

Hampton Roads Regional Broadband Strategy

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Hampton Roads Planning District Commission
October 31, 2017





1. PROJECT NAME

Provide a name for the project that is proposed in this funding application:

Hampton Roads Regional Broadband Strategy

2. APPLICANTS

List applicant organizations:

Cities of Chesapeake, Norfolk, Portsmouth, Suffolk, and Virginia Beach

3. PRIMARY CONTACT INFORMATION

Primary contact (for this application): Robert A. Crum	Position/title: Executive Director, Hampton Roads Planning District Commission
Mailing Address: 723 Woodlake Drive, Chesapeake, VA 23320	Telephone: 757-420-8300
Email: rcrum@hrpdcva.gov	Website (URL) if applicable: www.hrpdcva.gov

4. RESOLUTIONS/LETTERS OF SUPPORT

Identify the municipalities/counties and other agencies (if any) that are providing a resolution or letter of support for this funding application (*must be two or more*):

Localities: Chesapeake, Franklin, Gloucester County, Hampton, Isle of Wight County, James City County, Newport News, Norfolk, Poquoson, Portsmouth, Southampton County, Suffolk, Virginia Beach, Williamsburg, Windsor, York County, HRPDC

Colleges/Universities: Norfolk State University, Old Dominion University, Tidewater Community College, Virginia Wesleyan University

Business: Bull & Company Mediaworks, Cetan Corp, Chesapeake Regional Healthcare, Clark Nexsen, Creative Office Environments, Dominion Enterprises, Dragas, Grow, Priority Automotive, TechArk Solutions, TFC Recycling

Community Stakeholders: Hampton Roads Innovation Collaborative, Norfolk Military Economic Development Advisory Committee, tHRive, Virginia Beach Military Economic Development Advisory Committee

**As of 10/30/17*

☒ The resolutions/letters of support are attached

**Applicants are responsible for securing a resolution outlining support for the GO Virginia Region 5 funding request from two or more municipalities/counties. The applicant must provide a copy of the resolutions of support to the GO Virginia Regional Council before an application can be considered for funding.*

**Sample Resolution: THAT, the (insert local government name) supports the application to Go Virginia Region 5 from the (insert applicant organization name) for a grant of up to \$(insert amount) for the (insert project name).*



5. OVERVIEW

Provide a detailed description of the proposed project to include primary goals and approach:

**Refer to the "Application Components" as outlined in Region 5 Information for Grant Applicants.*

The Hampton Roads Regional Broadband Strategy proposes the creation of a fully integrated regional fiber optic network that connects employment areas, higher education facilities, research institutions, and municipal facilities throughout the region. This regional broadband network will allow Hampton Roads to continue to develop as a nationally connected 21st century community and international information gateway, and provide our region the necessary infrastructure to support job creation centered around a number of emerging industry clusters identified in the GO Virginia Region 5 Economic Growth and Diversification Plan. As communities continue to evolve around technological advancements, regions will not be able to compete for high paying jobs without a regionally coordinated and affordable broadband system.

The broadband strategy will also allow the region to leverage job creation opportunities related to the 4,000 mile trans-Atlantic cable, known as MAREA, that was recently constructed from Bilbao, Spain to Virginia Beach and is a venture led by TELXIUS. A second trans-Atlantic cable will also be installed by TELXIUS. This cable known as BRUSA, will connect Virginia Beach directly to Rio De Janeiro, Brazil, with branching connections to Puerto Rico and Fortaleza, Brazil. It will be ready for service in 2018. These cables will more than double current transatlantic capacity, and position the Hampton Roads region to emerge as a Tier I Broadband Region. The Hampton Roads Broadband Initiative is key to the obtainment of this designation and is the centerpiece of a strategy to attract high paying 21st century jobs to Hampton Roads.

The goals and benefits of the Hampton Roads Regional Broadband Initiative to the Job Creation/Business, Education and Government sectors include the following:

GOALS

Job Creation/Business

- Foster an ecosystem that attracts high paying jobs by providing a regionally interconnected broadband system, and brand the Hampton Roads region as a global information gateway.
- Leverage the job creation opportunities presented by the trans-Atlantic cable(s).
- Transform the region's economy by attracting new enterprises within the cluster areas identified in the GO Virginia Region 5 Economic Growth and Diversification Plan:
 - Advanced Manufacturing
 - Cyber Security, Data Analytics and Mod-Sim
 - Business Services
 - Life Sciences
 - Unmanned Systems and Aerospace
 - Port Operations, Logistics and Warehousing
 - Water Technologies
 - Shipbuilding and Repair
 - Tourism and Recreation

See next page for further details



- Create an environment for low-cost internet service providers to meet the demand for internet to address the business digital divide.
- Construct broadband infrastructure to support business incubators, technology innovators, product accelerators and data centers.
- Retain an educated and skilled workforce by expanding advanced technology business creation.
- Create fiber infrastructure and connectivity to meet “smart region” capabilities.

Education

- Interconnect the region’s higher education institutions to promote an environment for collaborative research and development and business spin-off opportunities.
- Provide bandwidth to support growing educational needs (e.g. virtual classrooms).
- Provide affordable access to underserved and unserved areas to address the residential digital divide.

Government

- Provide connectivity between jurisdictions in the Hampton Roads region.
- Create regional interoperability
 - Build a robust Public Safety Infrastructure network.
 - Consider a unified and redundant 911 center.
- Develop potential for expanded and shared services for all departments.

APPROACH

The Hampton Roads Broadband Initiative will use a 4-phase middle mile approach to interconnect the region and provide a broadband network that will serve as a foundation for the creation, attraction and retention of high paying jobs. The framework for this phased project has been detailed by a two-phase Pre-Engineering Study that has been funded by the City of Virginia Beach and reviewed and endorsed by the Hampton Roads Planning District Commission (HRPDC) and Hampton Roads Chief Administrative Officers (CAO) Committee. Technical support for this effort has been provided by the regional Chief Information Officer (CIO) Committee. This 4-phase approach is described below and illustrated in Attachment 10.9.

Phase 1: Construct Southside Fiber Infrastructure

The first phase of this effort will be advancement of a Southside fiber network that interconnects the localities of Virginia Beach, Norfolk, Portsmouth, Chesapeake and Suffolk. This Southside network will interconnect institutions of higher education, including Tidewater Community College, Norfolk State, Regent University, Virginia Wesleyan and Old Dominion University campuses. It will also interconnect key job centers, anticipated growth areas and municipal centers/facilities and offer a “middle mile” network to support job creation. To reduce costs, existing municipal fiber will be used as part of the network. Monies are also requested in this GO Virginia proposal to support a Pre-Engineering Study to outline a similar fiber infrastructure on the Peninsula. A map which illustrates employment and residential densities in Southside Hampton Roads that can be served by this network is provided in Attachment 10.8.

See next page for further details



Phase 2: Construct Peninsula Fiber Infrastructure

The second phase of this initiative will be the construction of a complimentary fiber network on the Peninsula. This network will be based on the Pre-Engineering Study referenced above, and is expected to interconnect Peninsula localities and the campuses of Hampton University, Christopher Newport University, Thomas Nelson Community College and the College of William and Mary. Other important assets such as NASA Langley and Jefferson Labs will also be interconnected with this network. As with the Southside network, existing fiber will be used to mitigate costs and a middle mile strategy will be utilized to promote job creation.

Phase 3: Connect Southside and Peninsula

The next step will be the connection of the Southside and Peninsula fiber networks to create an interconnected and coordinated regional broadband network. Connection points are expected to be made using the Hampton Roads Bridge Tunnel (HRBT) and Monitor Merrimac Bridge Tunnels to create redundant connection points. Plans to complete an expansion of the HRBT facility in 2024 offers an excellent opportunity to coordinate the integration of this connection into this project.

Phase 4: Connect Rural Jurisdictions

The final phase involves the extension of this fiber network westward to the region's more rural areas. The regional fiber optic network will also be integrated with an expanded Wi-Fi network in lower density areas to improve public safety, reduce the digital divide, serve existing small businesses and promote innovation and new business start-ups.

PRE-ENGINEERING ANALYSIS – SOUTHSIDE

To begin the advancement of this four-phase regional broadband plan, the City of Virginia Beach financed the completion of a Regional Fiber Optic Interconnection Pre-Engineering Study for the Southside of Hampton Roads (attached). This analysis was completed by CTC Technology & Energy, an engineering and business consulting firm. This pre-engineering analysis lays the foundation for an interconnection framework between five Southside localities (Virginia Beach, Norfolk, Portsmouth, Chesapeake, Suffolk) that would expand in subsequent stages and would support regional economic development objectives and public-private partnerships in addition to inter-governmental and higher education institution collaboration. This report provides a pre-engineering analysis and develops a conceptual design and cost estimates for interconnecting the fiber optic networks of five Southside Cities and higher education institutions in the Hampton Roads region.

