This report is a starting point to advance the conversation about broadband in our state. Not every option included in the report may be the answer for Tennessee, nor is there one simple solution. An internal working group will review the report and have discussions with stakeholders to develop potential solutions to close the gap on broadband access in Tennessee.

About Strategic Networks Group (SNG)
Focused on economic advancement through broadband utilization, SNG is a group of broadband economists who develop strategies for most effectively leveraging broadband investments. SNG addresses broadband utilization from the individual organization level all the way up to working with more than 10 states across the United States. SNG looks to help make the most broad-reaching and transformational impacts that broadband can bring to enable businesses, communities and regions by delivering the data and analysis decision makers need to maximize broadband's potential. Learn more about SNG at www.sngroup.com.

About NEO Connect
At the forefront of broadband initiatives, from planning to execution, NEO is one of the nation's leaders in planning, engineering and developing strategies for community networks. With extensive experience in both the public and private sector, the NEO team is able to apply real-world business sense to every type of project. NEO has helped communities across the United States create successful and sustainable networks that meet each community's specific needs. Visit NEO online at www.NEOconnect.us.

About the Tennessee Department of Economic and Community Development
The Tennessee Department of Economic and Community Development's mission is to develop strategies which help make Tennessee the No. 1 location in the Southeast for high quality jobs. To grow and strengthen Team Tennessee, the department seeks to attract new corporate investment in Tennessee and works with Tennessee companies to facilitate expansion and economic growth. Tennessee is the only three-time winner of "State of the Year" for economic development by *Business Facilities* magazine. Find us on the web: tnecd.com. Follow us on Twitter: @tnecd. Like us on Facebook: facebook.com/tnecd.

strategic networks group
the broadband economists

Internet Connectivity and Utilization in Tennessee 2016

June 2016

Prepared for

Table of Contents

EXECUTIVE SUMMARY

During 2015, elected leaders, business executives and economic development professionals across the State identified broadband availability as a key strategic initiative to improve future economic development efforts in rural Tennessee. In response, the Tennessee Department of Economic and Community Development (TNECD) undertook an initiative to assess the current availability and utilization of broadband and to provide strategies for the State of Tennessee to improve broadband service availability and utilization.

This report includes two types of data:

1. Part A of this report describes the current broadband infrastructure in Tennessee based on data provided by Internet Service Providers (ISPs) to the Federal Communications Commission (FCC) and collected by Connected Tennessee for NTIA's Broadband Map.
2. Part B presents data collected in early 2016 by TNECD directly from consumers of Internet services in Tennessee. This section presents the most up-to-date information on broadband in Tennessee. The data collected directly from customers provides a valuable complement to data provided by ISPs. Over 23,000 responses were received, including every county in the state.

For purposes of this report, the FCC definition of broadband as 25 Mbps download and 3 Mbps upload will be used in assessing whether or not citizens, businesses, and counties have access to broadband services.

Key Findings

Broadband Infrastructure Capability (according to FCC and Broadband USA data)

- 87 percent of Tennessee's population has access to broadband that meets the FCC definition (25 Mbps down and 3 up) leaving 366,115 households (834,545 people) without access.
- The vast majority of the areas in Tennessee without access are located in rural regions of the state. For example, only 2 percent of urban citizens do not have access to 25/3 broadband connectivity in Tennessee compared to 34 percent of rural citizens.

Broadband Connectivity Results (according to the TNECD Broadband Assessment data)

- Internet infrastructure capacity is not fully utilized, with Tennessee speed test results from 69.2 percent of organizations and 76 percent of households failing to meet the FCC definition of broadband.

- Businesses and households in counties designated as at-risk and distressed[1] are less likely to meet the FCC standard than those in counties designated as transitional, attainment or competitive.
- Pricing within similar offerings and technologies is relatively consistent across the state.
- Reliability is the most highly rated attribute of Internet service by businesses and households, more so than speed or cost. Concerns over reliability impacts the consumers' willingness to purchase premium services.
- According to business and household respondents, fiber connectivity is the most reliable, fastest, and most highly rated of Internet services, by a significant margin. Cable and fixed wireless are rated as the next best, with DSL and mobile wireless performing at lower speeds and with less reliability. Satellite and dial-up are by far the poorest rated Internet services based on reliability and value for money.
- Broadband infrastructure is affected by
  - The economic status of the community
  - Number of ISPs (level of competition)
  - Type of connection and
  - Population density
- 4.6% of household respondents do not have an Internet connection at home. Over half of these respondents (54.1%) stated that there was no broadband available where they lived. The second most frequently mentioned reason for not having an Internet connection was affordability. Only 2.1% said that they did not have a need for the Internet

Broadband Internet Utilization

- Participating businesses reported that the Internet enabled 43 percent of net new jobs. Of the businesses reporting revenues, an average of 66.2 percent of business revenues were enabled by the Internet.
- Availability and suitability of broadband plays an important role in corporate decisions with 34 percent of businesses saying that broadband service was "essential" in selecting their business location and 55.7 percent saying broadband is "essential" for remaining in their current location. 15.5 percent of economic development agencies in Tennessee stated that businesses frequently chose not to locate in an area due to its broadband quality.

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[1] *This report uses the County Economic Status Classification System developed by Appalachian Regional Commission. Appendix E includes the classification to all counties in Tennessee.*

Distressed: *Distressed counties are the most economically depressed counties. They rank in the worst 10 percent of the nation's counties.*

At-Risk: *At-Risk counties are those at risk of becoming economically distressed. They rank between the worst 10 percent and 25 percent of the nation's counties.*

Transitional: *Transitional counties are those transitioning between strong and weak economies. They make up the largest economic status designation. Transitional counties rank between the worst 25 percent and the best 25 percent of the nation's counties.*

Competitive: *Competitive counties are those that are able to compete in the national economy but are not in the highest 10 percent of the nation's counties. Counties ranking between the best 10 percent and 25 percent of the nation's counties are classified competitive.*

Attainment: *Attainment counties are the economically strongest counties. Counties ranking in the best 10 percent of the nation's counties are classified attainment*

- Broadband Internet enhances earning ability of households and provides employment and training opportunities. 23.5 percent of participating households run a home-based business, with 14.1 percent of all households running a home-based business exclusively from their home.
- Telework is also an important Internet enabled activity, with almost 26 percent of participating households teleworking (13 percent of households teleworking one or more days a week in a formal arrangement with the employer).
- Over 36 percent of households in Tennessee reported additional household income from using the Internet with 20 percent of households reporting at least $5,000 per year in additional income.
- Actual utilization of the Internet varies notably across the state for businesses and households correlating with economic status of the community, population density, and type and speed of connection.
- The largest barriers to greater Internet use for businesses are concerns over security and privacy, while for household the greatest barriers are the reliability and speed of the connection.
- 75 percent of households want to improve how they use the Internet.

INTRODUCTION

Having access to broadband services is quickly becoming the most important differentiating infrastructure of our time. Access to advanced broadband networks impacts every area of American lives and is critical to support our nation's competitiveness and economic development. Education, healthcare, business operations and innovation, workforce training and e-government applications all rely upon advanced broadband networks.

The challenges facing Tennessee are 1) unequal access to high-speed Internet; and, 2) under-utilization of Internet enabled applications. These gaps have major tangible impacts on businesses, households and communities.

TNECD hired Strategic Networks Group (SNG) and NEO Connect (NEO) to assess the current availability and utilization of broadband technology and to provide strategies for the State to improve broadband service availability and utilization.

The aim of this research initiative is to facilitate better connectivity and utilization leading to economic development and community wellbeing. Findings will be presented in two reports:

- *Internet Connectivity and Utilization in Tennessee 2016* is a descriptive assessment of the current state of the Internet in Tennessee.
- *eStrategy Report: Broadband as a Driver of Economic and Social Development in Tennessee* identifies goals and strategies for improving Internet connectivity and utilization.

This report covers the following areas:

a) The advertised capabilities of Internet infrastructure in Tennessee, primarily in terms of speeds and types of technology as reported data for this section comes from Internet Service Providers (ISPs).
b) The actual performance of the Internet in Tennessee as experienced by businesses, non-commercial organizations and households. Performance measures consist of recorded connection speeds, perceived reliability and cost.
c) Internet impacts as reported by businesses and households, including employment creation, revenue generation, and spending patterns.
d) Consumer utilization of the Internet by business, non commercial organizations, and households.

This report uses benchmarks to compare current capacity and utilization with peer groups and strategic targets established by the FCC. For purposes of this report, the new FCC definition of broadband as 25 Mbps download and 3 Mbps upload will be used in assessing whether or not citizens, businesses, counties have access to broadband services.

This report includes two types of data collected from different sources:

- Part A of this report describes the current broadband infrastructure in Tennessee based on data provided by Internet Service Providers (ISPs) to the Federal Communications Commission (FCC) and collected by Connected Tennessee for NTIA's Broadband Map.
- Part B presents data collected in early 2016 by TNECD directly from consumers of Internet services in Tennessee. This section presents the most up-to-date information on broadband in Tennessee. A total of 5,539 organizations and 17,776 households contributed to the broadband assessment.

The outreach and participation levels were very strong in Tennessee, with household participation three time the levels achieved by Strategic Networks Group in other states (many of which were significantly larger than Tennessee). The high levels of participation were achieved in large part due to the widespread interest in this issue and the efforts of outreach partners.[2]

About the Tennessee Department of Economic and Community Development (TDECD)

The Tennessee Department of Economic and Community Development's mission is to develop strategies which help make Tennessee the No. 1 location in the Southeast for high quality jobs. To grow and strengthen Team Tennessee, the department seeks to attract new corporate investment in Tennessee and works with Tennessee companies to facilitate expansion and economic growth. Tennessee is the only three-time winner of "State of the Year" for economic development by *Business Facilities* magazine.

About Strategic Networks Group (SNG)

SNG is a group of broadband economists developing strategies that maximize economic and social returns from broadband investments. SNG provides evidence-based recommendations to communities, regions, and States who are looking for proactive ways to protect and grow local business profitability through broadband utilization. SNG's holistic approach looks at both the supply (availability) and demand (utilization) of broadband and how addressing each strategically drives economic development. Learn more about SNG at www.sngroup.com.

About NEO Connect

At the forefront of broadband initiatives, from planning to execution, NEO is one of the nation's leaders in planning, engineering and developing strategies for community networks. With extensive experience in both the public and private sector, the NEO team is able to apply real-world business sense to every type of project. NEO has helped communities across the United States create successful and sustainable networks that meet each community's specific needs. Visit NEO online at www.NEOconnect.us.

[2] *Outreach included efforts by the Department of Labor and Workforce Development and Tennessee State Library and Archives to make computers available for anyone without Internet access to take the assessment. Other important partners included broadband providers, government agencies, economic development organizations, stakeholder associations and business organizations.*

PART A: Existing Connectivity Characteristics

1. Defining Broadband

There is much debate occurring in the U.S. on how to properly define "broadband". Prior to February 2015, the Federal Communications Commission (FCC) defined broadband as having the ability to download 4 Mbps of data and upload 1 Mbps of data. In February of 2015, the FCC increased the definition of broadband by raising the minimum download speeds needed from 4 Mbps to 25 Mbps and the minimum upload speed from 1 Mbps to 3 Mbps[3].

Meanwhile, the FCC's Connect America Fund[4] is targeted at areas that do not currently have 10 Mbps of download and 1 Mbps of upload speeds. In essence, while the FCC has a long-term target for broadband defined as 25 Mbps download / 3 Mbps upload, they have a short-term objective of addressing the poorest performing areas with "broadband build" projects at 10 Mbps download / 1 Mbps upload. ***For purposes of this report, the new FCC definition of broadband of 25/3 will be used in assessing whether or not citizens, businesses, counties and cities have access to broadband services.***

The current definition of broadband can be supported by a number of technologies – including wireless, cable modem, DSL, and fiber optic technologies. However, with the tremendous growth in broadband demand, plans for long-term implementation of infrastructure must take into consideration the need for more fiber networks to be deployed and expanded.

Although the current FCC definition for broadband is 25 Mbps download and 3 Mbps in upload speeds, it should be noted that broadband demand and consumption of broadband is growing very rapidly every year. The gold standard for bandwidth capability is quickly becoming offering Gigabit services or speeds that support 1,000 Mbps.

Despite improvements in wireless communications and technologies that enhance existing cable modem networks, industry leaders are seeing the need to extend fiber optic network technologies further and deeper into neighborhoods, business parks and industrial centers. As more devices are connected to the Internet and applications are more bandwidth rich, there is a strong argument that favors more all-fiber connections to homes and businesses.

[3] *2016 Broadband Progress Report*, Federal Communications Commission, https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-6A1.pdf.
[4] *Connect America Fund, https://www.fcc.gov/general/connect-america-fund-caf*

2. Broadband Availability Mapping Sources

A number of entities collect and map broadband availability by state in the U.S. This section of the report summarizes existing data about broadband availability in Tennessee from the following sources:

The **FCC** collects information from facilities-based Internet providers – providers that own their own network facilities. Facilities-based providers include telephone companies, cable system operators, wireless, satellite service providers and other facilities-based providers of advanced telecommunications capability. All facilities-based providers are required to file data with the FCC twice a year (Form 477) regarding where they offer Internet access service at speeds exceeding 200 kbps in at least one direction.[5] As of February 2016, 216 facilities-based providers filed Form 477 in Tennessee.[6]

Additionally, the National Telecommunications and Information Administration (NTIA) designated Connected Tennessee to collect broadband datasets to be included in **NTIA's National Broadband Map** for the State of Tennessee. This effort was started in 2009, when through the American Recovery and Reinvestment Act, Connected Tennessee, received $2.24 Million in grant funding to map broadband resources and availability. While the National Broadband map provides a significant level of detail about broadband across the country, updates to map have not been funded since 2015.

[5] *FCC mapping data on Form 477 is reported on a census-block basis rather than based upon whether or not service is available at a particular home, business or other location within the census-block.*
[6] *FCC Form 477, see http://transition.fcc.gov/Daily_Releases/Daily_Business/2016/db0330/DOC-338630A1.pdf*

3. Current Broadband Availability and Speeds in Tennessee

According to the most recent FCC's 2016 Broadband Progress Report, Tennessee is the 29th most connected state in the U.S with 87 percent of Tennesseans having access to 25 Mbps download and 3 Mbps upload speeds. The 13 percent that does not have access to a wired service capable of supporting download speeds of 25/3 consists of 834,535 people in Tennessee.

Figure 1 – Percent of Tennessee Population with Access to Broadband[7]

87% of Tennesseans have access to broadband that meets the FCC's 25/3 standard.

According to the National Broadband Map, Tennessee ranks above the national statistics in the percentage of the population that has access to very high bandwidth capacity (100 Mbps and 1,000 Mbps or a Gigabit of bandwidth speed). 17.8 percent of the Tennessee population has access to a symmetrical Gigabit connection compared to only 7.9 percent nationwide. Tennessee also leads with 83 percent of its population having access to 100 Mbps compared to 64.8 percent nationwide.

Figure 2 – Percentage of Tennesseans with Access to Higher Speed Broadband[8]

83% of Tennesseans have access to broadband 100 Mbps or faster.

17.8% of Tennesseans have access to 1 Gigabit broadband or 1,000 Mbps or faster.

For lower speeds, Tennessee tracks consistently with national statistics. Upload speeds available in Tennessee follow national statistics closely as well.

[7] *2016 Broadband Progress Report,* Federal Communications Commission, https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-6A1.pdf.
[8] *National Broadband Map, see http://www.broadbandmap.gov/analyze*

Figure 3 – Percent Population, Download Speeds[9]

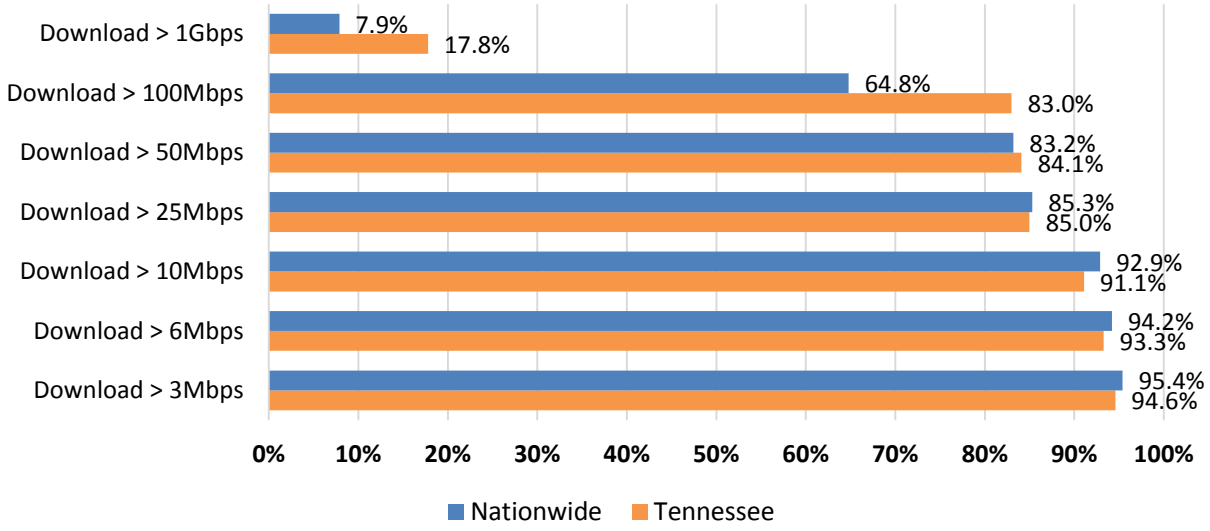
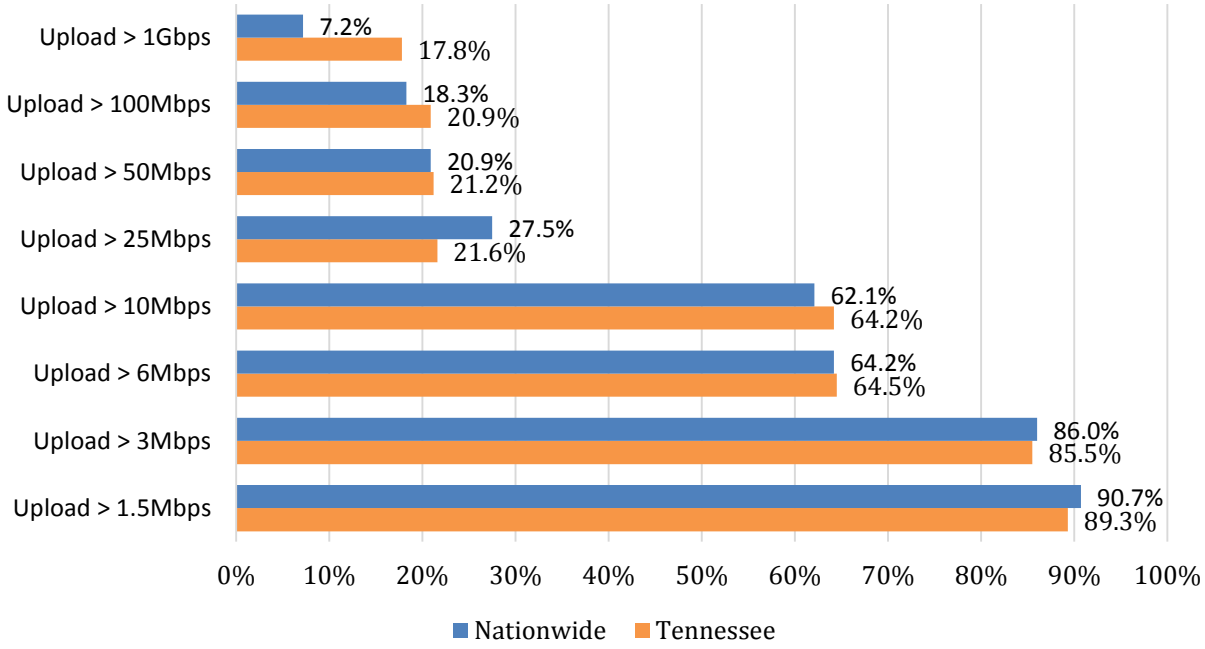


Figure 4 – Percent Population, Upload Speeds[10]

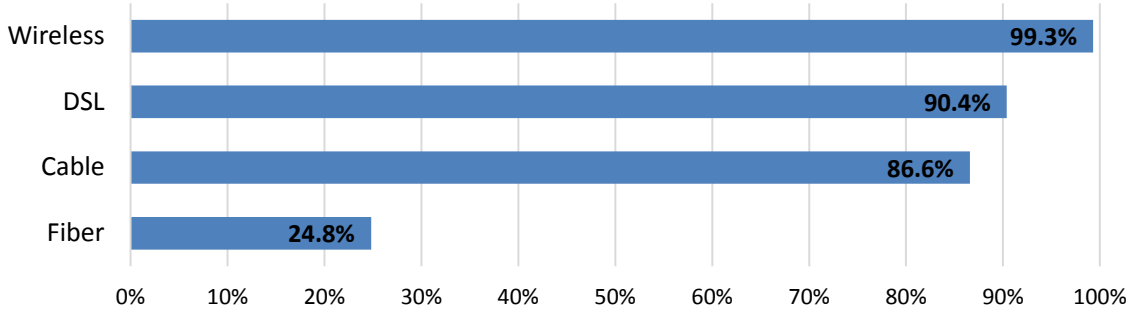


[9] *National Broadband Map, see http://www.broadbandmap.gov/analyze*
[10] *National Broadband Map, seehttp://www.broadbandmap.gov/analyze*

3.1 Broadband Technology Available

Most of the state's population has access to wireless or cellular broadband services (99.3 percent) and most also have access to DSL (90.4 percent) and cable modem (86.6 percent). Only 24.8 percent of the population has access to a direct fiber optic connection.

Figure 5 – Broadband Technology Availability in TN: Percent of Population with Access[11]



3.2 Connectivity of Tennessee Counties and Communities

Figure 6 shows the top ten counties and bottom ten counties in percent of population with access to broadband.

Figure 6 and Figure 7 – Top 10 Counties and Bottom 10 Counties in Percent of Population without Broadband[12]

Tennessee Counties	% without 25/3 Mbps
1. Hamilton County	1%
2. Hamblen County	2%
3. Knox County	2%
4. Blount County	3%
5. Bradley County	3%
6. Pickett County	3%
7. Shelby County	3%
8. Washington County	3%
9. Anderson County	4%
10. Davidson County	4%

Tennessee Counties	% without 25/3 Mbps
94. Bledsoe County	99%
93. Cannon County	99%
92. Houston County	99%
91. Scott County	88%
90. Sequatchie County	88%
89. Morgan County	86%
88. Hancock County	81%
87. Perry County	80%
86. Wayne County	69%
85. Hickman County	65%

[11] *National Broadband Map, see http://www.broadbandmap.gov/analyze*
[12] *2016 Broadband Progress Report,* Federal Communications Commission, https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-6A1.pdf. (Sullivan County data not available)

4. Areas that are Unserved or Underserved

Using the definition of broadband of 25 Mbps in download speeds and 3 Mbps of upload speeds, the FCC's 2016 report on broadband finds that 34 million Americans – 10 percent of the population – lack access to broadband. More significantly, 39 percent of rural Americans do not have broadband access that meets this definition. In contrast, only 4 percent of urban Americans lack access to 25 Mbps/3 Mbps broadband service. In Tennessee, according to the FCC report, 34 percent of the rural population does not have access to broadband, compared to only 2 percent of the urban population.[13] Having access to competitive options is limited in rural areas throughout the country with only 13 percent of Americans living in rural areas having more than one choice of service providers, compared to 44 percent of Americans living in urban areas.

[13] *2016 Broadband Progress Report,* Federal Communications Commission, https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-6A1.pdf.

5. Pricing

It is helpful to understand what is being offered in other cities across the U.S. and the world at what price points to get a frame of reference regarding what is affordable. According to Open Technology Institute's 2014 Cost of Connectivity Report[14] the top 25, best-in-class or speed leaders around the world have the following service levels and pricing:

Figure 8 – Top 25 Cities Worldwide for Inexpensive, Abundant Broadband

Rank	City	ISP	Download Speed	Upload Speed	Price	Price per Mbps
1(tie)	Seoul	HelloVision	1000	1000	$ 30.30	$ 0.03
1(tie)	HongKong	Hong Kong Broadband Netv	1000	1000	$ 37.41	$ 0.04
1(tie)	Tokyo	KDDI	1000	1000	$ 39.15	$ 0.04
1(tie)	Chattanooga, TN	EPB	1000	1000	$ 69.99	$ 0.07
1(tie)	Kansas City, KS	Google Fiber	1000	1000	$ 70.00	$ 0.07
1(tie)	Kansas City, MO	Google Fiber	1000	1000	$ 70.00	$ 0.07
1(tie)	Lafayette, LA	LUS	1000	1000	$109.95	$ 0.11
8	Zurich	Swisscom	1000	100	$157.55	$ 0.16
9	Bristol, VA	BVU	1000	50	$319.95	$ 0.32
10	Bucharest	RCS & RDS	1000	30	$ 32.35	$ 0.03
11	Paris	Free	1000	.	$ 35.28	$ 0.04
12(tie)	Amsterdam	XS4ALL	500	500	$ 72.29	$ 0.14
12(tie)	Copenhagen	SES-NVE	500	500	$129.24	$ 0.26
12(tie)	Riga	Baltcom	500	500	$142.29	$ 0.28
12(tie)	Los Angeles, CA	Verizon	500	500	$299.99	$ 0.60
12(tie)	New York, NY	Verizon	500	500	$299.99	$ 0.60
12(tie)	Washington, DC	Verizon	500	500	$299.99	$ 0.60
18	Toronto	Rogers	350	350	$182.25	$ 0.52
19	Prague	UPC	240	20	$ 83.63	$ 0.35
20(tie)	San Francisco, CA	Webpass	200	200	$ 30.00	$ 0.15
20(tie)	Mexico City	Axtel	200	200	$156.32	$ 0.78
22	Berlin	Deutsche Telekom	200	100	$ 57.63	$ 0.29
23	Dublin	UPC	200	10	$ 63.41	$ 0.32
24	London	Virgin	150	0	$ 55.71	$ 0.37

The U.S. cities are highlighted. The price per Mbps ranges from .32/Mbps to .07/Mbps.

Since 2012, almost every city in the ranking above has increased the top speed offering and dramatically lowered their pricing. For example, Lafayette (LA) charged $999.95 per month for its Gigabit service in 2013 and dropped that price to $109.95 per month in 2014. In Mexico City, a 200 Mbps package was available for nearly $100 less than the price offered for that speed by a different provider in 2013.

[14] *See http://www.newamerica.org/downloads/OTI_The_Cost_of_Connectivity_2014.pdf New America*

The average download speed of Internet services in this ranking increased from 233 Mbps in 2012 to around 500 in 2013, and almost 650 Mbps in 2014. Nearly half of all cities in this ranking offer Gigabit speeds, and more than two-thirds of all cities offer service over 500 Mbps.

Per the rankings, Chattanooga, Bristol (VA), and Lafayette now offer some of the fastest and most affordable high-speed residential products available in the country despite the fact that they have some of the lowest population densities among the cities that are surveyed. All three cities offer Gigabit speeds that place them on par with Hong Kong, Seoul, Tokyo, and Zürich.

It's important to note that the prices above are for residential customers. Business customers typically pay higher prices than residential customers.

Another relevant data point is to understand on ***average*** what is being offered within the U.S. According to a broadband report by Point Topic[15] which was conducted in the first quarter of 2014, the average monthly combined stand-alone and bundled residential broadband subscription in North American came in at $8.54 per megabit for DSL networks, $2.03 for cable and $1.45 for fiber.

Globally, Point Topic found the global average monthly charge for residential broadband services was $76.61. The average bandwidth worldwide provided for residential services was 55 Mbps, meaning the global average cost per megabit was $1.39.

According to the Point Topic report, The U.S. ranked 43rd in average cost of services of 90 countries surveyed, ranking just behind Colombia and one place ahead of Greece.

[15] *See http://www.telecompetitor.com/report-average-u-s-broadband-prices-are-below-world-average-of-76-61/*

PART B: Tennessee Assessment of Internet Use

This section presents findings from data collected in early 2016 from consumers of broadband services in Tennessee. This section presents the most up-to-date information on broadband in Tennessee and complements data provided by Internet Service Providers (as outlined in Part A).

On behalf of TNECD, SNG reached out to households, community institutions, and businesses across the state to encourage participation in an online assessment that collected information on the availability of broadband, how the Internet is being used in the business or the home and benefits, and drivers and barriers to adoption and utilization. In order to ensure coverage across the state, households in over 60 counties were targeted with phone surveys.

This research effort collected data primarily through an online self-assessment of businesses, organizations and households. Due to the distinct nature of the uses and benefits of different categories of Internet users, separate assessments were used for businesses or organizations and for households.

A total of 5,539 organizations and 17,776 households contributed to the broadband benchmarking effort. The organizations consisted of 3,986 commercial businesses, 843 government entities and 708 not-for profits.[16]

Further details on methodology are provided in Appendix B with a Glossary of report terminology in Appendix E.

Assessment responses were received from 821 people who do not have an Internet connection in their home. This group made up 4.6% of all respondents. There was no clear correlation between not having an Internet connection and income, education, age or employment status. There was a modest correlation between lower population density and the likelihood of not having an Internet connection.

Over half of respondents (54.1%) without Internet stated that there was no broadband available where they lived. The second most frequently mentioned reason for not having an Internet connection was affordability. Only 2.1% said that they did not have a need for the Internet

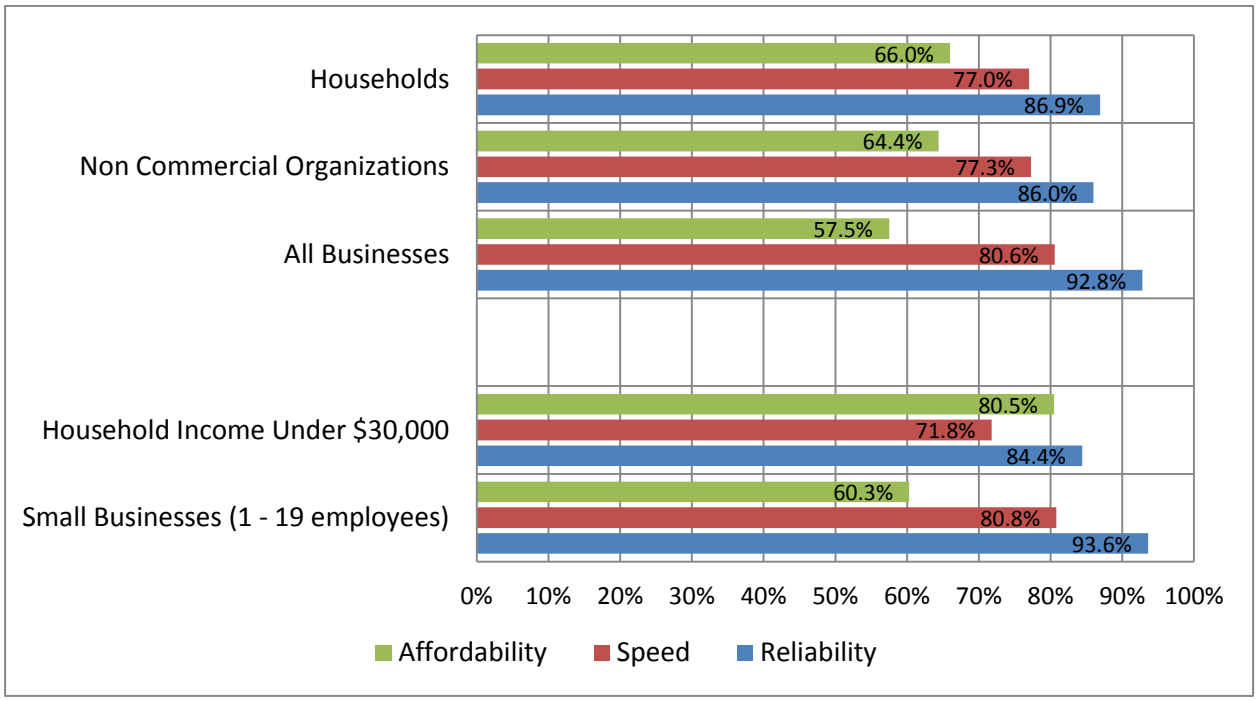
[16] *The majority of respondents fully completed the assessments (72.4 percent of organizations and 80.2 percent of households). However, partially completed assessments are included in the analysis on the basis that the responses provided are valid and useful even if the respondent chose not to complete the entire assessment. Every data chart in this report indicates the N= value that provides the number of data points included to generate each particular figure.*

1. Broadband Connectivity

The speed and quality of Internet connections strongly impact many uses of the Internet. This section of the report looks at Internet connectivity from a variety of perspectives: speed, reliability, cost, and value. Before examining these different aspects of Internet connectivity, it is worth identifying what the consumers of Internet services said they were looking for and value most.

As seen in Figure 9, reliability was the attribute valued most highly by businesses, households and community anchor institutions. Speed was the second most valued attribute, except among lower income households, which rated affordability second.

Figure 9 – Priorities Rated as "High" by Internet Consumers



N: households =16,654; businesses = 3,676; other orgs = 1,377; low income households = 1,562; small businesses = 2,413

Satisfaction with connection speed and reliability improve with the consumers recorded connection speed. The faster the connection, the more satisfied the consumer is with both connection speed and reliability. As seen in Figure 10, 31.4% of households with recorded speeds of 6 to 10 Mbps are dissatisfied with their current speed. Dissatisfaction with connection speed drops to 14.7% for households in the speed tier above 25 Mbps (the FCC definition of broadband). The reported frequency of reliability problems also drops from 18% in the 6 to 10 Mbps tier to 11% for households in the 25 to 50 Mbps tier (Figure 12).

Figure 10 –Household Satisfaction with Download Connection Speed by Speed Tier

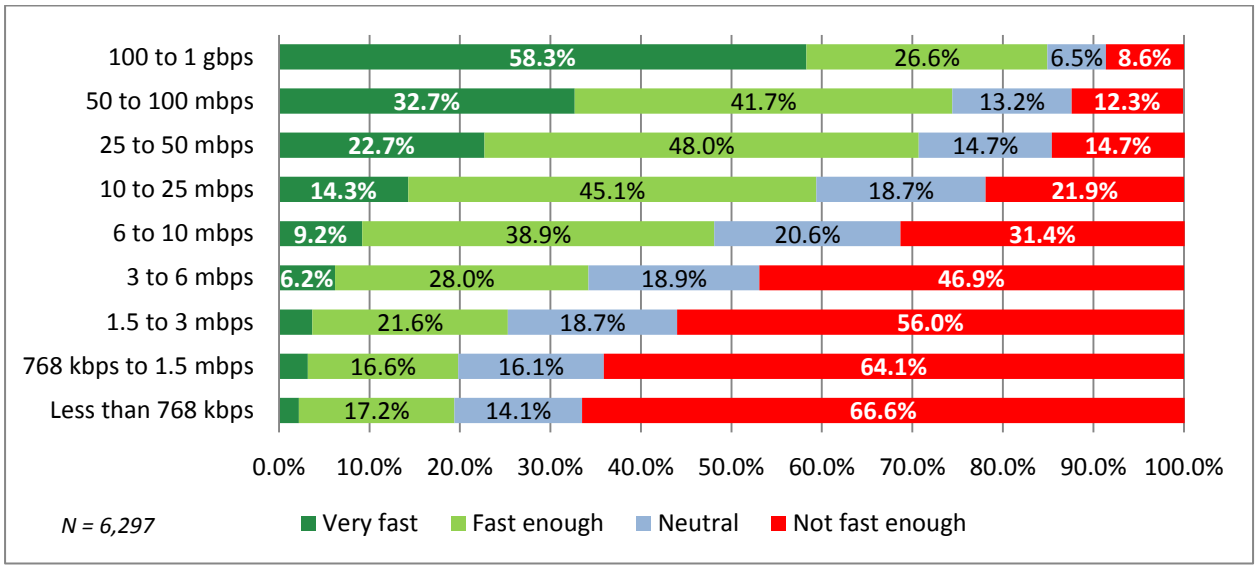


Figure 11 – Household Satisfaction with Upload Connection Speed by Speed Tier

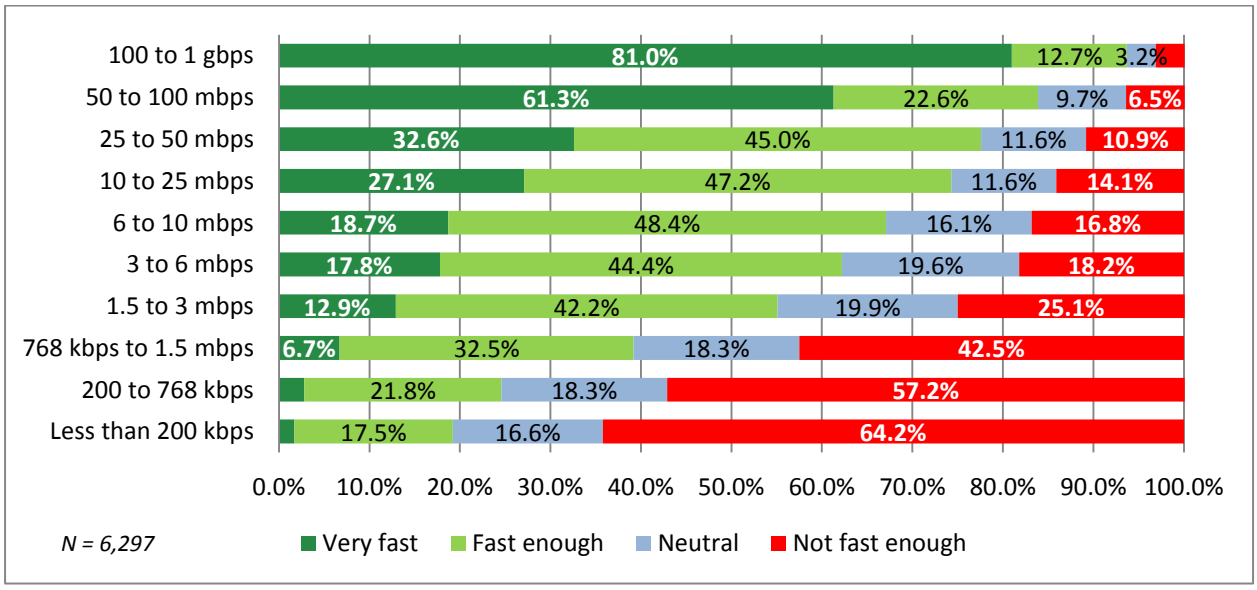
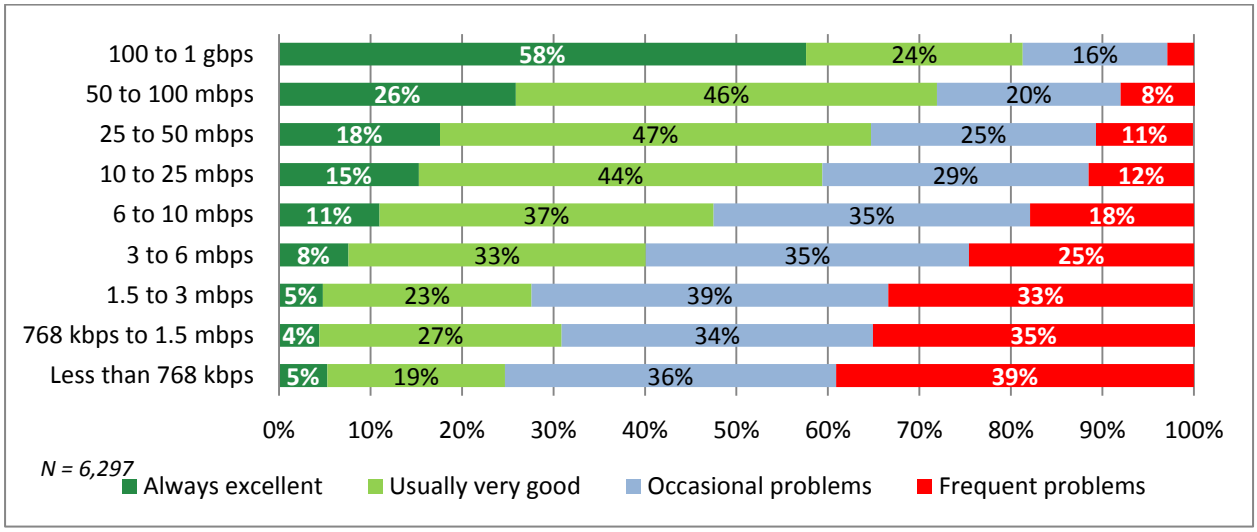


Figure 12 – Household Satisfaction with Reliability by Speed Tier



1.1 Broadband Technologies

There are many types of broadband connections available to consumers. The main options include:

DSL (Digital Subscriber Line) uses existing copper phone lines to deliver download and upload speeds typically between 1.5 Mbps to 25 Mbps according to the Tennessee speed tests. DSL speeds diminish as distance increases from the telephone company's central office. Homes or businesses located more than three miles from the central office will receive slower speeds. There have been many improvements to DSL technologies to improve the speed available. VDSL (Very High Bit Rate Digital Subscriber Line) can support up to 52 Mbps, but most Internet service providers do not support this type of service, including providers in the Tennessee region.

Cable modem service uses coaxial cables already installed by the cable TV operators to provide broadband service. Cable operators are upgrading their cable networks by installing fiber optic cable closer to neighborhoods. These network improvements allow cable modem service to support up to 400 Mbps though Tennessee speed test results typically fell between 10 and 100 Mbps. This connection type is a shared service, meaning, as more people are on the network within a neighborhood, the speed available to each customer diminishes.

Wireless broadband connects a home or business to the Internet using a radio link between the customer's location and the service provider's facility. Wireless technologies using longer-range directional equipment provide broadband service in remote or sparsely populated areas where DSL, cable modem or fiber service would be costly to provide.

Wireless broadband can be mobile or fixed. Wireless services can be offered using both licensed spectrum and unlicensed devices. Wi-Fi networks typically use unlicensed spectrum. Wi-Fi networks use wireless technology from a fixed point and often require direct line-of-sight between the wireless transmitter and receiver. Wi-Fi networks can be designed for private access within a home or business,

or be used for public Internet access at "hot spots" such as restaurants, coffee shops, hotels, airports, convention centers, and city parks. Using licensed spectrum, greater amounts of bandwidth can be delivered and often do not require direct line-of-sight.

In some communities, especially sparse, geographically diverse rural communities, providers may build out a wireless solution as an alternative to capital-intensive fiber optic infrastructure. While wireless technology does have its limitations, needing to design for “line of sight’ requirements as well as to support “shared” bandwidth on the network, smart engineering can deliver good connectivity.

Wireless Local Area Networks (WLANs) provide wireless broadband access over shorter distances and are often used to extend the reach of a "last-mile" wireline or fixed wireless broadband connection within a home, building, or campus environment. An in-home Wi-Fi network is a WLAN – it does not use spectrum, rather it sends radio waves at a limited range. Mobile wireless broadband services are also becoming available from mobile telephone service providers. These services are generally appropriate for highly-mobile customers and require a special wireless card with a built-in antenna that plugs into a user’s laptop computer. The speed test results in Tennessee recorded typical speeds for fixed wireless between 3 and 100 Mbps and for mobile wireless between 3 and 50 Mbps.

