



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

Strategies, Options, and Recommendations

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Prepared for



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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 also sets objectives necessary to position the State of Tennessee as an Internet 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 and recommendations 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 scalable¹.

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.

- 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 programming for older, low income, and low educational attainment groups.

Objective 3: Enhance institutional 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 has undertaken 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 some 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 index².

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 counties⁷
- A number of identifiable groups significantly underutilize the Internet connection that they have: small businesses; businesses and community anchor institutions in economically disadvantaged counties; older households, 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.**

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 scalable⁸.

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 institutional 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:

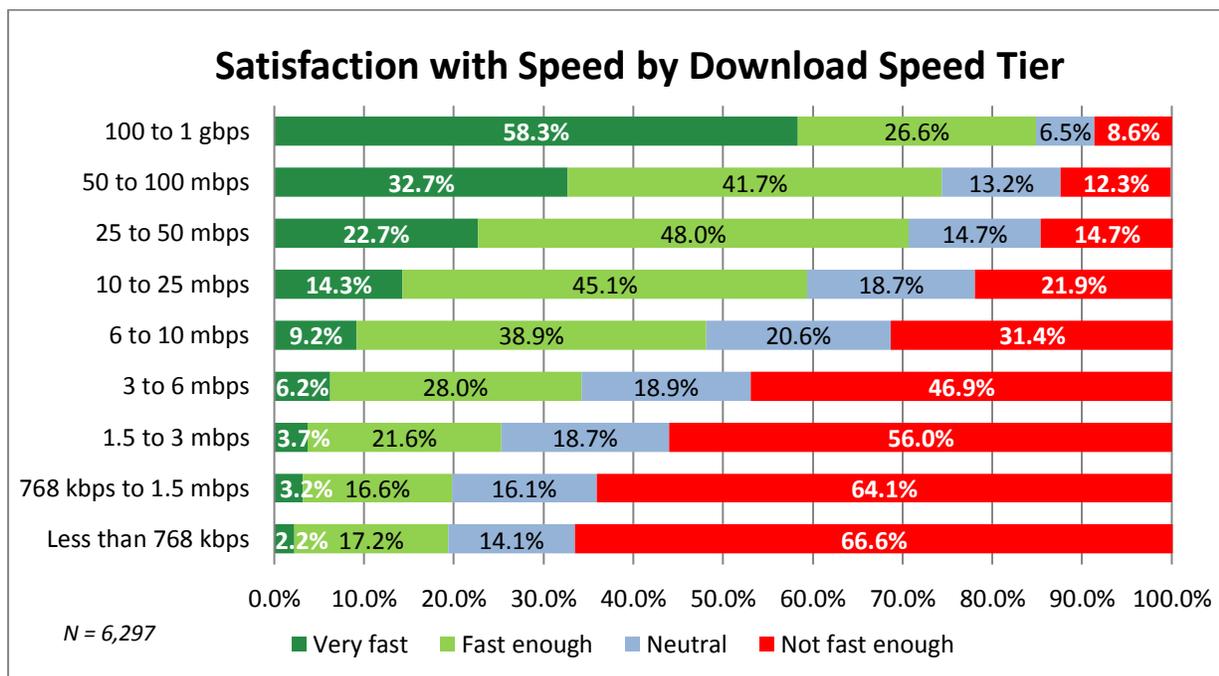
Objective 1: The State should work toward equitable access for all communities through Internet infrastructure that is reliable and scalable.