NEXT STEPS – GRANT REQUEST

This GO Virginia application requests GO Virginia funding through a combination of regional and statewide funds to allow Phase I of the Regional Broadband Initiative to advance to construction in a collaborative effort between government, higher education and private sector/incumbent providers. These implementation steps and the corresponding cost estimate for each are outlined below:

See next page for further details



Implementation Step 1: Complete Final Engineering for the Southside Fiber Network
GO Virginia Funding Request: \$ 800,000 from regional pool (to be matched by \$ 800,000 from 5 participating jurisdictions)

Final engineering for the Southside Fiber Network will address final routing, design, right-of-way, permitting and preparation of contract/construction documents for this project. By funding this implementation step, GO Virginia will play a critical role in supporting the region's efforts to initiate this transformative broadband initiative. The total costs for this final engineering work is estimated at \$ 1.6 million, with 50 % requested from GO Virginia Region 5 Funds, and a corresponding 50% local match being provided by the participating jurisdictions.

Implementation Step 2: Complete Pre-Engineering for the Peninsula Fiber Network
GO Virginia Funding Request: \$ 40,000 from regional pool (to be matched by \$ 40,000 from participating jurisdictions)

The Pre-engineering analysis for the Peninsula Fiber Network would mirror the work completed by CTC for the Southside and produce a cohesive plan for the Peninsula that prepares these localities to expand the regional broadband initiative and connect to the Southside in future phases of this effort. The total costs for this effort are expected to be \$ 80,000, with 50% requested from GO Virginia Region 5 Funds and a 50% local match being provided by the participating jurisdictions.

Implementation Step 3: Develop Governance Structure
GO Virginia Funding Request: \$ 30,000 from regional pool (to be matched by \$ 30,000 from participating jurisdictions)

This step will result in the development of a collaborative governance structure that will include the participating localities, higher education facilities and incumbent internet service providers. Other important community stakeholders such as military representatives will also be included in this process. Best practices will be evaluated from other metropolitan regions and important stakeholders will reach consensus on a government structure for implementation. Total costs for this step are estimated at \$ 60,000, with 50% requested from Go Virginia Region 5 Funds and a 50% local match being provided by the participating jurisdictions.

Implementation Step 4: Construction of Southside Fiber Network
GO Virginia Funding Request: \$ 3.9 million from statewide pool (to be overmatched by \$ 7.3 million from participating jurisdictions)

The fourth step of this effort will be the construction of the Southside Fiber Network, interconnecting the cities of Virginia Beach, Norfolk, Portsmouth, Chesapeake and Suffolk, and institutions of higher education and economic development/job creation areas. Construction costs for the Southside network are estimated at \$ 11.2 million, with 35% requested from GO Virginia Statewide Funds and 65% of the costs to be provided by the participating jurisdictions.

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GOVERNANCE

The region's 17 localities have unanimously supported the Hampton Roads Broadband proposal through the HRPDC, and are committed to the appointment of an Executive Committee to develop a governance approach for management of the regional broadband system. Based on best practices learned from other areas, the region expects to release a request for proposals to invite bids from interested providers to operate and provide service from this municipal fiber network. This competitive bid process will be open to all prospective companies/providers to ensure cost savings and efficiencies for the Hampton Roads business, education and government communities.

The development of a governance structure will be a collaborative process that will include local governments, incumbent broadband providers, institutions of higher education and other community stakeholders such as military representatives. Best practices will be evaluated from other metropolitan regions who have successfully implemented regional broadband initiatives, and the most appropriate approach will be designed and selected for implementation to guide the Hampton Roads Broadband Initiative.

Explain how the proposed project relates to Region 5's Economic Growth and Diversification Plan:

**Focus on long term community or regional needs.*

The Hampton Roads Broadband Initiative provides a critical foundation to support the goals and industry clusters outlined in the Region 5 Economic Growth and Diversification Plan. The Growth and Diversification Plan identifies six priority industry clusters as key to the region's economic prosperity:

1. Port Operations, Logistics and Warehousing
2. Advanced Manufacturing
3. Cyber Security, Data Analytics and Mod-Sim
4. Shipbuilding and Ship Repair
5. Water Technologies
6. Unmanned Systems and Aerospace

To fully realize our region's economic potential and create high paying jobs in these key industrial sectors, our region must have an interconnected, affordable and robust broadband network that fully leverages the transatlantic cables and provides the 21st century infrastructure to support, attract and grow businesses in these cluster areas. Each of these priority clusters requires a robust broadband system for success, and the Broadband Initiative addresses this need in a regionally coordinated manner.

See next page for further details



The Growth and Diversification Plan also identifies three goals, each of which are addressed by the Hampton Roads Broadband Initiative:

Goal 1: Create a Coordinated Regional Capacity for Innovation in the Region’s Key Cluster Areas

The Hampton Roads Broadband Initiative furthers this goal by establishing a regionally coordinated broadband network that is critical to support innovation in our region. Combined with the transatlantic cables discussed earlier, the Hampton Roads Broadband Initiative can create a technology friendly brand for Hampton Roads that can be transformational for our regional economy. By funding this initiative, GO Virginia can be viewed as the “game changer” that set the foundation for innovation and economic success.

Goal 2: Increase the Pace of Small –and Medium-Sized Enterprises (SME) Job Creation Through Both Expansion of Existing Firms and, in particular, the Attraction of Out-of-Region Firms in Key Cluster Areas

The key to small to medium size business expansion will be the creation of an ecosystem/brand and support system for Hampton Roads that promotes entrepreneurship. A strong regional broadband network must be part of this ecosystem and will be a requirement for the region to achieve this goal. The Hampton Roads Broadband Initiative is a critical element of this goal statement.

Goal 3: Close all Skills, Credentialing and Degree Gaps in the Regional Clusters’ Workforce by 2022 Through Both In-Region Production and Talent Importation

A consortium of institutions of higher education have offered support for the Hampton Roads Broadband Initiative, demonstrating the critical nature of a robust and interconnected broadband network to our education and workforce development system. A robust broadband network will attract a talented and creative workforce that is needed to support our businesses and emerging sectors.



6. ECONOMIC IMPACT

Return on Investment/Direct Economic Benefits

Outline the projected economic benefits to the regional or state economy:

To calculate the jobs created based on our level of investment, we used two studies: a 2009 report from the Information Technology & Innovation Foundation (ITIF), titled “The Digital Road to Recovery: A Stimulus Plan to Create Jobs, Boost Productivity and Revitalize America,” and a 2015 study authored by Dr. Bento J. Lobo of the University of Tennessee at Chattanooga titled, “The realized value of fiber infrastructure in Hamilton County, Tennessee.”

Based on these sources, we expect this initiative could create as many as 350 jobs over the first five years. Additionally, both indicate jobs associated with broadband generally pay higher than average. For this reason, we have calculated estimates for returns on investment at a slightly higher level of \$60,000, in contrast to the \$46,000 per capita income level for the region.

At the \$60,000 level, income tax revenue would yield \$1.92 million and sales tax revenue would generate \$950,400. This would indicate a total return on investment of \$2.87 million. The chart below illustrates these benefits.