Satellite is another form of wireless Internet, and is also useful for serving remote or sparsely populated areas. Typically, a consumer received (download) at a speed of between 1 to 25 Mbps and send (upload) at a speed of between 200 kbps and 1.5 Mbps. Service can be disrupted in extreme weather conditions.

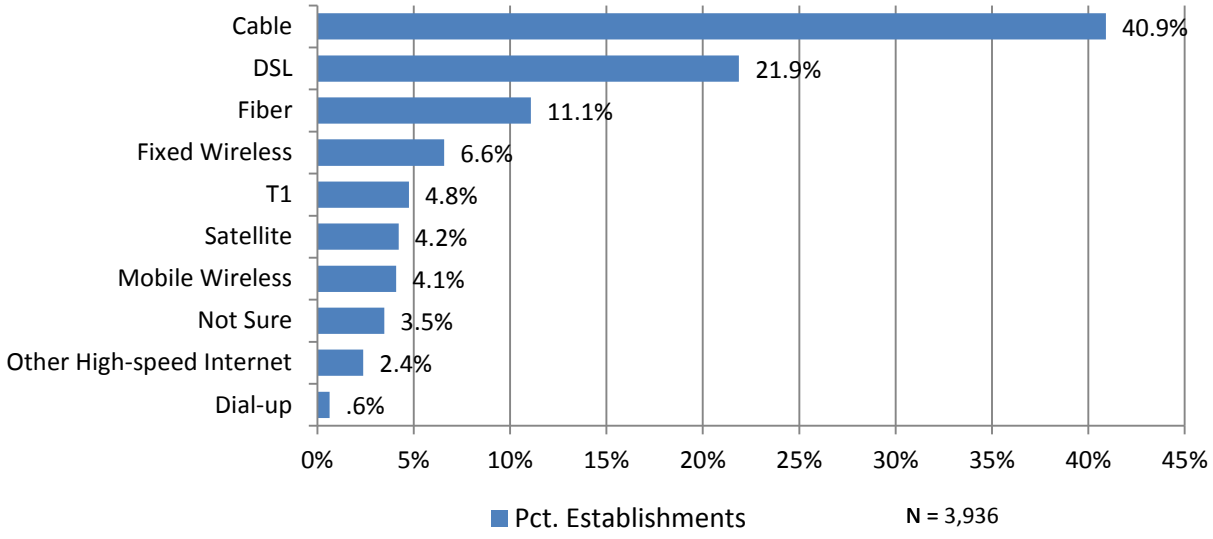
Fiber optic technology converts electrical signals carrying data to light and sends the light through glass fibers about the diameter of a human hair. Fiber transmits data at speeds exceeding one Gigabit per second, well in excess of all other mainstream technologies. Fiber to the home or to the business is the best way to provide abundant broadband, but it often is the most capital-intensive to build. Speeds for fiber in the Tennessee speed test results typically fell between 10 Mbps and 1 Gigabit. Fiber to homes and businesses is not yet available anywhere on a comprehensive, statewide basis, and the State of Tennessee is in line with much of the U.S. with the percentage of homes that are connected directly with fiber. Across the U.S., approximately 25 percent of the homes are connected with fiber.

Other Technologies: Respondents sometimes indicate that they are served by a technology other than those listed above. In some cases this may be a result of a lack of knowledge about the technology that underlies their ISP branded service.

1.2 Business Connectivity Characteristics

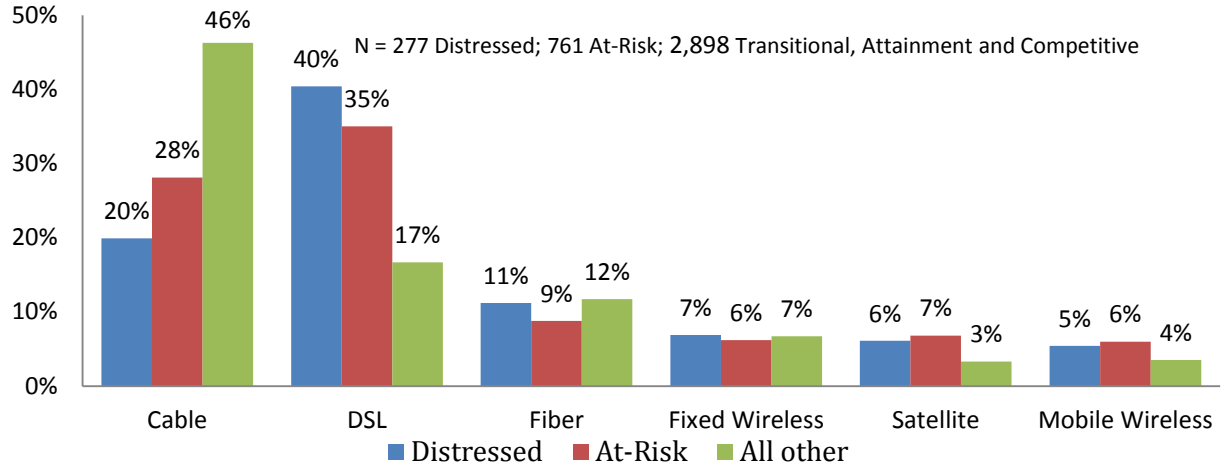
In Section A, data was provided on the percentage of population covered by different types of broadband services from existing sources based on provider reported information. For information on the actual types of services used by consumers, Figure 13 shows the actual market share of different services among the almost 4,000 businesses participating in the statewide Internet assessment. Among this large group, cable, DSL, and fiber are the predominant technologies. A small percentage of businesses use dial-up (0.6 percent) and satellite (4.2 percent) as their primary connection to the Internet. These are predominantly small businesses. Businesses with less than 50 employees are more likely than larger businesses to use cable and DSL. Larger businesses are far more likely to have a T1 or Fiber connection.

Figure 13 – How Tennessee Businesses Connect to the Internet



The type of technology used by business to access the Internet varies significantly by economic status of counties. By applying the classifications used by the TNEDC, Figure 14 shows that DSL is the dominant technology in distressed and at-risk counties, while cable is dominant in all other regions (Transitional, Attainment and Competitive). This distinction is quite dramatic and is particularly relevant given that respondents with cable report greater speeds than respondents with DSL (see section 1.2.1).

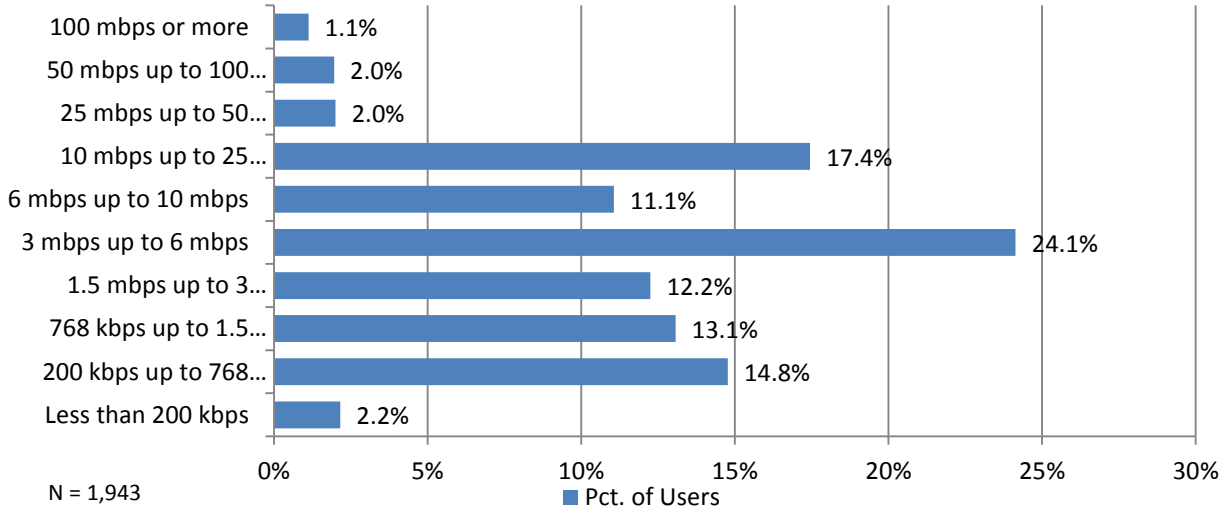
Figure 14 – How Tennessee Businesses Connect to the Internet – By County Economic Status



1.2.1 Internet Speeds[17]

SNG's assessment of Internet use included an opportunity for respondents to take a speed test that assessed their actual upload and download speeds.[18] Figures 15 through 20 summarize the results of the speed test portion of the business assessment.

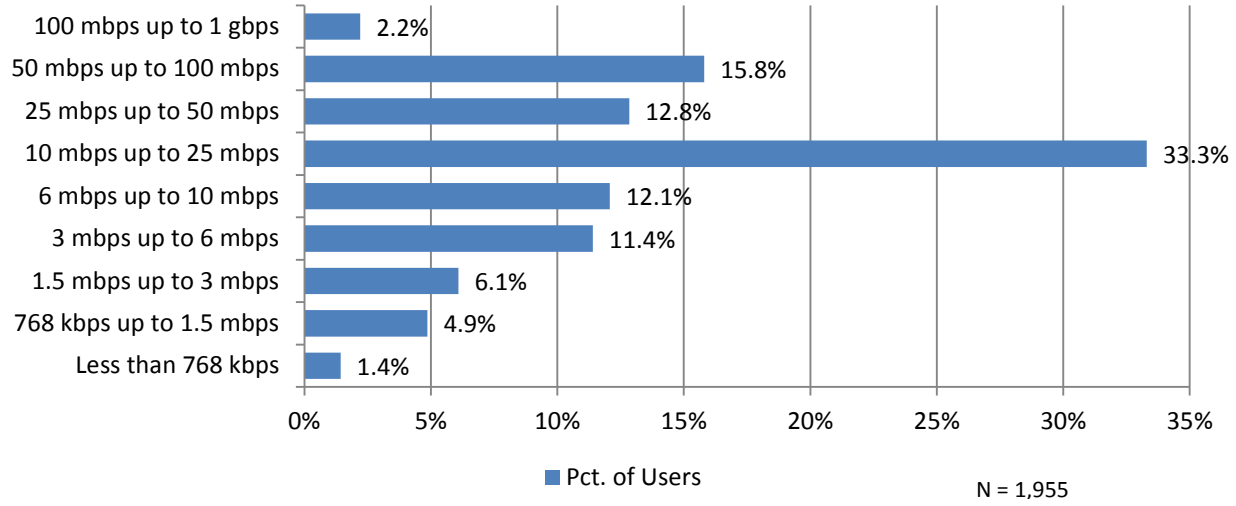
Figure 15 – Speed-Test Results for Average Upload Speeds (Businesses)



[17] Note: Speed test results should be used with care due to the wide variety of factors that influence an individual consumer's speed. Speed test data from this assessment include the measured actual upload and download speeds at the time the test was taken.

[18] The number of responses (indicated by N in each chart) varies because completion of the speed test portion was optional.

Figure 16 – Speed-Test Results for Average Download Speeds (Businesses)



Connectivity speeds for businesses failed to meet the current FCC definition of broadband for 69.2 percent of respondents. Moreover, 17 percent of those taking the speed test had upload speeds of less than 768 kbps. This is consistent with SNG's research across eight other States. It is worth noting that SNG's internal analysis shows a stronger correlation between Internet utilization and upload speeds than with download speeds. This reflects the requirements of Internet applications for greater symmetrical connectivity (as opposed to asymmetrical connections where download speeds greatly exceed upload speeds). For businesses to get the most out of broadband, upload speed is a critical factor.

These results are in sharp contrast to the availability of speeds that service providers are reporting, as seen in Part A. The FCC has monitored the difference between advertised and actual speeds for Internet services since 2011 and has found that on average the two are closely aligned. However, "even though the actual download speeds experienced by most ISPs' subscribers are close to or exceed the advertised download speeds, for each ISP there are some panelists for whom actual download speed falls significantly short of the advertised download speed. Relatively few subscribers to cable, fiber, or satellite broadband service experience such shortfalls." [19]

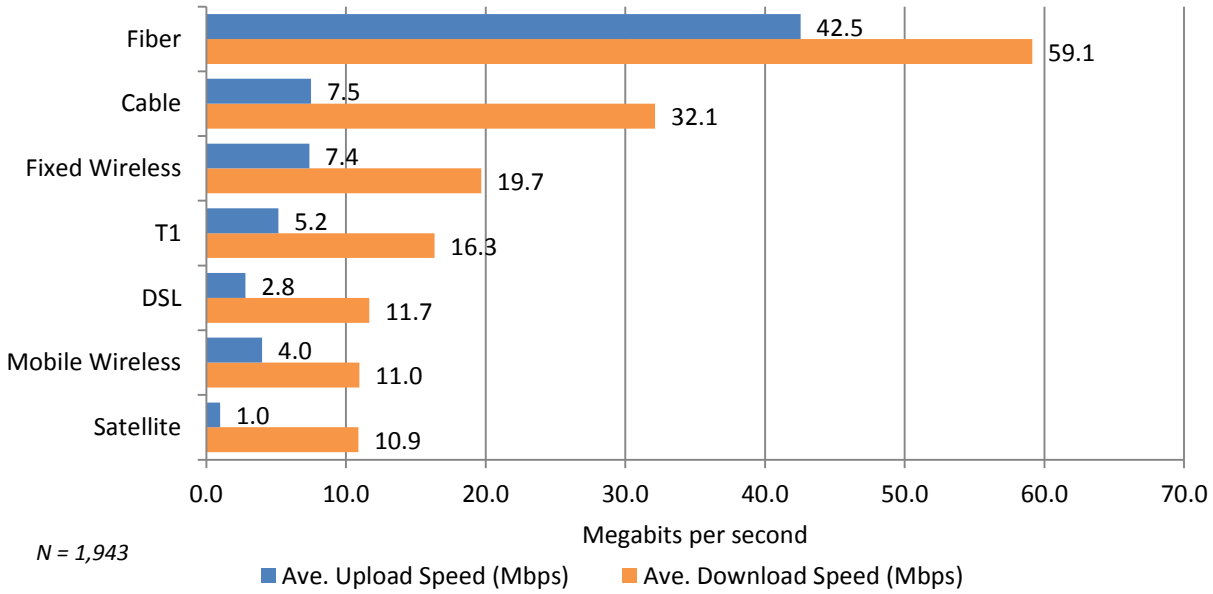
For subscribers that have speeds less than those advertised for their area, there are a number of possible explanations. Reported available speeds often reflect the maximum speed in a larger geographic area, not necessarily the speed available at that specific location. Moreover, many consumers purchase Internet service with less than the maximum available speed, usually due to cost. The age and capacity of routers inside a home can also limit speeds below that provided by the ISP. To better understand the factors and motivations influencing selection of ISPs and service packages by those businesses with less than 25/3 broadband, follow-up telephone calls were made to approximately 50 businesses. The main finding from these calls was that many businesses are actively looking for options outside of their current

[19] *2015 Measuring Broadband America – A Report on Consumer Fixed Broadband Performance in the United States; FCC's Office of Engineering and Technology and Consumer and Government Affairs Bureau, Page 7.* https://www.fcc.gov/reports-research/reports/measuring-broadband-america/measuring-broadband-america-2015

carrier and while some are finding alternatives (or installing their own fiber), most are not finding options, or the options are cost prohibitive. [20]

As seen in Figure 17, the speed test results varied greatly between different technologies, with fiber leading by a wide margin. Cable and fixed wireless formed the second fastest tier of service, while T1, DSL, mobile wireless and satellite recorded the slowest speeds. It is worth noting that recorded speeds are increasing rapidly for fiber, cable, and both fixed and mobile wireless, based on FCC data as well as SNG data collected since 2010.[21]

Figure 17 – Speed-Test Results by Type of Connectivity



Figures 18 and 19 show that connectivity speeds for both downloads and uploads vary by the economic status of a county, with distressed and at-risk counties having a larger percentage of recorded speeds below the FCC definition of broadband. For upload speed, 68.8 percent of distressed and 61.4 percent of at-risk counties had speed test result that did not meet the FCC definition of broadband compared to only 35.3 percent from businesses in other counties. A contributing factor to this variation by county economic status is the dominant share that DSL has in distressed and at-risk counties. Another factor is willingness or ability to pay for premium services.

[20] *See Appendix C for more details.*

[21] *FCC, Op.Cit: Page 6: "Spurred by the deployment of enabling technologies such as DOCSIS 3, the maximum advertised download speeds among the most popular service tiers offered by ISPs using cable technologies has increased from 12-30 Mbps in March 2011 to 50-105 Mbps in September 2014. In contrast, the maximum advertised download speeds that SamKnows tested among the most popular service tiers offered by ISPs using DSL technology has remained generally unchanged since 2011. There is a growing disparity in most download speeds tested between many DSL-based broadband services and most cable-based broadband services."*

Figure 18 – Businesses with Upload Speeds (Mbps) Below FCC Target by County Economic Status

Upload Speed Range	Distressed	At-Risk	All other	Statewide
Less than 200 kbps	3.2%	3.1%	1.8%	2.2%
200 kbps up to 768 kbps	24.0%	26.9%	11.0%	14.8%
768 kbps up to 1.5 Mbps	20.8%	20.2%	10.7%	13.1%
1.5 Mbps up to 3 Mbps	20.8%	11.2%	11.8%	12.2%
% below FCC Standard	*68.8%*	*61.4%*	*35.3%*	*42.3%*

Figure 19 – Businesses with Download Speeds (Mbps) Below FCC Target by County Economic Status

Download Speed Range	Distressed	At-Risk	All other	Statewide
Less than 768 kbps	.8%	1.4%	1.5%	1.4%
768 kbps up to 1.5 Mbps	8.7%	7.2%	4.0%	4.9%
1.5 Mbps up to 3 Mbps	10.3%	11.1%	4.5%	6.1%
3 Mbps up to 6 Mbps	19.0%	19.9%	8.7%	11.4%
6 Mbps up to 10 Mbps	13.5%	13.9%	11.5%	12.1%
10 Mbps up to 25 Mbps	28.6%	25.8%	35.6%	33.3%
% below FCC Standard	*80.9%*	*79.3%*	*65.8%*	*69.2%*

Another factor that influences the quality of Internet service is the level of competition among ISPs. The presence of single providers is greater in small towns and isolated rural areas.[22] Figure 20 shows that respondents that reported having only one ISP in their area tended to have slower Internet connections. This dynamic was even more pronounced for households (see Sub-Section 1.3).

Figure 20 – Average Download Speeds by Number of Internet Service Providers (Businesses)

Businesses Download Connectivity in Mbps	Metropolitan	Micropolitan	Small Town & Isolated Small Town*	Statewide
More than three providers	43.5	21.8	74.2	43.8
Three providers	46.8	15.5	17	35.4
Two providers	31.7	23.7	18	28.4
One provider	25.7	18.2	16	22.5

**** These two categories, representing very rural areas, were merged due to the small number of respondents.***

Closer examination of the data shows that within any given technology (DSL, cable, fiber), speeds do not change much by number of ISPs in a community. More important is the fact that DSL (one of the lowest performing on the speed tests) is more prevalent in areas with only one ISP. The assessment results show that 45.2 percent of DSL business respondents are in areas with only one ISP. In contrast, the percentages for fiber are 23.2 percent; fixed wireless 35.2 percent; and cable 35.8 percent.

[22] *A metropolitan area is defined by the Census Bureau as having a core urban area of over 50,000 with a population density greater than 1,000 people per square mile. A Micropolitan area has a population of 10,000 to 49,999. A small town has a population of 2,500 to 9,999. The category of "isolated small town" includes the remainder.* http://www.ers.usda.gov/data-products/rural-urban-commuting-area-codes.aspx

1.2.2 Internet Reliability and Consumer Satisfaction (Businesses)

Business respondents were asked about their level of satisfaction with their existing Internet service, both in terms of reliability and value for level of service. When examining the four most prevalent types of connectivity (cable, DSL, fiber and fixed wireless), a clear hierarchy emerges, with fiber rated by far the most reliable service and best value. Cable and fixed wireless are rated close to the overall average of all Internet services, while DSL has the lowest rated reliability and satisfaction of the four dominant types of connectivity. Figure 21 has a breakdown of satisfaction ratings by businesses for technology types.

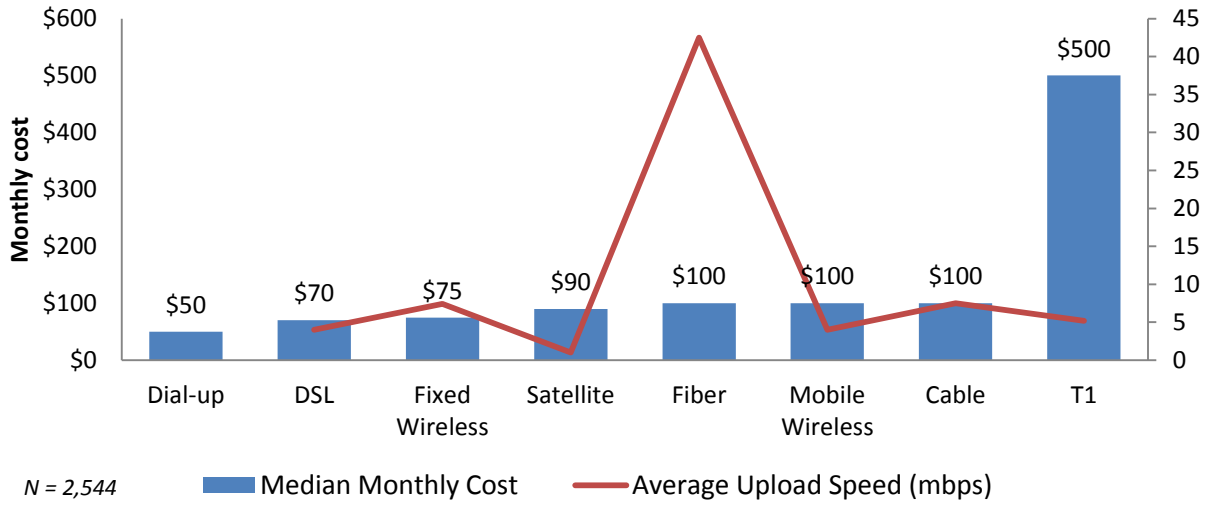
Figure 21 – Respondent Satisfaction by Type of Connection (Businesses)

	Reliability	Value for Price
	Frequent or Occasional Problems	Poor value or below expectations
Fiber	9.1%	11.1%
T1	35.7%	38.7%
Cable	37.5%	32.0%
Fixed Wireless	40.6%	33.6%
DSL	48.4%	42.4%
Mobile Wireless	53.0%	54.7%
Satellite	73.8%	69.4%

1.2.3 Internet Costs

Costs for Internet services (as reported by respondents) vary greatly, ranging from a median of $50 a month for dial-up, just over $70 for fixed wireless and DSL, to between $90 and $100 for satellite, mobile wireless, fiber and cable. T1 connections were by far the most expensive.

Figure 22 – Median Internet Costs and Speed by Type of Connection (Businesses)



There was little variance in Internet cost based on the number of service providers available to the purchaser. It is important to note that businesses usually can choose between different levels of Internet service (greater speed and larger data caps) from any individual ISP. Some of the variation in costs, especially within a given technology, for example cable, is likely a result of businesses choosing different levels of service based on their needs and ability or willingness to pay for a higher level of service.

The monthly expenditures on Internet connectivity generally increase with organization size. Over 60 percent of small businesses with 1-4 employees spend less than $100 per month, while 50 percent of establishments with 50 or more employees spend $400 or more per month.

1.3 Non-commercial Entities and Internet Connectivity

Data from community anchor institutions shows that connectivity varies by type of community anchor institution. This section examines only government entities or non-profit organizations, unless otherwise noted. As seen in Figure 23, educational, public safety and health care organizations have notably higher Internet speeds than local governments, libraries, economic development organizations, and other community service organizations. Additionally, the size of organization influences connectivity: the bigger the organization, the faster its Internet connection. It should be noted that while Figure 23 identifies the percentage of institutions below the FCC definition of broadband, the FCC has indicated that standards for community anchors, especially schools and libraries should be significantly higher.[23]

Figure 23 – Download Speeds (Mbps) Below FCC Target by Type of Community Anchor Institution

Download Speed Range (Mbps)	*Less than 3*	*3 to 10*	*10 to 25*	*% below FCC Standard*	*Total # of Respondents with Speed Test*
Public Safety	14.3%	9.5%	23.8%	47.6%	21
College or University	22.6%	14.6%	14.5%	51.7%	62
K - 12 Education (public & private)	9.1%	20.4%	22.6%	52.1%	186
Health Care	3.4%	31.0%	24.1%	58.5%	54
Other Community Service	18.9%	21.6%	33.3%	73.8%	111
Economic Development Agency	9.3%	27.9%	37.2%	74.4%	43
Library	7.3%	18.2%	49.1%	74.6%	55
Local Government	12.2%	31.3%	34.3%	77.8%	99

** Due to small sample sizes, these data should be used with caution.*

Data collected shows that the non-commercial entities experience the same regional patterns of internet connectivity as businesses. Non-commercial entities in "at-risk" and "distressed" counties generally have lower Internet speeds, with 80.3 percent of entities in distressed counties having Internet connectivity below the FCC target of 25 Mbps download – compared to 59.2 percent in counties designated as transitional, attainment, or competitive.

Figure 24 – Non-commercial Organizations with Download Speeds below FCC Target by County Economic Status

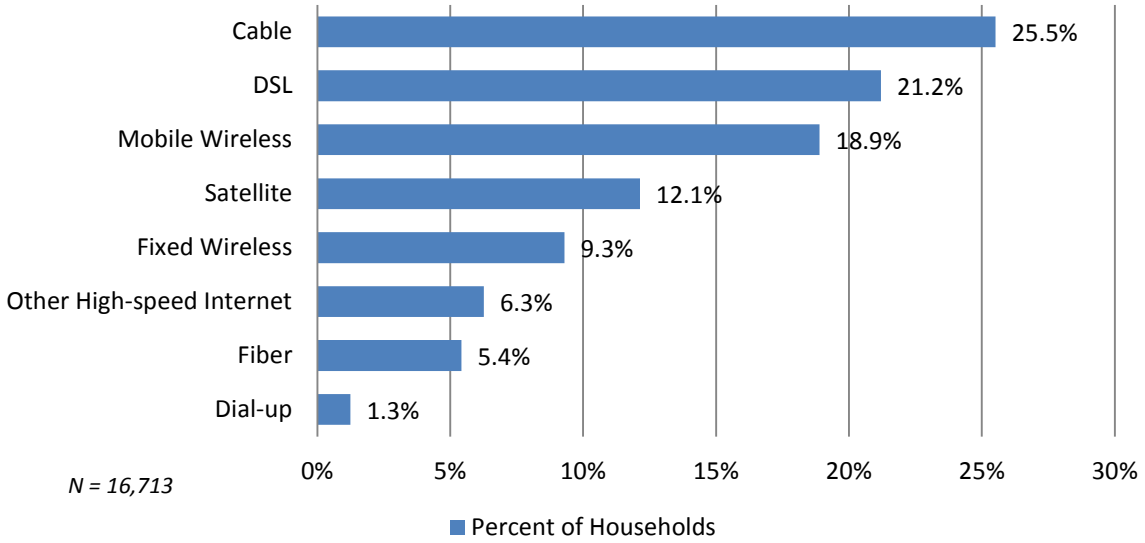
Download Speed Range (Mbps)	*Less than 3*	*3 to 10*	*10 to 25*	*% below FCC Definition*	*# of Respondents*
Other Counties	10.9%	19.9%	28.4%	59.2%	909
At Risk	15.2%	27.0%	28.4%	70.6%	439
Distressed	13.6%	38.6%	28.1%	80.3%	188

[23] *2012 WCB Cost Model Virtual Workshop, FCC 2012, https://www.fcc.gov/news-events/blog/2012/06/01/wcb-cost-model-virtual-workshop-2012-community-anchor-institutions*

1.4 Household Connectivity Characteristics

Figure 25 identifies the primary Internet connection that households subscribe to in Tennessee. The dominant technologies are DSL and cable, though mobile wireless and satellite are used to access the Internet more by households than by businesses. Fiber is still only a small share of the residential market. Only 209 (1.3 percent) out of 16,713 households reported their Internet connection as dial-up. [24]

Figure 25 – How Households Connect to the Internet



Three of the four most common types of Internet connections (DSL, satellite and mobile wireless) have lower speeds and more reliability issues. Use of DSL and satellite tends to increase in non-metropolitan areas, while cable use increases in metropolitan areas.

1.4.1 Internet Speeds

Households were provided the option to take a speed test to measure the upload and download speeds of their connections. Like businesses, households in at-risk and distressed counties reported slower connections than households in other counties.

The recorded speed test results differ markedly from the potential speeds marketed by the Internet service providers. To a large extent this difference is a result of consumers purchasing service packages that are less expensive and less robust than the services that meet the FCC definition of broadband. However, in some cases, especially where cable or fiber are not available, higher speed packages will just not be offered.

[24] *The chart is not reflective of all the connections households have access to, but rather the services they choose to purchase. For instance, a household may have a choice of fiber, cable, or DSL at their home, but they may choose to subscribe to DSL. The assessment does not identify what types of connections fall into the "other high-speed Internet" category, though it is possible that the respondent was unsure or did not know that the ISP branded service that they purchase falls into one of the other categories (e.g. fiber).*

Figure 26 – Households with Upload Speeds (Mbps) Below FCC Target by County Economic Status

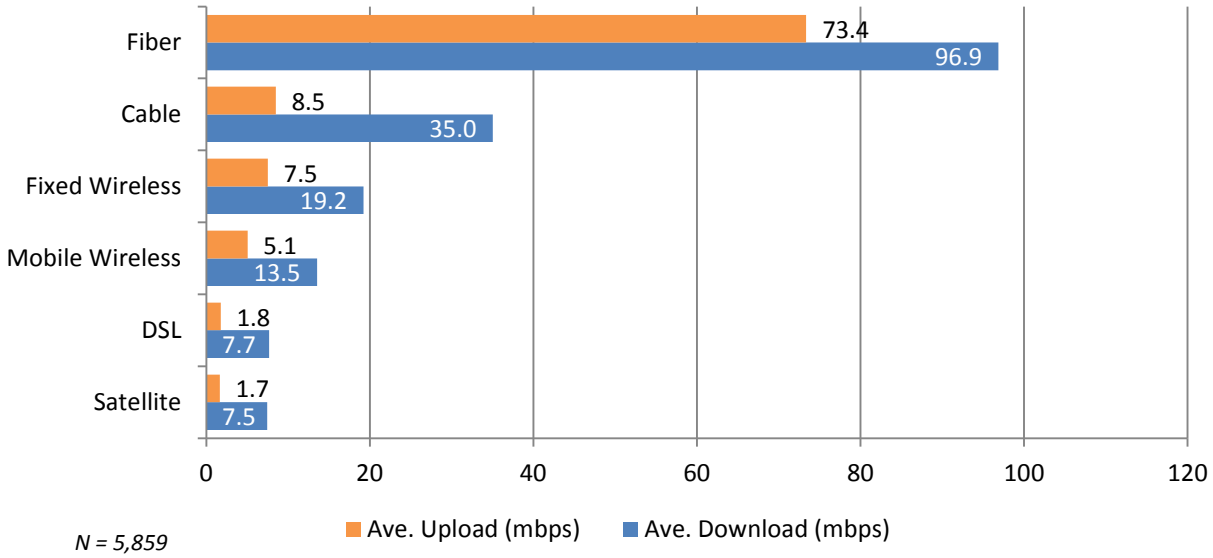
Upload Speed Range	Distressed	At-Risk	All other	Statewide
Less than 200 kbps	9.6%	7.0%	4.2%	5.6%
200 kbps up to 768 kbps	37.7%	35.1%	19.8%	26.2%
768 kbps up to 1.5 Mbps	16.3%	15.6%	13.0%	14.1%
1.5 Mbps up to 3 Mbps	10.9%	9.8%	13.5%	12.1%
% below FCC Standard	*74.5%*	*67.5%*	*50.5%*	*58.0%*

Figure 27 – Households with Download Speeds (Mbps) Below FCC Target by County Economic Status

Download Speed Range	Distressed	At-Risk	All other	Statewide
Less than 768 kbps	8.8%	6.6%	3.6%	5.1%
768 kbps up to 1.5 Mbps	10.3%	8.8%	4.7%	6.5%
1.5 Mbps up to 3 Mbps	15.8%	12.9%	9.0%	10.9%
3 Mbps up to 6 Mbps	20.5%	21.8%	15.9%	18.2%
6 Mbps up to 10 Mbps	10.7%	11.8%	12.3%	12.0%
10 Mbps up to 25 Mbps	18.9%	19.3%	26.2%	23.4%
% below FCC Standard	*85.0%*	*81.2%*	*71.7%*	*76.1%*

Figure 28 below provides a summary of the speed test results by connectivity type. No dial-up respondents took the speed test. For residential service, fiber connectivity provided the fastest access, followed by cable and fixed wireless. Satellite and DSL had the lowest recorded Internet connections.

Figure 28 – Speed (Megabits per second) by Connection Type



N = 5,859

As with businesses, the level of competition influences the quality of Internet service available. Figure 29 shows that households that reported having only one ISP in their area tend to have slower Internet connections.

Figure 29 – Download Speed-Test by Number of Internet Service Providers

Household Download Connectivity in Mbps	Metropolitan	Micropolitan	Small Town	Isolated Small Town	Statewide
More than 3 providers	**52**	**34.8**	**19.8**	**n/a***	**41.8**
Three providers	**62.3**	**26.2**	**21.6**	**n/a**	**47.2**
Two providers	**36.3**	**24.8**	**17.9**	**14.2**	**30.4**
One provider	**24.7**	**13.8**	**12.3**	**7.7**	**17.4**

* Sample size too small

1.4.2 Household Internet Costs

The reported median cost for household Internet access was just over $60. While dial-up service was the least expensive Internet service, cable, fixed wireless and fiber Internet service were closely clustered around the median cost of $60, with DSL being slightly less expensive and satellite and mobile wireless being more expensive.

Figure 30 – Cost by Speed of Household Connection and Access Type[25]

	Average Cost for Level of Service		
Access Type	Median Price Range	Average Upload Speed (Mbps)*	Average Download Speed (Mbps)*
Dial-up	$30		
DSL	$50 to $60	1.77	7.69
Fixed Wireless	$50 to $60	7.55	19.23
Fiber	$50 to $60	73.37	96.86
Cable	$60.00	8.51	35.03
Satellite	$60.00	1.67	7.45
Mobile Wireless	$80.00	5.05	13.54

N = 6,175

1.4.3 Internet Reliability and Consumer Satisfaction

Households were asked to rate how well their current Internet service meets their needs in terms of speed, reliability and value. Fiber has by far the best reliability of the broadband connection options. Cable and fixed wireless are comparable in terms of meeting household needs and expectations for speed, reliability and value. Over 50 percent of households reported reliability as poor (occasional or frequent problems) for DSL, mobile wireless and satellite Internet, which contributed to poor ratings on price/value expectations.

[25] *The speed test results can be impacted by "outliers" whose very high results "skew" the average. This is particularly noticeably in fiber where Gigabit service is available.*

Figure 31 – Household Satisfaction with Reliability and Value

	Reliability	Value for Price
	Frequent or Occasional Problems	Poor value or below expectations
Fiber	13.8%	20.5%
Cable	37.7%	54.7%
Fixed Wireless	46.6%	50.4%
Mobile Wireless	53.7%	63.1%
DSL	61.0%	69.5%
Satellite	76.1%	84.9%
Dial-up	85.1%	79.3%

N = 16,477

2. Employment and Financial Impacts from Internet Use

2.1 Business Impacts

To gauge the impacts of Internet use on their operations, businesses were asked to quantify how using the Internet has affected revenue generation, operating cost savings and employment.[26] Businesses were asked to identify changes resulting from use of the Internet, specifically:

- **Number of new jobs created** in the past 12 month period and the number of new jobs created that can be attributed to using the Internet.
- **Total Annual Revenue** from the Internet over the past 12 month period.
- **Total Annual Cost Savings** from using the Internet over the same period.

Figure 32 examines overall job creation and losses within the 1,004 businesses that answered this part of the assessment. While 5,152 new positions were created, there were also sizeable job reductions, resulting in a net job increase of 4,325 positions. The net job increase attributed to using the Internet (Figure 33) was 1,860 positions (full and part-time) or 43 percent of all net new jobs.

Figure 32 – Summary of Employment Changes in Businesses (Full and Part Time combined)

Size of Employer	Number of Businesses	Current Employees	New Jobs Created in Last 12 Months	Lost Jobs	Net Jobs
0 to 19	734	4,815	1,211	338	873
20 to 49	144	4,432	785	113	672
50 to 99	63	4,175	741	109	632
100 to 499	54	9,970	901	165	736
500 or more	9	12,508	1,514	102	1,412
Totals	1,004	35,900	5,152	827	4,325

Figure 33 – Summary of Employment Impacts Specific to Internet Use (Full and Part Time combined)

Size of Employer	New Jobs from Internet Use	Lost Jobs from Internet Use	Net Jobs from Internet Use	Net Jobs from Internet Use as Percentage of Net New Jobs
0 to 19	525	36	489	56.0%
20 to 49	298	28	270	40.2%
50 to 99	221	55	166	26.3%
100 to 499	343	19	324	44.0%
500 or more	611	0	611	43.3%
Totals	1,998	138	1,860	43.0%

[26] *Due to the proprietary and sensitive nature of this information, these questions were optional for assessment respondents. As a result, the sample sizes are significantly less than for the total response set. The largest amount of "impact" data collected was in relation to employment, for which 1,004 establishments reported data. 689 and 328 businesses reported data for revenues and operating cost savings related to the Internet, respectively.*

The Internet has created jobs in Tennessee for all sizes of businesses.

Of the revenues reported by the 689 Tennessee businesses respondents, 66.2 percent of 12-month revenues were generated through the Internet. From a cost-savings perspective, 328 businesses responded to the cost savings questions and reported a 12-month operating cost savings of 3.6 percent due to their use of the Internet.

While sample sizes are small, it is worth looking at how businesses performed based on the economic status of their county. As seen in Figure 34, businesses in at-risk or distressed counties reported significantly lower revenues facilitated by the Internet, 35.8 percent and 36.2 percent, respectively, compared to 68.3 percent from the other counties.

Figure 34 – Annual Revenues and Cost Savings from Internet Utilization

Annual Revenue Impacts				
	# of Establishments	Total Annual Revenue ($M)	Annual Revenue from Internet ($M)	Percent Internet Revenue
Statewide	689	$3,683	$2,436	66.2%
Distressed Counties	41	$34	$12	36.2%
At-risk Counties	123	$210	$75	35.8%
Other counties*	525	$3,440	$2,349	68.3%

Annual Operating Cost Impacts (Statewide)			
Number of Establishments	Total Annual Operating Cost ($M)	Cost Saving from Internet ($M)	Percent Cost Saving
328	$803	$29.70	3.60%

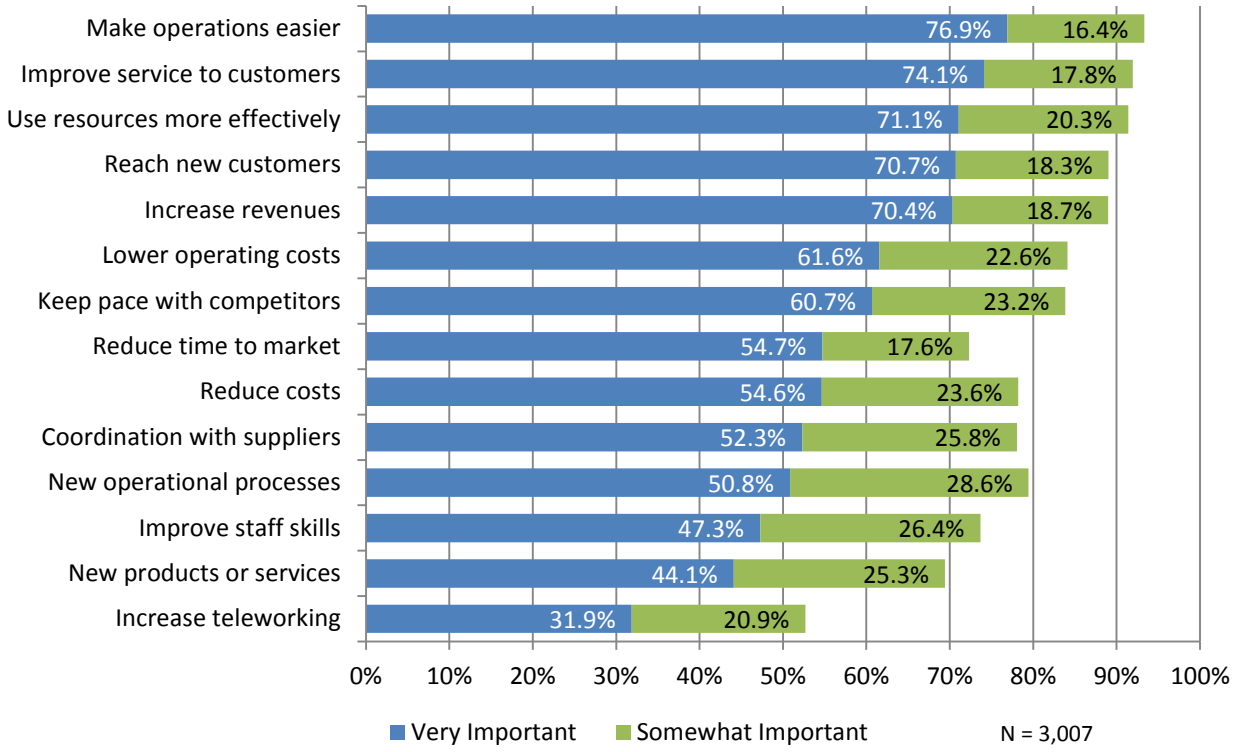
2.1.1 Broadband and Deciding Where to Locate

Businesses were asked about the importance of broadband for both selecting and remaining in their current location. Responses to the assessment clearly indicate that availability and suitability of broadband play an important role in corporate decisions to remain in a community, and if a business is moving, which areas it is willing to consider. Over 34 percent of businesses say that broadband service was “essential” in selecting their business location, and 55.7 percent say broadband is “essential” for remaining in their current location. Economic Development agencies in Tennessee were also asked about their experience with businesses and locational decisions. Out of 65 participating economic development agencies, 15.5 percent stated that businesses frequently chose not to locate in an area due to its broadband quality. Another 27.7 percent stated that this happened occasionally.

2.1.2 Overall Broadband Benefits for Businesses

Overall, the majority of businesses recognize broadband as important across multiple dimensions. The benefits rated as most important are related to improved efficiency and productivity, improving service to customers and increasing revenues. The net effect of these benefits is to increase competitiveness, productivity and revenues, while reducing costs and improving profitability.

Figure 35 – Importance of Broadband Benefits for Businesses



2.2 Household Impacts

Having a good broadband connection also has a major impact on the employment and financial wellbeing of households as demonstrated by the number of home-based businesses and money spent or earned by households online.