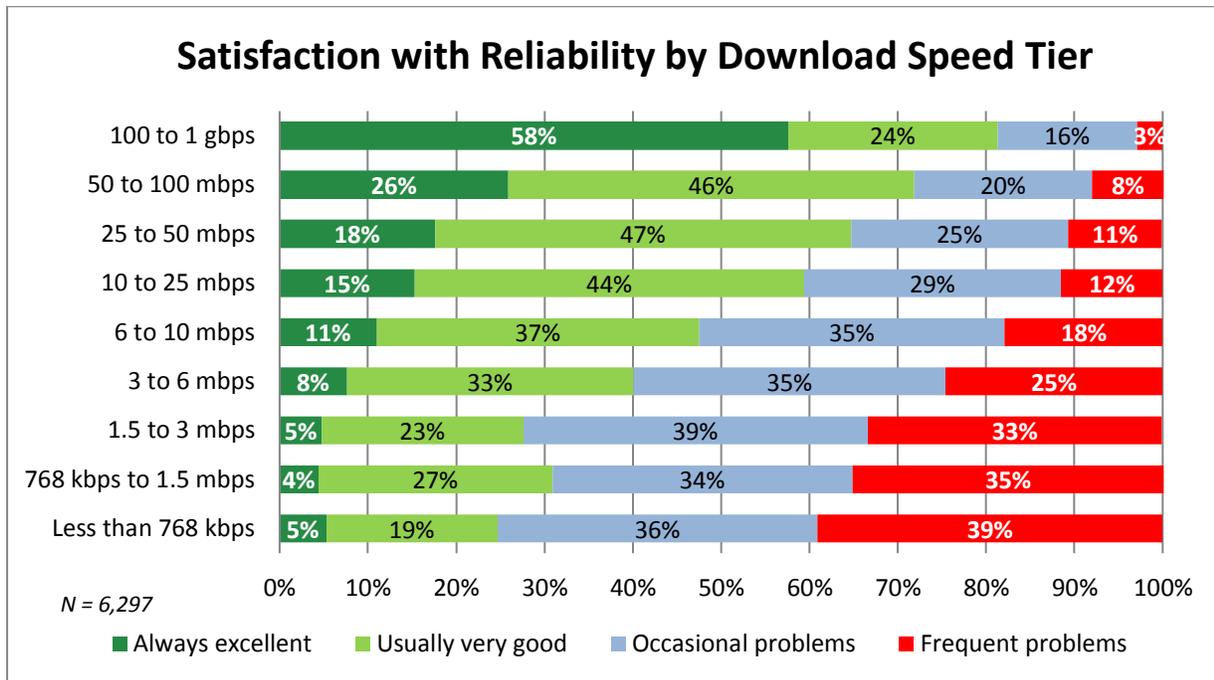
Recommendation: Within three to five years, ensure all communities have fiber to their core and community anchor institutions, as well as last mile Internet service that meets the 25/3 standard.

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 strategies 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

These strategies and considerations are discussed in detail in this section.

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. Continued investment by the existing providers should continue to be encouraged. However, much of the broadband investment in the U.S. has been sparked by competition. In many cities and towns, there is a near monopoly or a friendly duopoly in which the two incumbent providers—the cable TV and major telecommunications company—have limited competitive pressure to improve their network infrastructures.

When a third player enters a market – be it Google Fiber, the municipality, the electric cooperative, a competitive local exchange carrier, or another entity -- the status quo is disrupted. Also if one of the two incumbent providers decides to build better infrastructure, this forces the other competitors to also invest in their infrastructure. Competition is a driving force behind broadband infrastructure investment. In many instances throughout the U.S., the only competition in broadband investment may be from a municipality or from an electric cooperative. Especially in rural, or hard to serve areas, the municipality or electric cooperative may be the only entity that can make a business case work, primarily because it has a vested interest in the economic vitality of the community.

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.

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

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 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. In general, it is advised to lift regulatory restrictions and barriers that limit broadband deployment and competition. 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

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

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. 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 should consider lifting administrative burdens and restrictions to broadband infrastructure investment and fostering an open regulatory environment.

¹³ *Broadband Coverage in the U.S., see www.broadbandnow.com*

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 whether to implement 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.

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 Agreements** 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.

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, these 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

Develop a policy that all construction permits issued would require the submission of final as-built drawings. 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-health 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 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, reliability 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.

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-

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 bandwidth 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 recommendation:

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.

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 Tennessee²⁶.

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 Tennessee²⁷.
- 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

Major Industry	Median DEi Score (Businesses)		
	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’ competitiveness 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 businesses³⁰. 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 growth³¹, 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 costs³². 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.

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)	<i>At Risk & Distressed Counties</i>	<i>Transitional, Competitive and Attainment Counties</i>
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 online³³. 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 groups³⁸. 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 institutional 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 regulation⁴⁰. 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 initiatives 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 infrastructure⁴¹, 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.*

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

*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		



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