Jobs	Salary	Total Wages	Income Tax Revenue*
350	\$ 60,000	\$48,000,000	\$1,920,000
			Sales Tax Revenue**^
350	\$ 60,000	\$48,000,000	\$950,400
			Total Tax Revenue**^
350	\$ 60,000	\$48,000,000	\$2,870,400

*4% effective personal income tax rate

**1/3 of salary assumed to be spent on items subject to sales tax

^6% Hampton Roads sales tax rate

New Employment (job creation schedule and median salaries)

**The current average annual wage for Region 5 is \$46,000.*

	Year 1	Year 2	Year 3	Year 4	Year 5	TOTAL
Estimated number of new jobs created	0	50	100	100	100	350
Projected average wage per job created	0	\$60,000	\$60,000	\$60,000	\$60,000	



Increased Revenue Generation to include out of state investment

**The following annual revenue generation will be reported on by the applicant organization for a five year period to demonstrate the direct economic benefits of the project:*

	Projected annual revenues				
Current annual revenues (if any):	Year 1	Year 2	Year 3	Year 4	Year 5
\$	\$	\$	\$	\$	\$
INCREASED REVENUE EXPECTED OVER FIVE YEARS:					
<i>*Increased revenue expected is the sum of the projected annual revenues for the five years after the project, minus the current annual revenues (if any) over the same five year period.</i>					\$
Describe how the revenue will be generated and the sources of revenue:					
<p>While it is difficult to accurately predict increased revenue generation, particularly on an annual basis from out-of-state sources, it is reasonable to expect increased revenue generation from private investment along the broadband network that this grant proposal would support. As development is attracted to areas adjacent to this system, localities will experience an increase in machinery and tools tax and real estate tax that is generated by this anticipated development. Additionally, the creation of high paying jobs that will be attracted to this ecosystem will help spur additional sales and use taxes that will increase revenue for jurisdictions, and allow continued investments in quality of life facilities such as public education which will in turn attract additional economic development opportunities.</p>					

GO Virginia Region 5
ECONOMIC GROWTH AND DIVERSIFICATION
 FUNDING APPLICATION



Operational Cost Savings (if applicable) – SEE CHART BELOW TABLE

**The following operational cost savings will be reported on by the applicant organization for a five year period to demonstrate the direct cost saving benefits of the project:*

	Projected costs														
Current costs (if applicable):	Year 1	Year 2	Year 3	Year 4	Year 5										
\$	\$	\$	\$	\$	\$										
COST SAVINGS EXPECTED OVER FIVE YEARS:															
*Cost savings expected is the sum of the projected costs for the five years after the project, minus the current costs over the same five year period.					\$										
Describe how the operational costs savings will be generated:															
<p>The opportunity for increased internet speeds while realizing substantial cost savings is a major reason for municipal investment in broadband. The anticipated increased speed and reduced costs are often related to the limited economic returns to the private sector investor in the “middle mile” and the limited competition in the market place. The City of Virginia Beach has provided the following data to illustrate the operational cost savings/cost avoidance that they have realized by making investments in broadband. It is expected that these savings can be extrapolated to the entire region if the Hampton Roads Regional Broadband Strategy is implemented.</p> <table border="1"> <thead> <tr> <th>Funding Amount</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>\$13,200,000</td> <td>Cost for COX Enhanced Services (maintenance) - 1 Gbps (similar to NGN) bandwidth for 60 locations for 5 years. (\$2.64M x 5)</td> </tr> <tr> <td>(4,100,000)</td> <td>City of Virginia Beach cost estimate for investment in Next Generation Network (NGN) - 1 Gbps bandwidth. (One-time expense.)</td> </tr> <tr> <td>(1,250,000)</td> <td>City of Virginia Beach cost for maintenance for 5 years (\$250K x 5)</td> </tr> <tr> <td>\$7,850,000</td> <td>Projected operational cost savings/cost avoided for first 5 years of NGN operation.</td> </tr> </tbody> </table>						Funding Amount	Description	\$13,200,000	Cost for COX Enhanced Services (maintenance) - 1 Gbps (similar to NGN) bandwidth for 60 locations for 5 years. (\$2.64M x 5)	(4,100,000)	City of Virginia Beach cost estimate for investment in Next Generation Network (NGN) - 1 Gbps bandwidth. (One-time expense.)	(1,250,000)	City of Virginia Beach cost for maintenance for 5 years (\$250K x 5)	\$7,850,000	Projected operational cost savings/cost avoided for first 5 years of NGN operation.
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\$7,850,000	Projected operational cost savings/cost avoided for first 5 years of NGN operation.														

Project Budget

Expense item:	Amount (\$):	Source of Estimate:
Final Engineering for the Southside Fiber Network	\$1,600,000	50%: GO Virginia Region 5 Funds 50%: Participating jurisdictions
Pre-Engineering for the Peninsula Fiber Network	\$80,000	50%: GO Virginia Region 5 Funds 50%: Participating jurisdictions
Develop Governance Structure	\$60,000	50%: GO Virginia Region 5 Funds 50%: Participating jurisdictions
Construction of Southside Fiber Network	\$11,200,000	35%: GO Virginia Statewide Pool 65%: Participating jurisdictions
TOTAL PROJECT BUDGET	\$12,940,000	TOTAL GO VA Preparatory Work Request: \$870,000 TOTAL GO VA Construction Request: \$3,920,000 TOTAL Local Match: \$8,150,000

**Complete the above, however if you wish to provide a more detailed project budget, please attach separately to this application.*



Leverage

The funding request as a percentage of total project funding is: 36.86 %

**Leverage % = (GO Virginia funding request) ÷ (Total project funding)*

Metrics

Provide a detailed description of the metrics that will be used to quantify success:

The following metrics will be used to document the success of the Regional Broadband Initiative on an annual basis:

- Number of high paying jobs created adjacent to the broadband infrastructure
- Number of company startups adjacent to the broadband infrastructure
- Number of underserved areas/population served
- Job creation at higher education institutions served by the broadband ring due to enhanced research investment and capabilities
- Number of data centers and technology firms attracted to the region
- Cost Savings for Higher Education Institutions
- Cost Savings for Local Governments

Anticipated outcomes

List the qualitative as well as anticipated tangible results that will come from the collaboration:

The Hampton Roads Broadband Initiative will be a transformational project that will create an environment that is attractive to business start-ups, create an ecosystem to support innovation, and begin the region on its journey to reinvent and diversify the Hampton Roads regional economy. This regional collaboration is unprecedented in its breadth and reach. All 17 local governments, institutions of higher educations, private sector businesses and community stakeholder organizations have come together in a collaborative manner to envision a project that can transform the region into a Tier I broadband community and a center for innovation. In addition, the proposed Governance structure outlined in this proposal will serve as a statewide model for integrating incumbent service providers into this process and developing a model for “win – win” opportunities that can be used by other Virginia communities.

GO Virginia Region 5
ECONOMIC GROWTH AND DIVERSIFICATION
 FUNDING APPLICATION



Milestones

**GO Virginia funds are provided upon completion of project milestones*

Stage of project:	Scheduled date: (mm-dd-yyyy)	Outcomes:
1) Complete Final Engineering for Southside Fiber Network	01/01/2018-06/30/2018	Provide final routing, cost, design, right-of-way and construction documents for Southside fiber network
2) Complete Pre-Engineering for the Peninsula Fiber Network	02/01/2018-04/30/2018	Develop plan for fiber network that interconnects localities, universities/colleges and federal facilities on Peninsula
3) Develop Governance Structure	01/01/2018-05/30/2018	Develop a governance structure that provides oversight for the implementation of the Hampton Roads Broadband Initiative through the participation of government, education and incumbent service providers
4) Construction of Southside Fiber Network	TBD following completion of final engineering	Construction of transformational fiber network on Southside that interconnects localities, job creation areas and institutions of higher education

**Complete the above, however if you wish to provide a more detailed project schedule, please attach separately to this application.*



7. REGIONAL COLLABORATION

Participating Localities

Describe the service area of the project and include a list of localities within the region participating in the project:

The Hampton Roads region stands united in its support of the Regional Broadband Initiative. This statement of regional support from the region's local governments, higher education institutions and private sector stresses the need for and importance of this initiative.

The goal of GO Virginia is to incentivize projects that involve collaboration between 2 or more local governments. The Hampton Roads Broadband Initiative exceeds this bar, with all 17 localities voting unanimously through the Hampton Roads Planning District Commission to support this initiative as a regional GO Virginia proposal. We believe this level of support exceeds any level of regionalism for any GO Virginia proposal in Virginia, and is exactly the type of regional collaboration GO Virginia was created to encourage.

The Hampton Roads Regional Broadband Strategy has been coordinated with Hampton Roads localities through the HRPDC and the Commission's Chief Administrative Officers (CAO) Committee (managers and administrators from each locality). The HRPDC is one of 21 PDCs in the Commonwealth of Virginia created under Section 15.2-4207 of the State Code "to encourage and facilitate local government cooperation and state-local cooperation in addressing, on a regional basis, problems of greater than local significance". HRPDC voting members include locally elected City Council and Board of Supervisor members as well as the City Managers and County Administrators of the seventeen Hampton Roads localities. The CAO Committee unanimously endorsed the Hampton Roads Regional Broadband Strategy as one of two regional GO Virginia grant applications at its September 6th 2017 meeting. The HRPDC unanimously endorsed the Hampton Roads Regional Broadband Strategy as one of two regional GO Virginia grant applications at its September 21st 2017 meeting. A timeline of the PDC's and CAO Committee's consideration of the GO Virginia program is provided in Attachment 10.7.

Letters of Support and/or Resolutions from the HRPDC and the region's 17 localities are located in Attachment 10.1.