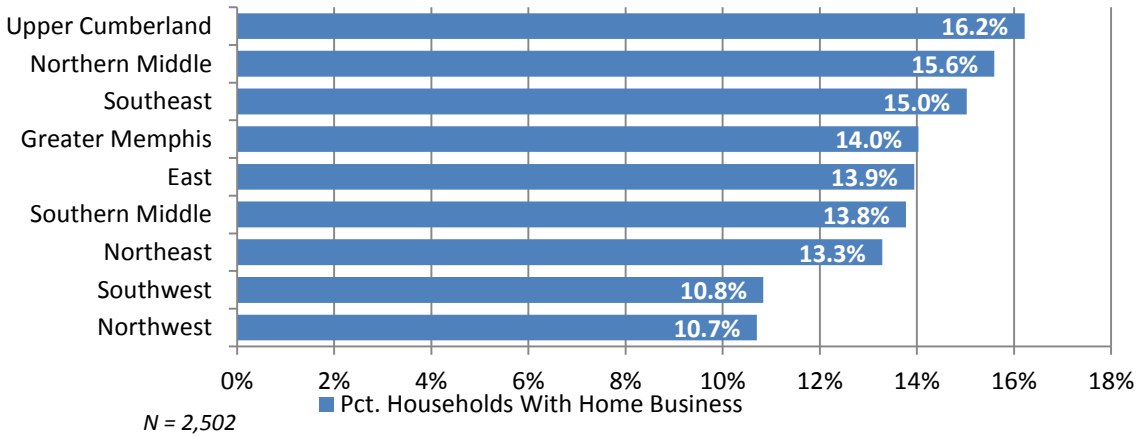
2.2.1 Home-based Business

An often underestimated economic impact of the Internet is the large portion of the population that operates a business out of their home, using the Internet as a key part of their operations. In Tennessee, 23.5 percent of households stated that they currently operate a business from their home.

Some of these businesses also have premises outside of the home. To distinguish between businesses run exclusively out of a residence and businesses that also operated from locations outside the home, households were further asked if they operated a home-based business that met the following definition: *"A part-time or full-time activity by one or more household members that operate their business exclusively from home. This may include self-employed professionals and many other types of entrepreneurial business activities."* 60 percent of the respondents who initially run a home-based business do so exclusively from their home. This represents 14.1 percent of all households surveyed. These businesses based exclusively from the home were asked to assess the impact of the Internet on their business. 66.8 percent of these businesses stated that they would not be in business without the Internet, and 54.2 percent would need to relocate to get broadband if it was not available. 92.8 percent of these businesses agree broadband is essential for their business to function.

The presence of home-based businesses varies across the state, with the Southwest and Northwest regions having the lowest incidence and Upper Cumberland and Northern Middle having the highest incidence of home-based businesses. In Tennessee, home-based businesses are slightly more prevalent in isolated areas than in small to medium sized towns. To the extent that home-based businesses do not need to be near metropolitan areas or large employers, home-based businesses represent an important opportunity for rural areas with high unemployment and/or low wages.

Figure 36 – Percentage of Households with a Home-based Business – by Geographic Region



N = 2,502

The three most common sectors for home-based businesses in Tennessee are: professional and technical services (17.2 percent); other services (17.1 percent); and retail trade (14.4 percent). The most frequent Internet uses by home-based businesses are Online Banking, Research, and Online Purchases, which are each used by over 80 percent of home-based businesses. Over half (58.7 percent) of home businesses have a business website, and a majority of home businesses currently use the Internet as a tool to increase productivity. Home-based businesses are more likely to sell online (61.8 percent) when compared to all businesses (49 percent).

2.2.2 Teleworking

In response to questions concerning use of the Internet for personal productivity almost 26 percent of households stated that they currently telework. To determine the extent to which telework has become a formal arrangement, these households were further asked if one or more household members "*works from home during normal working hours as part of an ongoing arrangement with your employer. Teleworking may be part time (one or more days per week) or all of the time"*

Of the original 25.9 percent of households that identified as currently teleworking, half confirmed they had formal arrangement for teleworking. Almost half (55.2 percent) of workers with formal telework arrangements are employed by organizations more than 30 miles (one-way) from their residence, and 24.2 percent would need to travel over 100 miles to their workplace. The most important motivation factors cited for these teleworking households are life-work balance, reducing commuting time, and more family time (all cited by 75 percent of teleworkers), followed by increased productivity (71.6 percent). The largest industry category for teleworkers with formal arrangements with their employers is "Professional and Technical Services" at 19.8 percent (of all teleworkers), followed by "Health Care" at 12.7 percent. However, teleworkers are found in a broad range of other industries.

2.2.3 Broadband and Household Income and Employment

Households were asked to provide information on the impact of the Internet on their income and employment. Over 36 percent of households in Tennessee reported some level of additional household income from using the Internet with 20 percent of households reporting at least $5,000 per year in additional income.

Looking at employment impacts, households were asked if the Internet had enabled a member of their household to gain higher-skilled or higher-wage employment in the prior two years. 25 percent of households answered yes, indicating that almost one out of every four households had a family member that improved their employment situation, in part through use of the Internet.

2.2.4 Online Transactions and Spending

The assessment of Internet use revealed that 95.6 percent of households use the Internet to purchase goods and services online, with 80 percent of those households conducting more than 10 purchase transactions per year, and 55.8 percent of households spending more than $500 per year online. Mobile broadband is also become increasing important to the digital economy with 83.8 percent of household respondents having made an online purchase with their mobile device.

3. Internet Utilization and Benchmarking

Access to and effective use of the Internet has become an essential element in the health and success of businesses, households and community anchor institutions. This section identifies key findings related to use of the Internet in Tennessee: what types of applications are used most and which barriers prevent more effective use. The findings are broken down by key respondent characteristics.

To assist in the process of making comparisons of how intensively an organization or household utilizes the Internet, a mechanism was developed for establishing benchmarks. Benchmarks are useful in creating reference points against which the performance of any individual or group can be compared. Strategic Networks Group has developed a benchmarking process based on its Digital Economy index (DEi).

As an indicator of the level of Internet utilization, the DEi score correlates with the level of benefits that a business derives from Internet use. While there are a large number of factors that determine the level of financial benefits a business will derive from increasing and improving their use of the Internet, a statistical analysis of Strategic Networks database from 2010 to 2015 shows a correlation between higher DEi (Internet utilization) and financial benefits from the Internet. Moreover, SNG data also shows that there is a positive correlation between the Internet speed of a business and it level of utilization (DEi).

3.1 Introducing the Digital Economy index (DEi)

The Digital Economy index (DEi) reflects an organization or household's utilization of a range of Internet applications and process: 17 for organizations and 30 for households (see Appendix B for the list of eSolutions). Based on the number of applications currently being used by an organization, a composite score is calculated that summarizes how comprehensively each business organization uses Internet-enabled eSolutions[27]. The DEi Score (from 0 to 10, with 10 being the highest score) can be used to compare organizations, regions, or industry sectors. A separate DEi is used to compare how different household types use the Internet.

In areas where DEi is lower than average, indicating lower utilization, an opportunity to increase utilization and benefits to businesses and non-commercial entities exists.

[27] *"**eSolutions**" refers to the integration of Internet technologies with the computer-based systems and applications for a variety of operational processes. eSolutions encompass not only product delivery and payment transactions (eCommerce) but also all processes that may be facilitated by computer-mediated communications over the Internet.*

3.2 Business Internet Utilization and Benchmarks

3.2.1 Business Benchmarks

For businesses in Tennessee, the median DEi Score was 6.99. These scores indicate a typical business in Tennessee was using about 11 of the 17 eSolutions noted in Appendix B. Looking at the differences between geographic areas, Figures 37, 38 and 39, show that more urban communities have higher Internet utilization levels and are more competitive than less urban areas.

As seen in Figure 37, businesses in isolated small towns have a median DEI score that is almost one point less than businesses in metropolitan areas. This one point difference is equal to almost 2 eSolutions (online business practices). More importantly this gap in utilization is most commonly found in eSolutions that have a high impact on business revenues, growth and sustainability, such as: selling on-line, delivering services online, and marketing (other than a basic web page).

Figure 37 – Utilization Benchmarks (DEi) for Businesses by Level of Urbanization

Utilization (DEi) by Level of Urbanization		
Region	**Median DEi**	**Number of Firms**
Metropolitan	7.18	2,631
Micropolitan	6.60	612
Small Town	6.50	459
Isolated Small Town	6.25	282

Figure 38 provides data on utilization levels from a regional perspective.

Figure 38 – Utilization Benchmarks (DEi) for Businesses by Region

Utilization (DEi) by Region		
Region	**Median DEi**	**Number of Firms**
Northern Middle	7.28	1,205
Greater Memphis	7.09	404
East	7.04	786
Southwest	6.99	192
Northeast	6.70	259
Southeast	6.70	358
Upper Cumberland	6.60	243
Northwest	6.55	171
Southern Middle	6.30	368

A dramatic difference in Internet utilization by businesses can be found by using county economic status, which shows businesses in “distressed” counties well behind businesses in “competitive” and “attainment” counties.

Figure 39 – Utilization Benchmarks (DEi) for Businesses by County Economic Status

Utilization (DEi) by Economic Status		
Region	**Median DEi**	**Number of Firms**
Competitive	7.86	54
Attainment	7.28	206
Transitional	7.09	2,672
At Risk	6.50	771
Distressed	6.41	283

The benchmarking process also reveals that smaller businesses consistently perform at lower levels than larger organizations that have access to greater resources (Figure 40). The gap in Internet utilization is most pronounced among micro businesses with 4 or less employees[28].

Figure 40 – Utilization Benchmarks (DEi) for Businesses by Size of Firm

Utilization (DEi) by Size			
Employment Range	**Median DEi Score**	**Number of Firms**	**Average DEI Score**
1 - 4 employees	6.60	1,675	6.32
5 to 9	7.09	554	6.81
10 to 19	7.48	332	7.18
20 - 49	7.38	246	7.16
50 - 99	7.18	91	7.09
100 - 249	7.86	77	7.46
250 or more employees	9.22	27	8.34

Lastly, the benchmarking process identifies differences in Internet utilization among industry sectors. As seen in Figure 41, the leading adopters of Internet solutions are Information Services, Administrative & Support Services, Financial Services, Arts & Entertainment, and Professional and Technical sectors. The lowest level of Internet utilization is found within the Agricultural and Construction sectors[29]. This is consistent with similar data obtained in other jurisdictions over the last few years.

[28] The DEi results for businesses with over 250 employees should be used with caution given the small sample size for that group.
[29] SNG research has shown the construction sector has low DEi scores because they use a small set of Internet applications. However, follow-up research has shown that construction firms tend to use those limited number of applications very intensively.

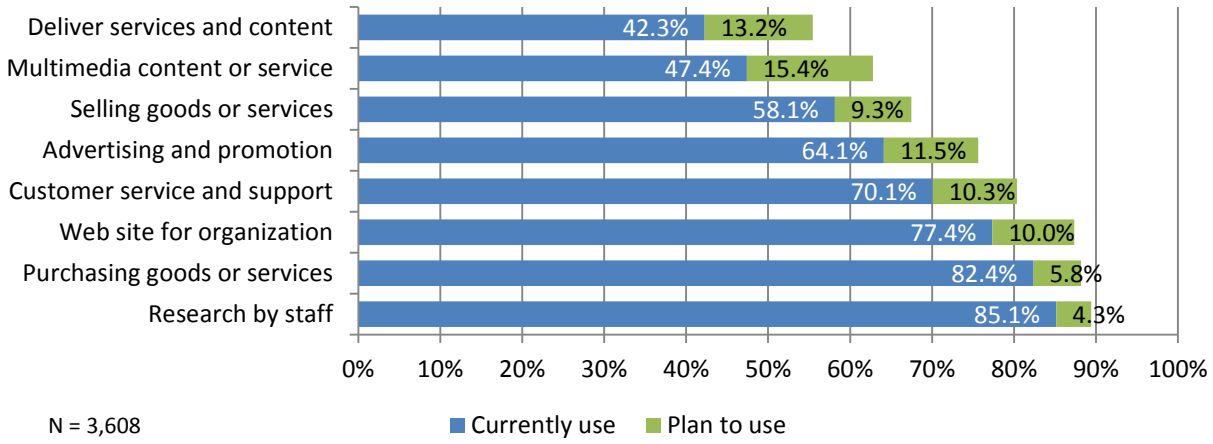
Figure 41 – Utilization Benchmarks (DEi) by Industry Sector[30]

Major Industry	Median DEi Score	# of Firms
Information	8.30	110
Administrative & Support Services	7.86	58
Finance & Insurance	7.77	247
Arts, Entertainment & Recreation	7.57	191
Professional & Technical Services	7.28	631
Real Estate	7.23	197
Manufacturing / Processing	7.09	299
Retail Trade	6.99	532
Educational Services	6.99	100
Wholesale Trade	6.80	155
Accommodation & Food services	6.80	127
Health Care & Social Assistance	6.70	298
Other services (exc. public admin)	6.60	382
Transportation & Warehousing	6.46	100
Construction	6.31	260
Agriculture / Forestry / Fishing	5.78	144

3.2.2 Businesses Broadband Utilization

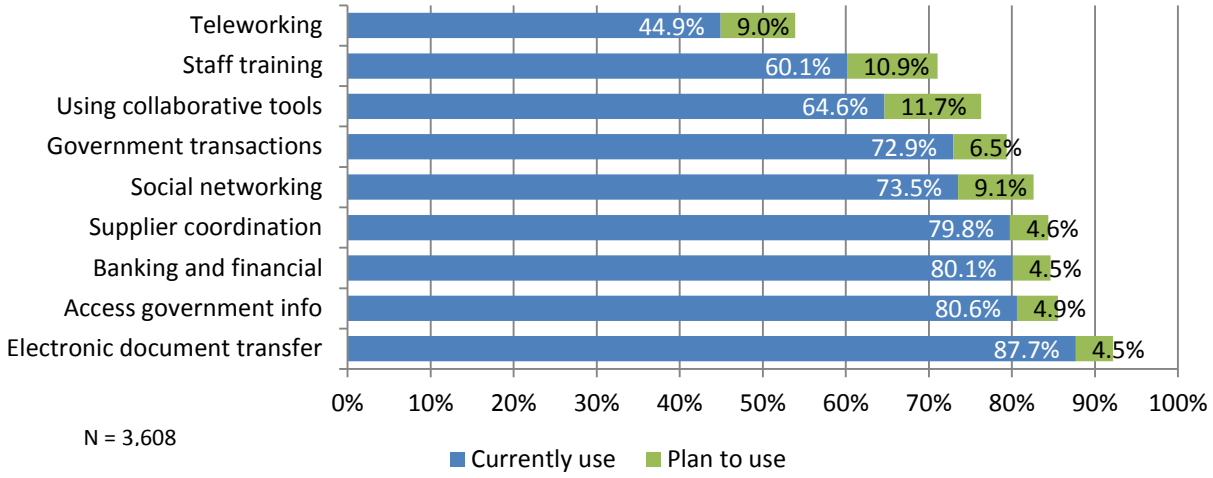
The extent to which businesses use eSolutions provides an indication of their degree of engagement in the digital economy and their leveraging of broadband capacity. The assessment of businesses explores the uses of the Internet in two major categories: **eCommerce**, which includes activities related to the sales, marketing and delivery of products and services and **eProcess**, which include internal operational uses, such as supplier coordination, training and teleworking. Figures 42 and 43 outline the percentage of businesses that currently use, or plan to use, the Internet for specific commerce or business process purposes.

Figure 42 – eCommerce Uses of Broadband



[30] *This table does not include industry sectors with less than 30 responding firms.*

Figure 43 – eProcess Uses of Broadband



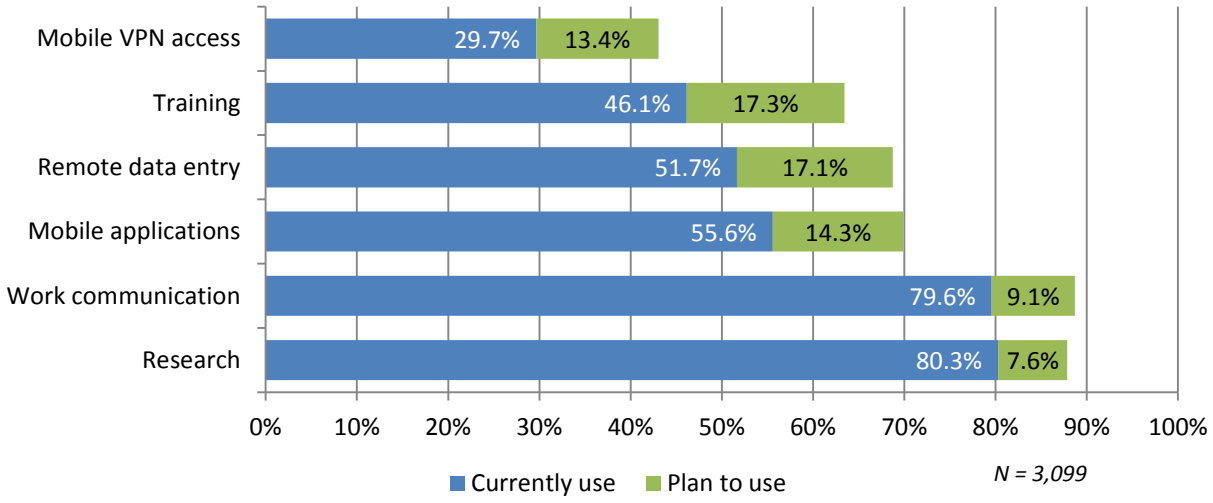
Utilization of Internet-enabled applications and operations is still evolving. Simpler processes that have long been available, such as email, are heavily accessed by all user types. Differentiation emerges in utilization patterns as more complex business and transactional processes come "online," and more current technologies spawn enhanced or new capabilities. The two most significant factors in broadband utilization levels are size of organization and industrial classification to which an organization belongs.

Broadband offers uses that can transform the way businesses conduct their operations. Over 79 percent of businesses use broadband for coordination with suppliers and another 70 percent for improving customer service. Likewise, 82.4 percent of businesses use the Internet to purchase goods and services online. In contrast, only 58.1 percent of organizations sell goods and services online and just over 42.3 percent deliver services and content online. Given the rapid growth of purchasing on line, the relatively low use of the Internet to sell or deliver goods and services represents an under-serviced market and an opportunity for all sizes of businesses.

3.2.3 Utilization of Mobility Services

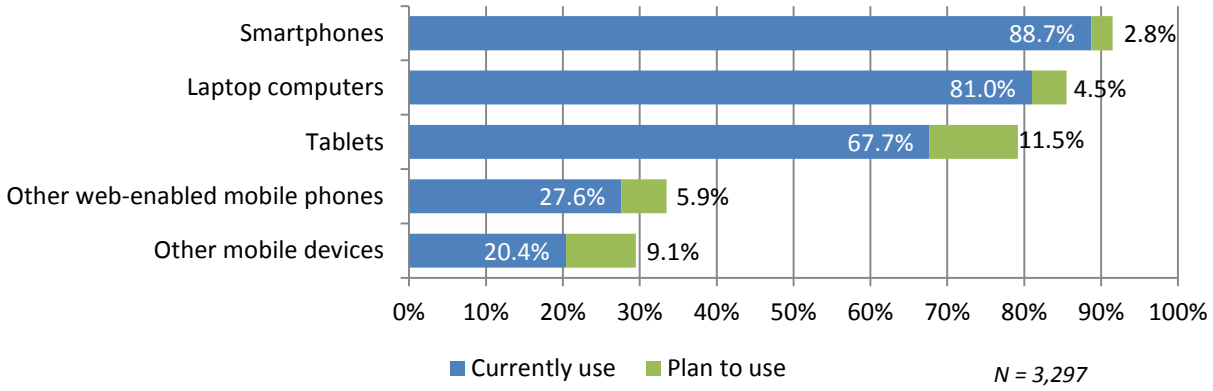
Businesses report a very high utilization of mobile devices for Internet access, which highlights the importance for mobility functions and services internal to their organizations for use when away from the office or place of business. Mobility services allow remote workers to access business resources when working at off-campus locations, such as at a client's location. The most frequently reported uses of mobile Internet were research (80.3%) and work communication (79.6%). The largest planned growth in mobile Internet use was in training (17.3%) and remote data entry (17.1%). These utilization percentages are expected to increase as more mobile access is available, more devices are adopted and more business applications are developed.

Figure 44 – Business Utilization of Mobile Internet



As seen in Figure 45 below, over 88 percent of businesses use a smart phone and 81 percent use web-enabled laptop computers. Tablets show the greatest planned growth, an expected finding as the other devices have long been around and are nearing market saturation. Many mobile analysts believe that the ceiling for tablets and laptop computers is around 93 percent, with smartphones potentially as high as 96 percent adoption. This data demonstrates that that mobile broadband service has become almost as essential as fixed line broadband, but it is not a substitute.

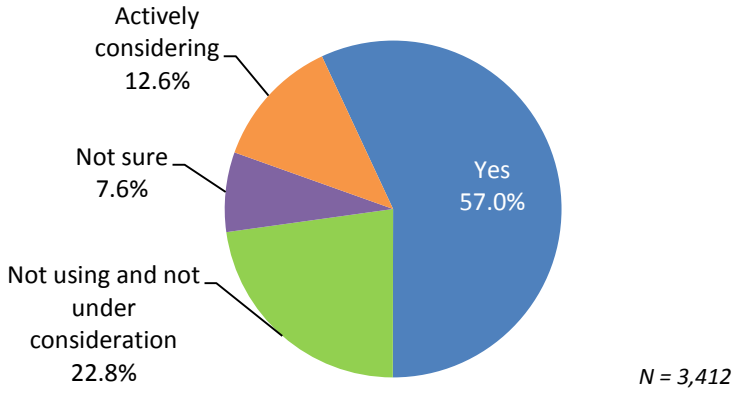
Figure 45 – Use of Web-enabled Mobile Devices



3.2.4 Cloud Services

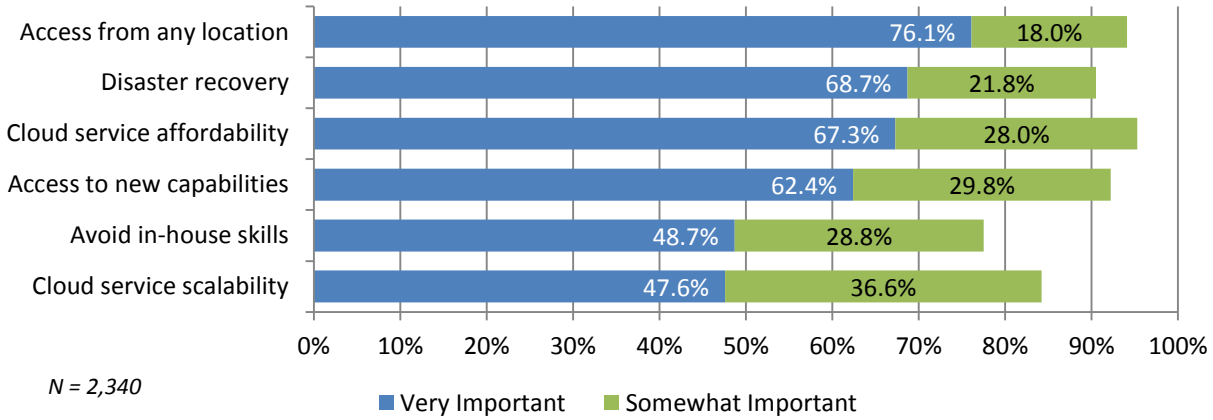
With the recent rapid growth in cloud-based services, the business assessment asked how many businesses were using these services and for what purposes. As seen in Figure 46 below, over half (57 percent) of respondents indicated they were already using cloud-based services, with another 12.6 percent actively considering them as a possible solution for internal and external connectivity and collaboration.

Figure 46 – Percentage of Businesses Using Cloud-Based Services



Among users of cloud-based services, the most used cloud-based service is electronic document storage (83.6 percent). Basic applications (like email, word processing, sharing spreadsheets and office documents) were, at 68.4 percent, closely followed by use of cloud services for collaborative platforms[31] at 67.6 percent. Motivations for utilizing cloud-based services are varied, with six possible motivating factors being identified as very important or somewhat important by over 75 percent of cloud services users. As Figure 47 shows, the most frequently cited drivers were mobile access to the Internet and the ability to facilitate offsite disaster recovery, with affordability a close third.

Figure 47 – Motivating Drivers of Adoption of Cloud Services



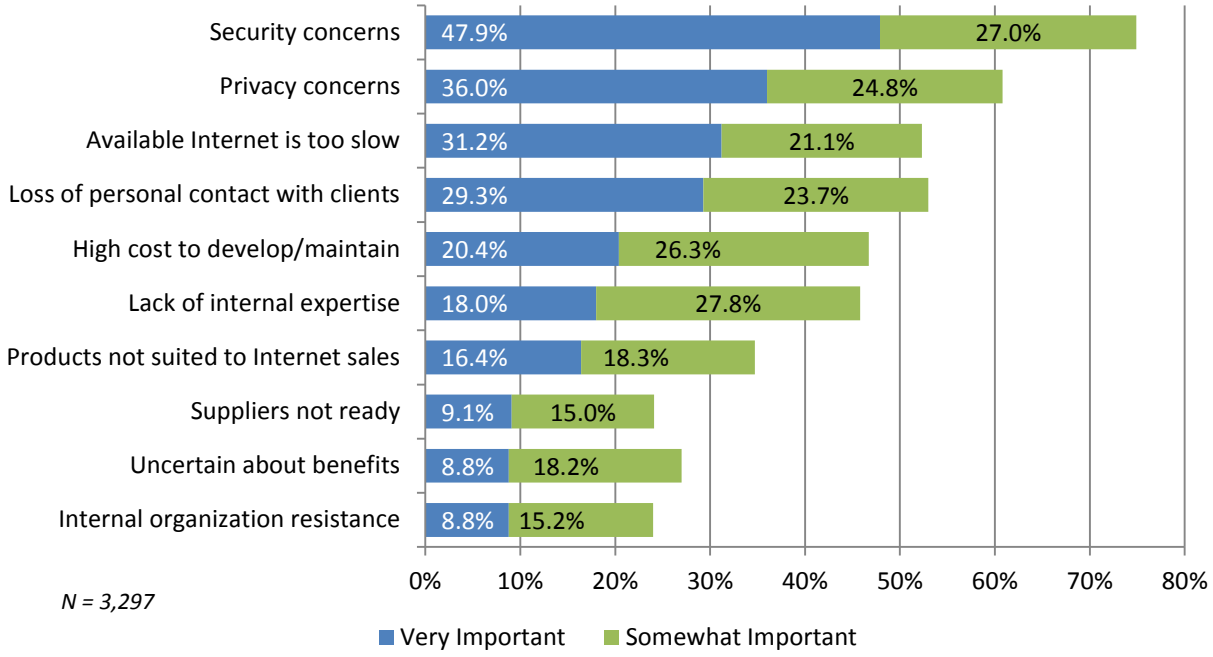
3.2.5 Barriers to Adoption

Businesses were asked to rate the significance of a number of barriers to effectively using broadband Internet in their operations. These barriers inhibit the adoption of eSolutions and need to be recognized and overcome if broadband utilization and its benefits are to be achieved.

Security and privacy concerns are the two barriers that rate the highest in importance, with almost 48 percent and 36 percent of businesses, respectively, rating them as very important barriers.

[31] *Collaboration platforms integrate a range of software components that enable groups of individuals and organizations to work together on common tasks or projects. Typical components are messaging (email, scheduling, and calendars); file sharing with version control and real-time communication (instant messaging and Internet conferencing).*

Figure 48 – Barriers to Adopting e-Solutions



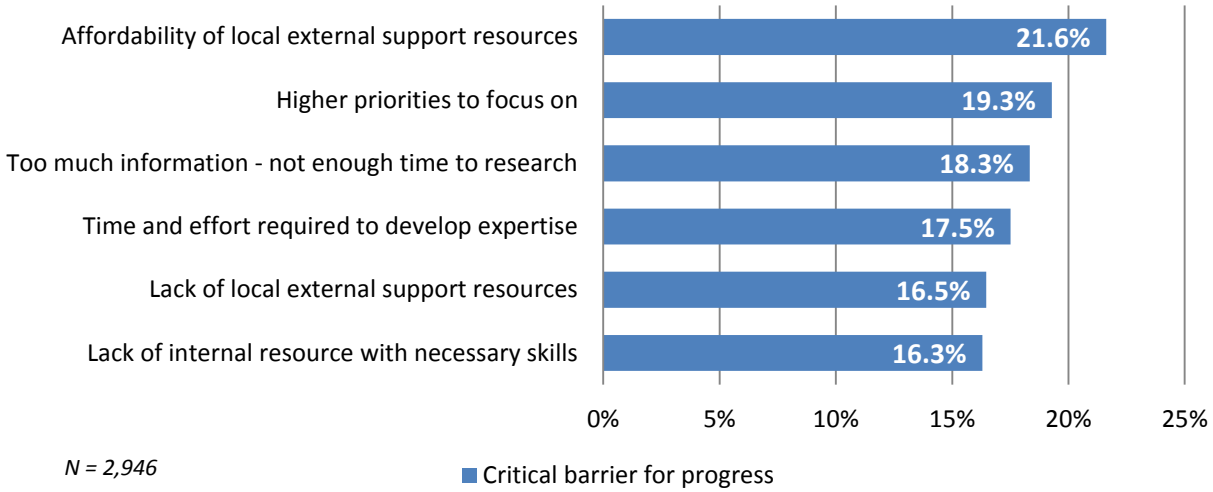
3.2.6 Expertise and Knowledge Issues

Expertise is needed to implement and use eSolutions. Businesses may encounter several interrelated issues in adopting eSolutions:

- Lack of internal resource with necessary skills
- Time and effort required to develop expertise
- Lack of local external support resources
- Affordability of local external support resources
- Too much information with not enough time to research options
- Higher priorities to focus on

Businesses were asked to identify which of these issues are critical barriers to progress. Overall, a lack of time/too much information represent the largest barriers, followed by competing priorities, the availability and cost of external supports, and the lack of internal resources.

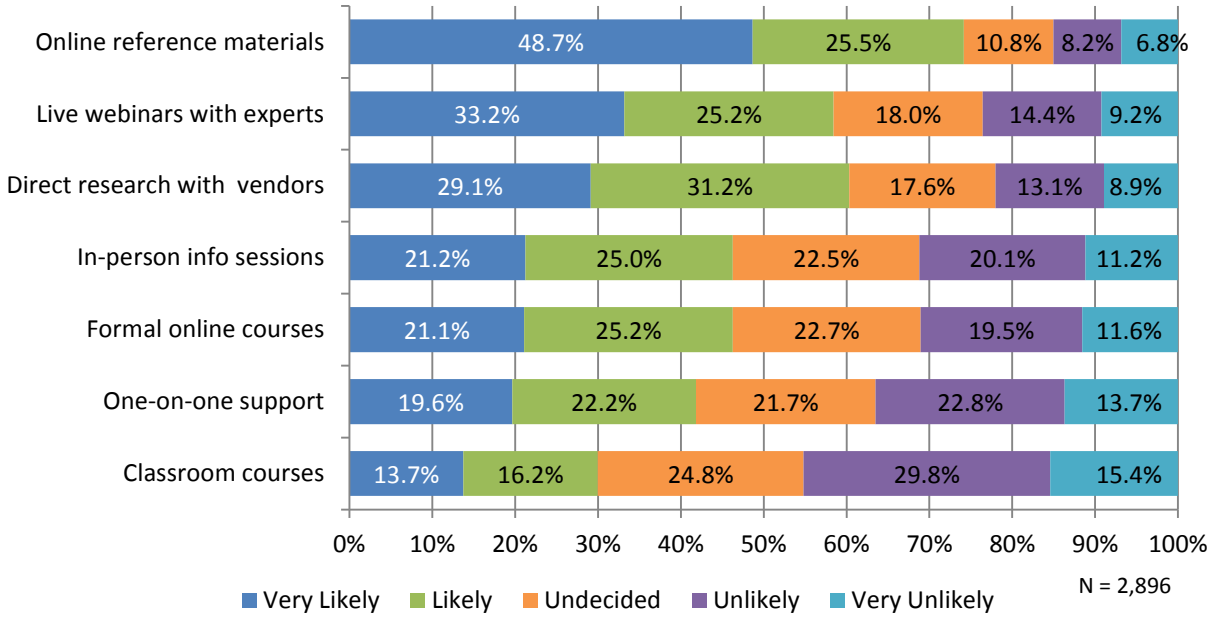
Figure 49 – Critical Barriers in Adopting eSolutions



3.2.7 Skill Acquisition

Businesses were asked about which methods they are most likely to use for the internal development of knowledge and expertise for researching, planning or implementing eSolutions.

Figure 50 – Preferred Methods for Acquiring Internal Knowledge



Self-directed methods of knowledge development, such as online research and webinars, are the most likely education methods to be used by the majority of businesses. Notably, formal training methods are less likely to be used, with classroom training the least likely to be used by over 45 percent of businesses. In addressing the barriers to adoption and expertise issues it is important to utilize the methods most amenable to the target segments. Multiple methods are likely to be needed and the use of mobility-enabled methods should be considered (e.g. podcasts).

3.3 Community Anchor Internet Utilization and Benchmarks

3.3.1 Benchmarks

As seen in Sub-Section 1.2, non-commercial organizations have connectivity patterns similar to businesses, with slower connectivity in distressed and at-risk counties. This lower level of connectivity is echoed in lower levels of Internet utilization, especially in distressed counties.

Figure 51 – Utilization Benchmarks (DEi) for Non-Commercial Entities by County Economic Status

Utilization Levels	*Median DEi*	*# of Respondents*
Other Counties	6.70	920
At Risk	6.41	440
Distressed	5.63	191
All CAIs	6.41	1551

However, the connection between connection speed and Internet utilization does not hold for some types of community anchor institutions. While local government have both the lowest connection speeds and utilization levels, economic development organizations and libraries demonstrate an intensive use of the Internet, despite connectivity significantly slower than their peers in health care, education and public safety.

Figure 52 – Utilization Benchmarks (DEi) for Non-Commercial Entities by County Economic Status

Utilization Levels	*Median DEi*	*# of Respondents*
Economic Development Org	7.77	74
Library	7.38	73
Health Care	7.08	55
College or University	6.94	113
Other Community Service	6.70	252
K - 12 Education	6.50	343
Public Safety	6.21	33
Local Government	5.63	228

3.3.2 Internet Utilization and Community Anchor Institutions

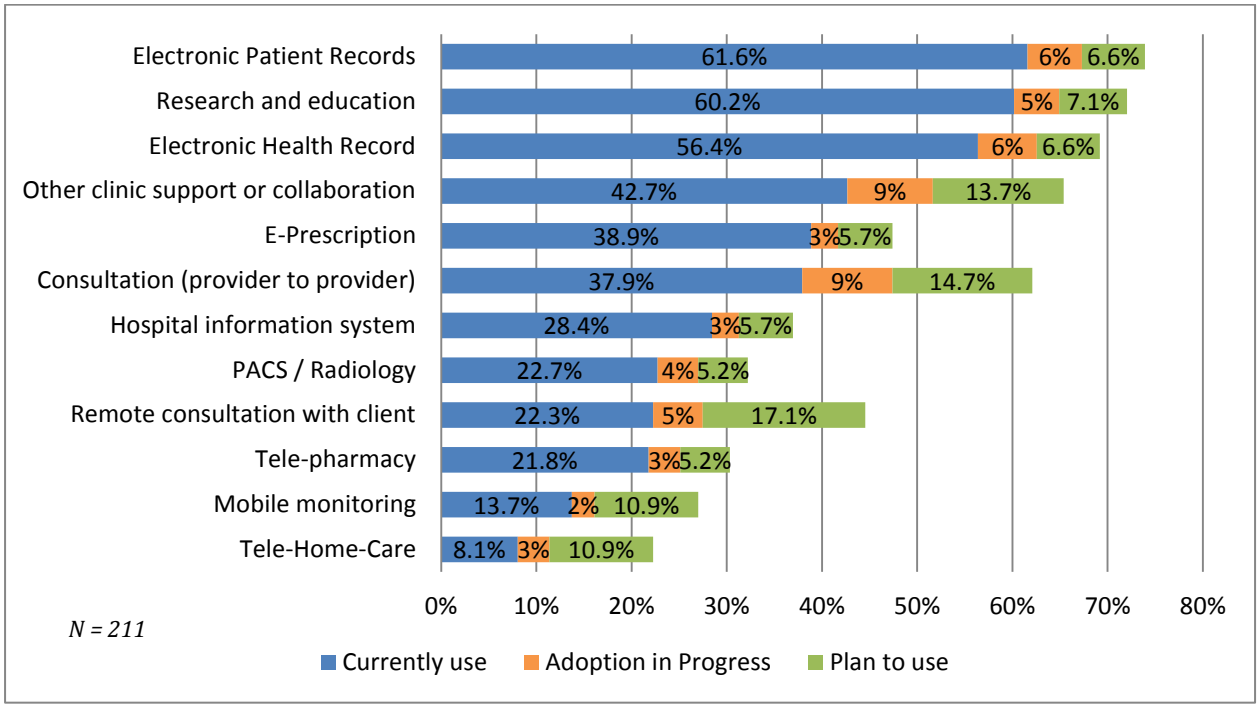
The Internet assessment collected data in two areas of special interest: telehealth and economic development agencies.

Telehealth

To learn more about the impact of Internet use on the health sector, data was collected from households and health organizations (both commercial and non-commercial). The following are highlights from data collected from 211 health provider organizations and over 15,300 households.

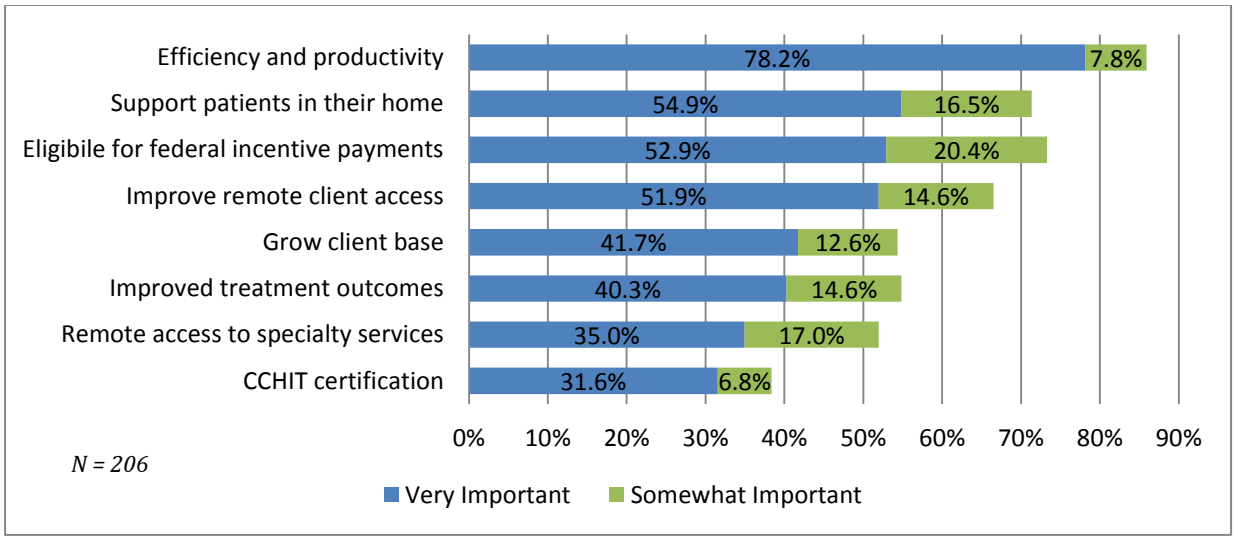
When health service providers were asked to identify which telehealth services they used, the most frequently identified services were electronic patient records, research and education materials, and electronic health records. As seen in the chart below, the least frequently provided telehealth services were tele-homecare (8.1 percent) and mobile monitoring (13.7).

Figure 53 – Telehealth Services: Current, Under Adoption, or Planned



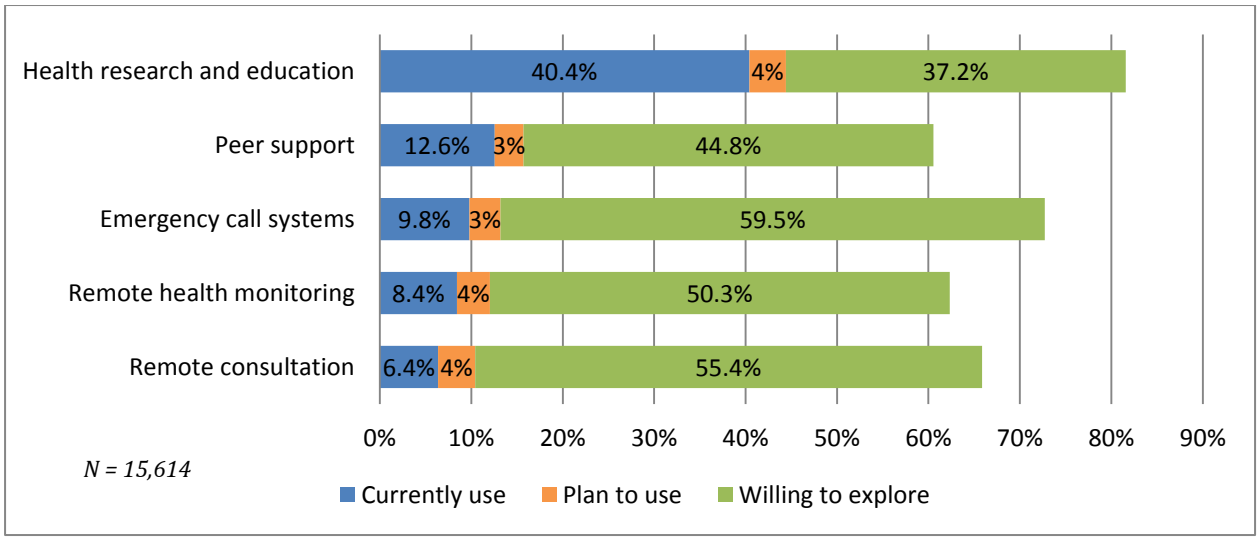
When health providers were asked to identify the most important motivations for providing telehealth services (Figure 54), efficiency and productivity were the most frequently mentioned by a wide margin. Two other highly cited motivations were supporting people in their homes and improved remote client access. This result contrasts with the low levels of current provision of mobile and tele-homecare services seen in the previous chart.