Higher Education

The Regional Broadband Initiative also has support from the region's institutions of higher education. A robust and interconnected broadband system is needed to promote enhanced research and development, workforce preparation and collaboration among our region's institutions.

Letters of support from our higher education partners are located in Attachment 10.4.

Business & Community Stakeholders

Reliable and affordable broadband service is critical to the growth and success of the Hampton Roads business community, and the production of high paying jobs.

Letters of support from business community leaders are located in Attachments 10.5 and 10.6.



If localities or regions (including interstate collaborations) outside the applying region are participating in the project, describe the nature of the collaboration and the anticipated impact.

Gloucester County, an HRPDC member locality located in an adjacent GO Virginia region, has offered resolutions of support for this initiative from the County Board of Supervisors and Economic Development Authority (EDA). This collaboration offers opportunities for coordination with this county in its ongoing efforts to develop broadband service.

Efficiencies

Identify cost efficiencies, repurposing of existing funds, leveraging of existing assets, or other evidence of collaboration that can be demonstrated as a result of the project.

The level of collaboration represented by this project is unprecedented and sets the bar for regional collaboration that can be modeled by other communities. Unanimous support from 17 local governments, higher education institutions and business representatives will promote cost savings and efficiencies for these entities, which in turn will spur an environment for job creation and growth.

Implementation partners

Describe the role of the businesses, colleges and universities, and other public and private entities within the region that will be involved in implementing the project.

All partners will be involved in a collaborative process to develop a governance oversight approach for this project. Local governments will own the broadband network, while various colleges and universities will have vital roles in serving as hubs for this broadband network. Plans are for private business providers to operate and maintain the system in a manner that will be advantageous to the private sector, businesses, local governments and higher education institutions.



Match Funding Sources – REFER TO PROJECT BUDGET ON PAGE 10

Funding Source:	Amount (\$):	Funding form:	Identify funding confirmation:
	\$	Applicant(s) contribution	<input type="checkbox"/> Confirmation letters attached
	\$	<input type="checkbox"/> Grant <input type="checkbox"/> In-kind <input type="checkbox"/> Other:	<input type="checkbox"/> Approval Letter attached
	\$	<input type="checkbox"/> Grant <input type="checkbox"/> In-kind <input type="checkbox"/> Other:	<input type="checkbox"/> Approval Letter attached
	\$	<input type="checkbox"/> Grant <input type="checkbox"/> In-kind <input type="checkbox"/> Other:	<input type="checkbox"/> Approval Letter attached
TOTAL OTHER FUNDING: \$ 0.00		TOTAL PROJECT FUNDING: \$ 0.00 <i>(GO Virginia funds + Other Sources)</i>	

**GO Virginia Region 5 must receive copies of letters of approval and the timing for all other funding sources. Please attach all letters of approval received to date with this application. If additional space is needed please attach a complete list separately.*

Existing programs

If the project has goals similar to an existing initiative, indicate how the proposed project is not duplicative, but additive to efforts to support economic diversification and the creation of more higher-paying jobs.

As evidenced by the level of support offered for this project by government, higher education and business partners, there is no other effort in Hampton Roads focused on creating a regional broadband network that leverages the transatlantic cables as economic drivers, while interconnecting job creation areas and institutions of higher education.

8. PROJECT READINESS

Capacity and capability

Provide a brief overview of the financial management and personnel capacity of the administrating agency that will oversee this project.

The Regional Broadband Initiative is supported by the expertise, qualifications, and personnel of the 17 local governments in the Hampton Roads region. In addition, the HRPDC has extensive experience and capabilities in the areas of financial management, project management, and project oversight in the management of federal and state grant programs and projects.



Barriers to successful implementation

Discuss any major barriers to successful implementation and other associated risks, along with a plan to overcome them.

A major challenge to this initiative is to ensure the creation of an effective governance structure that is collaborative in nature and includes government, higher education, and incumbent provider representation. This challenge will be directly addressed by this initiative through the development of a governance structure that directly addresses this barrier. This governance structure will be essential to addressing other potential barriers that may arise through the life of this project.

Prerequisite activities

Provide an overview of activities undertaken by the collaborating parties to increase efficiency in program delivery and support for the project once launched.

- The City of Virginia Beach has played a key role in initiating this effort by funding a pre-engineering analysis and providing staff support to assist in the preparation of a regional broadband vision
- The Region's Chief Information Officers from local governments and higher education institutions have mapped existing municipal networks and identified opportunities for interconnectivity, cost savings, and efficiencies.
- The HRPDC has played a key role in garnering regional support for this initiative and serving as a vehicle for discussions on potential cost savings, efficiencies and economic development opportunities that may result from this effort.
- Local higher education institutions have collaborated to determine how their institutions can leverage this fiber network to enhance research, provide cost savings and strengthen regional workforce preparation.

9. PROJECT SUSTAINABILITY

Describe your ability to meet the project performance metrics and take remedial actions in the event those measures are not achieved:

The Hampton Roads Broadband Initiative will receive oversight from the participating jurisdictions and the HRPDC. Each of these entities are experienced project managers and fiscal agents. In addition, this project will produce an accountable governance structure that will review performance metrics on a regular basis and make adjustments as needed to project approach, management, and delivery.



Describe how the program will achieve stable, long-term sustainability past the initial funding period:

The Broadband Initiative will:

- Generate cost savings for local jurisdictions and higher education institutions
- Create high paying jobs which will in turn generate tax revenues
- Reduce costs for businesses which will spur job creation
- Create an ecosystem for innovation and start up business growth

These cost savings and job creation benefits will serve to sustain this effort beyond the start-up period.

10. ATTACHMENTS

**List all documents attached to this application:*

Document name:	
<input checked="checked" type="checkbox"/>	1) Required: Local Government resolutions
<input type="checkbox"/>	2) Required (if applicable): Funding approval letters (<i>as outlined in Section 15. Other Funding Sources</i>)
<input type="checkbox"/>	3) Required (if applicable): Copy of non-profit designation letter from IRS (<i>not applicable for local governments or universities</i>)
	4) Letters of Support: Colleges/Universities
	5) Letters of Support: Businesses
	6) Letters of Support: Community Stakeholders
	7) Chronology of HRPDC Discussion of GO Virginia Program
	8) Map: Population & Employment Density
	9) Map: 4-Phase Approach for Hampton Roads Broadband Strategy
	10) CTC Regional Fiber Optic Interconnection Pre-Engineering Study

GO Virginia Region 5
ECONOMIC GROWTH AND DIVERSIFICATION
FUNDING APPLICATION



11. AUTHORIZATION

- ☒ I have read the GO Virginia Economic Growth and Diversification Plan and grant scoring guidelines.
- ☒ I confirm that the information in this application is accurate and complete, and the project proposal, including plans and budgets, is fairly represented.
- ☒ I agree that once funding is approved, any change to the project proposal will require prior approval of GO Virginia Region 5.
- ☒ I agree to submit reporting materials as required by GO Virginia Region 5, and where required, financial accounting for evaluation of the activity funded by GO Virginia Region 5.
- ☒ I understand that the information provided in this application may be accessible under the Freedom of Information Act (FOIA).
- ☒ I agree to publically acknowledge funding and assistance by GO Virginia Region 5.
- ☒ I authorize GO Virginia Region 5 to make inquiries, collect and share information with persons, firms, corporations, federal and local government agencies/departments and non-profit organizations, as GO Virginia Region 5 deems necessary for decision, administration, and monitoring for this project.
- ☒ I agree that information provided in this application may be shared with the appropriate regional advisory committee(s), regional council, GO Virginia Regional Council staff and consultants.

Name (organization signing authority) Robert A. Crum, Jr. HRPDC	Position/Title: Executive Director	Date: 10/31/2017
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Attachment 10.1

Resolutions & Letters of Support

Localities

Hampton Roads Planning District Commission
October 31, 2017



#17-R-056

**RESOLUTION ENDORSING THE PROPOSED HAMPTON ROADS REGIONAL
BROADBAND INITIATIVE AND SUPPORTING THE BROADBAND PROPOSAL
AS A GO VIRGINIA PROJECT.**

WHEREAS the Hampton Roads Planning District Commission (HRPDC) has expressed its support for the formation and implementation of a regional broadband initiative to provide the necessary infrastructure to connect all seventeen (17) of its member jurisdictions; and

WHEREAS the implementation of digital technology infrastructure throughout Hampton Roads will accelerate the creation of jobs and support the development of new and expanded businesses throughout the region; and

WHEREAS, the first transatlantic cable (Marea) landing has occurred on the shores of Virginia Beach and is connecting to a newly constructed cable landing station; and

WHEREAS, a second cable (Brusa) is currently under construction; and

WHEREAS, future transatlantic cable landings are anticipated and will spur the construction of data centers and encourage the expansion of Internet-based economic development throughout Hampton Roads; and

WHEREAS, the regional broadband strategy anticipates a four phase program to connect both Peninsula and Southside jurisdictions, along with the many academic institutions, research, modeling and technology centers located in Hampton Roads; and

WHEREAS, the City of Chesapeake strongly supports the development of a regional broadband system that will bring technological opportunities to Hampton Roads; and

WHEREAS, the advancement of a regional wireless network will require the backhaul of data and communications through improved digital infrastructure; and

WHEREAS, the installation of fiber along regional streets and highways of Hampton Roads will create a “sensor-ready” environment to allow the testing and adaptation of autonomous vehicles; and

WHEREAS, the purpose of the regional broadband initiative is to create a “middle mile” infrastructure that will enhance public services; improve the ability of private Internet service providers to reach underserved and unserved neighborhoods; and expand affordable broadband services to the small business community; and

WHEREAS, GO Virginia is a bipartisan, business-led economic development initiative that encourages Virginia’s diverse regions to collaborate on economic and workforce development activities; and

WHEREAS, the GO Virginia Growth & Opportunity Board is responsible for awarding allotted funds to relevant economic development projects; and

WHEREAS, the HRPDC has unanimously endorsed the regional broadband initiative as worthy of support through the Go Virginia project evaluation process; and

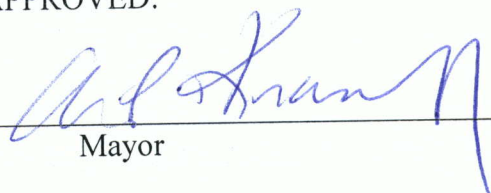
WHEREAS, the Council of the City of Chesapeake finds that the regional broadband initiative will be economically beneficial to Hampton Roads by providing connectivity among the localities; improving the ability of private providers to offer Internet services to underserved and unserved areas of the region; expanding affordable broadband services to the small business community; promoting technological advancement; and increasing employment opportunities and revenues.

NOW, THEREFORE, BE IT RESOLVED by the Council of the City of Chesapeake that the City supports the regional broadband initiative and endorses the project for evaluation under GO Virginia.

ADOPTED by the Council of the City of Chesapeake, Virginia, this 17th

day of October, 2017.

APPROVED:



Mayor

ATTEST:



Clerk of the Council

Resolution # 2017 – 09

RESOLUTION BY THE COUNCIL OF THE CITY OF FRANKLIN TO SUPPORT ENDORSING THE REGIONAL BROADBAND INITIATIVE AND A GO VIRGINIA GRANT APPLICATION

WHEREAS, the Hampton Roads Planning District Commission (HRPDC) unanimously endorsed the formation and implementation of a regional broadband strategy to connect all 17 of its member jurisdictions and

WHEREAS, the implementation of this new digital technology infrastructure throughout the Hampton Roads region will accelerate the creation of 21st Century jobs and support the creation of new and expanded businesses throughout the region and

WHEREAS, the first transatlantic cable (Marea) landing has occurred on the shores of Virginia Beach and is connecting to a newly constructed cable landing station with the second cable (Brusa) under construction with additional transoceanic cable landings being planned and

WHEREAS, those future cable landings will spur the construction of data centers and incentivize the expansion of internet knowledge based economic development throughout the region and

WHEREAS, the regional broadband strategy anticipates a four phase program to connect both Peninsula and Southside jurisdictions along with the many academic institutions, research, modeling and technology centers within the region and

WHEREAS, the implementation of Wireless Networks requires the backhaul of data and communications via improved digital infrastructure and

WHEREAS the build out of fiber adjacent to our road network will create a "sensor-ready" environment to serve the testing and adaptation of autonomous vehicles

WHEREAS the intent of this Regional Broadband Initiative is to create a "middle mile" infrastructure that will also support private internet service providers' ability to reach underserved and unserved neighborhoods and expand affordable services to the small business community

NOW, THEREFORE, BE IT RESOLVED by the Council of the City of Franklin that the Council supports the creation and implementation of a Regional Broadband Strategy and GO Virginia Application.

Resolved by the Council of the City of Franklin, Virginia on the 23rd day of October, 2017.

APPROVED:


MAYOR

ATTEST:


CLERK OF COUNCIL

AT A REGULAR MEETING OF THE GLOUCESTER COUNTY BOARD OF SUPERVISORS, HELD ON TUESDAY, OCTOBER 17, 2017, AT 7:00 P.M., IN THE COLONIAL COURTHOUSE, 6504 MAIN STREET, GLOUCESTER, VIRGINIA: ON A MOTION DULY MADE BY MR. HUTSON, AND SECONDED BY MR. CHRISCOE, THE FOLLOWING RESOLUTION WAS ADOPTED BY THE FOLLOWING VOTE:

Phillip N. Bazzani, yes;
Ashley C. Chriscoe, yes;
Christopher A. Hutson, yes;
Andrew James, Jr., yes;
John C. Meyer, Jr., yes;
Robert J. Orth, yes;
Michael R. Winebarger, yes;

**RESOLUTION TO SUPPORT AND ENDORSE SUBMITTAL
OF THE REGIONAL BROADBAND PROJECT IN GO VIRGINIA
REGION 5**

WHEREAS, the Hampton Roads Planning District Commission (of which Gloucester County is an active member in good standing) has unanimously endorsed submittal of the Regional Broadband Initiative proposal ("the proposed project") as a regional economic development initiative worthy of support through the Go Virginia Region 5 project evaluation process; and

WHEREAS, the proposed project is envisioned to be incrementally developed over time across all 17 Hampton Roads jurisdictions; and

WHEREAS, access to reliable, affordable broadband is critical to support education, workforce development and economic development; and

WHEREAS, the proposed project seeks to interconnect municipal networks, incorporating connectivity between institutions of higher education across Hampton Roads, two of which are located in Gloucester County (Virginia Institute of Marine Science and Rappahannock Community College); and

WHEREAS, approximately 71% of the Middle Peninsula workforce commutes out of the district in service to and/or in search of high wage employment opportunities; and

WHEREAS, the Gloucester County Board of Supervisors' Vision for 2035 includes "universal broadband access provid[ing] citizens with an opportunity to work where they live and support[ing] the growth of home-based entrepreneurs"; and

WHEREAS, the infrastructure investments outlined in the proposed project would serve to enable future endeavors in support of the Gloucester County Board of Supervisors' Vision for 2035; and

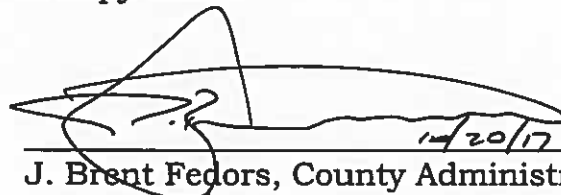
WHEREAS, the residents of Gloucester County, being part of Go Virginia Region 6, stand to benefit from the creation of employment opportunities anticipated to develop pending implementation of the proposed project within Go Virginia Region 5; and

WHEREAS, Gloucester County's endorsement of the proposed project submitted in Go Virginia Region 5 would constitute the participation of multiple Go Virginia regions collaborating together toward a common goal of economic growth and prosperity; and

WHEREAS, a regional management and governance structure is anticipated that transparently allows the participation of all willing Hampton Roads local government partners based on parameters to be mutually established;

NOW, THEREFORE, BE IT RESOLVED that the County of Gloucester does hereby support and endorse submittal of the proposed project within Go Virginia Region 5.

A Copy Teste:



12/20/17
J. Brent Fedors, County Administrator



OFFICE OF THE CITY MANAGER

October 30, 2017

Reinvent Hampton Roads
101 W. Main Street, #4500
Norfolk, VA 23510
Attn: Regional GO Virginia Council

To Whom It May Concern:

On behalf of the City of Hampton, I am pleased to provide this letter of support for the Hampton Roads Regional Broadband Go Virginia application. The regional connectivity amongst the seventeen regional localities will help to accelerate the creation of new and expanded businesses throughout the region, thus bringing additional high wage jobs and a further diversification of our economic.

The first transatlantic cable (Marea) landing has occurred on the shores of Virginia Beach and is connecting to a newly constructed cable landing station with the second cable (Brusa) under construction with additional transoceanic cable landings being planned. Those future cable landings will spur the construction of data centers and incentivize the expansion of internet knowledge based economic development throughout the region.