Figure 54 – Motivations for Providing Telehealth Services



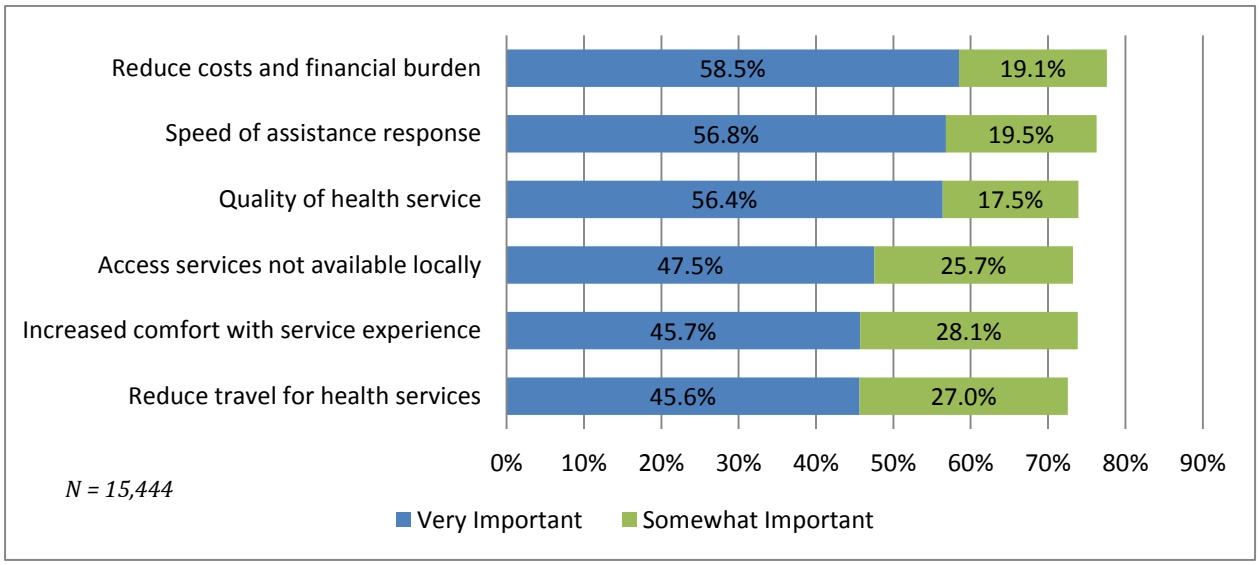
Taking the perspective of the consumer, Figure 55 identifies the percentage of households that use, plan to use or are willing to explore different telehealth services. While a modest number of households are currently using most telehealth services, the clear majority of households are open to the idea of exploring such telehealth services as remote monitoring and remote consultation. It would appear that the consumers' willing to consider telehealth services is ahead of the capacity of health providers to provide those services.

Figure 55 – Consumer Use of Telehealth Services



To better understand which motives drive telehealth choices, households were asked to identify the level of importance of a number of factors. The results showed a high level of motivation across all of the six factors presented to the respondents, as seen in the table below.

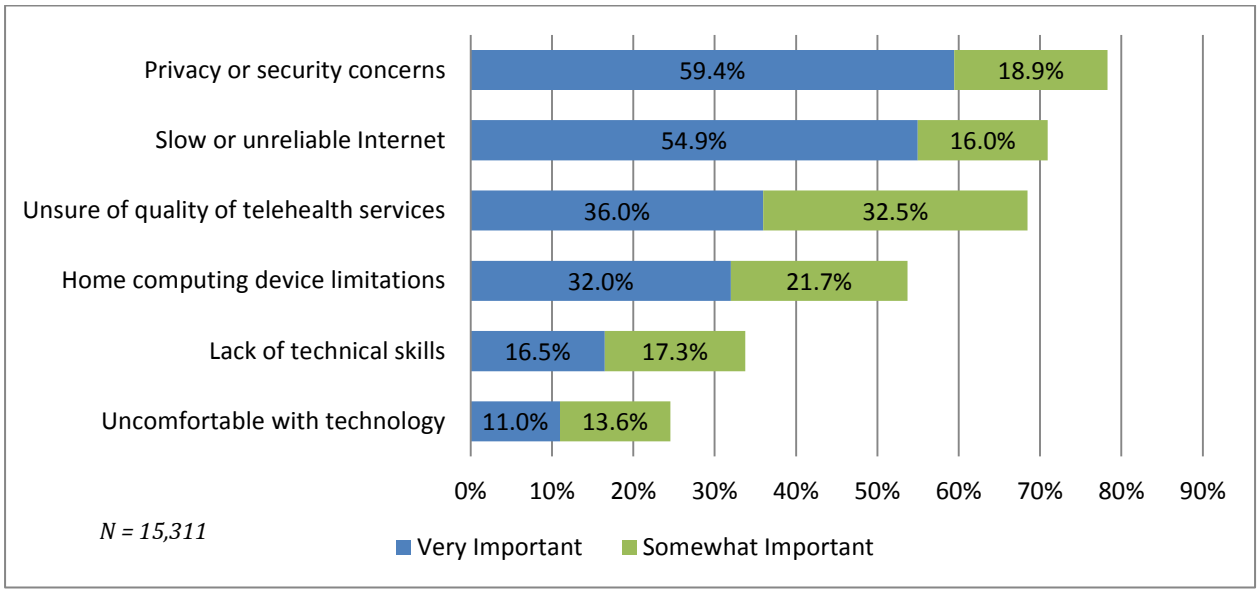
Figure 56 – Consumer Motivations Regarding Telehealth Services



Lastly, households were asked to identify barriers to their use of telehealth services. The top two barriers are the same as the top barriers to general use of the Internet: privacy or security and slow or unreliable Internet. Lack of technical skills was cited as very important by less than 17 percent of households.

Discomfort with technology was cited as very important by only 11 percent. While seniors and households with less than $30,000 income reported slightly higher levels of barriers, the general hierarchy of barriers remained consistent.

Figure 57 – Consumer Barriers to Use of Telehealth Services



Economic Development Agencies

Sixty-five organizations that perform economic development functions answered questions specific to their role. Generally, availability and quality of broadband is an important locational factor for businesses (as seen in Sub-Section 2.1.1). Thirty three (50.8 percent) economic development agencies reported that they were asked frequently about Internet services in their area. Ten of these organizations reported that businesses frequently chose not to locate in an area due to level of broadband services. Another 18 organizations reported that this happened occasionally. As for businesses leaving an area due to its level of broadband, seven economic development organizations reported that this happened frequently, with another 16 reporting that this happened occasionally. Organizations reporting that businesses frequently chose not to locate into or frequently chose to relocate out of a given area came disproportionately from counties designated as distressed or at-risk.

Percent of economic development organizations saying businesses frequently chose not to locate in their area due to broadband issues:

- Distressed or at-risk counties = 23.5%
- Transitional, Attainment, or Competitive counties = 6.5%
- Statewide = 15.4%

Over 86 percent of the 65 economic development agencies stated that there was a high or medium level of interest from businesses in three different areas related to the Internet: assessment of their use of the Internet; training on Internet uses in their businesses; and mentoring. Despite the high level of interest reported, less than a third of economic development agencies (31.2 percent) provide such services themselves, though other organizations in the area may do so.

3.4 Household Internet Benchmarks and Utilization

The following analysis is based on assessment responses from 17,776 households from across Tennessee. The results presented in this section focus on key findings related to Internet usage, benefits and barriers, with selected results broken down by key respondent characteristics, such as household income, Internet connectivity type and region.

Households were asked about their current uses of the Internet as well as their planned use over the next 12 months. This report focuses primarily on household utilization in the productivity category as described in Appendix C.

3.4.1 Household Utilization Benchmarks

Not only does Internet utilization by businesses vary across regions, utilization by households varies as well. This has implications for delivery of government services, self-employment, and access to a range of Internet based services, both commercial and non-commercial. A divergence in Internet utilization can also be seen among counties of different economic status.

Figure 58 – Utilization Benchmarks (DEi) by Region

Household Utilization (DEi) by Region		
Region	**Median DEi**	**Number of Households**
Greater Memphis	7.12	1,304
Northern Middle	7.05	4,193
Southeast	7.05	1,837
East	6.99	3,284
Upper Cumberland	6.86	820
Northeast	6.73	873
Southern Middle	6.67	3,063
Southwest	6.54	1,421
Northwest	6.35	981
Statewide	6.86	17,776

Figure 59 – Utilization Benchmarks (DEi) by County Economic Status

Utilization (DEi) by Economic Status		
Region	**Median DEi**	**Number of Households**
Competitive	7.37	207
Attainment	7.56	492
Transitional	6.99	9,655
At Risk	6.67	5,316
Distressed	6.73	2,106

Looking at household characteristics, the most consistent factors impacting utilization of the Internet are household income and age. Basically, the poorer one is and the older one is, the less likely one uses the Internet and the less productively one uses it. Educational attainment closely mirrors income in its impact on Internet utilization. The following charts show the impact of age, income and educational attainment on utilization as expressed by DEi scores.

Figure 60 – Household Utilization (DEi) by Age and Income

	Household Income			
Respondent Age	Less than $30,000	$30,000 to $49,999	$50,000 to $100,000	More than $100,000
18 to 34 years	6.6	7.24	7.66	8.14
35 to 54 years	6.47	6.86	7.37	7.95
55 to 64 years	5.77	6.22	6.6	7.44
65 years and over	5.06	5.35	6.03	6.79

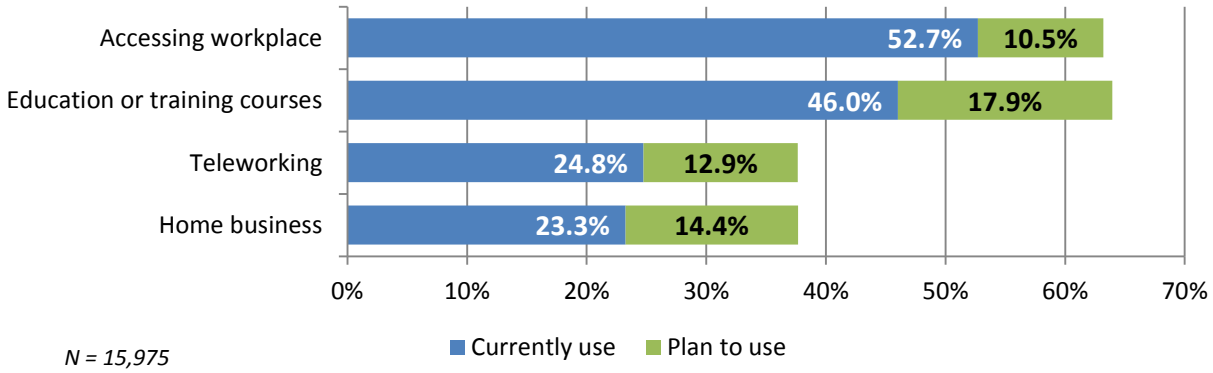
Figure 61 – Household Utilization (DEi) by Age and Income

	Educational Attainment				
Respondent Age	Less than high school	High school completion	Some college or associate's degree	Bachelor's degree	Advanced degree
18 to 34 years	6.19	6.09	6.99	7.63	7.82
35 to 54 years	6.03	6.38	7.12	7.50	7.63
55 to 64 years	5.26	5.62	6.28	6.79	7.05
65 years and over	4.52	4.71	5.48	5.83	6.09

3.5 Households Internet Utilization

The chart below shows that households actively use the Internet to improve their economic situation and skills.

Figure 62 – Household Internet Utilization for Productivity

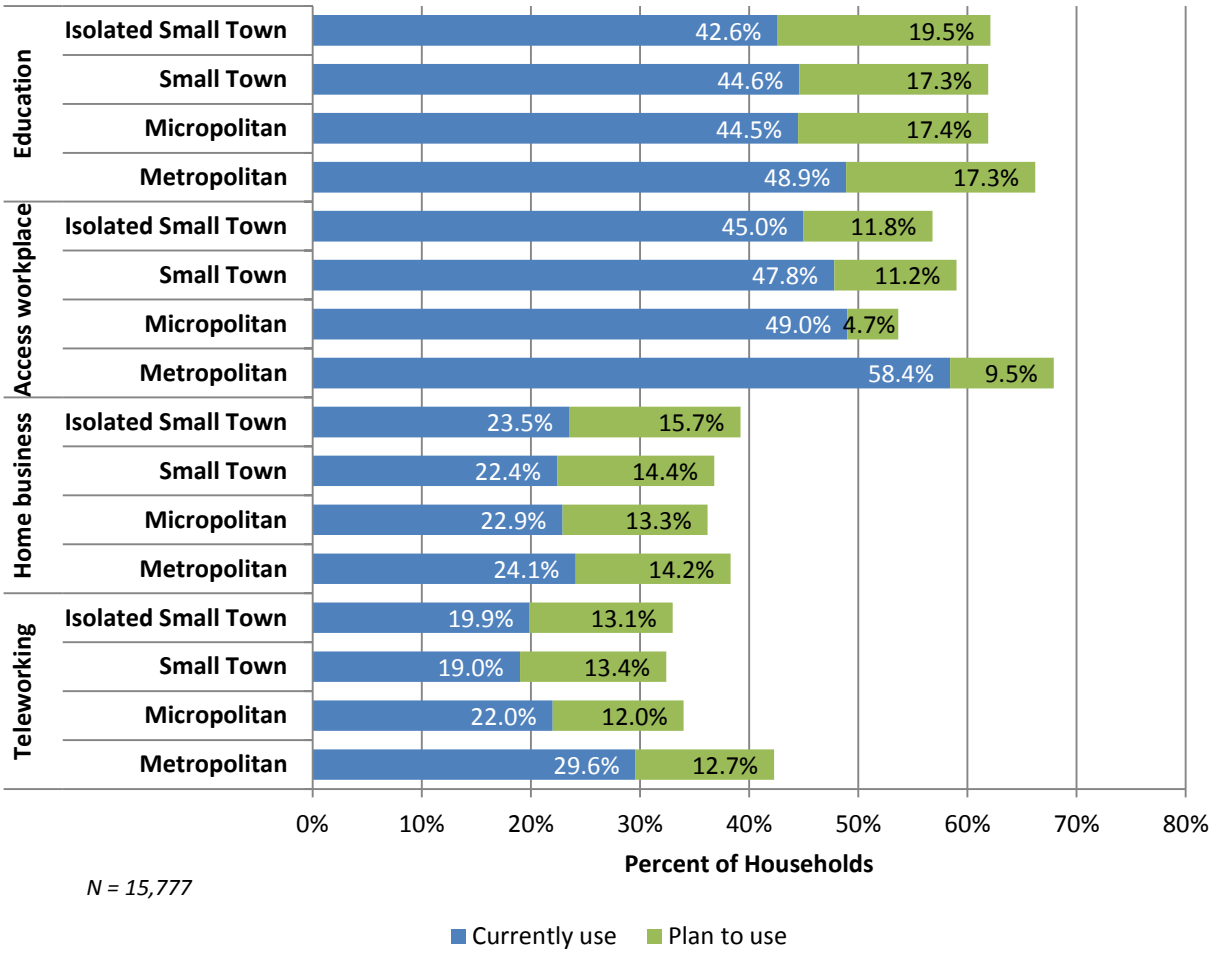


N = 15,975

In previous research, SNG has found that population density correlates with the extent to which households productively use broadband. As seen in Figure 63, Tennessee respondents from metropolitan areas are more likely to use the Internet for all four productivity activities. However, non-metro areas have reasonably high activity levels as well. Isolated small towns show almost as high current use of the Internet for home-based businesses as metro areas. With higher population density linked to the use of the Internet to telecommute and access the workplace, this speaks to the power of broadband being an equalizer of opportunity. However, many productivity activities simply cannot be realized with dial-up, low speed or unreliable Internet connections. For these users, the lack of broadband becomes a meaningful impediment to practical benefits to personal and household efficiencies and productivity.

For example, teleworking requires home-based employees to be able to operate with the same effectiveness and efficiency as they would at their normal workplace. However, participation with online services and applications that include real-time audio-visual interactions for meetings, presentations or training sessions is impractical if not impossible with low speed or unreliable Internet connections.

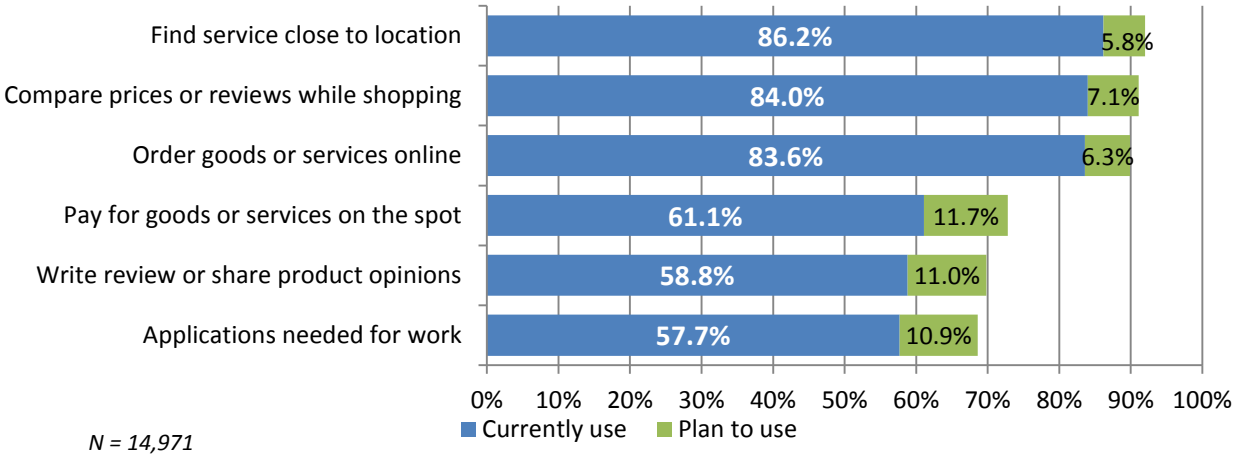
Figure 63 – Broadband Productivity Uses by Community Population Density



3.5.1 Mobile Uses

As with businesses, the impact of mobile Internet on households is significant. During the online assessment, households were asked to respond to questions to think about the services and applications used most with their mobile devices. The results shown in Figure 64 demonstrate the large and growing impact of mobile Internet on the retail sector.

Figure 64 – Types of Mobile Applications use by Households



N = 14,971

3.5.2 Household Benefits

While it is important to understand patterns of Internet use to identify gaps and opportunities for increased utilization, it is equally important to understand the benefits and impacts of broadband utilization for households and their communities.

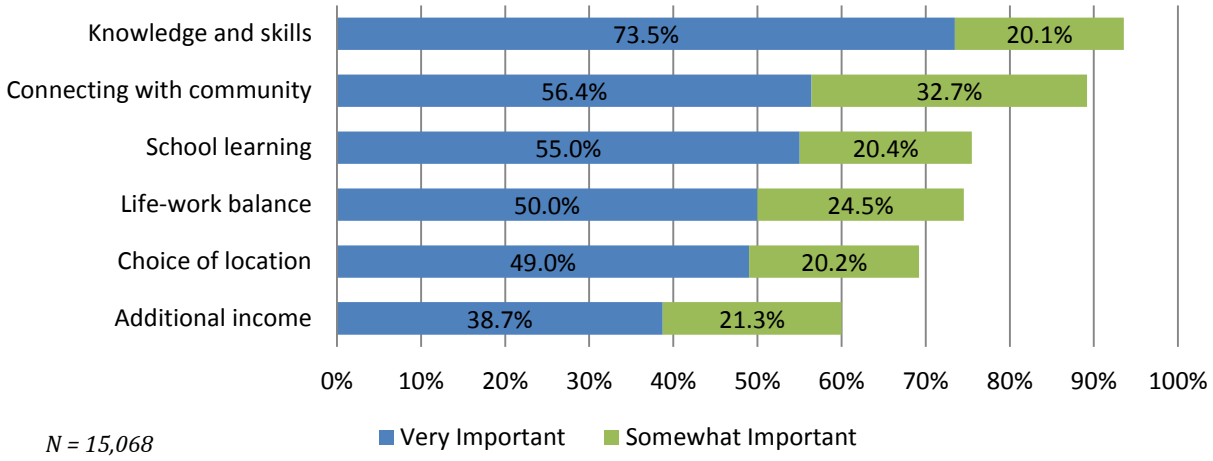
To provide a perspective on the overall importance of broadband, households were asked, *"Assuming you could never get broadband service, how likely is it that you would leave to relocate to a community that offers broadband?"* More than one out of every four (26.5 percent) of households would definitely relocate to another community in order to access broadband services. An additional 20.2 percent would consider relocation very likely.

Households were also asked to rate the significance of the Internet for achieving the following household benefits:

- Improves knowledge and skills (through online education and/or research),
- Enhances ability to earn additional income,
- Enhances school learning (through research and study),
- Enhances awareness of what is happening in the community,
- Supports better balance of personal and work time,
- Supports choice of living location (e.g., for selecting or remaining in your community).

The following figure shows the perceived benefits of using the Internet by households.

Figure 65 – Significance of Broadband for Household Benefits



N = 15,068

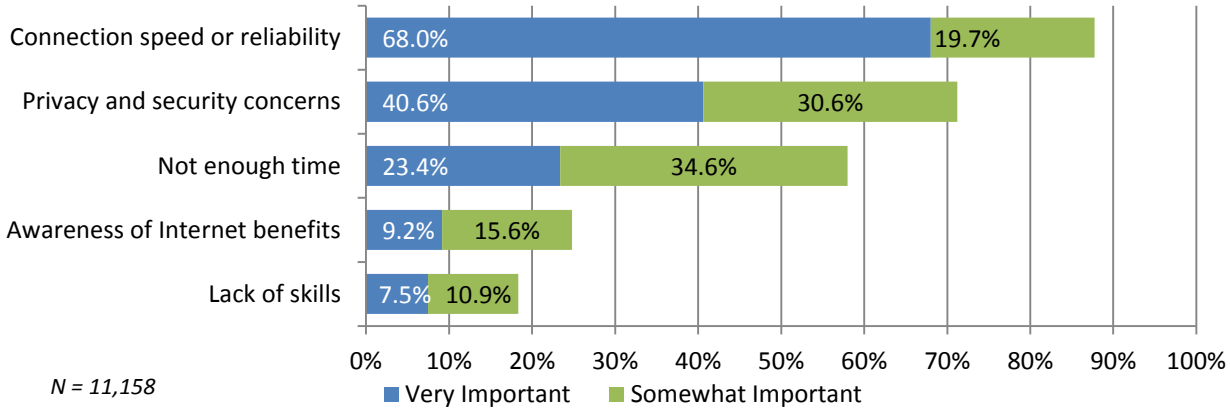
3.5.3 Barriers and Adoption Issues

The data collected from households identifies how households can get the most out of broadband by looking at their goals, barriers to achieving those goals, and how they can acquire the skills to overcome those barriers. The first question is whether households are satisfied with their current level of Internet use, including the level of benefits they derive from using the Internet.

While 23.9 percent of households feel their current level of use is about right, 75 percent of household respondents want to improve how the use the Internet, with only 1.1 percent desiring to reduce their use.

With 75 percent of all households wishing to increase or improve their use of the Internet, the next issue is what barriers they see in striving to achieve that objective. As seen in Figure 66, the main barriers are an inadequate Internet connection (68 percent of households say this is a very important barrier) and concerns over privacy and security (40.6 percent).

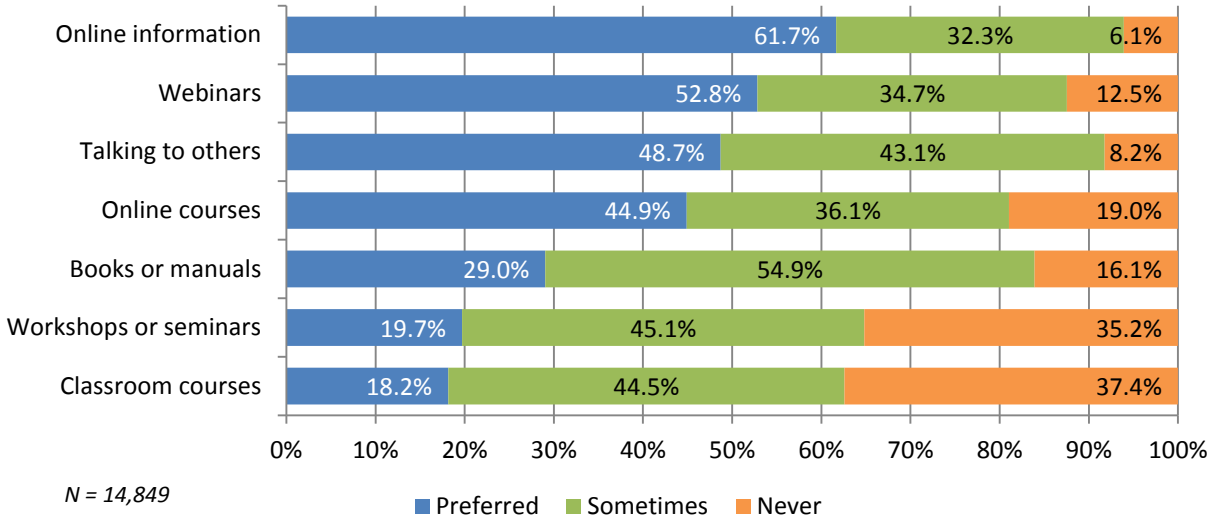
Figure 66 – Barriers to Enhanced Use of the Internet



N = 11,158

With three fourths of households interested in increasing their skill levels, the preferred learning methods, as seen in Figure 67, are self-directed, either by accessing online resources or talking with other people who have experience. The least favored methods are formal and classroom activities. These statistics are important for initiatives designed to deliver training and support to households for increasing broadband utilization. In particular, providing access to online training would be favored by an overwhelming percentage of households, while also being a cost-effective method for delivering information and support for using broadband services.

Figure 67 – Preferred Means for Increasing Broadband Skills



N = 14,849

4. Concluding Comments

The findings in this report provide a solid foundation for assessing the current state of broadband in Tennessee, as well a starting point for identifying strategies to address challenges and opportunities.

Key findings in shaping policy and funding include:

The strengths:

a) Current Internet infrastructure meets the short to medium term needs of 85 percent of the population.
b) The levels of Gigabit service in Tennessee are commendable and well above national levels. The longer-term impacts of Gigabit services should be tracked to document the cost-benefit of investments in world-class Internet service.
c) Tennessee is well positioned to build on the experience and expertise that it has developed. Policy and decision makers need to have an eye on long term Internet infrastructure needs which will require a central role for fiber.

The challenges:

a) A sizeable portion of Tennessee does not have broadband infrastructure that meets the FCC definition. Not having FCC broadband Internet will likely have negative impacts over time for those affected communities, businesses and households.
b) Areas without FCC defined broadband are largely lower density areas, for which a business case may be weak. These are also more likely to be single provider areas with DSL.
c) A significant portion of consumers purchase Internet service packages that underutilize the built capacity in their area. This reduces the incentive to providers to invest in upgrades to current infrastructure.
d) The reliability of Internet services appears to be a concern for businesses and households. Reliability issues may impede the willingness of consumers to spend more on Internet service.
e) Underutilization of broadband is detrimental to economic and social well-being. The challenge is heightened in distressed and at-risk counties where businesses and community anchor institutions underperform their peers in other parts of Tennessee. This has major impacts on jobs creation, revenue generation and locational decisions.

A companion document, *Tennessee eStrategy Report: Broadband as a Driver of Economic and Social Development in Tennessee* identifies goals and strategies for addressing the challenges noted above.

Appendix A - List of Figures

Appendix B - Data Collection Methods and Results

The core methodology is founded on primary research via data collection through online assessments of Internet use by businesses, non-commercial entities and households. The businesses, CAI and household assessments collect information directly from Internet users in the following categories:

User Profile – information that characterizes each respondent for purposes of statistical analysis based on user characteristics, such as: organization size by employment; time of Internet use; household age, income, education and location.

Internet Utilization – the current and planned uses of the Internet across multiple categories relevant to how businesses, non-commercial entities and households use the Internet. The primary type of Internet connection used is also identified for selected cross tabulations with other response data.

Internet Benefits – information on how businesses, non-commercial entities and households assess the benefits of using the Internet.

Barriers - information on the importance of factors that prevent or inhibit businesses, non-commercial entities and households from taking full advantage of the Internet.

The assessments were made available for online access through one of two means:

- Individual businesses, non-commercial organizations, and households were invited to participate via direct email invitations sent from a large, statewide contact list.
- Individual businesses, non-commercial organizations and households were encouraged through a variety of communications channels to access a web link to the assessment of Internet use.

Household Productivity - Households were also asked more specifically about how they use the Internet for personal productivity[32] for:

- Educational or training courses (remote learning or supplemental courses from home)
- Accessing workplace from home (occasional use)
- Teleworking (formal workplace all or part of normal work hours)
- Home-based business (full-time or part-time)

The overall error margin for statistical analysis is +/- 2.9% (with a 95% Confidence Interval).[33] The sample error margin indicates the accuracy of the statistics derived in relation to how they represent the larger population. Using a 95% Confidence Interval, a statistic should fall within the error margin for 95% of any

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[32] In addition to questions of use of the Internet for personal productivity, household were asked to identify if they used the Internet for four other five major categories: Communication; Research and information; Online transactions; Entertainment and recreation.

[33] The error margin at 95% Confidence Interval is often referred to as +/- X% accuracy, 19 times out of 20. Error margins increase for detailed analysis that uses subsets of the overall sample. Where applicable, sample sizes and sample error margins are indicated – example: N= 1,428 [2.6%].

random samples of the population. The sample error margin is calculated based on the sample size, the population size, and the confidence interval. For 95% confidence interval and for populations much larger than the sample, the sampling error is 0.98 divided by the square root of N, where N is the sample size. For this report all population sizes are much larger than the sample sizes.

The following is an example for interpretation of statistics provided in this report:

- 61.9% of organizations use the Internet for selling goods or services online.
- The sample size for organizations reporting Internet utilization is 745, providing a sample error margin of +/- 3.6% with a 95% confidence interval.

This means that any similar sample of the population of organizations across the state will result in a statistic for selling goods or services one between 58.3% and 65.5% (61.9% +/- 3.6%) 95% of the time. The statistic would fall outside this range 5% of the time for other random samples of the population. In practical terms the sampling error can be taken as the accuracy of the statistic as it applies to the entire population.

Smaller sample sizes result in larger sampling errors. When comparing statistics between two independent samples, the sample errors for each sample must be considered to determine if the difference is significant.

Where the higher end of a statistic (X% + error margin) for sample A is less than the lower end of the same statistic (Y% – error margin) for sample B, the difference can be considered statistically significant. Where the difference between statistics is within the sampling error margin ranges, then such differences may not be real or significant for other random samples of the same sizes. For simplicity of reporting the statistics are stated as given with sample sizes and sampling error margins provided for interpretation.

Appendix C - Results from Phone Outreach Regarding ISP Selection

To better understand the factors and motivations influencing decisions that businesses make in choosing an Internet Service Provider, SNG made follow-up contact with nearly fifty businesses that participated in the Tennessee Internet assessment. All of the businesses contacted had recorded less than speeds of 25 Mbps download and 3 upload. Most of the Tennessean businesses we spoke with are not very aware of the Internet service or speed they currently have. Nonetheless, a majority (more than 90 percent) interviewed stated that they were unhappy with the Internet service they have presently.

The dissatisfaction with their current Internet service is troubling because most respondents said that broadband service is "critical" to their business operations and success.

Many businesses *are actively looking* for options outside of their current carrier, and while some are finding alternatives (or installing their own fiber), most are not finding options or the options are cost prohibitive.

As for the businesses not looking to switch Internet service providers, satisfaction with service speeds rests almost solely with home-based businesses (10% of our sampling) who currently only require basic service. More often, businesses that are dissatisfied have resigned themselves to sticking with their carrier, or their current level of service, because current alternatives are seen as cost prohibitive.

A portion of the sampling (8%) reported that the only Internet service available to them was satellite service. Speed tests among this small group showed consistently lower results than speeds businesses thought they were receiving. These, as well as mobile Internet subscribers, both expressed frustration with data usage caps. Businesses note that they cannot adjust their business operations to conform to limitations, leaving them with expensive overage charges.

Additionally, the phone outreach was used to “spot check” and verify both the financial outcomes reported and speed test results. When respondents were asked to run the speed test, the results approximated those obtained through the online assessment.

Business Anecdotes

“We've spent hundreds of thousands of dollars on mail outs, newspaper inserts, etc. but seems like the only way to reach people in this day and time is the Internet, website, etc. We have hired 1 additional person just to help us with social media and such.” Swan Ridge Lake Resort, LLC

“We have created 2 new jobs based on website/ social media/ marketing and sales. Revenue from the Internet accounts for an additional $100,000 sales annually. We also experience cost savings of at least $100,000 from being able to use the Internet to find better rates for equipment, research and development, etc.” Barky Beaver

“If it storms, none of us can get online.” Mitchell Creek Marina

“We would do anything we need to do to get better service.” Honest Abe

Appendix D - e-Solutions that Comprise the DEi

The e-Solutions noted in the tables below are compiled to create a DEi score for businesses, non-commercial organizations and households.

eSolutions Categories for Businesses and Organizations	
e-Commerce Related	***e-Process Related***
Selling goods or services	Purchasing goods or services
Deliver services and content	Supplier communication and coordination
Rich media or service creation	Electronic document transfer
Customer service and support	Staff training and skills development
Advertising and promotion	Teleworking
Social networking	Accessing collaborative tools
Web site for organization	Banking and financial
Research by staff	Government transactions
	Access government information

eSolutions Categories for Households	
Communication	***Transactions***
E-mail	Buying goods or services
Voice over IP	Selling items
Online chat	Investments / trading
Sharing information	Online banking
Personal website	Paying bills
Productivity	Government services
Education or training courses	Music or video download
Accessing workplace	Software download
Teleworking	Booking travel
Home business	***Research***
Recreation	Product information
News and sports	Investments
Listen to radio	Government information
Watch TV programs	Community events
Watch movies	Education and training
Online gaming	Health information
	Travel information

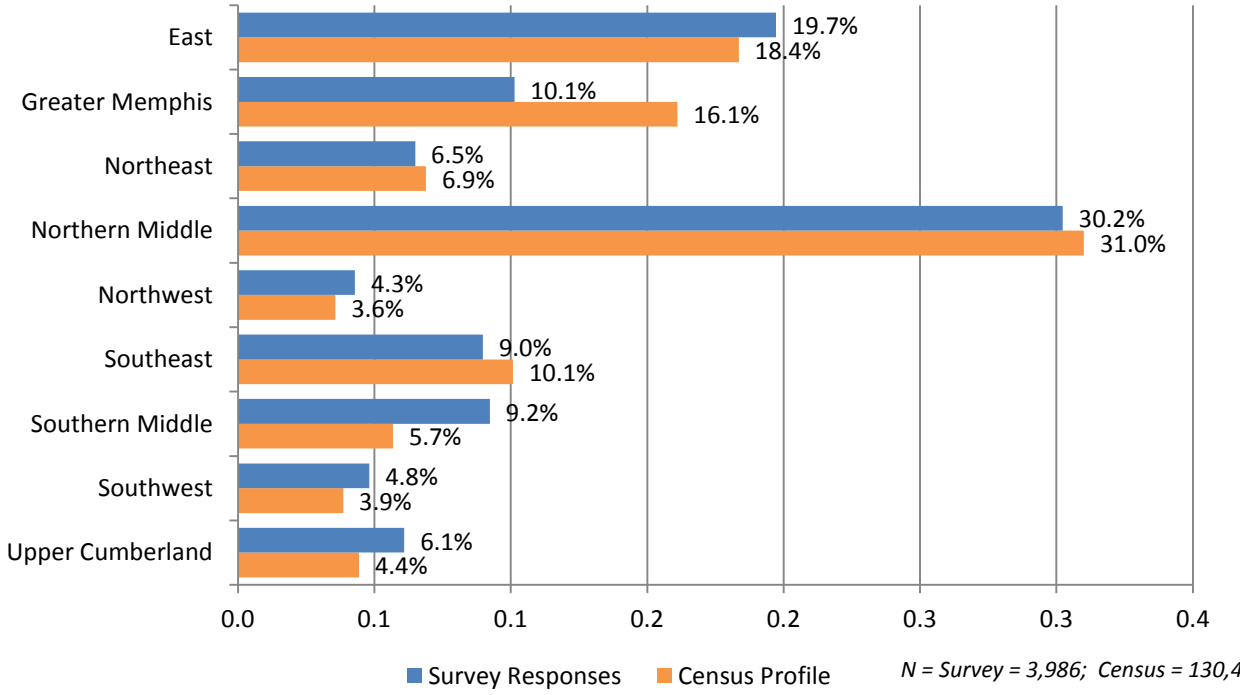
Appendix E - Respondent Profile

Business Respondents

The data set outlined in this report includes responses from 3,986 businesses across the state. The data includes responses from businesses across all 20 industries classified by NAICS.[34]

Data collected has been geo-coded, allowing responses to be broken down into geographic regions. Figure 68 compares assessment results to the area populations as determined by the Census Bureau. The assessment's results roughly parallel the census, though Greater Memphis is under represented and the Southern Middle region is over-represented.

Figure 68 – Assessment Responses by Region

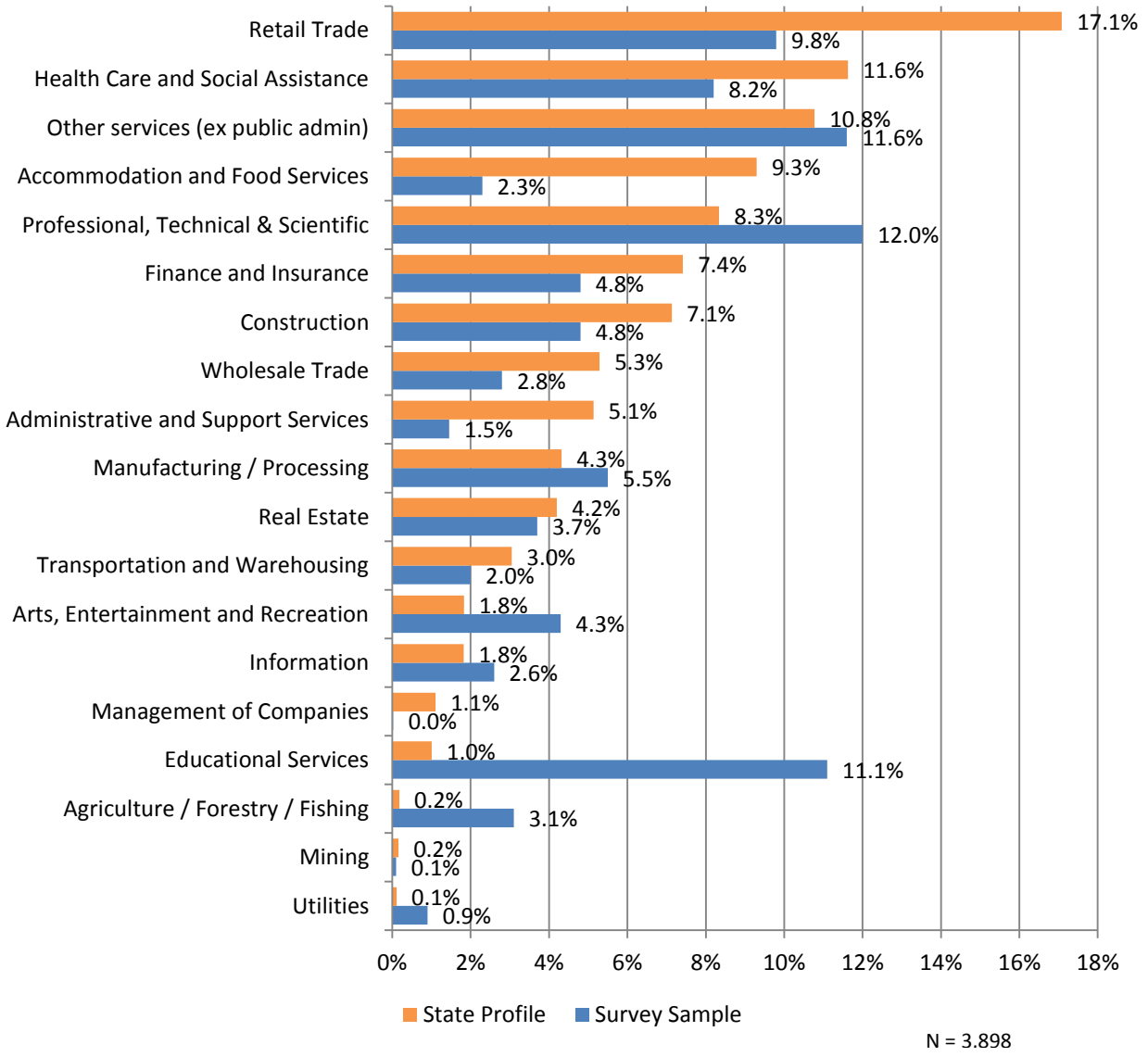


How businesses access and use the Internet varies by industry sector. Figure 69 provides a comparison of responses to the industrial profile of Tennessee, including both commercial and non-commercial organizations. Note that the profile of statewide organizations from the Census Bureau does not include Government entities. The sample resulting from the assessment is under-represented in retail trade, health care, construction, accommodation and food services, and administration services. Survey respondents were over-represented in Educational Services, Professional and Technical, Arts and

[34] *North American Industry Classification System. Industry breakdowns are at the 2-digit NAICS code level. Some responses did not have an industry classification.*

Entertainment and Agriculture, while under-represented in Retail Trade, Wholesale Trade, Health Care, Administrative Services, and Construction. Profile data does not include data on Public Administration.[35]

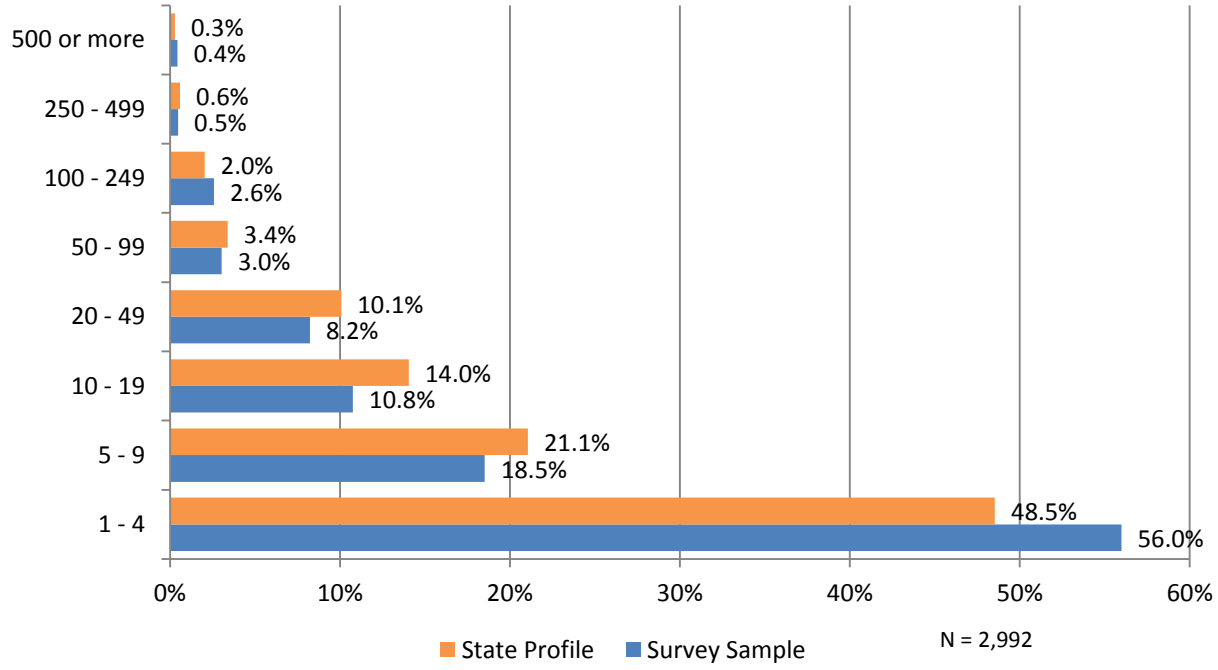
Figure 69 – Assessment Responses by Industry Sector



Previous studies conducted by SNG have shown that that the size of a business correlates to access and use of the Internet. Figure 70 shows the breakdown of responses by size of establishment, as measured by number of employees. The chart provides a comparison to the state profile of establishments. The respondent profile from the assessment is similar to the state profile as reported by the Census Bureau, with a slight under-representation of small businesses 5 to 49 employees.