The regional broadband strategy anticipates a four phase program to connect both Peninsula and Southside jurisdictions along with the many academic institutions, research, modeling and technology centers within the region. Further, this Regional Broadband Initiative would create a "middle mile" infrastructure that will also support private internet service providers' ability to reach underserved and unserved neighborhoods and expand affordable services to the small business community.

For all of these reasons, the City of Hampton is pleased to support this Go Virginia application.

Sincerely,

Mary B. Bunting
City Manager

RESOLUTION TO ENDORSE THE REGIONAL BROADBAND INITIATIVE AND A GO VIRGINIA GRANT APPLICATION

WHEREAS, the Hampton Roads Planning District Commission (HRPDC) unanimously endorsed the formation and implementation of a regional broadband strategy to connect all 17 of its member jurisdictions; and,

WHEREAS, the implementation of this new digital technology infrastructure throughout the Hampton Roads region will accelerate the creation of 21st Century jobs and support the creation of new and expanded businesses throughout the region; and,

WHEREAS, the first transatlantic cable (Marea) landing has occurred on the shores of Virginia Beach and is connecting to a newly constructed cable landing station with the second cable (Brusa) under construction with additional transoceanic cable landings being planned; and,

WHEREAS, those future cable landings will spur the construction of data centers and incentivize the expansion of internet knowledge based economic development throughout the region; and,

WHEREAS, the regional broadband strategy anticipates a four-phase program to connect both Peninsula and Southside jurisdictions along with the many academic institutions, research, modeling and technology centers within the region; and,

WHEREAS, the implementation of Wireless Networks requires the backhaul of data and communications via improved digital infrastructure and

WHEREAS, the build out of fiber adjacent to our road network will create a “sensor-ready” environment to serve the testing and adaptation of autonomous vehicles


WHEREAS, the intent of this Regional Broadband Initiative is to create a “middle mile” infrastructure that will also support private internet

service providers' ability to reach underserved and unserved neighborhoods and expand affordable services to the small business community

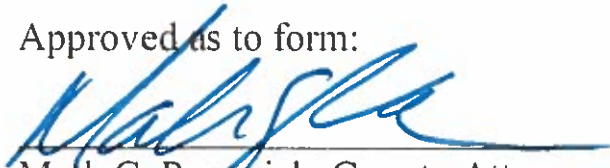
NOW, THEREFORE, BE IT RESOLVED that Board of Supervisors of the County of Isle of Wight, Virginia supports the creation and implementation of a Regional Broadband Strategy and GO Virginia Application.

Adopted this 19th day of October, 2017.


Carey Mills Storm, Clerk


Rex W. Alphin, Chairman

Approved as to form:


Mark C. Popovich, County Attorney



Administration
101-D Mounts Bay Road
P.O. Box 8784
Williamsburg, VA 23187-8784
P: 757-253-6728
jamescitycountyva.gov

October 19, 2017

Mr. Thomas R. Frantz, Chairman
GO Virginia Region 5 Regional Council
c/o Reinvent Hampton Roads
101 West Main Street, Ste. 415
Norfolk, VA 23510

Re: Letter of Support Endorsing the Regional Broadband Initiative

Dear Chairman Frantz:

James City County wishes to express their support for the Regional Broadband Initiative put forth by the Hampton Roads Planning District Commission. The implementation of this new digital technology infrastructure throughout the Hampton Roads region will accelerate the creation of 21st century jobs and support the creation of new, and expanded, businesses throughout the region.

The first transatlantic cable (Marea) landing has occurred on the shores of Virginia Beach and is connecting to a newly constructed cable landing station with the second cable (Brusa) under construction with additional transoceanic cable landings being planned. Those future cable landings will spur the construction of data centers and incentivize the expansion of internet knowledge based economic development throughout the region.

The regional broadband strategy anticipates a four phase program to connect both Peninsula and Southside jurisdictions along with the many academic institutions, research, and modeling and technology centers within the region. The intent of this Regional Broadband Initiative is to create a “middle mile” infrastructure that will also support private internet service providers’ ability to reach underserved and unserved neighborhoods and expand affordable services to the small business community.

James City County is pleased to offer their support and endorsement of this Regional Broadband Initiative.

Sincerely,

Bryan J. Hill
County Administrator

BJH/tjf



City of Newport News

Virginia 23607

Office Of The City Manager

2400 Washington Avenue
(757) 926-8411
Fax (757) 926-3503

October 27, 2017

Mr. Thomas R. Frantz, Chairman
GO Virginia Region 5 Regional Council
101 West Main Street, Ste. 415
Norfolk, Virginia 23510

Re: Letter of Support for the Regional Broadband Initiative

Chairman Frantz:

The Hampton Roads Planning District Commission has unanimously endorsed the Regional Broadband Initiative for submission as a GO Virginia project. On behalf of the City of Newport News, I would like to provide my full support for its submission under the GO Virginia Program.

The regional broadband strategy anticipates a four phase program to connect both Peninsula and Southside jurisdictions as well as the many academic institutions and modeling and technology centers within the region. The implementation of this new digital technology infrastructure in Hampton Roads has the potential to foster the creation of 21st century jobs and the establishment of new and expanded businesses opportunities throughout the region. I am pleased to offer support for the Regional Broadband Initiative GO Virginia application.

Sincerely,

Cynthia D. Rohlf
City Manager

Form and Correctness Approved:

By *RAH in L*
Office of the City Attorney

Contents Approved:

By *Stan DeBerry*
DEPT.

NORFOLK, VIRGINIA

Resolution 1,685

R-9

A RESOLUTION SUPPORTING AND ENDORSING THE REGIONAL BROADBAND INITIATIVE AND A "GO VIRGINIA" GRANT APPLICATION.

- - -

WHEREAS, the Hampton Roads Planning District Commission (HRPDC) unanimously endorsed the formation and implementation of a regional broadband strategy to connect all 17 of its member jurisdictions; and

WHEREAS, the implementation of this new digital technology infrastructure throughout the Hampton Roads region will accelerate the creation of 21st century jobs and support the creation of new and expanded businesses throughout the region; and

WHEREAS, the first transatlantic cable (MAREA) landing has occurred on the shores of Virginia Beach and is connecting to a newly constructed cable landing station with the second cable (BRUSA) under construction with additional transoceanic cable landings being planned; and

WHEREAS, those future cable landings will spur the construction of data centers and incentivize the expansion of

internet knowledge based economic development throughout the region; and

WHEREAS, the regional broadband strategy anticipates a four-phase program to connect both peninsula and southside jurisdictions along with the many academic institutions, research, modeling and technology centers within the region; and

WHEREAS, the City of Norfolk developed its Information Technology Strategic Plan in 2016 and began an upgrade of its fiber ring in 2017 and is actively collaborating with the 17 municipalities within the region to determine the best way to facilitate regional connectivity; and

WHEREAS, the implementation of wireless networks requires the backhaul of data and communications via improved digital infrastructure; and

WHEREAS; the intent of this regional broadband strategy is to create a "middle mile" infrastructure that will also support private internet service providers' ability to reach underserved and unserved neighborhoods and expand affordable services to the small business community; now, therefore,

BE IT RESOLVED by the Council of the City of Norfolk:

Section 1:- That the City Council does hereby pledge to participate in the proposed Go Virginia Grant Application for a regional broadband strategy to connect all seventeen Hampton Roads jurisdictions including the many academic institutions, research,

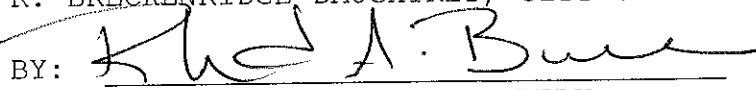
modeling and technical centers, allowing for expandable services to small businesses and neighborhoods that today are underserved with affordable digital internet services.

Section 2:- That this resolution shall be in effect from and after its adoption.

Adopted by Council October 24, 2017
Effective October 24, 2017

TRUE COPY
TESTE:

R. BRECKENRIDGE DAUGHTREY, CITY CLERK

BY: 
DEPUTY CITY CLERK



CITY OF POQUOSON

Office of the Mayor

500 City Hall Avenue, Poquoson, Virginia 23662-1996
(757)868-3000 Fax (757)868-3101

October 24, 2017

Mr. Robert A. Crum, Executive Director
Hampton Roads Planning District Commission
723 Woodlake Drive
Chesapeake, VA 23320

Dear Mr. Crum:

Enclosed you will find a certified true copy of the resolution adopted by the Poquoson City Council on Monday, October 23, 2017. This resolution supports the regional broadband initiative proposal and the submission of the GO Virginia application.

Sincerely,

Judy F. Wiggins

Assistant City Manager

JFW/kah

RECEIVED

OCT 27 2017

HRPDC

Attachment 10.1

RESOLUTION NO. 5009

**A RESOLUTION TO SUPPORT A BROADBAND INITIATIVE PROPOSAL
AS A REGIONAL ECONOMIC DEVELOPMENT INITIATIVE
THROUGH THE GO VIRGINIA PROGRAM**

WHEREAS, the Hampton Roads Planning District Commission (HRPDC) unanimously endorsed the formation and implementation of a regional broadband strategy to connect all 17 of its member jurisdictions; and

WHEREAS, the implementation of this new digital technology infrastructure throughout the Hampton Roads region will accelerate the creation of 21st Century jobs and support the creation of new and expanded businesses throughout the region; and

WHEREAS, the first transatlantic cable (Marea) landing has occurred on the shores of Virginia Beach and is connecting to a newly constructed cable landing station with the second cable (Brusa) under construction with additional transoceanic cable landings being planned; and

WHEREAS, those future cable landings will spur the construction of data centers and incentivize the expansion of internet knowledge based economic development throughout the region; and

WHEREAS, the regional broadband strategy anticipates a four-phase program to connect both Peninsula and Southside jurisdictions, along with the many academic institutions, research, modeling, and technology centers within the region; and

WHEREAS, the implementation of wireless networks requires the backhaul of data and communications via improved digital infrastructure; and

WHEREAS, the build-out of fiber adjacent to our road network will create a "sensor-ready" environment to serve the testing and adaptation of autonomous vehicles; and

WHEREAS, the intent of this Regional Broadband Initiative is to create a "middle mile" infrastructure that will also support private internet service providers' ability to reach underserved and unserved neighborhoods and expand affordable services to the small business community.

NOW, THEREFORE BE IT RESOLVED, by the Council of the City of Poquoson:

Section 1: That City Council does hereby support the creation and implementation of a Regional Broadband Strategy and GO Virginia Application.

Section 2: That this resolution shall be in effect on and after its adoption.

ADOPTED: October 23, 2017

TESTE: Judy F. Wiggins
City Clerk

I hereby certify this to be a true and exact copy of Resolution No. 5009 adopted by the Poquoson City Council on the 23rd day of October, 2017.

Judy F. Wiggins
Judy F. Wiggins
City Clerk



CITY OF PORTSMOUTH

Office of the Mayor

John L. Rowe, Jr.
Mayor

October 27, 2017

Mr. Thomas R. Frantz, Chairman
GO Virginia Region 5 Regional Council
c/o Reinvent Hampton Roads
101 West Main Street, Ste. 415
Norfolk, Virginia 23510

Dear Chairman Frantz,

The City of Portsmouth fully supports the Regional Broadband Initiative to provide the necessary infrastructure to connect all seventeen member jurisdictions as submitted by the Hampton Roads Planning District Commission (HRPDC). The implementation of digital technology infrastructure throughout Hampton Roads will accelerate the creation of jobs and support the development of new and expanded businesses throughout the region.

With the transatlantic cable (Marea) landing on the shores of Virginia Beach and the construction of the requisite cable landing station (Brusa), our region will have the potential for greater connectivity globally. Such connectivity will spur the development of data centers and encourage the expansion of internet-based economic growth throughout Hampton Roads.

As you may know, the regional broadband strategy anticipates a four-phase program to connect both Peninsula and Southside jurisdictions along with the many academic institutions, research, and modeling and technology centers within the region. The Regional Broadband Initiative intent will create a "middle mile" infrastructure that will support private internet service providers' ability to reach underserved and unserved neighborhoods and to expand affordable services to the small business community. This initiative is so very vital to the future economic vitality of our region.

We are pleased to support and endorse of this Regional Broadband Initiative, and we ask that you give this initiative your favorable consideration.

Sincerely yours,



John L. Rowe, Jr.
Mayor

C: Dr. L. Pettis Patton, City Manager



BOARD OF SUPERVISORS SOUTHAMPTON COUNTY, VIRGINIA

RESOLUTION 1017-12A

At a meeting of the Board of Supervisors of Southampton County, Virginia, held in the Southampton County Office Center, Board of Supervisors' Meeting Room, 26022 Administration Center Drive, Courtland, Virginia on Monday, October 23, 2017 at 7:00 p.m.

PRESENT

The Honorable Dallas O. Jones, Chairman
The Honorable Ronald M. West, Vice Chairman
The Honorable R. Randolph Cook
The Honorable Alan W. Edwards, Jr.
The Honorable Carl J. Faison
The Honorable S. Bruce Phillips
The Honorable Barry T. Porter

IN RE: Support of Regional Broadband and GO Virginia Application

Motion by Supervisor West:

WHEREAS the Hampton Roads Planning District Commission (HRPDC) unanimously endorsed the formation and implementation of a regional broadband strategy to connect all 17 of its member jurisdictions; and

WHEREAS the purpose and intent of the regional broadband strategy is to accelerate creation of twenty-first century jobs and support the creation of new and expanded businesses throughout the Hampton Roads region; and

WHEREAS the first high capacity transatlantic cable (Marea) between Spain and the U.S. terminates on the shores of Virginia Beach, and a second transatlantic cable (Brusa), currently under construction, will connect Brazil, Puerto Rico and Virginia Beach in early 2018; and

WHEREAS these and other transatlantic cable landings will serve as catalysts, spurring the construction of data centers and expansion of other internet-based economic opportunities throughout the region; and

WHEREAS the regional broadband strategy contemplates a four-phase program to connect both Peninsula and Southside jurisdictions, including Southampton County, along with many academic institutions, research, modeling and technology centers within the region; and

WHEREAS this regional broadband strategy will create a “middle mile” infrastructure to support private internet service providers’ ability to reach underserved and unserved communities and rural areas and a series of Wi-Fi access points across the region for “last mile” connections in rural areas.

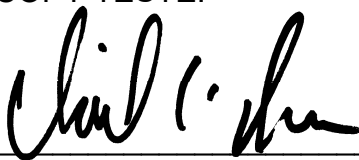
NOW, THEREFORE, BE IT RESOLVED by the Board of Supervisors of Southampton County that it supports creation and implementation of the Hampton Roads Regional Broadband Strategy and further supports submittal of a GO Virginia Application to advance that strategy in all communities in Hampton Roads.

Seconded by Supervisor Porter.

VOTING ON THE ITEM: YES – Supervisor(s) Jones, West, Cook, Edwards,
Faison, Phillips and Porter

NO – None

A COPY TESTE:

A handwritten signature in black ink, appearing to read "Michael W. Johnson", is written over a horizontal line.

Michael W. Johnson, County Administrator/
Clerk, Southampton County Board of Supervisors



CITY MANAGER

CITY OF SUFFOLK

P.O. BOX 1858, SUFFOLK, VIRGINIA 23439-1858 PHONE: (757) 514-4012

October 30, 2017

Mr. Thomas R. Frantz, Chairman
GO Virginia Region 5 Regional Council
c/o Reinvent Hampton Roads
101 West Main Street, Ste. 415
Norfolk, VA 23510

RE: Support for Regional Broadband Initiative

Dear Chairman Frantz:

I am writing to convey the City of Suffolk's support for the Region 5 Broadband Initiative put forth by the Hampton Roads Planning District Commission. My staff and I are fully engaged in this project and we support the opportunity to enhance Hampton Roads' digital infrastructure to support new technology jobs.