[35] *State data source: US Census Bureau County Business Patterns 2011 – Number of establishments shown for sample do not include Public Administration in the totals for comparative purposes.*

Figure 70 – Assessment Responses by Employment Size of Business (Number of Employees)



Community Anchor Institutions Respondents

Data was also collected from 1,551 non-commercial entities. Of these entities, 1,187 could be considered community anchor institutions (see Figure 71 for response levels by type of community anchor institution). This report includes only a small amount of data from these entities. Section 2 includes data on Internet connectivity, while Section 3.3 contains benchmarking data on how intensively community anchor institutions in Tennessee use the Internet.

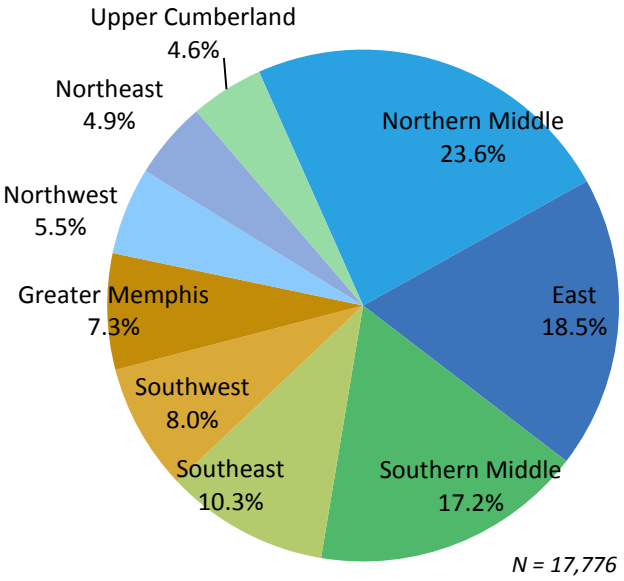
Figure 71 – Response Levels from Community Anchor Institutions

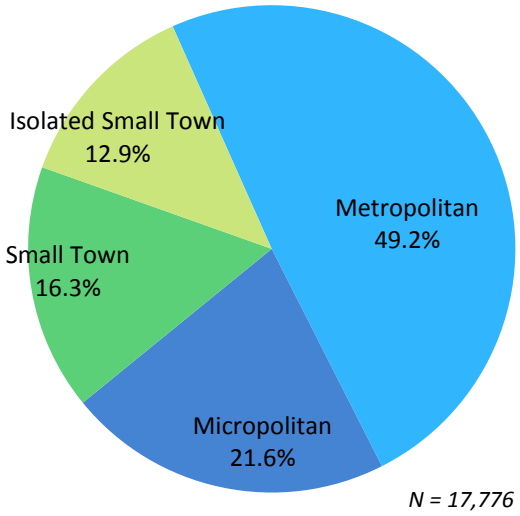
Types of Community Anchor Institutions	*# of Respondents*
K - 12 Education	342
Other Community Service	252
Local Government	228
College or University	112
Economic Development Organizations	73
Library	73
Health Care	54
Public Safety	32

Household Respondents

The data set outlined in this report includes responses from 17,776 households across the state and represents a good mix of demographics based on age, household income, and employment status, as well as a mix of communities from urban/metropolitan, micropolitan, small town and isolated small towns.[36]

Figure 72 – Distribution of Respondents by Region

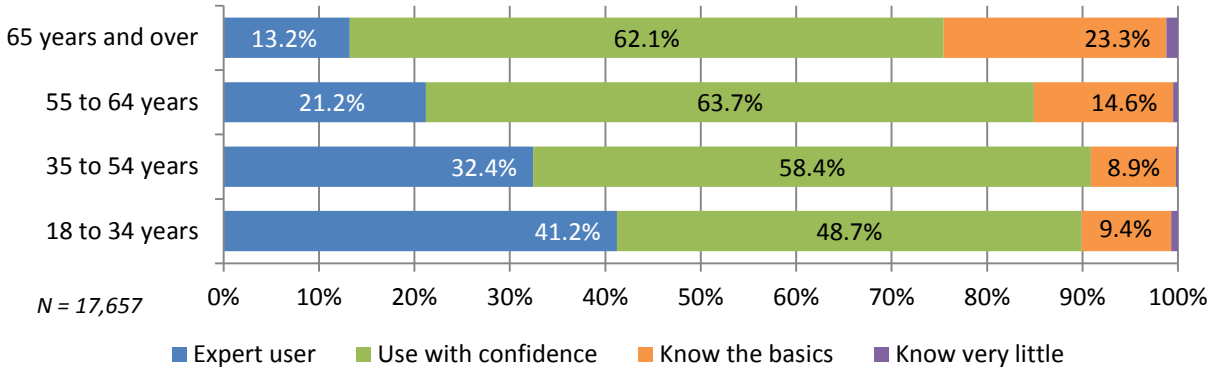




[36] *A metropolitan area is defined by the Census Bureau as having a core urban area of over 50,000 with a population density greater than 1,000 people per square mile. A micropolitan area has a population of 10,000 to 49,999. A small town has a population of 2,500 to 9,999. The category of "isolated small town" includes the remainder.*

The data collected also covers a diverse range of computer skill levels. Computer skill levels provide an important frame of reference when evaluating and utilizing broadband services. As one might expect, the level of computer expertise is greater for younger age groups, with 41.2 percent of respondents under age 34 considering themselves expert users, compared to 13.2 percent of those aged 65 and more. At the opposite level of computer skills, 23.3 percent of those over the age of 65 consider themselves a basic user, compared to just 9.4 percent of 18-34 year olds.

Figure 73 – Computer Skills by Age Group



Appendix F - Glossary

Internet Connectivity and Utilization in Tennessee Report: This report presents the results of survey-based research carried out for the State of Tennessee. The assessments collected information from businesses and community anchor institutions (non-commercial entities) on the availability of broadband (high speed Internet access) and its uses, benefits, drivers and barriers. This largely descriptive report results provide insight into gaps and opportunities for increasing broadband utilization by businesses and non-commercial entities.

Digital Economy Analysis Platform (DEAP): The DEAP has been developed as an online resource that provides clients with access to the data collection results and the ability to customize their analysis across a range of variables, including industry sector or geographic region. The DEAP is accessed online by authorized users. Users are presented with **dashboards** for businesses and for households. Each dashboard is organized around a series of **pages** focused on specific topics, e.g. Connectivity, Utilization, DEi, Impacts, etc. Within each page is a set of predefined **reports** that present a chart and/or table of processed results from the datasets.

eSolutions: refers to the integration of Internet technologies with the internal computer-based systems and applications within or among organizations for a variety of operational processes. eSolutions encompass not only product delivery and payment transactions (e-commerce) but also all processes that may be facilitated by computer-mediated communications over the Internet.

eProcess: uses of the Internet which include internal operational uses, such as supplier coordination, training and teleworking.

eCommerce: uses of the Internet which include activities related to the sales, marketing and delivery of products and services; and,

Tennessee Digital Economy Index (TN DEi): The Digital Economy index (DEi) is part of the benchmarking process and provides reference points against which the performance of any individual or group can be compared. The DEi summarizes an organization's or household's utilization of 17 Internet applications and process. Based on the number of applications currently being used by a businesses or CAI, a composite score is calculated that summarizes how comprehensively each organization uses Internet-enabled eSolutions. The DEi can be used to compare organizations, regions, or industry sectors.

Utilization refers to the third stage in the broadband development process. The first stage is providing a community, household or organization with access (availability) to the Internet. The second stage is adoption or the process whereby a person or organization starts to actually use the Internet. The third stage is utilization whereby a person or organization uses their Internet connection to create value. Many people and organizations have access and have adopted the Internet, but are relatively ineffective in how they use and derive benefits from the Internet. The field of analysis labeled "utilization" explores patterns of Internet use and how these patterns can be enhanced.

Appendix G - List of Counties by Economic Status

County	Status	County	Status	County	Status
Anderson	Transitional	Hamilton	Transitional	Morgan	Distressed
Bedford	Transitional	Hancock	Distressed	Obion	At Risk
Benton	At Risk	Hardeman	Distressed	Overton	At Risk
Bledsoe	Distressed	Hardin	At Risk	Perry	Distressed
Blount	Transitional	Hawkins	Transitional	Pickett	Distressed
Bradley	Transitional	Haywood	At Risk	Polk	At Risk
Campbell	Distressed	Henderson	At Risk	Putnam	At Risk
Cannon	Transitional	Henry	Transitional	Rhea	Distressed
Carroll	At Risk	Hickman	At Risk	Roane	Transitional
Carter	At Risk	Houston	At Risk	Robertson	Transitional
Cheatham	Transitional	Humphreys	Transitional	Rutherford	Transitional
Chester	At Risk	Jackson	At Risk	Scott	Distressed
Claiborne	Distressed	Jefferson	At Risk	Sequatchie	Transitional
Clay	At Risk	Johnson	Distressed	Sevier	Transitional
Cocke	Distressed	Knox	Transitional	Shelby	Transitional
Coffee	Transitional	Lake	Distressed	Smith	Transitional
Crockett	Transitional	Lauderdale	Distressed	Stewart	At Risk
Cumberland	At Risk	Lawrence	At Risk	Sullivan	Transitional
Davidson	Transitional	Lewis	Distressed	Sumner	Transitional
Decatur	At Risk	Lincoln	Transitional	Tipton	Transitional
DeKalb	Transitional	Loudon	Transitional	Trousdale	Transitional
Dickson	Transitional	Macon	At Risk	Unicoi	At Risk
Dyer	Transitional	Madison	Transitional	Union	At Risk
Fayette	Transitional	Marion	Transitional	Van Buren	Distressed
Fentress	Distressed	Marshall	At Risk	Warren	At Risk
Franklin	Transitional	Maury	Transitional	Washington	Transitional
Gibson	At Risk	McMinn	At Risk	Wayne	Distressed
Giles	Transitional	McNairy	Distressed	Weakley	At Risk
Grainger	At Risk	Meigs	At Risk	White	Distressed
Greene	At Risk	Monroe	At Risk	Williamson	Attainment
Grundy	Distressed	Montgomery	Transitional	Wilson	Competitive
Hamblen	At Risk	Moore	Transitional		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the broadband economists

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Tennessee eStrategy Report: Broadband as a Driver of Economic and Social Development in Tennessee

Strategies, Options, and Recommendations

June 2016

Prepared for

Table of Contents

EXECUTIVE SUMMARY

This eStrategy Report provides a foundation for developing policies and strategies that will help the State of Tennessee address identified broadband availability and usage gaps and make strategic investments to emerge as a leader in an Internet enabled economy and society. This report includes a **Strategic Framework for Broadband Investments in Tennessee** that establishes the two overarching goals of increasing the access and meaningful use of broadband to drive local economic development and civic advancement:

A. **Ensure equitable access to broadband Internet for community anchor institutions, businesses and households throughout the State.**

B. **Leverage the benefits from broadband infrastructure for communities, businesses and residents by facilitating increased adoption and improved utilization of Internet capabilities.**

The Strategic Framework provides objectives to position the State of Tennessee as an Internet infrastructure leader both nationally and globally. For Internet connectivity, the Strategic Framework is based on a standard for Internet infrastructure that will respond to future utilization and demand.

While connectivity is necessary, it is not by itself a sufficient condition for an Internet enabled economy. Availability of reliable and fast Internet must be accompanied by the ability of individuals, businesses and institutions to maximize the use of impactful online processes and applications that the Internet makes available. The Strategic Framework establishes as a specific objective to increase the utilization of the Internet in a manner that maximizes jobs, incomes, competitiveness, and community well-being.

To achieve the goals and objectives established in the Strategic Framework, this report identifies strategic options available to Tennessee. These strategic options build on the best practices and experiences in other jurisdictions.

Finally, this report provides recommendations on how the State can build the capacity to take decisive and coordinated approach to improving Internet connectivity and utilization within the State by establishing a broadband office and a multi-year action plan.

The objectives, recommendations, and options for implementation of this report are summarized in the table below.

Strategic Objectives and Recommendations

Objective 1: Work toward equitable access for all communities through Internet infrastructure that is reliable and scalable[1].

Recommendation: Within three to five years, ensure all communities have fiber to their core and community anchor institutions, as well as last mile Internet service that meets the 25/3 standard.

Options for achieving this recommendation:

- Create an Open Regulatory Environment
- Explore Tax Incentives to Promote Broadband Deployment
- Implement Broadband Friendly Policies and Ordinances
- Facilitate Community, Middle Mile and Statewide Broadband Initiatives
- Make Investments in Broadband
- Access Other Funding and Grants

Objective 2: Leverage existing and new broadband infrastructure by promoting broader and more intensive utilization of the Internet by residents, businesses and community anchor institutions.

Recommendation: Develop specific initiatives that target key constituencies that are either not using or are under-utilizing the Internet.

- **Businesses**: Target low performing industry sectors, small to medium size businesses, and businesses in non-metro areas. Develop online and local based support to promote the most impactful Internet applications.
- **Community anchor institutions**: Focus on increasing utilization among local governments and health care providers. Support efforts of libraries and economic development agencies in driving Internet utilization.
- **Households**: Design utilization programing for older, low income, and low educational attainment groups.

Objective 3: Enhance instititional capacity and leadership to promote and facilitate the State's broadband initiative.

Recommendation: Establish a State Broadband Office and Local Technology Teams with defined functions and measurable objectives.

Objective 4: Dedicate multiyear resources to making Tennessee a national broadband leader.

Recommendation: Develop and adopt a three to five year action plan supported by appropriate legislation, regulation and financial resources.

[1] ***Scalability*** *is the capability of a network to handle a growing amount of work, or its potential to be enlarged in order to accommodate that growth.*

INTRODUCTION

Broadband is the most important differentiating infrastructure today and is critical to the economic competitiveness of the State of Tennessee, its businesses, and the social wellbeing of its communities and its residents. Moreover, education, healthcare, business operations, workforce training and e-government applications all rely upon advanced broadband networks.

In response to feedback from all regions of the State about the need from improved broadband access and use, the State of Tennessee undertook an impartial assessment of broadband access, adoption and usage in Tennessee's communities to improve broadband services and the benefits that can derived from using the Internet. The findings and recommendations from this initiative are presented in two reports:

- *Internet Connectivity and Utilization in Tennessee 2016* ("Connectivity and Utilization Report") is an assessment of the current state of the Internet in Tennessee.
- *Tennessee eStrategy Report* (this report) identifies goals and strategies for improving Internet connectivity and utilization based on costs and benefits.

As described in the Connectivity and Utilization Report, Tennessee faces the challenges of:

1. Unequal access to high-speed Internet.
2. Under-utilization of the Internet enabled applications.

These gaps have major, tangible impacts on businesses, households and communities.

In order to address these gaps, this report is broken out in five sections:

- Section A proposes a strategic framework for broadband initiatives in Tennessee over the coming decade.
- Sections B and C identify a range of policy options that could be implemented to achieve the goals and objectives.
- Section D proposes options for building the capacity to facilitate Internet connectivity and utilization.
- Section E provides concluding comments.

This broadband research uses benchmarks to compare current capacity and utilization. This report uses the FCC definition of broadband as 25 Mbps download and 3 Mbps upload to assess broadband availability. To evaluate and analyze Internet utilization, this research uses the Digital Economy index[2].

[2] *The Digital Economy index (DEi) reflects an organization's or household's utilization of a range of Internet applications and process. Based on the number of applications currently being used by an organization, a composite score is calculated that summarizes how comprehensively each organization or household uses the Internet. In areas where DEi is lower than average, indicating lower utilization, an opportunity to increase utilization and benefits to businesses and non-commercial entities exists.*

TNECD engaged Strategic Networks Group (SNG) and NEO Connect (NEO) to assess the current availability and utilization of broadband technology and to provide strategies for the State to improve broadband service, availability and utilization.

About the Tennessee Department of Economic and Community Development (TNECD)
The Tennessee Department of Economic and Community Development's mission is to develop strategies which help make Tennessee the No. 1 location in the Southeast for high quality jobs. To grow and strengthen Team Tennessee, the department seeks to attract new corporate investment in Tennessee and works with Tennessee companies to facilitate expansion and economic growth. Tennessee is the only three-time winner of "State of the Year" for economic development by *Business Facilities* magazine.

About Strategic Networks Group (SNG)
Focused on economic advancement through broadband utilization, SNG is a group of broadband economists who develop strategies for most effectively leveraging broadband investments. SNG addresses broadband utilization from the individual organization level all the way up to working with more than 10 ten states across the United States. SNG looks to help make the most broad-reaching and transformational impacts that broadband can bring to enable businesses, communities and regions by delivering the data and analysis decision makers need to maximize broadband's potential. Learn more about SNG at www.sngroup.com.

About NEO Connect
At the forefront of broadband initiatives, from planning to execution, NEO is one of the nation's leaders in planning, engineering and developing strategies for community networks. With extensive experience in both the public and private sector, the NEO team is able to apply real-world business sense to every type of project. NEO has helped communities across the United States create successful and sustainable networks that meet each community's specific needs. Visit NEO online at www.NEOconnect.us.

SECTION A: A Framework for Broadband Strategies in Tennessee

Section A proposes a strategic framework for broadband initiatives in Tennessee over the coming decade. The framework identifies two primary goals and four key objectives. These goals and objectives provide a foundation on which comprehensive and coherent Tennessee broadband initiatives can be constructed.

The proposed strategic framework is based on key findings from the Connectivity and Utilization Report*:*

- 87 percent of Tennesseans have access to at least 25 Mbps download and 3 Mbps upload speeds and the remaining 13 percent (834,535 people) do not have access to wired service capable of supporting these speeds.[3]
- Actual connectivity speeds failed to meet the current FCC definition of broadband for 69.2 percent of businesses and 76.1 percent of households. The difference between available and actual speeds is caused by a variety of factors including consumers purchasing service levels lower than what is available in their community.[4] Those without FCC defined broadband are largely located in rural and economically disadvantaged areas.[5]
- Over 50 percent of households and 39 percent of businesses reported reliability issues (occasional or frequent problems).
- Among over 1,000 reporting businesses, 43 percent of all net new jobs (full and part time) in the prior year were enabled by the Internet.[6]
- Businesses in distressed or at risk counties generate far less of their revenues with the aid of the Internet when compared to businesses in other Tennessee counties[7]
- A number of identifiable groups significantly underutilize the Internet connection that they have: small businesses; businesses and community anchor institutions in economically disadvantaged counties; and older households and households with lower income or low educational achievement.

Given these findings, this report recommends that the State of Tennessee**,** in partnership with communities and stakeholders, adopt the following **Broadband Goals**:

A. Ensure equitable access to broadband Internet for community anchor institutions, businesses and households throughout the State.

B. Leverage the benefits from broadband infrastructure for communities, businesses and residents by facilitating increased adoption and improved utilization of Internet capabilities.

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[3] *2016 Broadband Progress Report,* Federal Communications Commission, https://apps.fcc.gov/edoc_public/attachmatch/FCC-16-6A1.pdf.
[4] *Consumers may choose to purchase less than the optimal service in part due to the cost of premium services or the need to change service providers to access the faster service.*
[5] *Ibid: Pages 30, 33 and 35.*
[6] *Ibid: Page 38.*
[7] *Ibid: Page 39.*

In pursuit of these two primary goals, it is recommended that the following **four objectives** be adopted and actively supported:

Objective 1: Work toward equitable access for all communities through Internet infrastructure that is reliable and scalable[8].

> **Recommendation**: Within three to five years, ensure all communities have fiber to their core and community anchor institutions, as well as last mile Internet service that meets the 25/3 standard.

Objective 2: Leverage existing and new broadband infrastructure by promoting broader and more intensive utilization of the Internet by residents, businesses and community anchor institutions.

> **Recommendation:** Develop specific initiatives that target key constituencies that are either not using or are under-utilizing the Internet.

Objective 3: Enhance instititional capacity and leadership to promote and facilitate the State's broadband initiative.

> **Recommendation:** Establish a State Broadband Office and Local Technology Teams with defined functions and measurable objectives.

Objective 4: Dedicate multiyear resources to making Tennessee a national broadband leader.

> **Recommendation:** Develop and adopt a three to five year action plan supported by appropriate legislation, regulation and financial resources.

The remaining sections of this report explain the options and other considerations for the State of Tennessee in meeting these objectives.

[8] ***Scalability*** *is the capability of a network to handle a growing amount of work, or its potential to be enlarged in order to accommodate that growth.*

SECTION B: Improving Connectivity

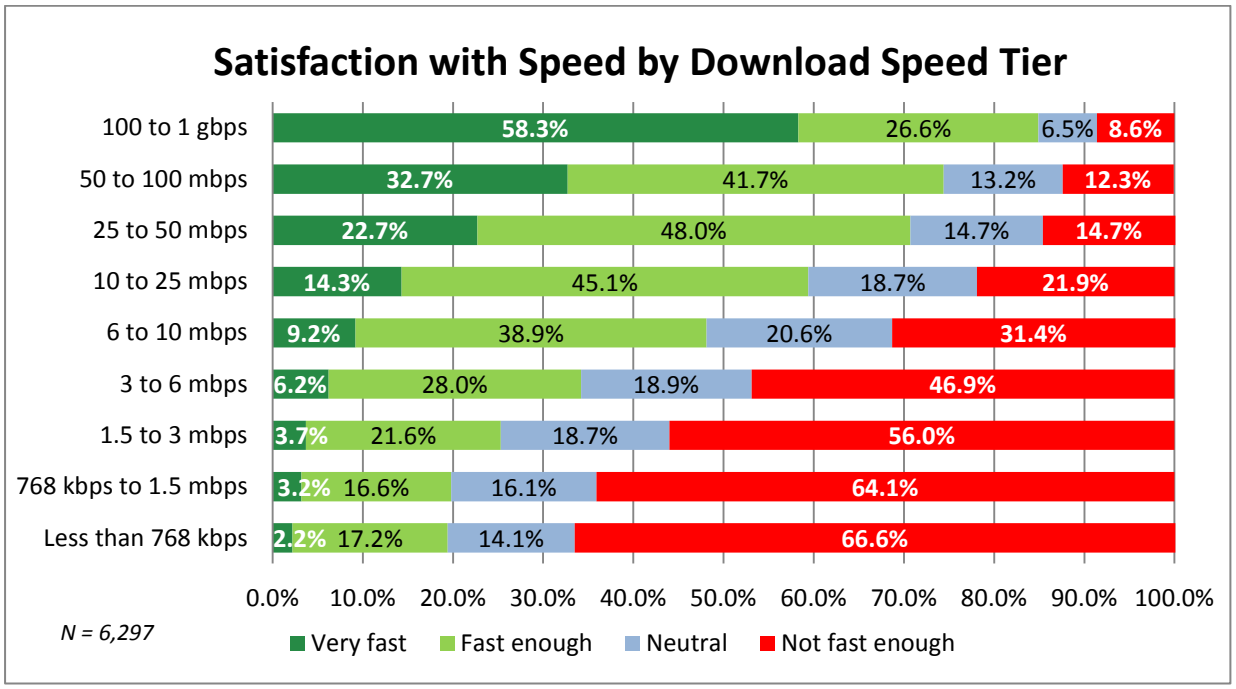
Section B identifies strategies and options for achieving Objective 1 of the Strategic Framework:

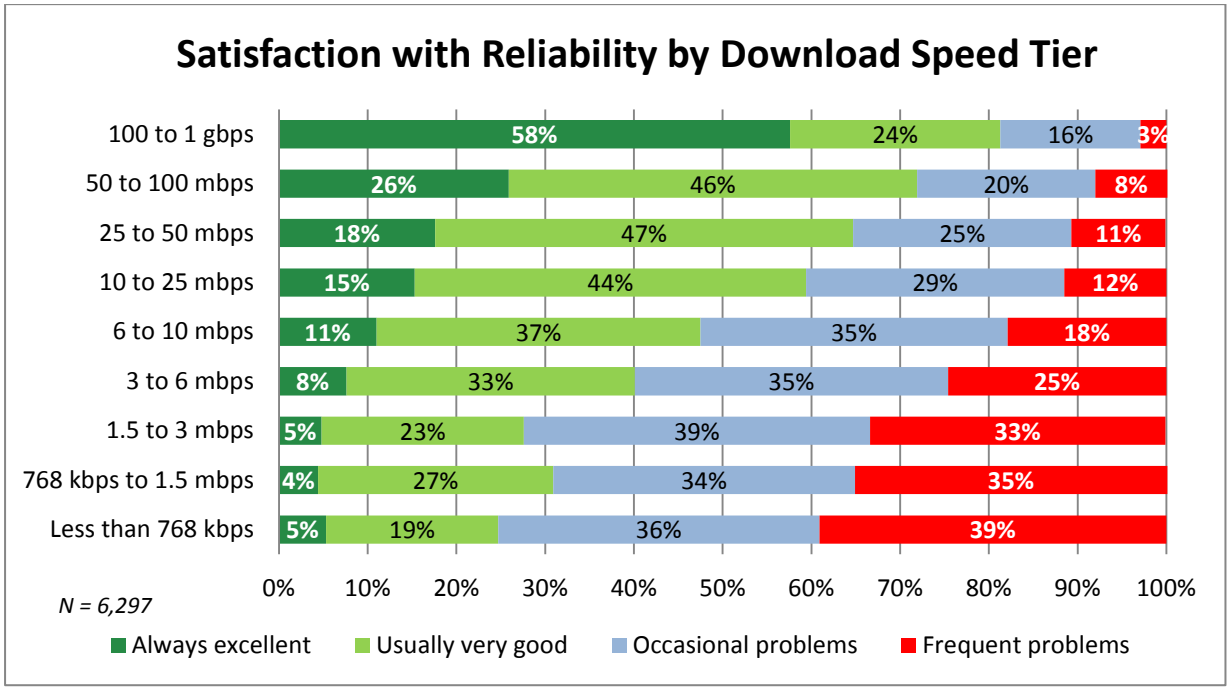
Objective 1: The State should work toward equitable access for all communities through Internet infrastructure that is reliable and scalable.

> **Recommendation:** Within three to five years, ensure all communities have fiber to their core and community anchor institutions, as well as last mile Internet service that meets the 25/3 standard.
>
> Community anchor institutions should have access to a minimum of 100 Mbps, with a potential to scale to 1 gigabit. Businesses and residents should have access to a minimum of 25 Mbps download and 3 Mbps upload.

Evidence of the desirability of the 25/3 standard can be found in data collected from consumers and summarized in the *Internet Connectivity and Utilization in Tennessee 2016 Report*.

- Reliability and consumer satisfaction with current speeds improves steadily with increased speed of the connection.
- 31.4% of households with recorded speeds of 6 to 10 Mbps are dissatisfied with their current speed. Dissatisfaction with connection speed drops to 14.7% for households in the speed tier immediately above 25 Mbps.
- Frequency of reliability problems drops from 18% (reporting frequent problems) to 11% for households in the 25 to 50 Mbps tier.





Demand for broadband speed and reliability has been increasing dramatically and is projected to continue its dramatic growth.[9] The FCC definition of broadband reflects an appreciation of both the current and foreseeable demand for broadband that meets consumer demand.

The Connectivity and Utilization Report outlines the current state of broadband infrastructure in Tennessee. To move forward and achieve the stated goal and objective above, this section addresses the following options and considerations for improving broadband service:

- Create an Open Regulatory Environment
- Explore Tax Incentives to Promote Broadband Deployment
- Implement Policies and Ordinances that are Broadband Friendly
- Facilitate and Support Community, Middle Mile and Statewide Broadband Initiatives
- Make Key Investments in Broadband
- Access Other Funding and Grant Programs

[9] *For further discussion on the importance of defining broadband goals in terms of future demand see Connectivity and Utilization Report particularly pages 11, 23 and 24.*

1. Create an Open Regulatory Environment

In the last six years, there have been significant improvements in broadband infrastructure investment in the United States. Incumbent providers in the State of Tennessee have made significant investments in upgrading their infrastructure and continued investment by the existing providers should continue to be encouraged. However, in some cities and towns, limited competitive pressures or weak businesses cases have resulted in access gaps.

Data collected in Tennessee included in the Connectivity and Utilization Report demonstrates that competition is an effective driver of infrastructure investment. Areas with more service providers have higher speeds for both businesses and residents. For example, the average download speed for businesses with access to only one provider was 22.5 Mbps while businesses with access to more than three providers averaged download speeds of 43.8 Mbps. [10]

In order to spur investment by promoting competition, the State of Tennessee can foster an open regulatory environment to allow any entity to build telecommunications infrastructure and offer broadband services. There are three primary regulatory barriers that exist within the current laws of Tennessee that limit or restrict electric cooperatives and municipalities from providing broadband services in some capacity:

1) Electric cooperatives, which are private, non-profit corporations, are not allowed to offer retail broadband services to homes and businesses. The current law allows the electric cooperatives to build out telecommunications infrastructure and offer services on a wholesale basis only (Tenn. Code Ann § 65-25-205). Many electric cooperatives have built fiber optic infrastructure between their power substations to better manage their power operations. Excess fiber from power management could be used to offer broadband services. Many of the cooperatives in the State have extensive fiber networks already deployed and some of them are partnering with other service providers to offer their fiber network on a wholesale basis. Whether they are offering wholesale fiber optic services or not, the electric cooperatives are well positioned to offer broadband services to their constituents.

2) Tennessee allows municipalities that operate their own electric utilities to provide cable, two-way video, video programming, Internet access, and other "like" services (not including paging or security services), but only upon complying with various public disclosure, hearing, voting and other requirements that a private provider would not have to meet. Additionally, these municipalities that operate their own electric utilities may only provide broadband services within their own service area (Tenn. Code Ann. § 7-52-601 et seq.).

3) Municipalities that do not operate electric utilities can provide services only in "historically unserved areas, meaning that the area does not have access to broadband Internet services, has been an area developed for residential use for more than five years, and is outside the service area of a video or cable

[10] *Connectivity and Utilization Report, page 31 for businesses and page 35 for households*

service local franchise holder" and only through joint ventures with the private sector (Tenn. Code Ann. § 7-59-316).

These barriers and administrative burdens may place unnecessary restraints on broadband investment. One option for increasing access to broadband is to lift regulatory restrictions on who can provide broadband. An open regulatory environment that allows any entity to build telecommunications infrastructure and any entity to offer broadband services can lead to greater broadband availability.

In States where there are no restrictions, administrative burdens or regulatory limitations for any entity to build telecommunications infrastructure and offer services, there is more competition and more broadband investment, especially in rural parts of the state. Municipalities and electric cooperatives who have a vested interest in the vitality of their local communities are investing in broadband infrastructure because it is a key driver to economic development. The Institute for Local Self-Reliance (ILSR) provides a map and list of communities where local governments have invested in advanced broadband networks. The map contains over 450 U.S. municipalities that have invested in broadband networks in a variety of ways. This includes 83 communities with a publicly owned fiber to the home (FTTH) network reaching most or all of the community, 77 communities with a publicly owned cable network reaching most or all of the community, over 185 communities with some publicly owned fiber service available to parts of the community, over 115 communities with publicly owned dark fiber available and over 50 communities in 19 states with a publicly owned network offering at least 1 Gigabit services.[11]

There are 19 states that have some form of regulation in place that limits or restricts public investment or participation in building broadband networks. Although there are many other factors that influence broadband availability in addition to the regulatory environment, comparing states that have similar demographics, size and geography, provides some indication of how regulation impacts availability. For example, Pennsylvania and Virginia do not have open regulatory environments. Pennsylvania is ranked 19th in broadband availability in the U.S. and Virginia is ranked 31st. Neighboring states of Rhode Island, Connecticut, New Jersey, New York, the District of Columbia and Massachusetts are in the top six states in the country in terms of broadband availability.[12] Similarly, Illinois and Indiana do not have regulatory restrictions in place for public investment and only 7% and 10% of their populations respectively are underserved, while neighboring states of Missouri (22%), Arkansas (26%), Louisiana (19%), Tennessee (15%) and Alabama (24%) that do have regulatory barriers are underserved.[13]

Rather than making determinations about these types of restrictions on a statewide basis, another approach to consider is to allow municipalities, communities or counties the opportunity to decide for themselves. In Colorado, for example, there is a current law (Senate Bill 05-152) that restricts local governments from building out telecommunications infrastructure to end users. It also restricts working with the private sector in a public-private partnership model to improve broadband services.

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[11] *Institute for Local Self-Reliance, "Community Network Map," updated October 2015, see http://www.muninetworks.org/communitymap.*
[12] *Broadband Coverage in the U.S., see www.broadbandnow.com*
[13] *Broadband Coverage in the U.S., see www.broadbandnow.com*

Communities may opt out of this bill by holding an election. Although requiring an election is another administrative burden, this leaves the decision in the hands of the local communities. The public vote restores the authority of the local government to improve broadband infrastructure. More than 60 communities have opted out of SB-152 since November 2015 with an average of 80% of votes cast to opt out of SB-152. The vast majority of local governments who have opted out are not providing broadband services themselves; they are merely serving their constituents by recognizing current gaps in service. How these service gaps are addressed is a question for planning, strategies, negotiations, asset assessment, public-private partnership meetings, etc. With so many communities opting out, many are uncovering opportunities to work together, aggregate demand and share costs.

The State of Tennessee could consider lifting administrative burdens and restrictions to broadband infrastructure investment to fostering a more open regulatory environment.

2. Explore Tax Incentives and Reforming Taxation to Promote Broadband Deployment

The State could consider implementing tax incentives or reforming taxation to promote broadband investment.

There are two main types of tax incentives that could be provided. The first is to eliminate or reduce sales tax on equipment or materials used to deploy or provide broadband. Many other states have eliminated or reduced sales taxes in this area.[14] The second is to provide a tax credit to incentivize broadband deployment. Mississippi is one state that has done this by providing a credit on income or franchise taxes.

Another possible mechanism for encouraging deployment of broadband is to reform taxation practices that result in higher taxes for certain broadband providers such as the elimination ad valorem taxes for telecommunications providers.[15]

When evaluating implementation of tax incentives or other reforms, it is important to balance a number of factors, such as the size of the reduction in state revenue, the overall fiscal impact of that reduction, and the State's ability to ensure that such a change will result in increased broadband availability.

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[14] *See e.g. Alabama (Ala. Code § 40-23-2 (3)) (reduced rate); Mississippi (Miss. Code Ann. § 27-65-101;) North Carolina (N.C. Gen. Stat. § 105-164.13 (5)(b-d)) (full exemption); Texas (Tex. Tax Code Ann. § 151.3186) (full/pro rata); West Virginia (W. Va. Code § 11-15-9 (b) (2)) (full exemption).*

[15] *Ad Valorem taxes in Tennessee treat telecommunication companies different than other businesses resulting in higher taxes for these companies.*

3. Implement Broadband Friendly Policies and Ordinances

There are many policies and ordinances that can be put in place to reduce the capital costs of broadband deployment. A discussion of these policies and ordinances are provided below.

Dig-Once, Shadow Conduit Policies and Joint Build/Trench Agreements

Sixty to eighty percent of a fiber optic network's capital costs are in opening a trench or in burying conduit that will house fiber optic cable. Policies that encourage placement of conduit or fiber optic cable when a trench is open eliminate much of the capital costs for network deployment. By coordinating with other City, County or State capital projects such as sidewalk improvements, establishment of trails, implementation of street lighting, road construction and road widening projects, additional conduit can be placed within the trench when other work is being performed in the right of way. Coordination with other utility projects can substantially decrease the costs of broadband infrastructure.

A ***Dig Once Policy*** typically has the following components:

- All public works or installation of other telecom, cable or utility infrastructure allows for conduit to be placed on behalf of the local or State government and any other entities that want to participate. If there is an open trench, the policy provides for coordination of street cuts and excavations with utilities, public works, developers and other interested parties. This maximizes the opportunity for broadband-specific conduit installation, while minimizing cost, community disruption and damage to existing infrastructure.
- A notice period informing other entities that an open trench will be available for placement of their conduit and/or fiber optic facilities.
- Allows for shadow conduit to be placed on behalf of the local and/or State government. The installation of empty and/or spare conduit by a public agency when excavations occur in the public right of way, with agency (Town, City or County) costs limited to the incremental costs of the conduit only.

A standard, conduit-specification document can be developed that addresses capacity, separation of facilities, proper sizing and placement. The specification document can also address access to the conduit with detailed provisions for vaults and all access points. Cost sharing or cost recovery stipulations can be put in place for materials and labor assignment. Engineering specifications and drawings that address conduit sweeps,bend radius and physical placement requirements can be provided with the standard conduit specification.

Additionally, various government agencies can establish ***Joint Trench Agreements*** and ***Joint Build Agreement***s with other telecommunications, cable or utility providers. Cost for placement of conduit or fiber will be shared amongst all entities, allowing each to take advantage of the other's trenching. Standardization of these agreements across all potential owners of underground infrastructure can be established to ensure all parties are aware of the joint trenching opportunities as they become available.

Streamlined Permitting Processes and Abandoned Fiber and Conduit Policies

A slow permitting process can add uncertainty in the construction timeline as well as significant costs. Crews can sit idle while waiting for permitting approvals and this adds to the overall cost of construction. A ***streamlined permitting process*** can be implemented placing the responsibility for approval of broadband infrastructure projects solely in the public works department via an encroachment permit process. Limiting this process to one department can reduce delays in the approval process. Additionally, a bulk permitting process can enable a single approval for multiple sections, further streamlining the overall process.

Local governments can create an ***Abandoned Fiber and Conduit Policy*** to regain control of abandoned facilities. Ownership of any abandoned fiber and/or conduit that is left vacant, and is not claimed by the owner within a designated time period, would revert to the local government agency. Additionally, abandoned water and sewer lines may potentially be used for broadband infrastructure.

One-touch Make Ready Processes

One of the most unpredictable and costly components of fiber optic construction is the "make-ready" process. "Make-ready" refers to the inspections, engineering, and rearrangements necessary to accommodate the installation of multiple cables on a utility pole. Make-ready engineering for placement of fiber optic cables needs to comply with the National Electric Safety Code (NESC). Compliance may include moving existing fiber optic cable, increasing the load bearing ability of poles and/or the transfer or replacement of existing poles required to accommodate the attachment of new fiber optic cable. At times, the make-ready process can require multiple companies to dispatch crews with specialized equipment and bucket trucks to move their physical attachments on the communications portion of utility poles, causing slowdowns and duplicate expenses for deployments.

In order to better streamline this time consuming and high-cost element, a ***One-touch Make-Ready Process*** or ***One Truck-Roll Procedure*** can be established to enable and encourage all of this work to be done by one company rather than by many.

Encourage standards for placement of conduit and/or fiber in new developments

The integration of broadband "utility" codes into land development policies and city ordinances ensures uniform and standardized placement of conduit and/or fiber optic facilities. These land development codes would require all new commercial and residential developments to install fiber optic infrastructure. New building codes could describe the specific and compatible communications components and architectures of all new construction. Further, theses codes could describe the development and use of city/county right of way for communications connectivity, and could specify standardized wiring requirements for new buildings.

Standardize Pole Attachment Rates for Placement of Aerial Fiber, Reducing the Operational Costs for Pole Rental Rates

Standardized and reasonable pole attachment rates reduce the operating expenses for placement of fiber optic cable and encourage the deployment of broadband infrastructure. Deploying fiber using existing utility poles is less expensive than placement of fiber in a conduit where a trench would need to be opened. Standardizing and minimizing the pole attachment rates can eliminate uncertainty and reduce costs which is particularly important in higher cost, rural areas.

Set up funding mechanisms or set-asides to allow for adoption of these policies

Conduit is not expensive. However, if the funding mechanism does not exist to place conduit, often opportunities to take advantage of open trenches or joint builds do not occur. A funding set-aside or budget process must be put in place to allow for implementation of these policies. The funding mechanism will allocate monies to build broadband infrastructure when opportunities arise and the fund would maintain a reserve or set-aside for unanticipated projects. A good best practice for funding may be setting aside a percentage of the road maintenance budget to tie the set-aside to right of way asset management and maintenance. Another consideration may be to include a set-aside tied to water, sewer or electrical facilities management for municipalities that are providing these utilities to their constituents.

Keep a Geographic Information System (GIS) database of all infrastructure and provide for a process to submit plans

A policy can be developed requiring the submission of final as-built drawings for construction permits. This policy would define all planning and construction documentation requirements for utilities, developers, contractors and others in an appropriate GIS format. This is important because existing conduit and fiber optic infrastructure that is owned by a local government or any other entity can be leveraged to build out broadband infrastructure. Keeping a database of all conduit and fiber optic infrastructure will allow the municipality or the county to have a record of all possible infrastructure that may be leveraged.

4. Facilitate Community, Middle Mile and Statewide Broadband Initiatives

There are a number of specific actions that can facilitate initiatives to improve broadband infrastructure. This section outlines the most important of these actions. The recommendation to establish a State Broadband Office and Local Technology Teams as facilitators is covered in Section D1 (page 39).

Map assets and provide a database of existing fiber in the State

Creating a map of existing assets that may be leveraged to expand broadband services is a best practice. Assets include water tanks and tower facilities where wireless, cellular and public safety equipment may be placed. Other assets include existing conduit and fiber optic cable. This involves maintaining a GIS database of all infrastructure and assets along with the infrastructure owners and providing a process to submit information to this database by many entities. The database could also include all buildings within the State that are connected with fiber optic cable.

As a deliverable of this project, the State was provided with a map of existing fiber optic assets that have already been deployed throughout the State. This list and mapping data includes fiber optic facilities placed by various carriers, service providers, electric cooperatives, middle-mile infrastructure companies, and State agencies. Much of the mapping and data provided during this deliverable is confidential; however, this information can be used to facilitate and better understand who potential partners may be for collaboration and expansion of fiber optic and broadband infrastructure and where assets already exist so that duplicate facilities are not constructed.

Encourage and Facilitate Intra- and Inter-Government Planning and Cooperation

Many State agencies are working on programs that utilize broadband services or are implementing broadband infrastructure for their constituents and to support internal government systems. For example, the Tennessee Department of Transportation has implemented a fiber network to facilitate traffic management and to better manage transportation operations. The Department of Education has initiatives to facilitate digital learning in schools and the Division of Healthcare Finance and Administration is implementing tele-heath programs.

President Obama implemented an Executive Order in 2012 for all federal agencies to work together to improve broadband. Section 1 of the Executive Order states, “While broadband infrastructure has been deployed in a vast majority of communities across the country, today too many areas still lack adequate access to this crucial resource. For these areas, decisions on access to Federal property and rights of way can be essential to the deployment of both wired and wireless broadband infrastructure.” The Order also provides for a working group made up of representatives from federal agencies to ensure a coordinated and consistent approach for use of Federal assets to further broadband deployment. Among other things, the Order also mandates deployment of conduit for broadband facilities in conjunction with federal or federally assisted highway construction (a Dig Once Policy).

Intra- and Inter-government planning and cooperation can further reduce the costs for broadband deployment and coordination of planning activities can assist in broadband to be implemented while

other infrastructure projects are underway. The Governor of Tennessee could issue a similar executive order mandating that States agencies work together and collaborate jointly on projects that may help broadband development.

Establish Local Technology Planning Teams to Help Plan and Implement Regional Approaches

Each region within the State of Tennessee faces its own sets of challenges. Consequently, many of the communities within each Region have similar goals, opportunities and possible solutions to solve broadband challenges. A State Broadband Office can establish Local Technology Planning Teams throughout regions in the State to work together to solve their specific challenges. These teams would need support from the State that includes education, training, sharing asset of information, technology planning support and potentially planning grants.

Establish a Resource Center for Best Practices, Sample Models and Requests for Proposal, Training and Education and Funding

The State Broadband Office could be a central point for information and training on best practices, sample models, sample RFPs for feasibility and planning services, design and engineering, construction, dark fiber leases and IRU agreements. The State Broadband Office could provide training online or through workshops and provide other resources and white papers. The repository of information will facilitate broadband planning and implementation.

5. Make Key Investments in Broadband

There are a large number of potential investments that the State of Tennessee could make to improve broadband infrastructure. The choices regarding how and where to invest in broadband communications are numerous and there are a range of potential broadband investment models. Building robust, next-generation broadband networks are capital intensive and new approaches are emerging to share in the capital costs and limit or mitigate risks. The primary risks that are involved in broadband execution are typically financial risks, or risks associated with g implementation and construction, as well as operational and political risks. Creative public-private partnerships are emerging and models for implementation are evolving on a regular basis. To better understand the options available, we are summarizing the approaches and considerations into two categories of investment and several approaches for financing and implementation:

Categories of Investment

The primary categories of investment are simply "Middle Mile Investment" and "Last Mile Investment." "Middle Mile" often refers to the telecommunication infrastructure between communities, between communities and primary Internet hubs and often within communities, connecting anchor institutions. Government offices, including federal, state, county and local municipal locations, emergency 911 centers, fire, public safety, ambulance, schools, healthcare institutions and clinics, universities and libraries are often considered community anchor institutions. In some cases, middle mile infrastructure can also be extended to key tower facilities or wireless access points to further promote broadband capabilities. Also middle mile infrastructure can be built to key industrial parks, urban centers and businesses within a community.

Investing in middle mile infrastructure accomplishes a number of important outcomes. First, it brings very high capacity fiber optic or digital backhaul microwave facilities to a community. This creates an opportunity to bring in abundant broadband access and often access to costly Internet "supply," meaning the connection to an Internet hub. Internet backhaul costs are often charged on a per-mile basis, and therefore, for remote and rural parts of the state, costs to access Internet "supply" are often high, as distance to the Internet hubs are often longer than in metropolitan areas. Connecting anchor institution locations can also create a state- or locality-owned private network, greatly reducing or eliminating monthly Internet access fees, while at the same time, aggregating and allocating Internet bandwidth demands. The State of Kentucky is currently constructing a middle mile network to connect state and local government buildings and various anchor institutions. As the State is a high Internet user, the capital costs to build this infrastructure can be justified by eliminating the State's contract with a private carrier for Internet access. This option for the State of Tennessee, along with various investment levels and associated capital costs, are discussed below.

Bringing high capacity fiber or wireless access to a community often creates a redundant path into the community as well, creating more than one option for accessing the Internet hubs. Extending high capacity infrastructure to various anchor institutions, towers and businesses can enable very high bandwidth Internet to these locations. With fiber optic cable and in emerging wireless equipment,

Gigabit access speeds can be achieved. Finally, once fiber or high capacity wireless is brought into a community or to an anchor institution, the capital costs for extending fiber further into the community are comparatively lower. Making the investment in middle mile infrastructure may augment service providers' abilities to enhance and extend their network capabilities to end users.

The second category of investment is Last Mile Infrastructure. This refers to the connection to end users – businesses and residential locations. Many localities, electric cooperatives, and service providers are investing in bringing fiber optic cable all the way to the home and to a business to enable Gigabit speeds for homeowners and businesses. This is a very capital intensive process with construction cost estimates ranging from $1,500 to $4,000 per premise. New wireless equipment is emerging that is more cost effective to deploy and yet offers high capacity service as well. In order to achieve high bandwidth speeds, the wireless equipment needs to be connected with fiber, but then can be used to distribute high bandwidth within a limited distance from the wireless access point. There are many programs that address improving last mile infrastructure, especially for unserved and underserved areas. These programs will also be discussed below and many inform the State on its participation for improving last mile infrastructure.

Financing and Implementation Approaches

These options can be further classified into various approaches regarding financing, incentives and implementation:

1. **Public Facilitation of Private Investment:** Localities encourage new private investment through incentives and other measures to reduce costs for private sector infrastructure deployment. Public facilitation of private investment options has been discussed within this section. These strategies include implementing policies and ordinances that are broadband friendly, creating an open regulatory environment, providing tax incentives and economic development incentives to promote more broadband infrastructure investment and consideration of State-backed efforts to enhance collaboration amongst various agencies and entities.

2. **Public Funding, with Private Execution:** This model helps to eliminate or mitigate the construction and operational risks by relying on the private sector for execution, but leverages public funding. A formal public–private partnership- agreement is negotiated between the public and private sectors describing public investment and ownership and private participation for implementation.

3. **Shared Public and Private Risk and Cost:** In this model, capital costs and ownership of the network is shared between the public and private sectors. Resources for financing, constructing, operating, and maintenance costs are shared amongst entities.

Potential Investments, Associated Capital Costs

This report examines a number of options for consideration and their respective projected capital costs. These options ranged from addressing the unserved and underserved areas within the State, connecting

anchor institutions in Distressed and At-Risk counties and implementing a middle mile network connecting various anchor institutions throughout the entire State.

The Connect America Fund is a federal grant program that targets areas that are unserved. On September 15, 2015 the Federal Communications Commission authorized ten telecommunications carriers to receive over $9 billion in support from Phase Two of the Connect America Fund. These funds are to be distributed over a six-year period for rural broadband deployment throughout the United States. In Tennessee, over $29.9 million per year for six years in funding was awarded to three telecommunication companies: AT&T, Frontier and Century Link. The goal of this program is to meet a minimum broadband speed of 10 Mbps download and 1 Mbps in upload speeds.

According to National Broadband Map data as of June 2014, the following chart- shows the number of housing units and the population that are unserved.[16]

Tier	% total pop	Housing Units Served	Housing Units Unserved	Population Served	Population Unserved
10/1 Mbps	89.30%	2,651,954	327,770	5,882,507	727,051
25/3 Mbps	85.50%	2,532,765	446,959	5,618,124	991,434

Projected capital costs to build a Fiber to the Premise (FTTP) network to housing units that do not meet the 10/1 definition of broadband, as well as the housing units that do not meet the 25/3 definition of broadband are provided below. The approach of calculating capital costs of FTTP technology versus DSL, wireless and/or cable modem technologies is used because this methodology mirrors the FCC's Connect America Fund II approach. The FCC's Alternative Connect America Cost Model (A-CAM)[17] calculates the forward-looking economic costs of deploying and operating a Fiber to the Premise (FTTP) network in rate-of-return areas of the country. FTTP technology is used because it currently is the most reliable technology to provide higher delivery of bandwidth capacity. There have been tremendous advances in wireless technology and the costs to deploy advanced wireless networks are more economical than fiber. However, because the FCC uses FTTP in its calculations for determining costs to unserved areas, this report mirrors the FCC's approach.

The following is a high-level estimate of the cost to build fiber to the housing units that do not meet these minimum targeted speeds. The range of costs per household to build fiber is estimated between $2,500 to $3,840. These costs represent design, engineering, permitting, and fiber construction, including the labor, materials, equipment, shelters, and all components of the outside plant infrastructure.

[16] *National Broadband Map, see http://www.broadbandmap.gov/analyze*
[17] *FCC A-CAM Model Methodology v.2.1. Released 11-29-15, https://transition.fcc.gov/wcb/ModelMethodologyACAM_2_11_29_15_Final.docx*

Tier	Housing Units Unserved	Low-End Estimate per Household	High-End Estimate per Household	Total Low-End Capital Costs	Total High-End Capital Costs
10/1 Mbps	327,770	2,500	3,840	$ 819,425,000	$ 1,258,636,800
25/3 Mbps	446,959	2,500	3,840	$ 1,117,397,500	$ 1,716,322,560

The total projected capital costs to build fiber to the housing units that do not meet the 10/1 definition is between $819 Million to $1.25 Billion. The total capital costs to build fiber to the housing units that do not meet the 25/3 target are estimated to be between $1.17 to $1.716 Billion.

Although the above numbers reflect capital costs to build fiber to every home, another consideration is to build fiber to the communities and then use advanced wireless technology to serve the homes and businesses within each of the communities. In order to support the minimum targeted speeds, fiber optic cable would still need to be built to the wireless access points and then the signal would be distributed using advanced wireless technology. Using this approach, the total capital costs could be reduced by $800 - $1400 per household.

Tier	Housing Units Unserved	Low-End Estimate per Household	High-End Estimate per Household	Total Low-End Capital Costs	Total High-End Capital Costs
10/1 Mbps	327,770	1,100	3,040	$ 360,547,000	$ 996,420,800
25/3 Mbps	446,959	1,100	3,040	$ 491,654,900	$ 1,358,755,360

The decision to determine whether wireless technology or fiber should be deployed weighs the factors of timeliness to install versus capacity, reliabiity and capital costs. Wireless technology can be deployed in a more timely manner than fiber. Fiber has more capacity and is more reliable than wireless technology, but is obviously more capital intensive.

The preliminary design and projected capital costs for connecting community anchor institutions (state agencies, schools, hospitals, county offices, city offices, libraries, universities, community colleges and technical colleges) in Distressed and At-Risk Counties were also examined for this report. Community anchor institutions within the Distressed and At-Risk Counties were identified, addressed, and mapped. A preliminary design for a middle mile network connecting all of these anchor institutions was created and the projected capital costs to implement this design were calculated. In the design, all community anchor institutions would be able to receive a Gbps of bandwidth.

Below is the estimated capital cost to build fiber between all of the communities within the Distressed and At-Risk Counties.

Estimated Capital Costs, Distressed and At-Risk Counties		
Engineering. Labor	$	13,012,770
Aerial Labor	$	95,937,925
Underground Labor	$	4,064,514
Tech Services Labor	$	4,287,080
Customer Premise Labor and Install Materials including Splitters	$	791,154
OSP Materials	$	23,216,728
Electronics	$	2,310,709
Total Estimated Costs	**$**	**143,620,880**

Approximately 977 miles of existing fiber assets that has been installed by a number of other entities were identified and the cost savings to use existing assets rather than build new fiber routes were calculated. If existing assets are used, a reduction between $20 Million and $47 Million could be realized.

Calculations to serve the community anchor institutions were separated between the east and west sides of the State as the costs to serve the more mountainous regions of the eastern side of the State are more expensive than the western part of the State. Below are the estimates to connect the community anchor institutions, broken down between the east and west sides of the State.

Anchor Institutions	East		West	
	# of Buildings	Estimate	# of Buildings	Estimate
State Buildings	108	$ 14,259,141	103	$ 13,151,170
Colleges	10	$ 775,207	6	$ 1,501,901
Hospitals	28	$ 1,796,634	21	$ 949,643
Libraries	368	$ 3,574,528	44	$ 1,249,054
Schools	368	$ 48,072,218	179	$ 12,172,546
Totals		$ 68,477,728		$ 29,024,314

In total, adding in the connections between the communities and connecting the community anchor institutions is estimated to be $241.1 Million. The summary of these costs is shown below.

Total Estimated Capital Costs - All Anchor Institutions Distressed and At-Risk Counties		
Between Communities	$	143,620,880
Within Communities, East	$	68,477,728
Within Communities, West	$	29,024,314
Total	**$**	**241,122,922**

This report also identified the estimated projected capital costs to building to all of the State buildings within Tennessee. To build to all of the State buildings, the total estimated capital costs are:

Total Estimated Capital Costs State Buildings Only in Tennessee		
Between Communities	$	143,620,880
State Buildings, East TN	$	14,259,141
State Buildings, West TN	$	13,151,170
State Buildings, Remaining Counties	$	47,656,847
Total	**$**	**218,688,038**

These projected estimates do not include the use of existing fiber optic assets.

Access Other Funding and Grants

There are numerous grant and low-cost loan programs that have been established to fund broadband infrastructure deployment. In order to take full advantage of the funding available, a number of steps are recommended.

Coordination Among State and Local Agencies and Leveraging Federal Funding

With coordination and collaboration amongst and between various State and local government agencies and in working collaboratively with the private sector, loan programs can be further maximized and leveraged. Certain grant and funding programs are available for schools and libraries and some are available for the healthcare industry. Other programs are designed for service providers to receive funding. The State could publish papers on various grant and funding programs, making this information available to both public and private sectors. Coordinating between the various public and private sectors to apply for grand funding can facilitate more investment in broadband infrastructure.

Take, for example, the State of Colorado. The State has set aside $20 Million in broadband implementation grants. The grant program is available for local government agencies to use in building middle mile infrastructure. It requires 50% in matching funds from the local municipalities and counties. Region 10, a consortium of six counties and twenty-two communities applied for grant funds made available through the State and further leveraged this funding by supplementing it with an Economic Development Administration grant. Region 10 will continue to leverage this funding by coordinating E-rate funds and healthcare grant funding. In rural areas in Colorado, the E-rate program and the Rural Healthcare Grant can be used to pay for 65% of the capital costs of fiber optic construction. Leveraging the EDA grant, E-rate, healthcare and the State programs will pay for much of the capital costs for this project.

North Carolina provides another example of coordination and leveraged funds. Since 1998, North Carolina's schools and libraries have received more than $650 million in E-rate discounts. The North Carolina Department of Public Instruction Connectivity Team was established to offer technical support, training and facilitation of the E-rate application. The team, per their website, offers the following free comprehensive E-rate training and support services to all preK-13 public schools in the State:[18]

- E-mail and telephone support in completing applications and program forms,
- Virtual reviews of applications and program forms,
- E-mail and telephone support in completing Compliance Reviews and Audits,
- Updates and training at conferences and regional meetings,
- Internet updates and information,
- Onsite outreach and training as requested,
- NC E-rate emails used to communicate updates, newsletters and executive summaries to designated E-rate contacts across the State,
- Access to experienced network analysts with working knowledge of the E-rate Program and

[18] *Public schools of North Carolina website, http://www.dpi.state.nc.us/erate/*

- Access to multiple State-level E-rate Specialists for continuity of service and "on-demand" service.

Additionally, The N.C. School Connectivity Initiative (SCI) was established to expand the number of schools with broadband Internet access, further develop communication networks for rural and underperforming schools, aid in professional development for technology staff and develop a scalable model to maintain and enhance network services to all schools in North Carolina.[19] This initiative manages programs that provide funding support for public and charter school broadband Internet access and provides consulting services for E-rate applications. The initiative also connected 115 public and charter schools to the North Carolina Research Education Network (NCREN). NCREN has established a private fiber optic network that connects K-12 schools, Duke University, Wake Forest University, and most of the private universities and colleges in the State. It also connects State government and regional community networks and medical and research institutions.

The State of Tennessee could leverage E-rate funding to build out critical infrastructure to schools and libraries and leverage these programs to build out to other agencies as well. The State could offer similar services to its schools, offering coordination, technical support and training services for schools to better access the E-rate funding programs. Whether the State manages this process internally or through a contracted agency, the idea of simplifying this process for schools to be able to best leverage the program can be considered.

Municipalities and Counties may finance broadband networks more cost-effectively than the Private Sector

Throughout the country, municipalities and counties have financed the capital costs to build broadband networks through obtaining revenue bonds or general obligation bonds. This financing is typically available for low interest rates of 3-6%. Alternatively, financing for a private sector fiber network may have interest rates of 5-15%. Leveraging municipal loan programs, especially in rural areas where it is difficult for the private sector to establish funding with marginal returns on investment, may prove to be a good strategy for rural areas throughout the State.

Additionally, there are a number of other financing options available, including New Market Tax Credits, economic development loans, retail sales tax funds, and bond financing through a number of different structures and types of bonds.

State-sponsored Competitive Grant Programs for Broadband Planning and Implementation

Many states have established competitive grant programs available for municipalities, counties or regional councils of governments. Other states have created grant programs that allow any entity to be eligible for funding. These grant programs can be designed for funding technical assistance and broadband planning and can also be available for broadband construction and implementation.

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[19] *The MCNC website for K12, The North Carolina Research & Education Network, and the NC School Connectivity Initiative, See https://www.mcnc.org/our-community/k12 and https://www.mcnc.org/collateral/north-carolina-research-education-network.html*

The top three states that have provided grant funding for broadband implementation include California, Massachusetts and New York. In January of this year, New York's Governor Andrew Cuomo launched a $500 million broadband initiative called "Broadband for All" with the goal to "ensure that every New Yorker has access to high-speed Internet service by the end of 2018."[20] This is the largest state-sponsored grant program in the country for broadband implementation. The program requires a 50% match, increasing the total investment to be made for broadband infrastructure to $1 billion. Per the Application Guide, "The program calls for applications for funding to provide access to broadband at speeds of at least 100 megabits per second (Mbps) (download) in most places, and 25 Mbps (download) in the most remote unserved parts of the State, with priority given to applications that will provide broadband to Unserved communities, libraries, and Educational Opportunity."[21]

Established in 2007, the California Advanced Services Fund (CASF) initially provided $100 Million in grant and loan programs for areas that are unserved or underserved. The State of California has continued to provide additional support for this program by allocating in 2010 additional funds of $100 Million in a Broadband Infrastructure Grant Account, $10 Million to the Rural and Regional Urban Consortia Account and $15 Million to the Broadband Infrastructure Loan Account.[22]

Massachusetts set aside $50 Million in grant funding targeted specifically to western Massachusetts, the most underserved area in the State. The fund encourages municipal and private sector collaboration to serve forty-five towns in this area of the State.[23] Additionally, the State established the Massachusetts Broadband Initiative (MBI) in 2008 to provide assistance, education and funding to further accelerate broadband deployment. The MBI was given the authority to invest up to $40 million in State-sponsored funding for broadband-related infrastructure and improvement projects.

Other states have smaller grant and loan programs but still have a significant impact on broadband acceleration. Mentioned previously, in Colorado, the State offered $20 Million in broadband infrastructure implementation funding which spurred investment primarily by leveraging this and other grant funding programs. These programs have facilitated more broadband infrastructure to be deployed especially in difficult to serve, rural and remote parts of the State.

The Connectivity and Utilization Report outlines the current state of broadband infrastructure in Tennessee. Areas in Tennessee that are lacking broadband services are located primarily in rural and remote areas of the State. In rural areas, the capital costs required to build out fiber or even wireless services are higher as rural areas are remote with the population geographically dispersed. Access to Internet "supply" (locations where there is an Internet hub) are often located in larger cities or population centers. Options for accessing Internet hubs, which are typically described as Internet backhaul or transport costs, are to either build fiber to this Internet hub location, to build a point-to-

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[20] *New NY Broadband Program, "Broadband for All," see https://www.ny.gov/programs/broadband-all*
[21] *New NY Broadband Grant Program Request for Proposal Guidelines, see http://nysbroadband.ny.gov/sites/default/files/documents/new-ny-broadband/New%20NY%20Broadband%20Program%20RFP%20Guidelines-%20FINAL.PDF*
[22] *California Advanced Service Fund, see http://www.cpuc.ca.gov/casf/*
[23] *Massachusetts Broadband Initiative, see http://broadband.masstech.org/ and Wired West, see http://wiredwest.net/*

point digital microwave link, or to lease existing facilities. In any of these options, the capital costs are high and/or the monthly access charges are high.

These high monthly backhaul charges or capital costs to connect to Internet hubs are difficult to finance as rural areas do not have the population to support an adequate return on investment for any providers to upgrade their networks. This leaves rural areas with few options for improving broadband services.

Further complicating the high capital costs to build infrastructure in or to rural markets, is the challenge of making a business model work in a rural market. Population density is lacking in rural areas and the number of potential business and residential customers is relatively small, creating an undersized revenue opportunity compared to a larger market. Additionally, the challenge of finding people, technicians and a management team to operate and manage the system in rural and remote areas is sometimes difficult.

Given these difficulties, the State of Tennessee could consider providing a subsidy program for rural areas throughout the State. Additionally, the subsidy or grant program could be made available on a regional basis as rural towns located within a region have similar challenges, often requiring a regional approach, rather than a one community application.

Provide for Accountability for CAFII Funding and Other Federal Funding Programs

On September 15, 2015 the Federal Communications Commission authorized ten telecommunications carriers to receive over $9 billion in support from Phase Two of the Connect America Fund. These funds are to be distributed over a six-year period for rural broadband deployment throughout the United States. In Tennessee, over $29.9 million in annual funding over six years was awarded to three telecommunication companies: AT&T, Frontier and Century Link.[24]

Funding by Carrier – as of August 2015

Price Cap Carrier	Homes & Businesses Targeted	Support Amount in Dollars
AT&T	81,173	$26,137,862
Frontier	6,458	$2,126,605
Century Link	5,791	$1,662,828
	Total	**$29,927,295**

[24] *FCC Connect America Fund, see https://www.fcc.gov/general/connect-america-fund-caf*

Similar amounts were awarded for all states to facilitate broadband infrastructure to unserved and underserved areas. The State of Tennessee could consider use of a State Broadband Office to better understand where these investments are being made in the State and to provide accountability for this funding as well as other federal funding programs. Education provided by the CAFII recipients on how funds will be spent can help inform the State on its other initiatives for furthering broadband deployment.

SECTION C: Improving Utilization and Broadband Impacts

At the core of broadband's economic importance is the expanding role of Internet applications as a critical factor of production, collaboration and innovation in a modern economy. While robust bandwith opens up the potential of the Internet, users must still acquire Internet tools and skills which they need to learn to apply effectively and efficiently. Businesses, households and community anchor institutions (CAIs) that do not effectively use Internet tools and processes are at a serious disadvantage compared to peers leveraging Internet applications.[25] This impacts the local and State economy as well as quality of life for Tennesseans.

In the Strategic Framework we suggest the following objective and reommendation:

Objective 2: Leverage existing and new broadband infrastructure by promoting broader and more intensive utilization of the Internet by residents, businesses and community anchor institutions.

> **Recommendation:** Develop specific initiatives that target key constituencies that are either not using or are under-utilizing the Internet.

The Connectivity and Utilization Report identified key groups of Internet users that are under-utilizing the Internet.

In this Tennessee eStrategy Report we examine steps that can be taken in driving meaningful use of Internet applications and the resulting economic impacts of this broadband goal. Additionally, this section provides strategies and options for targeting under-performing groups among businesses, community anchor intuitions and households. In each of these three sectors, this report identifies:

- Strategic target groups where there are significant gaps, barriers, and/or opportunities that offer significant socioeconomic impacts by addressing them.
- Areas of focus with actionable insights and steps to address the gaps, barriers, opportunities with the target groups.
- Options for engaging these groups in a process that drives utilization of impactful Internet applications.
- Analysis of investments required and benefits of program options.

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25 The current use and impact of broadband in Tennessee has been documented in the report on Internet Connectivity and Utilization in Tennessee 2016 which also documents business revenues, job creation and household income, see Section B2 – pages 37 to 41.

1. Internet Utilization by Businesses

Target Businesses Sectors

Businesses with lower utilization of the Internet and its applications are less competitive and productive than their peers. Addressing low levels of utilization should be a priority to help firms effectively compete in their existing and potential new markets. Prioritization of business target groups should include assessing the potential for retention and expansion of existing local businesses as well as creating new well-paying jobs. Initiatives should target industry sectors that make the largest contribution to the economy and that have the greatest growth potential.

To develop a more precisely defined target group, it is useful to examine which groups are under-utilizing the Internet and correspondingly under-performing. A consistent factor in under-utilization by businesses is **location in a non-metropolitan area, especially one that is economically disadvantaged.** Businesses outside of a metropolitan area and in economically disadvantaged counties do not benefit from dense networks of support or skilled labor pools. This is reflected in the significantly lower Internet utilization levels of businesses in At Risk and Distressed counties in Tennessee[26].

Small to medium sized businesses with 1 to 49 employees are also effective targets to benefit economies. This segment is important for the following reasons:

- It includes 93.7% of all establishments in Tennessee[27].
- This segment is a dynamic engine for employment growth, especially through use of the Internet.[28]
- These organizations experience the weakest utilization levels compared to businesses with larger numbers of employees.[29]
- Small businesses have the least internal capacity and expertise to adopt more sophisticated and productive Internet applications.

Utilization by Industry Sector is a third critical factor in identifying target businesses. As seen in the following table, many industry sectors in economically disadvantaged counties are more likely to lag behind their peer groups. The table also identifies the three largest industry sectors by employment (in bold). The information in this table can assist the State in selecting target industry sectors.

[26] *Internet Connectivity and Utilization in Tennessee 2016, Page 43.*
[27] *County Business Patterns – 2013*, US Census Bureau, http://www.census.gov/data/datasets/2013/econ/cbp/2013-cbp.html
[28] *Internet Connectivity and Utilization in Tennessee 2016, Page 36.*
[29] *Internet Connectivity and Utilization in Tennessee 2016, Page 43.*

Figure 1: Business Internet Utilization by Sector and Economic Status

	Median DEi Score (Businesses)		
Major Industry	**Distressed and At Risk**	**Transitional, Competitive and Attainment**	**Variance**
Information	7.28	8.64	1.36
Construction	5.34	6.50	1.16
Transportation & Warehousing	5.63	6.70	1.07
Accommodation & Food services	6.12	7.18	1.06
Wholesale Trade	6.07	7.09	1.02
Health Care & Social Assistance	**6.26**	**6.99**	**0.73**
Arts, Entertainment & Recreation	6.94	7.62	0.68
Manufacturing / Processing	**6.65**	**7.18**	**0.53**
Retail Trade	**6.65**	**7.18**	**0.53**
Professional & Technical Services	6.89	7.38	0.49
Real Estate	6.89	7.28	0.39
Finance & Insurance	7.77	7.77	0.00

Prioritizing industry sectors and other economic groups is best done within a local or regional context. Local and county level planning can consider regional factors and considerations, such as industry sectors in decline or existing regional efforts to develop specific sectors. Rather than undertaking broad but untargeted efforts, a strategic approach to leveraging broadband should focus on industries that have the highest economic contribution and highest growth potential.

Target groups with the greatest local economic contribution and highest growth potential among businesses:

1. **Lagging sectors with large economic impact: information services, transportation and warehousing, health care, manufacturing and retail trade.**
2. **The small-to-medium enterprise segment.**
3. **Businesses in non-metropolitan areas, especially those in economically disadvantaged counties.**

Areas of Focus: Actionable insights and Steps to address gaps, barriers, opportunities

Data from the Connectivity and Utilization Report shows which types of Internet enabled applications and processes have the greatest disparity in usage between smaller and larger businesses. The same assessment found a similar pattern of variation between businesses in economically disadvantaged counties (At Risk and Distressed) and the other counties in Tennessee, with the largest variances occurring in teleworking, delivery of services and content online, multimedia content on website, and accessing collaborative tools.

Figure 2: Business Internet Utilization by Size of Firm and Selected Applications

Currently Used Applications and Processes	0 to 19	20 to 99	100 +	Level of Variance*
Staff training and skills	56.5%	76.9%	88.5%	32.0%
Teleworking	42.4%	53.4%	70.2%	27.8%
Multimedia content on website	43.8%	57.0%	67.3%	23.5%
Accessing collaborative tools	62.4%	74.2%	85.6%	23.2%
Web site for organization	74.6%	87.2%	92.3%	17.7%
Supplier coordination	78.2%	88.7%	93.3%	15.1%
Deliver services and content	40.4%	45.1%	53.8%	13.4%
Customer service and support	68.8%	73.9%	80.8%	12.0%
Advertising and promotion	62.8%	64.4%	69.2%	6.4%
Purchasing goods or services	82.6%	81.0%	88.5%	5.9%
Selling goods or services	57.5%	56.1%	58.7%	1.2%
Social networking	72.8%	73.6%	70.2%	-2.6%

*Variance is calculated as the difference between small firms (0-19 employees) compared to firms with 100+ employees.

Focus on the most impactful Internet applications for increasing utilization among small to medium businesses which are those with relatively low utilization and high variation:

1. **Multimedia & interactive web content**
2. **Delivery of services and content online**
3. **Teleworking**
4. **Staff training and skills development**
5. **Accessing collaborative tools**
6. **Customer service and support**

Options for Driving Utilization with Target Businesses

Businesses need to understand how to capitalize on opportunities available online through the use of Internet applications. Investments needed to support initiatives aimed at improving Internet utilization and increasing businesses' competiveness are relatively small when compared to costs of new Internet infrastructure. An example of costs for improving utilization by businesses would be the funding of specialized capacity within existing organizations such as economic development agencies, chambers of commerce or workforce training agencies. This new capacity should be targeted at economically disadvantaged areas.

The Connectivity and Utilization Report clearly identifies self-directed, online approaches as the most attractive learning process option for most businesses[30]. A relatively low cost initiative would be to develop online resources aimed at specific business target groups. Combining specialized human resources at a local level with statewide online assessment and learning resources can be a cost effective approach.

Two distinct approaches should be considered that draw on existing institutional capacity:

1. **Delivering online support to specific industry sectors by using Statewide industry associations to deliver awareness and skill building initiatives to their members.[1]**
2. **Deploying a small business Internet utilization initiative that partners with local and regional business support organizations (chambers, small business development centers, and economic development agencies) to carry out outreach, assessment and education.**

Benefits from Driving Utilization with Target Businesses

The desired benefits from investing in improved Internet utilization by businesses can be broken down into at least five categories:

1. **Revenue creation for businesses**: the most immediate and tangible benefit from improved Internet utilization should be seen in the individual businesses that adopt or improve their use of specific Internet processes. The largest impacts, as seen in Tennessee business data collected in 2016 (Figure 3), are in revenues facilitated by the Internet.

Figure 3: Annual Revenues and Cost Savings from Internet Utilization

Annual Revenue Impacts				
	# of Establishments	Total Annual Revenue ($M)	Annual Revenue from Internet ($M)	Percent Internet Revenue
Statewide	689	$3,683	$2,436	66.2%
Distressed Counties	41	$34	$12	36.2%
At-risk Counties	123	$210	$75	35.8%
Other counties*	525	$3,440	$2,349	68.3%

Annual Operating Cost Impacts (Statewide)			
Number of Establishments	Total Annual Operating Cost ($M)	Cost Saving from Internet ($M)	Percent Cost Saving
328	$803	$29.70	3.60%

The new revenues and cost savings are significant for businesses that reported benefits. With just over 50 percent of business having a DEi utilization score of less than 7, the majority of

[30] *Internet Connectivity and Utilization in Tennessee 2016, Page 49.*

businesses in Tennessee seem to have significant opportunities increase their understanding of the impact of the Internet on their business, but they need help. This is especially true in economically disadvantaged counties that lag other counties in both Internet use and revenues enabled by the Internet.

2. **Business adaptation to global and national shifts in markets and supply chains**: Adaptation and opportunism are keys to the sustainability of a business today. The Internet is a huge part of meeting ever-changing threats and opportunities. Businesses need to understand and respond to these changes as they relate to their specific business.

3. **Job creation and the local economy**: The Connectivity and Utilization Report outlines the extent to which the Internet contributes to job growth[31], with jobs facilitated by the Internet accounting for 43 percent of all net new jobs. The findings of the report underscore the large and critical role that the Internet plays in the shift to a knowledge economy at the local, regional and State levels. Furthermore, additional local jobs are created when businesses decide to implement Internet applications. The need for technical support and business management expertise offers well-paying job opportunities, especially with small businesses and in rural, economically distressed areas.

4. **Innovation and incorporation of the growing knowledge economy into the structure of local and regional economies:** The health and sustainability of a local or regional economy consists of more than job creation. It requires the emergence of new businesses and new business models that innovate and respond to opportunities, whether local or not. The Internet and its effective use are essential to this process because innovative businesses look for a supportive environment when making locational decisions. Whether looking for skilled employees, experienced contractors or possible partners, modern businesses increasingly look for a community that is supportive of their efforts. The ability of a community to encourage, support and train businesses in making more effective use of the Internet can produce major benefits for the local economy.

5. **Sustainability and continued growth of Internet service provision**: Internet Service Providers (ISPs) of all types need customers to pay for the development, maintenance and growth of Internet infrastructure and services. Moreover, if ISPs are to develop high capacity Internet infrastructure they need customers willing to pay for premium services. It is not uncommon for an ISP to develop a fiber network and then struggle to find customers willing to pay for more than the basic costs[32]. Increasing Internet utilization by businesses results in more businesses understanding why they need premium services and willing to pay more for faster and more reliable service.

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[31] *Internet Connectivity and Utilization in Tennessee 2016, Page 36.*

[32] *Strategic Networks Group has worked with fiber-based ISPs who have struggled to establish the penetration rates need to sustain their networks. Even where penetration rates are healthy, fiber-based ISPs can find it particularly difficult to sell premium services to businesses.*

2. Community Anchor Internet Utilization

Community anchor institutions (CAIs – libraries, local governments, schools, etc.) comprise a key sector that utilizes the Internet to improve the well-being of communities and their residents. Many community anchor institutions also play a critical role in the adoption and utilization of the Internet by local businesses and residents. Improving the effectiveness of these CAIs is a worthwhile objective that can generate significant benefits to the citizens, businesses and civic bodies of Tennessee.

Target Community Anchor Institutions

The Connectivity and Utilization Report carried out in early 2016 identified local government bodies and CAIs in economically disadvantaged counties as having low utilization, both in comparison to other CAIs in their area and compared to local governments in other parts of the State. There is also a large difference in utilization between health care providers in economically disadvantaged counties and counties designated as transitional, competitive or attainment.

Figure 4: CAI Utilization by Type of Institution and County Economic Status

Utilization Levels (Median DEi)	*At Risk & Distressed Counties*	*Transitional, Competitive and Attainment Counties*
Economic Development Org	7.67	8.06
Library	7.09	7.48
K - 12 Education	6.41	6.70
Health Care	6.21	7.38
Local Government	5.34	5.92

Target local governments and health care providers in counties that are at-risk or distressed and which have the highest potential for improving Internet utilization and generating gains in productivity, service delivery improvement and budget savings.

Areas of Focus: Actionable insights and steps to address gaps, barriers, opportunities

Local Government: Data collected for the Connectivity and Utilization Report in 2016 included responses from 192 local governments and how they utilize the Internet. The findings show that local governments in economically disadvantaged counties are less likely to deliver services online (29.3% versus 47.1% in non-economically disadvantaged counties) and less likely to use cloud computing (28.6% versus 51.9%). These are two areas that require a shift in the mindset of a local government, as well as requiring the acquisition of those skills not available in-house.

Health: With the growing demands for health services from an aging population, tele-homecare and remote consultation with patients would seem to be natural priorities. Evidence from Connectivity and Utilization Report indicates that patients are open to receiving health care services remotely or online[33]. However, only 8.1% of the not-for-profit and government health service providers currently have tele-homecare service and 22.3% provide remote consultation with patients.

Any strategies targeting a CAI sector need to be developed in close consultation with that sector. An appropriate strategy for improving Internet utilization among CAIs would include having a State Broadband Office (or other entity) that works with the health and local government sectors to better understand and articulate initiatives for acquiring skills and capabilities.

Option for Using Community Anchor Institutions to Drive Utilization with Households and Businesses

Community anchor institutions play an important role in broadband initiatives aimed at the general public and business community. Given their strong performance in utilizing the Internet and the role in their communities, an attractive strategy would be to partner with economic development agencies and libraries. The connectivity and utilization assessment of Tennessee provides evidence that economic development agencies and libraries have high utilization regardless of the economic status of their counties.

Economic development agencies are well placed to help businesses increase their Internet utilization and maximize the potential benefits. Many of these agencies already have connections with individual businesses and provide some forms of skills development, mentoring and support. Similarly, libraries have existing profile and capacity to reach the general public, especially children and seniors. Libraries can, with additional resources to expand their awareness and education efforts, focus on people with low or no Internet skills. Libraries also are a key source of free access to the Internet for school-aged children and lower income individuals.

Libraries and economic development agencies should be considered strategic partners in driving Internet utilization, as well as Internet access. Targeted investments in expanding the capacity of community anchor institutions to increase Internet utilization is a cost effective strategy.

Benefits from Using Community Anchor Institutions to Drive Utilization with Households and Businesses

The benefits from increased utilization by local governments and health care providers, especially in economically disadvantaged areas, can be anticipated in a number of areas including but not limited to:

1. Increased access to government information and services by citizens and businesses, especially rural residents, resulting in less time and money spent on travel;
2. Transparency and participation by citizens in local government;

33 Internet Connectivity and Utilization in Tennessee 2016, Page 52.

3. Financial savings by local governments due to the ability to share program delivery costs that can be delivered online or through shared cloud services with other local and regional governments (e.g. GIS services and permit applications);
4. Financial savings by health care funders due to more efficient delivery of services, especially in regards to the elderly who can age-in-place for longer and require less institutional care; and
5. Higher quality of life for many elderly consumers of health services, including more responsive services and greater access to specialized consultations.

In addition, assisting organizations such as libraries and economic development agencies to extend their capacity to address the Internet needs of their members and constituents is a very efficient and effective strategy that will result in:

6. Enhanced library services that respond to the changing needs and cultural dynamics of their communities.
7. Greater access to Internet related training and mentoring for local businesses and residents.

3. Household Internet Utilization

Improved utilization of the Internet brings significant economic benefits to households, including additional income, telework, home-based businesses, access to the work place from home and education or training. The 17,776 households from across Tennessee that participated in the Connectivity and Utilization Report provide a rich source of information that can inform policy and planning.

Target Populations

Households that underutilize the Internet are disproportionately lower income, less educated, older and/or rural. Low income households tend to have affordability issues, with 80.5% of households with less than $30,000 income stating that affordability was a major concern in selecting their Internet Service Provider.[34] There are strong similarities between people that do not adopt and who under-utilize the Internet. [35]

For seniors (65 and older), major barriers are Internet skills and a limited appreciation of potential benefits. When compared to people between 18 and 35, those 65 and older are 50% more likely to say that the complexity of the Internet is a major barrier to improved utilization. Additionally, while they face more health issues than younger Tennesseans, seniors are slightly less likely so cite improved health services as a benefit of the Internet. [36]

Households with low Internet adoption represent an important group due to the social and economic benefits that can be accessed through the Internet. As governments and businesses move their services online to achieve better reach and cost efficiencies, it is increasingly important that citizens have the ability to access and benefit from these online services.

Given that utilization is strongly tied to age and income, programming should be targeted at people 65 and older as well as households with lower incomes.

Areas of Focus: Actionable insights and steps to address gaps, barriers, opportunities

The two most important issues for those that under-utilize the Internet are reported as:

- slow or unreliable Internet service
- concerns over privacy and security

[34] *Data collected for the Internet Connectivity and Utilization in Tennessee 2016 report.*
[35] *An excellent source of information and analysis on non-adoption of the Internet (as well as not having home-based broadband) is the Pew Research Center.*
[36] *Data collected for the Internet Connectivity and Utilization in Tennessee 2016 report.*

Connectivity issues are addressed to some extent in Section B. However, one aspect of poor connectivity is the affordability of premium or higher quality Internet services. While broadband that meets the 25/3 standard may be available, it may not be seen as affordable or of sufficient value. Improving the affordability, reliability and predictability of broadband connectivity is one key to improving Internet utilization by households.

Concerns with security and privacy are more closely related to the skill and experience of the user. Households that identify themselves as having basic or few Internet skills are almost twice as likely to state that privacy and security concerns are a very important barrier to increased use of the Internet.[37] Improving the ability of consumers to deal with privacy and security concerns should be a major focus of any effort to increase broadband utilization.

Options for Driving Utilization with Households

Driving utilization of the Internet among target populations requires increasing awareness and appreciation of the potential benefits of using the Internet, as well acquiring specific skills. Utilization initiatives and digital literacy should focus on themes rather than merely skills and could include:

- Learning to start a business, work remotely, or supplement income
- After school access to learning, online training, certification opportunities, etc.
- Accessing health services remotely, especially for aged or chronic care patients
- Better access to government services and more effective participation in government processes

Participants in the statewide assessment of Internet connectivity and utilization clearly identified self-directed online learning as the preferred means of increasing their skills. Rather than trying to entice target populations into traditional training programs such as classroom courses, Internet adoption and utilization initiatives should reflect the preference for both self-directed online resources, as well as existing informal networks that already have participation by these target groups[38]. These can include senior centers, libraries, churches and community centers.

In designing initiatives to increase and improve Internet utilization by households and organizations, considerable weight should be given to those learning methods that are preferred by the target populations.

[37] Data collected for the Internet Connectivity and utilization in Tennessee 2016 report. 58.9% of less skilled Internet users reported privacy and security concerns as a major barrier to increased Internet use. The equivalent percentage for highly skilled users was 30%.
[38] *Internet Connectivity and Utilization in Tennessee 2016, Page 59.*

Benefits from Driving Utilization with Households

Numerous benefits arise from improving Internet utilization by the general public. Some of these accrue to the individuals and households who improve their Internet utilization. However, many of the benefits accrue to government service providers and to the overall community. Those benefits that pertain to productivity and economic well-being include:

1. Improvement in personal and household income and employment:
    - Home-based businesses: Broadband provides individuals with the option to earn a living by establishing their own home-based business. More than 23% of Tennessee households surveyed said they ran a home-based business, thereby increasing their incomes and providing additional income security. Thirty-six percent of households in Tennessee reported some level of additional household income from using the Internet while 20 percent of households reported at least $5,000 per year in additional income. More than 90% of home-based businesses said broadband was essential for their business. Improving the skills of this group would result in more profitable and sustainable incomes.
    - Telework: Twenty-five percent of households said someone in their home teleworked. This enabled them to be more productive, improve their lifestyle through less travel and more time with family and remain in their current community even though their employer was located elsewhere. Improving skills among the general public would make teleworking a more attractive option. Increasing teleworking has additional benefits of reducing demand on transportation systems, while also reducing carbon emissions.
    - Training and job advancement: Improving Internet skills helps individuals earn more income by enhancing their job situation. 25 percent of households stated that they had a family member that improved their employment situation (at least in part) through use of the Internet.[39]

2. Improved access to government services:
    - By moving some or all of their services to the Internet, public service providers can reach their consumers more quickly and efficiently. This is especially true in low population density areas, where consumers need to travel long distances to access government services. However, the ability of agencies to move their services to the Internet is constrained by those members of the public that do not want to or cannot access the Internet. Increasing the number of active Internet users reduces the need for expensive parallel service delivery systems. Initiatives to increase Internet literacy are a sound long-term investment from both a social and fiscal perspective.

[39] *Internet Connectivity and Utilization in Tennessee 2016, Page 40.*

SECTION D – Building Capacity to Facilitate Internet Connectivity and Utilization

In order to succeed in achieving the goals and objectives set out in the Strategic Framework (Section A), Tennessee must develop the capacity and instruments needed to define and implement broadband regulations and programs by adopting the following objectives and recommendations:

Objective 3: Enhance instititional capacity and leadership to promote and facilitate the State's broadband initiative.

> **Recommendation:** Establish a State Broadband Office and Local Technology Teams with defined functions and measurable objectives.

Objective 4: Dedicate multiyear resources to making Tennessee a national broadband leader.

> **Recommendation:** Develop and adopt a three to five year action plan supported by appropriate legislation, regulation and financial resources.

This section examines in greater detail the steps that can be taken in pursuit of the above broadband goals and objectives.

1. Establish a State Broadband Office and Regional Technology Teams

A key factor in achieving high standards for broadband at the State level is the State's institutional capacity and regulatory environment. A recent comparative assessment of 48 States ranked performance on broadband across five different measures: availability, adoption, meaningful use, investment and regulation[40]. Tennessee ranked 40th. Half of all States and 25 of 48 States surveyed reported that they have a broadband office. State broadband offices average 3.8 employees, with a median of 3 employees. The most common activity carried out by these Broadband Offices is "planning and support", carried out by 82% of Broadband Offices. Infrastructure is being funded by 45% of Broadband Offices.

After ranking the performance of the States, a key finding that was that State broadband offices were closely related to performance results:

- 19 of 20 States in the top 20 have a State broadband office.
- 16 of the bottom 20 do not have a State broadband office.

State broadband offices play a critical role in developing, managing and evaluating broadband initiatives such as those described in the preceding sections on improving Internet connectivity and utilization. Section B describes in some detail the roles that a State broadband office can play to facilitate

[40] *Strategic Networks Group (SNG) in partnership with the Rural Telecommunications Congress (RTC). See Appendix 3. http://sngroup.com/wp-content/uploads/2016/05/50-States-of-Broadband-Overview-reissued-3may2016.pdf .*

broadband infrastructure that meets the objectives of 25/3 connectivity to the home and fiber to every community.

In addition to facilitating connectivity efforts, a State broadband office can play an important role in promoting broadband adoption and improved utilization. Most of the recommendations included in Section C to increasing Internet utilization and its impacts would greatly benefit from leadership and monitoring by a State broadband office.

However, in addition to capacity at the State level, institutional capacity is also needed at the local and regional levels as much as the State level. The success of State broadband offices can be greatly enhanced by developing regional and local partners. In some States this takes the shape of regional technology or planning teams. As described in Section B, regional technology teams can play a critical role in assessment of infrastructure needs and opportunities, as well as the development of local and regional solutions and partnerships. The benefits of regional technology teams are particularly important in economically disadvantaged counties which have the greatest gaps in both Internet infrastructure and utilization.

This report recommends that the State establish a broadband office with specific responsibilities for heading up the initiatives outlined in the report. The core responsibilities of the broadband office should include:

1. **In the first year of operation, development of a detailed work plan for implementation of broadband initiates approved by the State Government**
2. **Implementation of the work plan**
3. **Facilitation of Intra- and Inter-Government planning and cooperation**
4. **Tracking the impact of broadband initiatives and report to the State Government**
5. **Initiation and support of local technology planning teams.**

2. Enact a Multi-year Action Plan

Broadband initiatives benefit from a clear mandate, a supportive regulatory environment, and needed financial resources. A key element of any mandate would be a multi-year commitment that allows for initiatives to take root and prosper. The mandate does not need to be open-ended, but it does need more than a one or two year commitment to allow enough time for broadband infrastructure to be built and for utilization initiatives to drive meaningful use and socio-economic returns. While the structure of this plan is best determined by the State and its stakeholders, the presence of such a framework is critical for success.

SECTION E – Concluding Comments

In an increasingly networked and knowledge intensive economy, high speed and reliable Internet is a growing differentiator that impacts businesses, communities and states. Tennessee has areas of leading-edge broadband infrastructure[41], however when compared nationally the State as a whole ranks 40th in broadband based on five different factors.[42]

Faced with this challenge, Tennessee needs to catch-up to other states in terms of broadband infrastructure and utilization of the Internet applications. In the longer run, the goal should be to become a leader in the knowledge economy. If Tennessee is able to succeed in building a platform for all to more effectively participate in the knowledge economy, it will enable greater prosperity for its citizens, businesses and communities. Moreover, Tennessee will be able retain and grow existing local businesses as well as attract innovative businesses, entrepreneurs and skilled workers.

The policies and strategies proposed in this report provide evidence-based insights for discussion, decisions and action. By uncovering the "why it matters" and quantifying the impacts of broadband, TNECD now has a strategic framework to manage the broadband ecosystem and drive economic opportunities and advancements for Tennesseans.

[41] *Internet Connectivity and Utilization in Tennessee 2016, Pages 14 – 15.*

[42] *This ranking takes into account five factors: availability of Internet service at 25 Mbps download and 3 Mbps upload; percent of households that subscribe to broadband (where available); whether States drive "meaningful use" of the Internet through training and education, as well as tracking of economic impacts; the degree to which a State invests in broadband, including infrastructure financing and funding of a State broadband office; whether the State has a regulatory environment that discourages, restricts or bans participation by municipalities or other entities. See Section D1 and Appendix 4.*

Appendix 1 - List of Figures

Appendix 2 - Broadband Technologies

There are many types of broadband connections available to consumers. The main options include:

DSL (Digital Subscriber Line) uses existing copper phone lines to deliver download and upload speeds typically between 1.5 Mbps to 25 Mbps according to the Tennessee speed tests. DSL speeds diminish as distance increases from the telephone company's central office. Homes or businesses located more than three miles from the central office will receive slower speeds. There have been many improvements to DSL technologies to improve the speed available. VDSL (Very High Bit Rate Digital Subscriber Line) can support up to 52 Mbps, but most Internet service providers do not support this type of service, including providers in the Tennessee region.

Cable modem service uses coaxial cables already installed by the cable TV operators to provide broadband service. Cable operators are upgrading their cable networks by installing fiber optic cable closer to neighborhoods. These network improvements allow cable modem service to support up to 400 Mbps though Tennessee speed test results typically fell between 10 and 100 Mbps. This connection type is a shared service, meaning, as more people are on the network within a neighborhood, the speed available to each customer diminishes.

Wireless broadband connects a home or business to the Internet using a radio link between the customer's location and the service provider's facility. Wireless technologies using longer-range directional equipment provide broadband service in remote or sparsely populated areas where DSL, cable modem or fiber service would be costly to provide.

Wireless broadband can be mobile or fixed. Wireless services can be offered using both licensed spectrum and unlicensed devices. Wi-Fi networks typically use unlicensed spectrum. Wi-Fi networks use wireless technology from a fixed point and often require direct line-of-sight between the wireless transmitter and receiver. Wi-Fi networks can be designed for private access within a home or business, or be used for public Internet access at "hot spots" such as restaurants, coffee shops, hotels, airports, convention centers, and city parks. Using licensed spectrum, greater amounts of bandwidth can be delivered and often do not require direct line-of-sight.

In some communities, especially sparse, geographically diverse rural communities, providers may build out a wireless solution as an alternative to capital-intensive fiber optic infrastructure. While wireless technology does have its limitations, needing to design for "line of sight' requirements as well as to support "shared" bandwidth on the network, smart engineering can deliver good connectivity.

Wireless Local Area Networks (WLANs) provide wireless broadband access over shorter distances and are often used to extend the reach of a "last-mile" wireline or fixed wireless broadband connection within a home, building, or campus environment. An in-home Wi-Fi network is a WLAN – it does not use spectrum, rather it sends radio waves at a limited range. Mobile wireless broadband services are also becoming available from mobile telephone service providers. These services are generally appropriate

for highly-mobile customers and require a special wireless card with a built-in antenna that plugs into a user's laptop computer. The speed test results in Tennessee recorded typical speeds for fixed wireless between 3 and 100 Mbps and for mobile wireless between 3 and 50 Mbps.

Satellite is another form of wireless Internet, and is also useful for serving remote or sparsely populated areas. Typically, a consumer received (download) at a speed of between 1 to 25 Mbps and send (upload) at a speed of between 200 kbps and 1.5 Mbps. Service can be disrupted in extreme weather conditions.

Fiber optic technology converts electrical signals carrying data to light and sends the light through glass fibers about the diameter of a human hair. Fiber transmits data at speeds exceeding one gigabit per second, well in excess of all other mainstream technologies. Fiber to the home or to the business is the best way to provide abundant broadband, but it often is the most capital-intensive to build. Speeds for fiber in the Tennessee speed test results typically fell between 10 Mbps and 1 gigabit. Fiber to homes and businesses is not yet available anywhere on a comprehensive, statewide basis, and the State of Tennessee is in line with much of the U.S. with the percentage of homes that are connected directly with fiber. Across the U.S., approximately 25 percent of the homes are connected with fiber.

Other Technologies: Respondents sometimes indicate that they are served by a technology other than those listed above. In some cases this may be a result of a lack of knowledge about the technology that underlies their ISP branded service.

Appendix 3 - Grant Programs

There are numerous grant and low-cost loan programs that have been established to fund broadband infrastructure deployment.

Rural Broadband Experiments and Connect America programs are available to unserved areas; the definition for eligibility is 3 Mbps combined upload and download. As the FCC in 2015 raised the definition of served to 25 Mbps download and 3 Mbps in upload speeds, there may be funds available through the Connect America to a wider group of communities. One caveat currently of the Connect America program is that it is available for Eligible Telecommunication Carriers.

The **Telecommunications Infrastructure Loan Program** available through the USDA "makes long-term direct and guaranteed loans to qualified organizations for the purpose of financing the improvement, expansion, construction, acquisition, and operation of telephone lines, facilities, or systems to furnish and improve Telecommunications service in rural areas. The definition for "rural area" is within the boundaries of any incorporated or unincorporated city, village, or borough having a population less than 5,000 inhabitants."

The **Rural Broadband Loan Program**, which is part of the Farm Bill, "is designed to provide loans for funding, on a technology neutral basis, for the costs of construction, improvement, and acquisition of facilities and equipment to provide broadband service to eligible rural communities." Again, the definition of rural includes communities with a population less than 5,000 inhabitants.

The E-rate Program is administered by the Universal Service Administrative Company (USAC) under the direction of the FCC and provides discounts of 20 to 90 percent for broadband to and within elementary and secondary schools (public and private) and public libraries in rural and non-rural areas. E-rate funding is available for schools and enables recipients to purchase high-speed connectivity to their premises and to purchase the equipment necessary to deploy Wi-Fi within their buildings. Beginning in 2016, schools and libraries can pursue E-Rate funding to construct their own networks, such as one for an entire school district. Discounts for support depend on poverty levels and whether the school or library is urban or rural. Funding is provided through an annual application process for schools and libraries. The funding year begins on July 1 and ends on June 30 of the following year.

Continued funding for recipients in the future will be increasingly contingent upon their ability to meet FCC bandwidth goals. Currently the FCC is targeting 100 Mbps per 1,000 students in the short run and 1Gbps bandwidth in the long term. Coordination throughout the State allows for additional funding to be made available.

The **Rural Healthcare** program is administered by the Universal Service Administrative Company (USAC) under the direction of the FCC, and provides funding support to healthcare providers for recurring and non-recurring expenses, as well as expenses associated with constructing, maintaining and upgrading broadband infrastructure. Eligible healthcare providers (HCPs) may include post-secondary educational institutions offering health care instruction, community health centers or health centers providing health care to migrants, local health departments/agencies, community mental health centers, not-for-profit hospitals, rural health clinics, and consortia of one or more of such entities. Eligible HCPs must be non-profit or public.

Eligible HCPs can take advantage of two open Rural Healthcare programs:

- The Healthcare Connect Fund - Provides support for telecommunications and broadband services necessary for the provision of health care. Eligible expenses include broadband services and equipment and HCP-constructed and owned network facilities.
- The Telecommunications Program - Ensures that eligible rural HCPs pay no more than their urban counterparts for telecommunications services

The **DLT Grant Program** is sponsored by the USDA and provides technology funding for Distance Learning and Telemedicine. Awards may be used for purchase of computer hardware, audio-visual and terminal equipment, inside wiring, instructional programs and technical assistance. The mission of the program is to overcome the effects of remoteness and low population through the use of this technology. Applicants are required to provide a minimum 15 percent match and awards can range from $50,000 to $500,000.

The **Economic Development Administration** provides funding that may be used to support broadband infrastructure projects under EDA's Public Works and Economic Adjustment Assistance competitive grant programs. These programs help struggling communities promote economic expansion by revitalizing physical infrastructure and by providing technical, planning and support for public works projects. Eligibility is contingent upon the regional level of economic distress defined by factors like unemployment and wage levels. The EDA has issued awards for a wide variety of projects including: assisting in major construction of backbone facilities in Virginia; a 100 Gigabit, health-services network in Cleveland; and for the installation of conduit in San Leandro Ca. to aid in the economic development of a critical industrial area.

The Department of Housing and Urban Development (HUD) provides additional sources of grant funding for broadband development. For fiscal year 2015, HUD received $3 billion to disperse through the Community Development Block Grants and Section 108 Loan Guarantee Programs. The objective of the programs is to eliminate slum and blight by revitalizing both urban and rural communities. Awards are invested in housing improvements and expanding economic opportunity. These programs are meant to provide revitalization investment capable of renewing entire neighborhoods and typically are most successful when they serve low and moderate-income residential areas. The Public Housing Capital Fund allows Public Housing Authorities to invest capital in so called Neighborhood Networks – Internet-connected, computer labs located in Public Housing areas. Covered investments for the first year of operation include connectivity, equipment, renovation/remodel, salaries and insurance.

The **Choice Neighborhoods Program** supports communities in three primary ways: by investing in housing improvements, educational opportunities and neighborhood development. Up to 15 percent of a Choice Neighborhoods Implementation Grant can be used for these three types of improvements, including the development of neighborhood broadband facilities.

Appendix 4 – Role of State Broadband Office in State Broadband Rankings

In 2016, Strategic Networks Group undertook an assessment and ranking of all fifty States in terms of their performance regarding broadband. Forty eight States (all but New Jersey and Rhode Island) participated in the two-month initiative to collect data on five key performance areas:

- Availability of broadband (based on FCC data)
- Adoption of broadband (based on FCC data)
- Meaningful use of broadband (economic impacts tracked and training initiatives supported)
- Investment in broadband (having a positive impact)
- Regulation of broadband (having a largely negative impact)

The ranking of the fifty States were:

1. New York*
2. Ohio*
3. Maine*
4. New Mexico*
5. New Hampshire*
6. Connecticut*
7. Massachusetts*
8. Delaware*
9. Wisconsin*
10. Iowa*
11. Wyoming*
12. Kentucky*
13. Minnesota*
14. North Carolina *
15. Vermont*
16. Utah*
17. Oregon
18. Colorado*
19. Virginia*
20. Nevada*
21. Mississippi*
22. Illinois
23. Pennsylvania*
24. Hawaii
25. Oklahoma
26. California
27. Kansas
28. North Dakota
29. Arizona*
30. Washington
31. West Virginia
32. Nebraska
33. Alabama*
34. Maryland
35. South Carolina
36. Idaho*
37. Georgia
38. Alaska
39. South Dakota
40. Tennessee
41. Michigan
42. Indiana
43. Florida
44. Arkansas*
45. Louisiana
46. Missouri
47. Montana
48. Texas

*Have a State Broadband Office

Key findings:

- 19 of 20 States in the top 20 have a State broadband office
- 16 of the bottom 20 do not have a State broadband office

Appendix 5 - Glossary

Internet Connectivity and Utilization in Tennessee Report: This report presents the results of survey-based research carried out for the State of Tennessee. The assessments collected information from businesses and community anchor institutions (non-commercial entities) on the availability of broadband (high speed Internet access) and its uses, benefits, drivers and barriers. This largely descriptive report results provide insight into gaps and opportunities for increasing broadband utilization by businesses and non-commercial entities.

Digital Economy Analysis Platform (DEAP): The DEAP has been developed as an online resource that provides clients with access to the data collection results and the ability to customize their analysis across a range of variables, including industry sector or geographic region. The DEAP is accessed online by authorized users. Users are presented with **dashboards** for businesses and for households. Each dashboard is organized around a series of **pages** focused on specific topics, e.g. Connectivity, Utilization, DEi, Impacts, etc. Within each page is a set of predefined **reports** that present a chart and/or table of processed results from the datasets.

eSolutions: refers to the integration of Internet technologies with the internal computer-based systems and applications within or among organizations for a variety of operational processes. eSolutions encompass not only product delivery and payment transactions (e-commerce) but also all processes that may be facilitated by computer-mediated communications over the Internet.

eProcess: uses of the Internet which include internal operational uses, such as supplier coordination, training and teleworking.

eCommerce: uses of the Internet which include activities related to the sales, marketing and delivery of products and services; and,

Tennessee Digital Economy Index (TN DEi): The Digital Economy index (DEi) is part of the benchmarking process and provides reference points against which the performance of any individual or group can be compared. The DEi summarizes an organization's or household's utilization of 17 Internet applications and process. Based on the number of applications currently being used by a businesses or CAI, a composite score is calculated that summarizes how comprehensively each organization uses Internet-enabled eSolutions. The DEi can be used to compare organizations, regions, or industry sectors.

Utilization refers to the third stage in the broadband development process. The first stage is providing a community, household or organization with access (availability) to the Internet. The second stage is adoption or the process whereby a person or organization starts to actually use the Internet. The third stage is utilization whereby a person or organization uses their Internet connection to create value. Many people and organizations have access and have adopted the Internet, but are relatively ineffective in how they use and derive benefits from the Internet. The field of analysis labeled "utilization" explores patterns of Internet use and how these patterns can be enhanced.

Appendix 6 – List of Counties by Economic Status

County	Status	County	Status	County	Status
Anderson	Transitional	Hamilton	Transitional	Morgan	Distressed
Bedford	Transitional	Hancock	Distressed	Obion	At Risk
Benton	At Risk	Hardeman	Distressed	Overton	At Risk
Bledsoe	Distressed	Hardin	At Risk	Perry	Distressed
Blount	Transitional	Hawkins	Transitional	Pickett	Distressed
Bradley	Transitional	Haywood	At Risk	Polk	At Risk
Campbell	Distressed	Henderson	At Risk	Putnam	At Risk
Cannon	Transitional	Henry	Transitional	Rhea	Distressed
Carroll	At Risk	Hickman	At Risk	Roane	Transitional
Carter	At Risk	Houston	At Risk	Robertson	Transitional
Cheatham	Transitional	Humphreys	Transitional	Rutherford	Transitional
Chester	At Risk	Jackson	At Risk	Scott	Distressed
Claiborne	Distressed	Jefferson	At Risk	Sequatchie	Transitional
Clay	At Risk	Johnson	Distressed	Sevier	Transitional
Cocke	Distressed	Knox	Transitional	Shelby	Transitional
Coffee	Transitional	Lake	Distressed	Smith	Transitional
Crockett	Transitional	Lauderdale	Distressed	Stewart	At Risk
Cumberland	At Risk	Lawrence	At Risk	Sullivan	Transitional
Davidson	Transitional	Lewis	Distressed	Sumner	Transitional
Decatur	At Risk	Lincoln	Transitional	Tipton	Transitional
DeKalb	Transitional	Loudon	Transitional	Trousdale	Transitional
Dickson	Transitional	Macon	At Risk	Unicoi	At Risk
Dyer	Transitional	Madison	Transitional	Union	At Risk
Fayette	Transitional	Marion	Transitional	Van Buren	Distressed
Fentress	Distressed	Marshall	At Risk	Warren	At Risk
Franklin	Transitional	Maury	Transitional	Washington	Transitional
Gibson	At Risk	McMinn	At Risk	Wayne	Distressed
Giles	Transitional	McNairy	Distressed	Weakley	At Risk
Grainger	At Risk	Meigs	At Risk	White	Distressed
Greene	At Risk	Monroe	At Risk	Williamson	Attainment
Grundy	Distressed	Montgomery	Transitional	Wilson	Competitive
Hamblen	At Risk	Moore	Transitional		


strategic
networks group
the broadband economists

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State of Tennessee
Considerations and Best Practices for Statewide Broadband Initiatives

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Prepared for

Department of
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Community Development

Table of Contents

Introduction: Solving the Digital Divide for our Communities

Our world is changing, and it is doing so rapidly. Technology is impacting every part and parcel of our lives -- from where and how we conduct work, to whether or not we thrive economically and socially. It has impacted the way we live, our entertainment, our culture, the way government services are provided and accessed, the way healthcare is being delivered, and the way we educate our children and provide education to better improve our workforce. With the introduction and accelerated advancement of technologies, having access to affordable and abundant broadband is quickly becoming the most critical infrastructure of our time, just like electricity and transportation were in the early 1900's. Advanced broadband infrastructure has the potential to create more jobs, increase a community's competitive ability globally, create new technologies, increase opportunities for a region's companies, enhance public safety, provide better and less expensive healthcare, and provide greater educational opportunities throughout the State. In a recent report produced by the Brookings Institute in May 2014, fiber was added as a critical infrastructure.[1]

Advanced broadband networks are creating seismic changes in local, state, national and global societies, as well as markets, business and in institutions around the world. Access to social media and the Internet has shifted governments, threatened national and local boundaries, inspired revolutions, and has changed us culturally. The Internet and its associated technologies have impacted wealth, work, education, government, health, public safety, and education. Having equal access to advanced broadband networks bridges the digital divide and creates better equality between the haves and the have-nots.

Like the introduction of electricity, advanced broadband networks are fundamentally changing our world in ways that were not expected or anticipated. Much like electricity, advanced broadband networks are the enabling technology in which all things are impacted. Electricity was invented to turn on the lights, but empowered, literally, the transformation to an industrial society. Advanced broadband networks are now the enabling technology to transform us yet again, to a global technology and information society: the new Knowledge Economy. The term "Knowledge Economy" refers to an interconnected, globalized economy where knowledge, trade secrets, expertise, and sharing ideas are as critical as other economic resource

Just as it was impossible to know in advance the impact that electrification would have on the critical infrastructure to power all of our modern appliances, computers, health monitoring systems, manufacturing facilities, computers, radio and television, and financial markets; so too, it is impossible to predict the impact and reach of advanced broadband networks. We do not yet know the far-reaching impacts that the Internet will have on our lives and on generations to come.

[1] *Beyond Shovel Ready: The Extent and Impact of U.S. Infrastructure Jobs*, Brookings Institution, May 2014, http://www.brookings.edu/research/interactives/2014/infrastructure-jobs#/M10420

Speed Matters.

Bandwidth refers to the capacity, or speed of the networks to carry traffic. The question is often presented, "How fast is fast enough?" and "What should be the definition of broadband?" In February of 2015, the FCC increased the definition of broadband by raising the minimum download speeds needed from 4 Mbps to 25 Mbps and the minimum upload speed from 1 Mbps to 3 Mbps[2]. Meanwhile, the FCC's Connect America Fund[3] is eligible for areas that do not currently have 10/1 services AND does not require build outs of more than 10/1 service. In essence, while the FCC is saying broadband is defined as 25/3, they are funding "broadband build" projects at 10/1. Given the growth trends in bandwidth needs and network traffic, questions exist about whether this newest definition will be sustainable in meeting future bandwidth needs.

Global network traffic has quadrupled from 2009 to 2014. Both commercial and residential Internet bandwidth consumption are doubling every year.

In the early days of the Internet, driven largely by non-bandwidth intensive text messaging, email and websites, the average consumer did not need extensive bandwidth. Universities, financial institutions and business enterprises drove the applications that required higher amounts of bandwidth.

Early Internet Days….Universities, Finance, Enterprise

Application	Rate
Personal communications	300 to 9,600 bits/second or higher
E-mail transmissions	2,400 to 9,600 bits/second or higher
Remote control programs	9,600 bits/second to 56 kbits/second
Digitized voice phone calls	64,000 bits/second
Database text query	Up to 1 Mbps
Digial audio	1 to 2 Mbps
Access images	1 to 8 Mbps
Compressed video	2 to 10 Mbps
Medical transmissions	Up to 50 Mbps
Document imaging	10 to 100 Mbps
Scientific imaging	Up to 1 Gbps
Full-motion video	1 to 2 Gbps

[2] *FCC's 2015 Broadband Progress Report* https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-10A1.pdf
[3] Connect America Fund, https://www.fcc.gov/general/connect-america-fund-caf

When YouTube burst upon the scene in 2005, this dramatically changed things. Consumers, small businesses and residential users started to also drive Internet bandwidth demand. One video download was the equivalent of downloading 30,000 web pages. Since that time, videos and picture-rich content have been downloaded and uploaded on a regular basis by the masses. The applications we use on the Internet are becoming much more feature-rich and bandwidth intensive, and our existing networks cannot keep up with the demand for networks that support these applications.

The Fiber to the Home Council (FTTH) stated its position clearly in a brief to the FCC. "Even today, with most users still operating on last-generation broadband technologies, the capabilities of advanced video, cloud-based services, and other bandwidth-intensive applications are growing at a pace beyond what our existing networks are capable. Cisco and other scientific companies talk about the network in terms of "terabytes" of capacity in the network center, or "core."[4] According to the Cisco 2012 Zettabyte Report, businesses today routinely require symmetrical Gigabit service between their locations."[5]

Also referenced in the Cisco 2012 Zettabyte Report, global Internet traffic grew 45 percent during 2009 alone and has doubled every year since then. Both commercial and residential Internet bandwidth consumption are doubling every year, as video, cloud computing, advanced storage solutions, telemedicine, telecommuting, video conferencing, etc., are becoming more prevalent. Applications are becoming more bandwidth intensive and as more devices—tablets, smartphones, computers, appliances—are being used both in the home and for business applications. ***Research conducted by Cisco[6] states by 2016, there will be nearly three Internet Protocol or IP-connected devices per person.*** This prediction seems to be easily met, as of 2013, the number of Internet-enabled devices outnumbered the number of people in the world.[7] The driver of this is not only smart-phones, tablets and computers, but even more so, the Internet of things—predominately wearables (clothing that has an Internet connection) and smart home applications. Additionally, with growth in Internet-connected televisions, radios, set-top boxes, Blu-ray players, Netflix, cameras and picture frames, the number of hours spent viewing entertainment applications online (i.e. movies and TV). Netflix is expected to be the "number one television network in 2016."[8]

With these bandwidth-intensive applications and the number of devices in the home using these applications, the consumer at home uses 74 Mbps to over 3.6 Gbps.

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[4] *America's Petition to the Federal Communications Commission for Rulemaking to Establish a Gigabit Communities Race-to-the-Top Program*, Fiber to the Home Council, July 2013, http://www.ftthcouncil.org/p/cm/ld/fid=47&tid=79&sid=1221

[5] *The Zettabyte Era*, Cisco, May 2012, http://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/VNI_Hyperconnectivity_WP.html

[6] *Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2015–2020 White Paper*, February, 2013, http://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/mobile-white-paper-c11-520862.html

[7] *Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2015–2020 White Paper*, February 2013

[8] *Netflix U.S. Viewing to Surpass ABC, CBS, Fox and NBC by 2016: Analysts*, Variety, June, 2015, http://variety.com/2015/digital/news/netflix-viewing-abc-cbs-fox-nbc-1201527442

Average Residential Bandwidth Needed, Applications 2015			
Service	**Bandwidth Need per Device**	**Number of Devices per Home**	**Internet Bandwidth Usage**
TV	2 to 20 Mbps	3.5	2 to 70 Mbps
DVR	2 to 20 Mbps	2	0
Home Theater	1 to 6 Mbps	1	0
Internet Browsing	1 to 20	1 to 5	1 to 10 Mbps
Printer	.5 to 1 Mbps	1 to 5	0
Digital imaging	1 to 20 Mbps	1 to 3	0
On-line Gamine	.5 to 1 Mbps	1 to 3	.2 to 1 Mbps
Video Capture	.1 to 1 Mbps	1 to 10	.2 to 3 Mbps
Portable Audio	1 to 20 Mbps	1 to 3	0
Video Steaming	10 to 1000 Mbps	3.5	35 to 3500 Mbps
Smart TV	35 Mbps	1	35 Mbps
Total	**54 to 1,163 Mbps**		**74 to 3,619 Mbps**

A home shares bandwidth amongst all the applications that are running at once, so if there are 10 applications running at the same time that each require 10 Mbps download, that home needs 100 Mbps connectivity. The table above illustrates this by showing the bandwidth needed for applications, how many devices are typically present, and the net impact of bandwidth usage.

While smartphones and Netflix are improving quality of life, the Internet's transformational power lies with the economic impact broadband provides a region, from opening up a world of online educational resources to providing businesses with the opportunities to expand their markets and improve efficiencies through ecommerce. Additionally, broadband connectivity is critical to communities looking to implement smart-grid[9] and smart-city[10] applications.

According to FTTH's brief to the FCC referenced above, "the average monthly traffic in 2014 on the Internet has been equivalent to 32 million people streaming Avatar in 3D, continuously for the entire month." The sum of all forms of Internet Protocol (IP) video (Internet video, video on demand, video files exchanged through file sharing, video-streamed gaming, and videoconferencing) was 64% in 2014 and is predicted to be 80 percent by 2019[11]. Applications supported by cloud-based services through multiple devices have created the need for always-on connectivity and advanced broadband network bandwidth.

[9] *Practical Applications of Smart Grid Technologies*, SEL, February 2009, http://www.energycentral.com/reference/whitepapers/103216
[10] *25 Technologies Every Smart City Should Have*, Mashable, December 2012, http://mashable.com/2012/12/26/urban-tech-wish-list/#i8dVC9NPnaqG
[11] *Online Video Will Account for 80 Percent of the World's Internet Traffic by 2019*, Digital Trends, May 2015, http://www.digitaltrends.com/home-theater/online-video-will-dominate-internet-traffic-by-2019/

Although there have been tremendous improvements in wireless communications, and in technologies that beef-up existing cable networks, industry leaders are seeing the need to extend fiber-optic network technologies further and deeper into neighborhoods, business parks and industrial centers. As more devices are connected to the Internet and applications are more bandwidth rich, there is a strong argument that favors more all-fiber connections to homes and businesses. The gold standard for bandwidth capability is quickly becoming offering Gigabit services or speeds that support 1,000 Mbps. With this being said, there is a strong need to also connect mobile and portable users through wireless or Wi-Fi technology and cellular networks also need to be upgraded. In areas where building an all-fiber-optic network is cost-prohibitive, such as rural, mountainous and geographically disperse areas, a combination of technologies, relying on wireless and fiber-optic cable may need to be considered.

A Brief History in Broadband, Understanding How Competition Drives Investment

In the last six years, there have been significant improvements in broadband infrastructure investment in the United States. Broadband investment has been sparked by competition. In order to best understand this, a brief history in broadband investment is needed. Prior to 2010, Verizon was the only incumbent service provider that implemented Fiber to the Home technology with rollout of its FIOS product. In 2010, approximately 2% of U.S. households had a fiber-optic connection. Meanwhile, in Japan, Korea, and Sweden, over 80% of their populations had a fiber connection.

Large, incumbent phone and cable companies had little incentive to further invest in their networks. Most cities and towns had either a near monopoly or a friendly duopoly in which the two incumbent providers—the cable TV and major telecommunications company—had limited competitive pressure to improve their network infrastructures.

Although the National Broadband Plan that was implemented by the U.S. had adequate goals and benchmarks to further broadband advancement, it fell short in terms of actual implementation plans to make these goals a reality. Additionally, state and local governments had done little to encourage further investments. On the municipal-level, many city ordinances and policies discourage further investment by any new providers with cumbersome building and permitting regulations, raising the capital costs and time to build out fiber-optic infrastructure.

This changed in 2012 when Google decided to invest in Gigabit infrastructure that included an all-fiber connection to every home and business. While Gigabit speeds are argued as not needed today, the goal of achieving Gigabit speeds is an aspirational one, looking to fill bandwidth needs for the foreseeable future. Google issued a Request for Proposal for the "Think Big with a Gig" program to host Gigabit test-beds and have Google build within their city, and over one thousand communities across the country submitted applications.[12] Google selected the bi-state Kansas City metropolitan region. Google's network build-out and their offering of residential Gigabit of service for $70 per month put Kansas City in the top five of the world's most connected cities with the world's most inexpensive bandwidth.

Since Google's rollout of Gigabit services in Kansas City, it made plans to build Fiber to the Home in Austin and then subsequently purchased an existing system in Provo, Utah. Google then announced plans to build FTTH in 34 municipalities across the country upon cooperation and attainment of a checklist put out by Google. Perhaps one of the biggest impacts of Google jumping into the broadband infrastructure market was

[12] *Topeka 'renames' itself 'Google, Kansas,'* CNN, March 2010, http://www.cnn.com/2010/TECH/03/02/google.kansas.topeka

In Tennessee, 13% of the population does not meet the broadband definition of 25/3.

the impact it had on other providers investing in infrastructure. After Google's entrance into the Internet infrastructure industry, other companies such as Time Warner Cable, SuddenLink, Grande Communications, Charter and Cox Communications made announcements to also build out Gigabit-cable infrastructure. Aside from this, in large markets where incumbent providers are trying to out-build Google and their competitors, broadband speeds have increased dramatically.

This too has inspired municipalities and electric cooperatives to also build fiber-optic infrastructure, knowing that a "wait for Google" approach is not shortly forthcoming. State governments have put together a number of initiatives to help spur more broadband development. This gap between need for more broadband capacity and the ability to fill this gap across the entire U.S. has not yet been filled.

While Investment Has Occurred, Progress Still Needs to be Made

While Google has helped disrupt the status quo in specific communities, in general the U.S. has yet a long way to go towards addressing bandwidth needs. According to an article recently published in December 2015 on Huffington Post which cites many sources measuring the U.S.'s progress in broadband advancement, "America's wireline or wireless broadband speeds are not even in the Top 20 in the world, much less are reasonably priced."[13] According to the article, the U.S. is ranked 55th in the world in wired and wireless broadband.

Tennessee is currently ranked as the 29th in the country with 87% of the state having broadband coverage of at least 25 Mbps download and 3 Mbps upload.[14] In order for the U.S. to effectively compete on a global scale in the new Knowledge Economy, the American workforce must have access to very high-speed broadband networks at an affordable rate.

[13] *America's Broadband Embarrassment*, Huffington Post, December 2015, http://www.huffingtonpost.com/bruce-kushnick/americas-broadband-embarr_b_8736488.html?mc_cid=b49548b233&mc_eid=1479b8f1cc
[14] *2016 Broadband Progress Report*, Federal Communications Commission, https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-6A1.pdf.

Rural Markets Have the Least Capacity Available

While there are federal funding programs to build broadband services to rural areas, the rural parts of the country still have the least capacity available. Using the FCC's definition of broadband of 25 Mbps in download speeds and 3 Mbps of upload speeds, the FCC's 2016 Broadband Progress Report finds that almost 34 million Americans – 10 percent of the population – lack access to advanced broadband. More significantly, 39% of rural Americans do not have broadband access that meets this new definition. In contrast, only 4% of urban Americans lack access to 25 Mbps/3 Mbps broadband service. In Tennessee, 13% of the population does not meet the broadband definition of 25/3, with only 2% of urban populations failing to meet this definition and while 34% of rural populations lack broadband.[15] This is often the result of carriers lacking a "business case" to receive an adequate return on their investment when building in lower populated areas.

[15] *2016 Broadband Progress Report*, Federal Communications Commission, https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-6A1.pdf.

What are the Primary Barriers to Better Broadband and How Can these Barriers Be Mitigated?

As it is understood that having access to abundant, affordable broadband is a necessity, then why is it that we don't have better broadband? The following provides insight into the difficulties and obstacles for better broadband and what steps can be taken to remove and mitigate these barriers.

A duopoly or monopoly can stifles investment. As discussed earlier in this document, one barrier to better broadband exists when the incumbent providers have little incentive to upgrade their networks. When cities and towns have had a comfortable duopoly or, in some cases, a monopoly for Internet service delivery, the incumbent carriers have had little competitive pressure to build more fiber, a capital-intensive process.

The entrance of a competitor can disrupt this status quo. Communities that have a number of choices for Internet service, especially if these choices provide a significant transformation of service delivery (i.e. leapfrogging the incumbent provider's 5 Mbps, or 8 Mbps to 100 Mbps or 1 Gbps), the incumbent providers will be required to upgrade their infrastructure or provide comparable services in order to maintain their market share.

In some communities, a competitor has come into the market and has either built out a fiber-optic system or has built out a wireless solution. Building a wireless infrastructure is not as capital-intensive as building out a fiber-optic infrastructure. However, wireless technology often does not disrupt the status quo because it cannot out-perform the existing service offerings available.

Capital costs are high to build fiber-optic networks. Building a Gigabit-enabled network is capital intensive. Current technologies that support this type of bandwidth availability require fiber to be built to every home or business if an advanced wireless network is used, fiber must be built to most of the wireless access points. In either case, the physical placement of fiber-optic cable is often too capital-rich for a small competitive provider. While some smaller carriers are able to provide fiber to an entire community, this typically needs to be a highly populated area to pay off the investment. A model to support the high costs of building fiber is harder to justify in sparsely populated, rural areas.

In rural areas, the capital costs required to build out fiber are higher, as rural areas are remote with the population geographically dispersed. Access to Internet "supply" – locations where there is an Internet hub – is often located in larger cities or population centers. Options for accessing Internet hubs, which is typically described as Internet backhaul or transport costs, are to either build fiber to this Internet hub location, to build a point-to-point digital microwave link, or to lease existing facilities. In any of these options, the capital costs are high and/or the monthly access charges are high.

These high monthly backhaul charges or capital costs to connect to Internet hubs are difficult to finance as rural areas do not have the population to support an adequate return on investment for any providers to upgrade their networks. This leaves rural areas with few options for improving broadband services. The Stimulus Program provided $7.2 Billion to mostly improve backhaul or transport costs by providing funding for middle-mile networks, but there still is an overwhelming number of communities that do not have options for inexpensive costs to access Internet "supply."

The business model to build in a rural market is challenging.

Further complicating the high capital costs to build infrastructure in or to rural markets, is the challenge of making a business model work in a rural market. Population density is lacking in rural areas and the number of potential business and residential customers is relatively small, creating an undersized revenue opportunity compared to a larger market. Additionally, the challenge of finding people, technicians and a management team to operate and manage the system in rural and remote areas is sometimes difficult. The return on investment is typically lower in rural areas.

Programs, policies and broadband-friendly ordinances can be put in place to try to mitigate the high-costs of building fiber networks.

Most of the costs (60-80% of the capital costs) for building fiber are in the actual opening of a trench or the labor to place conduit in an existing right of way or road. Broadband-friendly ordinances such as a "dig once" policy can help mitigate this cost by allowing multiple providers to place conduit within an open trench when other utility work is being done. Other policies such as streamlined permitting, standardized and cost-effective pole attachment rates, and collaboration in creating joint-build or joint-trench agreements can also promote more broadband deployment.

Collaboration and use of existing assets can be leveraged to reduce capital costs.

Many electric utilities have placed fiber-optic cable to connect electric substations and power locations to manage power operations. Existing fiber owned by the electric utilities can sometimes be leveraged or used for broadband purposes. Existing land, structures, tower locations, conduit, and fiber can be used to help reduce the costs of building new fiber infrastructure. Often the Department of Transportation or the municipality has built fiber-optic cable to manage traffic operations. Many schools and medical facilities have also built their own networks to improve broadband services available.

Coordination and collaboration with other entities that have built fiber can dramatically reduce the costs of building broadband infrastructure. Breaking down the silos that exist between entities—schools, other government agencies, hospitals, and the electric utilities—can facilitate a collaborative and more effective ability to improve broadband services within a community. Having the ability to collaborate and coordinate with other entities will reduce the costs of building networks for broadband service and can aggregate demand for Internet service as these entities are often the largest broadband users within a community.

What have other States or Regions done to Facilitate Better Broadband?

NEO's team researched statewide broadband initiatives in eight states to uncover both best practices for success, as well as pitfalls to avoid. This section includes general observations from broadband programs in California, Connecticut, Kentucky, Maryland, Minnesota, Missouri, and New York.

General Observations

All of the States included in this Study demonstrated a belief that access to robust, 21st century broadband speeds is a critical component for their respective State. No two States are taking the same approach to overcome potential connectivity and speed deficits. There is truly no one-size-fits-all model, as each State is taking an approach that is unique and customized for their needs.

For example:

- Missouri, California and Kentucky have created entities that are tasked with expanding broadband access and adoption. However, each of these three is taking a slightly different approach. Missouri created MoBroadbandNow, a public-private partnership of multiple cooperative partners. The State of California established the Emerging Technology Fund (CETF) - a nonprofit corporation established pursuant to requirements from the California Public Utilities Commission in approving the mergers of SBC-AT&T and Verizon-MCI in 2005. The State of Kentucky, created a public-private partnership called KentuckyWired that is tasked with building out a 3,300 middle-mile fiber network.

- Minnesota and New York have, or are in the process of setting up, grant programs to foster infrastructure deployment. In Minnesota, the State Legislature authorized an initial $20 million (plus additional funds in subsequent years) for a state broadband fund to be distributed to underserved and unserved areas via competitive grants. The grants focus only on last-mile projects that connect homes and businesses. New York, on the other hand, has allocated $500 million to be made available to the private sector to expand broadband service to underserved areas.

- Connecticut is working with at least 46 State municipalities to make it the first Gigabit state through public-private partnerships by building an open access fiber network. The details are yet to be determined as the project is in progress. It is still unclear where the funding for thisinitiative will come from.

- Maryland, in conjunction with 9 participating municipalities, took the lead in building a 1,300 middle-mile network that connected every County in the State and directly connects community anchor

institutions. In this public-public partnership, the State and the municipalities own and operate the fiber network. This initiative was funded by ARRA.

Funding Models

Funding is a critical part of every broadband endeavor. Aside from the monies needed for engineering, construction and deployment, every initiative must also provide a plan for sustainable funding sources that will secure the long-term health of the network.

Below is a chart that provides details on the funding for each project.

STATE	PUBLIC (STATE) INVESTMENT	PRIVATE INTVESTMENT	PUBLIC-PRIVATE PARTNERSHIP (YES/NO)	GRANT PROGRAM (YES/NO)	GRANTS AVAILABLE (TO DATE)	MATCH REQUIRED (YES/NO)
California	$0	$60 Million	Yes	Yes	$29 Million	Yes
Colorado		$0	No	Yes		Yes
Connecticut	To be determined	To be determined	Yes	No	N/A	N/A
Kentucky	$30 Million	$250-$350 Million	Yes	Yes	$250,000	No (But projects with a match are more likely to receive funding)
Maryland	$160 Million	$0	No	Yes	$160 Million	Yes
Minnesota	$30 Million	$0	No	Yes	$30 Million	Yes
Missouri	$261 Million*		Yes	Yes	**	Yes
New York	$500 Million	$0	No	Yes	$500 Million	Yes

**Funds for the project total $261 Million (including federal grants) but it is unclear how much has been contributed by the State or private partners.*

***It is unclear how much has been made available in grants for MoBroadbandNow.*

The three primary funding models are as follows:

- **Public funding only**. Maryland is the only state where the project was and is solely funded by Public funds. Federal/State and Local funds were utilized to build the network, and State and local funds are being applied for the ongoing maintenance and operations. This model is successful in Maryland.
- **Public and private funds are combined** for deployment and operations. Kentucky is a traditional public-private partnership model wherein the State is contributing significant public funds and the private sector also provides significant investment in return for fees to be paid back over a long period of time. Missouri, California, and Connecticut are all public-private partnerships with a slightly different kind of partnership.
- **Public funding is provided in the form of grants for planning**, to offset costs of build-out and to encourage private investment.

Best Practices and Lessons Learned

Best Practice Program Attributes

In each of these state initiatives, there are elements that help make the projects successful. Some of these elements include:

- **The presence of strong public leadership including elected officials that champion the projects.** In Connecticut, Kentucky, Minnesota, Missouri, and New York either the governor and/or a contingent of other elected officials publicly backed the state's broadband initiative and talked about ways broadband would improve quality of life for people in the state. In the case of Kentucky, a member of Congress, Congressman Hal Rogers (R – KY 5th District), has also publicly supported the endeavor, underscoring the importance of an elected official publicly endorsing a state's broadband work so as to ensure public (and voter) confidence.

- **The establishment of a state broadband office or similar entity.** While broadband infrastructure can be related to other infrastructure development and may be most effectively developed when it is coupled with transportation or community development, its planning and implementation need special attention. By developing a state broadband office, broadband development for a state has dedicated resources to ensure its effective implementation. It also relieves the burden from other departments.

- **Effective use of partnerships.** In all eight states, some form of partnership was established. Whether the partnerships were between the State and municipalities as in the cases of Maryland and Connecticut, between the State and private entities, or a combination thereof, there is a pattern of establishing partnerships that help to move the project forward.

- **Creation of grant programs to encourage private investment and build-out.** Multiple States have established grant-funding programs that encourage private sector investment.

- **Creation of an entity that will manage the network.** Not every State or locality is in the best position to internally manage ongoing network operations. Some – like Kentucky (through its public-private partnership) have created an entity that will be responsible for network maintenance and operations.

- **Establishment of funding solutions that utilize public and private funding sources.** Each of these projects had a unique approach to funding that in most cases did include a significant investment made by the State with additional funds applied by the private sector.

While these state broadband programs are largely success stories (with the exception of Connecticut, where the jury is still out), there are some key lessons to be learned. For example:

- **Conducting public and stakeholder engagement.** As the public stands to gain the greatest benefit, educating the community on why public investment or partnerships with the private sector is needed is an important factor to ensuring success and mitigating criticism.
- **Providing for public seed funding at a minimum.** While the state of Connecticut is currently negotiating with a private sector partner to make the bulk of the investment in the network, the success of this venture is to be determined. While a risk, by providing some funding, the State is in a better negotiating position with potential investors and others.
- **Ensuring an open and transparent process for the initiative.** The KentuckyWired project has received some criticism lately from providers. It is difficult to eliminate or prevent public detractors. However, following an open and transparent process throughout the initiative, including strong community engagement, will help to mitigate the problems.
- **Ensuring that the initiative has undergone proper planning and due diligence.** Those without adequate preparation may run into necessary and detrimental course-changes that could have been avoided with the right plan.

California - California Emerging Technology Fund

California is rated the 11th most connected state in the country and average statewide broadband speed is 42.8 mbps.[16] 2015 penetration rate at 25 Mbps download and 3 Mbps upload: 93%[17]

Resources

- Wide Differences in Broadband Connectivity Across California Households, The Field Poll, California Emerging Technology Fund, June 16, 2015
- California Emerging Technology Fund Strategic Action Plan, June 2007

What the project will accomplish? (i.e. connecting all schools and government agencies within the state)	The California Emerging Technology Fund (CETF) is a nonprofit corporation established pursuant to requirements from the California Public Utilities Commission in approving the mergers of SBC-AT&T and Verizon-MCI in 2005. These merged companies committed to contributing a total of $60 million in seed capital over five years to advance broadband, reaching CETF's goals by 2010.[18] The fund is still operating today, as it continues to offer grants[19]. CETF's mission today is to provide leadership across the state to accelerate the deployment and adoption of broadband services to unserved and underserved communities in the state. This will be accomplished by making investments and providing grants to programs to improve access, affordability, accessibility and assistance to broadband. Priority communities for CETF include rural, urban poor, and disadvantaged communities and disabled populations that lack technology accessibility. Strategies to ensure success of this initiative include compiling best practices from research and results of pilot projects and engaging knowledgeable experts and stakeholders, investing in strategic opportunities, conduct performance measurements on funded programs and projects and measure progress which would be published regularly in progress reports.[20] Of the $60 million received in initial seed capital, CETF has approved just over $29 million in grants to eligible stakeholders in the state to meet the initiative's goals.[21] Applicants must meet certain requirements including a cash match.[22]
What are the capital costs?	In 2008, CETF received $24 million from the $60 million seed capital contributions to recruit and hire personnel and establish retirement plans, secure offices, develop and adopt operating budgets and expenditure

[16] *Broadband Internet in California*, Broadband Now, http://broadbandnow.com/California
[17] *Appendix E: Americans Without Access to Fixed Broadband by County*, Federal Communications Commission, February 2015, https://www.fcc.gov/reports-research/reports/broadband-progress-reports/2015-broadband-progress-report
[18] CETF Overview, http://www.cetfund.org/aboutus/overview
[19] CETF Grant Opportunities 2016, http://www.cetfund.org/investments/Grant_Opportunities_2016
[20] CETF Mission, http://www.cetfund.org/aboutus/mission
[21] CETF Financials, http://www.cetfund.org/files/2014_2013_financials.pdf
[22] CETF Eligibility, http://www.cetfund.org/investments/grantprocess/eligibility

	policies, establishing a meeting schedule for CETF's Board of Directors, and develop and launch a website.[23]
What is the timeframe to completion?	The merged companies of SBC-AT&T and Verizon-MCI were given 5 years to meet the established goals of CETF.
How is the project being funded?	The initial seed capital of $60 million came from SBC-AT&T and Verizon-MCI as a condition of the approved merger with a goal of leveraging these investments to $250 million from other sources.[24]
Is this a public private partnership? What is each partner bringing/offering and how is each partner participating?)	This may not be considered a true public-private partnership since CETF is a nonprofit organization and not a governmental entity but there was considerable investment from SBC-AT&T and Verizon-MCI as a condition of their mergers. The private entities provide the capital and CETF manages the capital and provides grants to applicants.
What is the service delivery model and how are services being offered?	CETF provides support to a number of critical initiatives such as education, healthcare, housing and infrastructure. Service delivery models are specific to each initiative.[25]
What services, pricing, bandwidth is going to be delivered?	This is training for existing connectivity, not an infrastructure project.
What has been the public response?	CETF's model has been touted as a good example of increasing digital literacy (through training in low-income neighborhoods) as recently as November 2015 at an event in Mountain View, CA.[26]

[23] CETF Overview, http://www.cetfund.org/progress/overview
[24] CETF Mission, http://www.cetfund.org/aboutus/mission
[25] CETF Overview, http://www.cetfund.org/investments/overview
[26] *At Inaugural AnchorNETs Conference in Silicon Valley, The Broadband Talk is About Public-Private Partnerships*, Broadband Breakfast, November 2015, http://broadbandbreakfast.com/2015/11/at-inaugural-anchornets-conference-in-silicon-valley-the-broadband-talk-is-about-public-private-partnerships/

What else is the State doing to improve broadband services?	CETF received over $7 million from the American Recovery and Reinvestment Act of 2009 for to help drive training and broadband adoption programs.[27] The State-Issued Broadband Bonds California Advanced Services Fund (CASF) is funded by a surcharge rate on revenues collected by telecommunications carriers from end-users for intrastate telecommunications services. The surcharge is authorized to collect $25 million per year. CASF will fund up to 70% of project costs for unserved areas and 60% for underserved areas. Underserved is defined as no wireline or wireless carrier offering service at advertised speeds of at least 6Mbps down and 1.5Mbps upload; unserved is defined as only having dial-up service available. A revolving loan program was also implemented to provide supplemental financing for projects also applying for CASF grant funding that will provide up to 20% of project costs up to a maximum of $500,000. In April 2014 four projects were funded with just over $12 million in grants and loans and in June 2014, CASF awards totaling $6.9 million in grants and loans for two projects that were awarded. The Broadband Public Housing Account will award up to $20 million for broadband connectivity and up to $5 million for up to 85% of the cost of adoption programs.[28] CETF partners with the Stride Contact Center, an independent, nonprofit entity that provides free telephone consultations on how to find broadband service as low as $10 per month for low-income households.[29]

[27] *California Emerging Technology Fund*, NTIA, http://www2.ntia.doc.gov/grantees/CETF
[28] *State Broadband Initiatives 2016*, Blandin, January 2016, http://blandinonbroadband.org/2016/01/23/state-broadband-initiatives-2016-help-me-create-a-better-list-please/
[29] *California Emerging Technology Fund Calls on FCC to Take Action on Affordable Broadband for America's Neediest*, June 2015, http://www.cetfund.org/files/CETF_Field-Poll_Press_150615Final.pdf

Connecticut - CT Gig Project

Connecticut is rated the 2nd most connected state in the country and average statewide broadband speed is 35.4 mbps.[30] 2015 penetration rate at 25 Mbps download and 3 Mbps upload: 99%[31]

What the project will accomplish? (i.e. connecting all schools and government agencies within the state)	In December 2014, a consortium of 46 Connecticut municipalities, representing 50% of the state's population, state officials and other stakeholders embarked on the CT Gig Project, an effort to make Connecticut the first Gigabit state, through public-private partnerships by building an open access fiber network.[32] The project, still in its early phase, issued a Request for Qualifications (RFQ) soliciting information and partnerships with potential providers to create Gig networks in their communities. The consortium is looking for potential partners to assist with the financing, fiber network construction and management, and Internet service providers of retail services. The goal of this phase is to issue RFPs that would lead to the creation of public-private partnerships resulting in open-access fiber networks in many Connecticut municipalities.[33] As of August of 2015, officials are optimistic about a potential agreement with Macquarie Capital.[34]
What are the capital costs?	These have not yet been determined. The consortium is currently developing the most efficient and cost-effective strategy for the network deployment.[35]
What is the timeframe to completion?	This has not yet been determined. The consortium is currently developing the most efficient and cost-effective strategy for the network deployment.[36]
How is the project being funded?	This has not yet been determined. The consortium is currently developing the most efficient and cost-effective strategy for the network deployment.[37]
Is this a public private partnership? What is each partner bringing/offering and how is each partner participating?)	This is still being discussed amongst the consortium members but they are hoping to enter into a partnership with Macquarie Capital. While the details of a partnership are not confirmed, it could most likely involve Macquarie providing the capital and the consortium members paying it back over 30 years.[38]

[30] Broadband Service in Connecticut, Broadband Now, http://broadbandnow.com/Connecticut
[31] *Appendix E: Americans Without Access to Fixed Broadband by County*, Federal Communications Commission, February 2015, https://www.fcc.gov/reports-research/reports/broadband-progress-reports/2015-broadband-progress-report
[32] State of Connecticut website, http://www.ct.gov/broadband/cwp/view.asp?a=4524&q=500852
[33] Information on Connecticut Municipal RFQ Seeking Partners to Develop Gigabit Internet Networks in Their Communities, http://ct.gov/broadband/cwp/view.asp?a=4524&q=525910
[34] Hartford Courant, http://www.courant.com/news/connecticut/hc-Gigabit-state-0814-20150824-story.html
[35] CT Gig Website, http://www.ctgig.com/
[36] CT Gig Website, http://www.ctgig.com/
[37] CT Gig Website, http://www.ctgig.com/
[38] Hartford Courant, http://www.courant.com/news/connecticut/hc-Gigabit-state-0814-20150824-story.html

What is the service delivery model and how are services being offered?	These have not yet been determined. The consortium is currently developing the most efficient and cost-effective strategy for the network deployment.[39]
What services, pricing, bandwidth is going to be delivered?	These have not yet been determined. The consortium is currently developing the most efficient and cost-effective strategy for the network deployment.[40]
What has been the public response?	Because the consortium is still in the "research" phase of this initiative, some communities are soliciting public input. Bradford, CT is one and has created an online survey for its residents.[41] The telecom industry has been vocal about their opposition of this initiative. Their concerns are that municipalities are best partnering with industry and should not be undertaking these types of initiatives alone and that, as a result, taxpayers could be left with the burden of paying for this.[42]
What else is the State doing to improve broadband services?	The state received almost $200,000 from the American Reinvestment and Recovery Act for mapping, infrastructure development, and sustainable adoption programs. In July 2015, the Governor Dannel Molloy created the Connecticut State Broadband Office.[43] Since then, the state has been involved in a variety of initiatives, such as raising awareness of the lack of broadband in rural areas.[44] There are also a number of state agencies such as the Connecticut Commission on Education Technology (CET), the Connecticut Education Network (CEN) and the Public Safety Date Network (PSDN) and the Nutmeg Network (comprised of CEN and PSDN) which coordinate and shape broadband policies for the state.[45] In February, 2016 it was reported that the broadband state office could be facing elimination.[46]

[39] CT Gig Website, http://www.ctgig.com/
[40] CT Gig Website, http://www.ctgig.com/
[41] Branford Gigabit Fiber Interest Project, http://www.branford-ct.gov/content/143/217/5190.aspx
[42] *State, telecom industry clash over Gigabit network expansion*, Hartford Business, May 2015, http://www.hartfordbusiness.com/article/20150504/PRINTEDITION/304309943/state-telecom-industry-clash-over-Gigabit-network-expansion
[43] State of Connecticut Website, http://www.ct.gov/broadband/site/default.asp
[44] State of Connecticut Website, http://www.ct.gov/broadband/cwp/view.asp?a=4696&Q=568290
[45] State of Connecticut Website, http://www.ct.gov/broadband/cwp/view.asp?a=4696&q=557292
[46] Hartford Courant, http://www.courant.com/hc-broadband-connecticut-20160218-story.html

Kentucky - KentuckyWired

Kentucky is rated the 42nd most connected state in the country and average statewide broadband speed is 18.8 mbps.[47] 2015 penetration rate at 25 Mbps download and 3 Mbps upload: 60%[48]

Resources

- Guide to Funding Broadband Strategies for Communities and Utilities, Prepared for the Commonwealth of Kentucky, May 2015, CTC Technology and Energy
- Business Development Agreement

What the project will accomplish? (i.e. connecting all schools and government agencies within the state)	KentuckyWired, formerly called the Next Generation Kentucky Information Highway, is an infrastructure project aimed filling in broadband service gaps by creating a statewide fiber "interstate" system. The project will connect all 120 counties in the state with a 3,400-mile open access "middle mile" network, ensuring that residents have access to high-speed Internet.[49]
What are the capital costs?	The total cost of the project depends on the availability to leverage existing infrastructure versus deploying new routes. This will be determined during the design phase and can be anywhere between $250 and $350 million.[50] In August 2015, it was reported that the total project is estimated to cost $324 million.[51]
What is the timeframe to completion?	The timeframe for a substantial portion of the project to be completed is 3 years.[52] The Eastern Kentucky region will be the first priority area with work beginning in the summer of 2015 and expected to be completed in April 2016.[53]
How is the project being funded?	The Kentucky General Assembly allocated $30 million in the 2014 legislative session and $23.5 million in federal funds have been appropriated. The remaining funding will come from consortium partners from the project's public-private partnership.[54] The state and the federal government provided seed funding. But the vast bulk of the $324 million network will be funded by debt and by equity raised by Macquarie. In exchange, Macquarie receives an annual concession fee of

[47] Broadband Service in Kentucky, Broadband Now, http://broadbandnow.com/Kentucky
[48] *Appendix E: Americans Without Access to Fixed Broadband by County*, Federal Communications Commission, February 2015, https://www.fcc.gov/reports-research/reports/broadband-progress-reports/2015-broadband-progress-report
[49] *Kentucky Deploys State-Wide Fiber Network Through Public Private Partnership with Macquarie Capital*, Broadband Breakfast, September 2015, http://broadbandbreakfast.com/2015/09/kentucky-deploys-state-wide-fiber-network-through-public-private-partnership-with-macquarie-capital/
[50] *KentuckyWired Wins The Bond Buyer's 2015 Deal of the Year Award*, http://finance.ky.gov/initiatives/nextgenkih/pages/default.aspx
[51] *KentuckyWired Launches,* http://finance.ky.gov/initiatives/nextgenkih/Pages/KentuckyWired-Lauch.aspx
[52] *KentuckyWired Launches,* http://finance.ky.gov/initiatives/nextgenkih/Pages/KentuckyWired-Lauch.aspx
[53] *KentuckyWired Wins The Bond Buyer's 2015 Deal of the Year Award*, http://finance.ky.gov/initiatives/nextgenkih/pages/default.aspx
[54] *KentuckyWired Launches,* http://finance.ky.gov/initiatives/nextgenkih/Pages/KentuckyWired-Lauch.aspx

	about $29 million. As the business model for the network came to be defined, this annual funding comes from what the state was previously already spending for state building's broadband connectivity, now redirected to Macquarie.
Is this a public private partnership? What is each partner bringing/offering and how is each partner participating?)	Yes. The project will be designed, built, operated and maintained through a 30-year public-private-partnership (P3) led by Macquarie Capital and industry partners. This is the largest P3 fiber partnership in the country, and the only one that is fully open-access.[55] Macquarie will receive an annual concession fee of about $29 million from the Commonwealth in exchange for raising equity and debt financing the project.[56]
What is the service delivery model and how are services being offered?	KentuckyWired will be responsible for creating the middle mile network by laying fiber-optic cable. Internet Service Providers (ISPs) will then need to connect to the network to ensure businesses and residents over the last mile are connected.[57]
What services, pricing, bandwidth is going to be delivered?	This is dependent on the ISPs, since KentuckyWired are not actually delivering services; they are building the infrastructure to facilitate service delivery.[58]
What has been the public response?	Kentucky Governor Steve Beshear, Congressman Hal Rogers (R-KY 5th District) and other state and local officials have all backed this initiative because of the need for better broadband in the state and jobs that the P3 will create. In September 2015, David Williams with the Taxpayers Protection Alliance, a group that is partially backed by Charles and David Koch of Koch Industries, voiced concerns over the initiative ranging from privacy to potential duplication as well as the possibility of internet service providers not utilizing the government's middle mile fiber.[59] Additionally, AT&T is 3 years into a 10-year contract to bring broadband to the state's school districts. The state issued an RFP looking for a new vendor – presumably, KentuckyWired. AT&T has filed a complaint against KentuckyWired, claiming that they have had an unfair advantage by having access to insider information during the RFP development process.[60] Newly-elected Governor Matt Bevin ran on a platform to reduce

[55] *KentuckyWired Launches,* http://finance.ky.gov/initiatives/nextgenkih/Pages/KentuckyWired-Lauch.aspx
[56] *Kentucky Deploys State-Wide Fiber Network Through Public Private Partnership with Macquarie Capital*, Broadband Breakfast, September 2015, http://broadbandbreakfast.com/2015/09/kentucky-deploys-state-wide-fiber-network-through-public-private-partnership-with-macquarie-capital/
[57] *KentuckyWired FAQ,* http://finance.ky.gov/initiatives/nextgenkih/Pages/faq.aspx
[58] *KentuckyWired FAQ,* http://finance.ky.gov/initiatives/nextgenkih/Pages/faq.aspx
[59] *Lawmakers, outside groups voice concerns over KentuckyWired*, CN2, October 2015, http://mycn2.com/politics/lawmakers-outside-groups-voice-concerns-over-kentuckywired-finance-cabinet-moving-forward-with-project
[60] *AT&T Files Protest Against KentuckyWired*, WKMS, November 2015, http://wkms.org/post/att-files-protest-against-kentuckywired#stream/0

	the size of government and could potentially impact KentuckyWired's role in this RFP.[61] As of early February of 2016, Governor Bevin has taken a position that he would like to "scale back" the project and focus on Eastern Kentucky as there has been a shortfall of funding.[62] Overwhelmingly, however, the public response has been positive.
What else is the State doing to improve broadband services?	The Commonwealth of Kentucky was awarded more than $5.3 million in American Reinvestment and Recovery Act funds for broadband mapping and outreach programs.[63] In October 2015, the "Shaping Our Appalachian Region" (SOAR) executive board made $250,000 in grants available for the Kentucky Appalachian Regional Development fund which is geared to helping improve economic opportunities in the Appalachian region of the state.[64] While a match is not specifically required, applicants without some kind of additional funding source or partner are unlikely to be awarded a grant.[65]

[61] *Officials look to wire Kentucky broadband deal for government-run project*, Watchdog.org, November 2015, http://watchdog.org/248009/kentucky-3/
[62] *Bevin aims to scale back broadband project to focus on Eastern Kentucky, Lexington Herald Leader*, February 2016, http://www.kentucky.com/news/politics-government/article58768608.html
[63] Commonwealth of Kentucky website, http://finance.ky.gov/initiatives/Pages/default.aspx
[64] *SOAR Executive Board approves criteria, application process for Kentucky Appalachian Regional Development fund*, October 2015, http://soar-ky.org/news/soar-executive-board-approves-criteria-application-process-for-kentucky-appalachian-regional-development-fund/
[65] SOAR Website, http://soar-ky.org/kard-grant-applications/

Maryland - One Maryland Broadband Network

Maryland is rated the 12th most connected state in the country and average statewide broadband speed is 43 mbps.[66] 2015 penetration rate at 25 Mbps download and 3 Mbps upload: 93%[67]

Resources

- One Maryland Broadband Network Status Report, November 1, 2013

What the project will accomplish? (i.e. connecting all schools and government agencies within the state)	In 2010, the State of Maryland in conjunction with Howard County, Maryland and the Maryland Broadband Cooperative received a $115 million dollar federal grant for middle mile broadband deployment under the American Reinvestment and Recovery Act. The Broadband Technologies Opportunities Program (BTOP) issued over $4 billion in competitive grant funding during the course of the program. The State of Maryland received the 2nd largest infrastructure grant and was the only $100 million dollar plus project to finish on time and on budget. The One Maryland project was also the only one of its kind in that it connected every county in the State and is solely owned and operated by State and local government. While the initial project is complete, the State and Counties in Maryland are continuing to build out and leverage the asset. The initial project built 1330 miles of fiber, connecting existing networks and providing direct connections to 1065 anchor institutions across the State.
What are the capital costs?	The project costs were in excess of $160 million dollars.
What is the timeframe to completion?	The project was completed in less than 3 years and was completed on August 31, 2013.
How is the project being funded?	It was funded by federal grant, state and county general funds.
Is this a public private partnership? What is each partner bringing/offering and how is each partner participating?)	No. The State and Counties provided cash and in-kind matching funds of over $45 million.
What is the service delivery model and how are services being offered?	The State maintains a portion of the network, while 9 other local jurisdictions own, operate and maintain the portion of the network that resides in their jurisdiction. Collectively, the entities are providing their own services to the anchor institutions on the network within their own jurisdiction. Howard County is now a recognized ISP and is providing the ERATE contract to Howard County Schools as well as service to commercial entities.
What services, pricing, bandwidth is going to be delivered?	Anywhere from 50-100 mbps to 1 Gbps.
What has been the public response?	Very good. Very little pushback from carriers.
What else is the State doing to improve broadband services?	Local jurisdictions are continuing to build out and leverage the middle mile network. For example, in January 2015, the City of Westminster, Maryland entered into a public-private partnership with Ting, a company that markets itself as a provider of "crazy fast"

[66] Broadband Service in Maryland, Broadband Now, http://broadbandnow.com/Maryland

[67] *Appendix E: Americans Without Access to Fixed Broadband by County*, Federal Communications Commission, February 2015, https://www.fcc.gov/reports-research/reports/broadband-progress-reports/2015-broadband-progress-report

	fiber Internet service. The city owns, funds, and maintains the network while Ting has a two-year exclusivity contract to lease the fiber. Additionally, Ting providing the investment for equipment and services, reducing the city's risk, makes this partnership possible. Ting is not new to the local government market and also provides high-speed broadband service in Charlottesville, VA and Holly Springs, North Carolina. This partnership was recognized as 2015's "Community Broadband Innovative Partnership of the Year" by the National Association of Telecommunications Officers and Advisors.[68] Using Westminster for inspiration, the City of Baltimore has also undertaken efforts to increase broadband for its residents. In September of this year, the city passed a resolution to develop a broadband plan, since industry will not be expanding existing services. The resolution had been referred to Departments of Planning, Transportation, Public Works, Finance and the city's public school system and is now in the Mayor's Office of Information Technology.[69] The public has also been getting involved ensuring better broadband for the community. Three citizens have kick-started the Baltimore Broadband Coalition, which is crowdfunding a campaign to increase competition in the city.[70]

[68] *Education Week Shines Light on Rural Schools' Plight*, Community Broadband Networks, January 2016, http://muninetworks.org/tags-341
[69] *Baltimore City Council Ponders Options for Moving Muni Fiber Forward*, Community Broadband Networks, January 2016, http://www.muninetworks.org/content/baltimore-city-council-ponders-options-moving-muni-fiber-forward
[70] *Baltimore Broadband Coalition*, Crowd Fiber, July 2016, http://www.crowdfiber.com/campaigns/baltimore-broadband-coalition

Minnesota - Border-to-Border Broadband Development Grant Program

Minnesota is rated the 16th most connected state in the country and average statewide broadband speed is 27.9 mbps.[71] 2015 penetration rate at 25 Mbps download and 3 Mbps upload: 87%[72]

Resources

- 2015 Grantees and Applications
- Funded Projects from 2014 Appropriations

What the project will accomplish? (i.e. connecting all schools and government agencies within the state)	In May 2014, Governor Mark Dayton signed into law the Border-to-Border Broadband Development Grant Program that made a modest amount ($20 million) in competitive grants available for broadband infrastructure development. The program, administrated by the Minnesota Department of Employment and Economic Development, allows for entities to apply for up to $5 million in grants for broadband infrastructure projects. Applicants must have at least 50% of the matching funds.[73] Eligible projects include those located in unserved or underserved areas and eligible applications include incorporated businesses, political subdivision, Indian tribes, Minnesota nonprofits, cooperative association or limited liability corporation.[74]
What are the capital costs?	There are no capital costs for the state associated with the grant program.
What is the timeframe to completion?	The program was instituted in 2014 and received $20 million. In the spring of 2015, $10 million were appropriated for the program.
How is the project being funded?	Funding for the Border-to-Border Development Grants is appropriated from the state's general fund.
Is this a public private partnership? What is each partner bringing/offering and how is each partner participating?)	No. This is a state managed grant program with no funding or assistance received from private entities for the grant program. Awarded applicants must contribute 50% matching funds as an investment in the project.
What is the service delivery model and how are services being offered?	It will vary based on projects that receive a grant.
What services, pricing, bandwidth is going to be delivered?	The grant program will pay up to 50 percent of the infrastructure deployment costs for qualifying projects. "Broadband deployment costs" or "costs" means the cost of the acquisition and installation of middle-mile and last-mile infrastructure that support broadband service scalable to speeds of at least 100 megabits per second download and 100 megabits per second upload.[75]

[71] Broadband Service in Minnesota, Broadband Now, http://broadbandnow.com/Minnesota
[72] *Appendix E: Americans Without Access to Fixed Broadband by County*, Federal Communications Commission, February 2015, https://www.fcc.gov/reports-research/reports/broadband-progress-reports/2015-broadband-progress-report
[73] State accepting broadband grant applications, Minnesota High Tech Association website, https://www.mhta.org/state-accepting-broadband-grant-applications/
[74] State of Minnesota website, http://mn.gov/deed/programs-services/broadband/grant-program/index.jsp
[75] State of Minnesota website,http://mn.gov/deed/programs-services/broadband/grant-program/

What has been the public response?	The state has received feedback from residents in communities that have received these grants and have posted these are success stories on the program website.[76] However, communities in more affluent areas have been passed over for these grants.[77]
What else is the State doing to improve broadband services?	In December 2015, Governor Mark Dayton proposed another plan to infuse $100 million in a separate program to bring more broadband to rural Minnesota. While the Governor has admitted that this figure might not be the right one, he says that it must be significant.[78] Just recently, a Minnesota state task force recommended that the state spend another $200 million to expand better Internet access to rural communities. This is twice the $100 million Governor Mark Dayton and the Democrat-controlled state senate are asking for and a significantly higher than the $35 million the GOP is recommending.

[76] State of Minnesota website,http://mn.gov/deed/programs-services/broadband/grant-program/
[77] *Affluent communities passed over for broadband grants*, The Washington Times, November 2015, http://www.washingtontimes.com/news/2015/nov/28/affluent-communities-passed-over-for-broadband-gra/
[78] *Minnesota governor to seek $100M for broadband expansion*, The Washington Times, December 2015, http://www.washingtontimes.com/news/2015/dec/3/minnesota-governor-to-seek-100m-for-broadband-expa

Missouri - MoBroadbandNow

Missouri is rated the 38th most connected state in the country and average statewide broadband speed is 48.5 mbps.[79] 2015 penetration rate at 25 Mbps download and 3 Mbps upload: 71%[80]

Resources

- Broadband Strategic Report, Building Broadband Access and Adoption in Missouri, Fall 2013

What the project will accomplish? (i.e. connecting all schools and government agencies within the state)	In 2009, Governor Jay Nixon created MoBroadbandNow, a public-private partnership of multiple cooperative partners to expand and enhance broadband accessibility and adoption to all areas of the state. The governor set an ambitious goal to increase broadband accessibility from 79 percent as of January 2009 to at least 95 percent by the end of 2014.[81] The state and multiple private entities jointly apply for grants and/or leverage other funding sources. These funds are then redistributed via a competitive grant application process. There are mixed reports and opinions on the true progress made. The NTIA reports that as of June 2014 "high speed downloading" was available to 94 percent of the state's urban population versus 40 percent of rural Missourians. State mapping reports that the underserved population is only 1 percent while the FCC estimated the number to be closer to 12 percent or 13 percent.[82]
What are the capital costs?	These depend on the project.[83]
What is the timeframe to completion?	Grantees are required to substantially complete their projects by the end of 2 years.[84]
How is the project being funded?	MoBroadbandNow has received $261 million from federal, state, local and private resources. Federal grant funding includes just over $188 million from the American Recovery and Reinvestment Act of 2009[85] and Rural Utilities Service grants.
Is this a public private partnership? What is each partner bringing/offering and how is each partner participating?)	Yes, MoBroadbandNow is a public-private cooperative.

[79] Broadband Service in Missouri, Broadband Now, http://broadbandnow.com/Missouri
[80] *Appendix E: Americans Without Access to Fixed Broadband by County*, Federal Communications Commission, February 2015, https://www.fcc.gov/reports-research/reports/broadband-progress-reports/2015-broadband-progress-report
[81] MoBroadbandNow website, http://mobroadbandnow.com/mo-broadband-initiatives/
[82] *After six-year push, rural Missouri still waits for high-speed Internet*, Missourian, August 2015, http://www.columbiamissourian.com/news/state_news/after-six-year-push-rural-missouri-still-waits-for-high/article_adedfcc4-3987-11e5-b153-27e843e52d3d.html
[83] MoBroadbandNow website, http://mobroadbandnow.com/projects/overview/
[84] MoBroadbandNow website, http://mobroadbandnow.com/mo-broadband-initiatives/mobroadbandnow-overview-test/
[85] Broadband USA (NTIA) website, http://www2.ntia.doc.gov/Missouri

What is the service delivery model and how are services being offered?	These vary based on the grant awarded.
What services, pricing, bandwidth is going to be delivered?	These vary based on the grant awarded.
What has been the public response?	There has been favorable response to the MoBroadbandNow initiative. Several summits have taken place around the state to help increase broadband access and improve industries in the state such as telehealth and agribusiness.[86]
What else is the State doing to improve broadband services?	MoBroadbandNow has created rural health and agribusiness initiatives to ensure that support is provided for these critical industries.[87]

[86] MoBroadbandNow website, http://mobroadbandnow.com/initiatives/
[87] MoBroadbandNow website, http://mobroadbandnow.com/initiatives/

New York - The New NY Broadband Program

New York is rated the 4th most connected state in the country and average statewide broadband speed is 41.8 mbps.[88] 2015 penetration rate at 25 Mbps download and 3 Mbps upload: 97%[89]

Resources

- Broadband Availability and Speeds in New York as of July 2014

What the project will accomplish? (i.e. connecting all schools and government agencies within the state)	In an effort to ensure universal broadband access to New York residents by 2018, Governor Andrew Cuomo created the New NY Broadband Program that provides $500 million in state matching funds to the private sector to expand broadband services to underserved areas.[90] A Request for Information was issued in September 2015 and closed on October 30. The RFI called for interested parties and stakeholders to contribute ideas and recommendations for designing the New NY Broadband Program which included how best to leverage partnerships and to identify barriers and challenges to meeting broadband access demands. Responses to the RFI are under review by the State's Broadband Program Office.[91]
What are the capital costs?	These are still to be determined.
What is the timeframe to completion?	The Governor is aiming to have the state fully connected by 2018.
How is the project being funded?	Funding for the New NY Broadband Program comes from capital resources from bank settlements.[92]
Is this a public private partnership? What is each partner bringing/offering and how is each partner participating?)	No. This is a state managed grant program with no funding or assistance received from private entities.
What is the service delivery model and how are services being offered?	It will vary based on project that receives a grant.
What services, pricing, bandwidth is going to be delivered?	In addition to the match requirement, broadband providers must provide internet speeds of at least 100 Mbps, with funding priority given to those delivering the highest speeds at the lowest cost. In certain limited cases, providers may offer 25 Mbps speeds to the most remote unserved and underserved areas of the state (more than three times the current standard) scalable to 100 Mbps or more - if this

[88] Broadband Service in New York, Broadband Now, http://broadbandnow.com/New-York
[89] *Appendix E: Americans Without Access to Fixed Broadband by County*, Federal Communications Commission, February 2015, https://www.fcc.gov/reports-research/reports/broadband-progress-reports/2015-broadband-progress-report
[90] *Albany, New York Studying Internet Access Needs*, Community Broadband Networks, March 2016, http://www.muninetworks.org/tags-191
[91] New York Broadband Office Website, https://www.nysbroadband.ny.gov/node/376
[92] New York Broadband for All website, https://www.ny.gov/programs/broadband-all

	provides the best means of achieving universal broadband access to the region.[93]
What has been the public response?	Very positive. That state's upstate region struggles with adequate high-speed access to foster economic development, so this program could significantly impact the underserved portions of the state.[94]
What else is the State doing to improve broadband services?	Earlier this year, Governor Cuomo launched the state's Broadband for All (#broadbandforall) initiative of which the New NY Broadband Program is a part. In addition to the state match grant program, each Regional Economic Development Council (REDC) will submit a comprehensive plan to the State that: 1) identifies unserved and underserved areas; 2) aggregates demand across residential, institutional and business sectors; 3) details the most cost-effective means to provide universal access; and 4) leverages state-owned assets where possible.[95] Adding to New York's efforts, the merger of Time Warner Cable and Charter Communications includes a condition that the company invest more than $1 billion in New York for speeds and upgrades that will lead to 100 Mbps statewide by the end of 2018, and 300 Mbps by the end of 2019. Merger conditions also include a requirement that high speed broadband is brought to 145,000 unserved customers who currently have no high speed broadband at all. Additionally, the state issued a $500 million solicitation for private sector partners to join the New NY Broadband Program, which will greatly expand Internet access in all regions of the state.

[93] New York Broadband Office Website, https://www.nysbroadband.ny.gov/node/376
[94] *County looks at lack of broadband coverage*, Register-Star, March 2015, http://www.registerstar.com/news/article_e251ef52-cea7-11e4-b084-8f62fc1082f3.html
[95] New York Broadband for All website, https://www.ny.gov/programs/broadband-all

Why this Matters

Stimulate Economic Development and Growth. States, municipalities, communities and regions that have deployed all-fiber networks have already seen the tremendous economic impact of building symmetrical Gigabit networks for businesses. These communities have fostered an environment of innovation, economic development and growth, collaboration, and creative activities. ***According to a 2012 survey of economic development professionals, 60 percent said that 1 Gigabit of service had a "definite impact" on new businesses that moved to an area.***[96]

States, municipalities, communities and regions that want to impact economic development must build 21st Century infrastructure.

Because access to advanced broadband services is a priority for businesses and entrepreneurs, the communities that have built Gigabit-enabled fiber networks have already benefited economically by attracting businesses and industries, in areas like manufacturing and technology, to re-locate to their communities. For example, Kansas City has already seen an uptake in new high-tech start-ups due mostly to Google's FTTH efforts. Through Homes for Hackers and the Kansas City Startup Village, entrepreneurs have built a community of innovators enticed by the possibilities presented by the Google Fiber network.[97] A prominent venture capitalist has even purchased a home in a Kansas City "fiberhood" to allow entrepreneurs to live for free in Kansas City and build Gigabit-ready applications.

Telecommuting Opportunities. The number of people working from home or telecommuting has increased enormously in the past few years and will increase exponentially in the future. According to a study conducted by the Global Workplace Analytics[98], telework grew nearly 80% from 2005 to 2012. In 2010, based on its own survey, *WorldatWork* estimated that 16 million employees worked at home at least one day a month[99], a number that increased almost 62% between 2005 and 2010. In 2015, Gallup found that 37% of U.S. workers telecommuted in 2015, up from 30% a decade before[100].

[96] *Building the Gigabit City, Craig Settles, 2013,* http://portal.calix.com/portal/calixdocs/mktg/w/gig/Building_the_Gigabit_City.pdf
[97] Kansas City Startup Village, http://www.kcstartupvillage.org; and Homes for Hackers, http://homesforhackers.com.
[98] Latest Telecommuting Statistics, Global Workplace Analytics, http://www.globalworkplaceanalytics.com/telecommuting-statistics
[99] *Telework 2011*, WorldAtWork, https://www.worldatwork.org/waw/adimLink?id=53034
[100] *In U.S, Telecommuting for Work Climbs to 37%*, Gallup, August 2015, http://www.gallup.com/poll/184649/telecommuting-work-climbs.aspx

There are significant economic benefits from telecommuting and working from home. According to Global Workplace Analytics, "If those with compatible jobs and a desire to work from home did so just half the time (roughly the national average for those who do so regularly) the national savings would total over $700 Billion a year." Global Workplace Analytics also notes:

- A typical business would save $11,000 per person per year
- The telecommuters would save between $2,000 and $7,000 a year
- The oil savings would equate to over 37% of our Persian Gulf imports
- The greenhouse gas reduction would be the equivalent of taking the entire New York State workforce permanently off the road.

Providing the ability for people to work from home or from Internet meeting rooms—the local coffee shops, libraries, community centers, co-working spaces, incubator locations, or virtual offices–requires access to advanced broadband services. The benefits and cost savings of telecommuting can only be realized when workers have access to abundant broadband. Adequate broadband connectivity also allows rural citizens to remain within their communities while working for urban organizations from their home.

Every "Thing" will be Connected to the Internet

Every good thing out there is connected to the Internet, the new "Internet of Things." These things include household systems that monitor security systems, locks, energy use, temperature, and water control. It includes appliances that call automatically for maintenance, make shopping lists, schedule events, order parts, and schedule repair—all without the need for human intervention or oversight.

Medical Devices, Health Monitoring Systems, Our Cars, Our Clothes, Household Systems, Appliances, Energy Controls – the "Internet of Things"

The Internet of Things includes medical devices that monitor our health to detect and alarm us when medical issues are present, clothes that detect glucose levels or heart conditions, and hats that monitor our brain activity. Cars are now connected to the Internet monitoring the car's status and performance and notifying drivers of traffic delays, alternative routes, hazardous conditions, and mechanical issues. Soon cars will drive themselves. Internet-connected cars will provide anti-collision technology automatically braking and steering clear of accidents or potential accidents. Devices are already Internet-enabled, but the Internet of Things is only possible with advanced broadband capacity.

Affordable Healthcare.

As the largest portion of our population (baby boomers) age, concerns of increased healthcare costs will need to be addressed by providing better, smarter, and more cost-effective healthcare. Telemedicine uses information technology (telephone, Internet and personal computers) for diagnosing, treating and monitoring patients. These advances are not only making care more accessible and convenient but also lowering the costs of medical care, while not sacrificing the quality of care, and in many

studies, improving the quality of care. Physicians can consult with more patients and patients can meet with their physicians in a shorter time period. Less time is spent checking the patient in and leading the patient to the exam room. In terms of economic advantages, telemedicine can save a great deal of time for patients who otherwise would have to leave work. Telemedicine can also eliminate many ER visits, which are often the costliest means of providing healthcare services. Finally, telemedicine delivers the care of world-class care to everyone, regardless of location. Rural patients can receive care from urban facilities, and patients throughout a state can access specialists across the globe.

Other medical applications enabled with advanced broadband include medical training and consultation with other physicians and providers, electronic health records, and the ability to log-in and read patient charts, MRIs and X-rays.

Education and Distance Learning. The methodology by which education is happening is changing. Homework assignments, tests and accessing educational videos are online. Some schools are providing a reverse classroom, where students download the lesson remotely while at home to watch the lecture, pause, reflect, rewind and watch again. The classroom time is then used for more in-depth study, homework, questions and interaction between the students and teachers. The FCC has adopted a short-term benchmark for schools of 100 Mbps per 1,000 users with a long-term goal of 1 Gbps per 1,000. Currently approximately 41% of schools fall short of this benchmark.[101]

For adult learners, the educational methods are also changing. The concept of working for a single company or within a single industry for thirty years until retirement is no longer an economic reality. Workers will change careers an average of seven times during their lifetime. Workers cannot expect to enjoy a "steady job" with a lifelong employer, nor expect that employer to provide the training and skills needed as the work changes. Workers will require on-going training, education and mentorship. Many of these resources for further education and mentoring are now available on-line. Educational institutions, workforce training, universities, and corporations provide education when people can use it, rather than at a specific place and time, working around lifestyle, schedules and work/home priorities and pressures.

Public Safety. Emergency response teams have unique needs and higher standards for broadband and communications. Our first responders need networks that are reliable, always on, secure, ubiquitous in coverage, and interoperable that can prioritize access to information and databases. Many tools and applications that could be used to improve public safety are supported by a sufficient mobile broadband network. For example, sensors can provide situational awareness for disasters, fires, emergencies, car wrecks and other events but require access to high bandwidth that current wireless networks do not support. The same is true for the many video applications used by first responders—body cameras, camera-equipped cars, and live ambulance video-links to hospitals.

[101] *2016 Broadband Progress Report*, Federal Communications Commission, https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-6A1.pdf.

U.S. public safety agencies will soon be able to use the FirstNet network that provides priority access for law enforcement, first responders, and public safety agencies. This is critical during disasters when cell phone networks can become congested, as FirstNet is a network that will have spectrum dedicated exclusively for public safety entities.

Digital Inclusion and Civic Engagement.

Broadband must be ubiquitous or it will further create a digital divide between the haves and the have-nots. When broadband is ubiquitous, it can be the great equalizer between different economic classes. However, not having advanced broadband access available to everyone can create further inequalities of wealth and potentially create further gaps in education, social institutions and government resources. Broadband must be abundant and available to everyone. Advanced Broadband Networks can transform civic engagement, access to government resources, and transparency of government. Many government documents, including GIS data, applications, information on initiatives, information on financial contributions, etc. are now available on-line. Providing citizens access to this data provides further transparency, community engagement, public input, and public impact on government.

Our first responders need reliable, ubiquitous coverage, higher standards than what our commercial networks currently have, interoperability between networks, and priority access to information and databases.

Financial Impact of Fiber: Higher Home Values

Statistics from the FTTH Council state that communities that have deployed FTTH networks have instantly improved home sales values. According to the FTTH Council, access to fiber adds 3.1% to the value of a home and having a Gigabit available increases home values by 7% over homes that have access to 25 Mbps or less.[102]

[102] Reevaluating the Broadband Bonus: Evidence from Neighborhood Access to Fiber and United States Housing Prices, June 2015, http://www.lightwaveonline.com/content/dam/lw/documents/FTTH_Report_06_26_2015.pdf

Conclusion

In conclusion, having access to affordable, abundant, high capacity Internet is no longer a luxury. Having access to abundant broadband is critical for:

- creating more jobs,
- creating vibrant communities that are economically stable,
- providing new opportunities,
- fostering an entrepreneurial-friendly environment,
- improving technology advancement,
- providing for better and less expensive healthcare,
- creating educational opportunities,
- improving public safety and better access to e-government services,
- facilitating more telework and telecommuting, and
- attracting the New Knowledge economy.

Advanced broadband networks are creating enormous shifts in local, state, national and global societies, as well as markets, business and in institutions around the world. Therefore, it is critical to have this infrastructure available to all citizens. This paper forms the foundation for researching alternatives, policies, programs, and strategies to promote more broadband investment within the State of Tennessee.