Sincerely,

Patrick G. Roberts
City Manager

RES-03868

1 A RESOLUTION BY THE COUNCIL OF THE CITY OF
2 VIRGINIA BEACH SUPPORTING AND ENDORSING
3 THE REGIONAL BROADBAND INITIATIVE AND A
4 "GO VIRGINIA" GRANT APPLICATION
5

6 WHEREAS, the Hampton Roads Planning District Commission (HRPDC)
7 unanimously endorsed the formation and implementation of a regional broadband
8 strategy to connect all 17 of its member jurisdictions;
9

10 WHEREAS, the implementation of this new digital technology infrastructure
11 throughout the Hampton Roads region will accelerate the creation of 21st Century jobs
12 and support the creation of new and expanded businesses throughout the region;
13

14 WHEREAS, the first transatlantic cable (MAREA) landing has occurred on the
15 shores of Virginia Beach and is connecting to a newly constructed cable landing station
16 and the second cable (BRUSA) is under construction with additional transatlantic cable
17 landings being planned;
18

19 WHEREAS, those future cable landings will spur the construction of data centers
20 and incentivize the expansion of internet knowledge based economic development
21 throughout the region;
22

23 WHEREAS, the regional broadband strategy anticipates a four phase program to
24 connect both Peninsula and Southside jurisdictions along with the many academic
25 institutions, research, modeling and technology centers within the region;
26

27 WHEREAS, the City of Virginia Beach established its Master Technology Plan in
28 2013 and implemented a Next Generation Network Fiber/Broadband Capital
29 Improvement Project in 2014 and is currently constructing fiber gap infill to create over
30 116 miles of in-ground fiber connecting government facilities, all the Virginia Beach City
31 Public Schools and integrating our transportation signal and camera system;
32

33 WHEREAS, the implementation of Wireless Networks requires the backhaul of
34 data and communications via improved digital infrastructure;
35

36 WHEREAS, the build out of fiber adjacent to our road network will create a
37 "sensor-ready" environment to serve the testing and adaptation of autonomous vehicles;
38 and
39

40 WHEREAS, the intent of this Regional Broadband Initiative is to create a "middle
41 mile" infrastructure that will also support private internet service providers' ability to
42 reach underserved and unserved neighborhoods and expand affordable services to the
43 small business community.
44

45 NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY
46 OF VIRGINIA BEACH, VIRGINIA:

47

48

49

That the City Council supports the creation and implementation of a Regional
Broadband Strategy and GO Virginia Grant Application.

Adopted by the Council of the City of Virginia Beach on the 17th day of
October, 2017.

APPROVED AS TO CONTENT


Department of Information
Technology

APPROVED AS TO LEGAL
SUFFICIENCY:


City Attorney's Office

CA14022

R-2

October 6, 2017



CITY OF WILLIAMSBURG

Office of the City Manager

October 26, 2017

Mr. Thomas R. Frantz, Chairman
GO Virginia Region 5 Regional Council
c/o Reinvent Hampton Roads
101 West Main Street, Ste. 415
Norfolk, VA 23510

Re: GO Virginia – Reinvent Hampton Roads Broadband Initiative – Letter of Support

Chairman Wynne,

The intention of this letter is to express the City of Williamsburg's support for the GO Virginia Reinvent Hampton Roads Broadband Initiative funding application.

The City of Williamsburg uses a biennial process of adopting Goals, Initiatives and Outcomes (GIOs) to guide policy, budgeting and resource decisions over the span of two years. These GIOs are developed using an open public process and ultimately are adopted in a public vote of the City Council. The GIOs are arranged in eight goal statements that each reflect key priorities of the City. Goal II is titled "Economic Vitality". Under this heading the Council and Community have identified a digital infrastructure initiative that aims to expand broadband inside the City by identifying opportunities to implement needed improvements and connectivity with regional partners.

The City of Virginia Beach has spearheaded an effort to expand broadband regionally through the connection of all 17 members of the Hampton Roads Planning District Commission. This initiative is particularly timely given the newly constructed transatlantic cable landing station and plans to add additional cables in the future.

The Hampton Roads Planning District Commission (HRPDC) unanimously endorsed the formation and implementation of a regional broadband strategy with the hope of creating 21st century jobs in expanded business opportunities throughout the region. Williamsburg is a voting member of the HRPDC and is pleased to support an effort that so closely aligns with the GIOs adopted by the City Council.

We look forward to collaborating with our regional partners on the expansion of new broadband. The City requests that the Virginia Growth and Opportunity Board approve the Reinvent Hampton Roads funding application supporting this regional priority.

Sincerely,

Marvin E. Collins III
City Manager

MC/aot

cc: Robert Crum, HRPDC Executive Director; David Hansen, Virginia Beach City Manager; Jim Spore, President and CEO Reinvent Hampton Roads

TOWN OF WINDSOR

Town Elected Officials
Carita J. Richardson, Mayor
Durwood V. Scott - Vice Mayor
Greg Willis
N. Macon Edwards, III
Patty Flemming
Tony Ambrose
Walter Bernacki



Established 1902

Town Manager
Michael R. Stallings, Jr.

Town Clerk
Terry Whitehead

Town Attorney
Wallace W. Brittle, Jr.

October 20, 2017

GO Virginia Region 5 Regional Council
c/o/ Reinvent Hampton Roads
Attn: Thomas Frantz, Chair
101 West Main Street, Ste. 415
Norfolk, VA 23510

RE: Letter of Support for the Regional Broadband Initiative

Chairman Frantz,

I am writing to express my full support for the Regional Broadband Initiative Proposal as a GO Virginia project. The project holds great potential for economic and job growth in all of Hampton Roads and the Commonwealth of Virginia. With the landing of the transatlantic cables in Virginia Beach, the Hampton Roads area has great potential to capitalize on this infrastructure. The potential for creation of high paying jobs in our Region is astounding. The Regional Broadband Initiative will have a positive impact on all aspects of life in Hampton Roads. This project is more than worth of your consideration.

Thank you,

Michael Stallings
Town Manager

BOARD OF SUPERVISORS
COUNTY OF YORK
YORKTOWN, VIRGINIA

Resolution

At a regular meeting of the York County Board of Supervisors held in York Hall, Yorktown, Virginia, on the 17th day of October, 2017:

<u>Present</u>	<u>Vote</u>
Sheila S. Noll, Chairman	Yea
Jeffrey D. Wassmer, Vice Chairman	Yea
Walter C. Zaremba	Yea
W. Chad Green	Yea
Thomas G. Shepperd, Jr.	Yea

On motion of Mr. Green, which carried 5:0, the following resolution was adopted:

A RESOLUTION TO SUPPORT AND PARTICIPATE IN A BROADBAND INITIATIVE PROPOSAL AS A REGIONAL ECONOMIC DEVELOPMENT INITIATIVE THROUGH THE GO VIRGINIA PROGRAM

WHEREAS, the Hampton Roads Planning District Commission (HRPDC) unanimously endorsed the formation and implementation of a regional broadband strategy to connect all 17 of its member jurisdictions; and

WHEREAS the implementation of this new digital technology infrastructure throughout the Hampton Roads region will accelerate the creation of 21st Century jobs and support the creation of new and expanded businesses throughout the region; and

WHEREAS the first transatlantic cable (Marea) landing has occurred on the shores of Virginia Beach and is connecting to a newly constructed cable landing station with the second cable (Brusa) under construction with additional transoceanic cable landings being planned; and

WHEREAS those future cable landings will spur the construction of data centers and incentivize the expansion of internet knowledge based economic development throughout the region; and

WHEREAS the regional broadband strategy anticipates a four-phase program to connect both Peninsula and Southside jurisdictions, along with the many academic insti-

tutions, research, modeling, and technology centers within the region; and

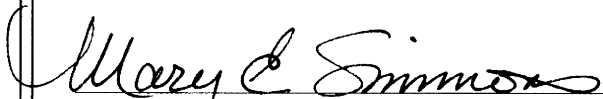
WHEREAS the implementation of wireless networks requires the backhaul of data and communications via improved digital infrastructure; and

WHEREAS the build-out of fiber adjacent to our road network will create a “sensor-ready” environment to serve the testing and adaptation of autonomous vehicles; and

WHEREAS the intent of this Regional Broadband Initiative is to create a “middle mile” infrastructure that will also support private internet service providers’ ability to reach underserved and unserved neighborhoods and expand affordable services to the small business community;

NOW, THEREFORE, BE IT RESOLVED by the York County Board of Supervisors this the 17th day of October, 2017, that the Board does hereby support the creation and implementation of a Regional Broadband Strategy and GO Virginia Application.

A Copy Teste:


Mary E. Simmons
Deputy Clerk

MEMBER
JURISDICTIONS

October 4, 2017

CHESAPEAKE

Mr. James K. Spore
President & CEO
ReInvent Hampton Roads
101 W. Main Street, Suite 415
Norfolk, VA 23510

FRANKLIN

GLOUCESTER

RE: Letter of Intent to Apply - GO Virginia Proposals

HAMPTON

Dear Mr. Spore:

ISLE OF WIGHT

On September 21, 2017, the Hampton Roads Planning District Commission (HRPDC) voted unanimously to endorse the following proposals as GO Virginia applications:

JAMES CITY

- Hampton Roads Unmanned Systems Testing, Demonstration and Recreational Facility
- Hampton Roads Regional Broadband Initiative

NEWPORT NEWS

NORFOLK

The HRPDC is a regional organization representing over 1.7 million people in the 17 localities of Hampton Roads, Virginia, including the cities of Chesapeake, Franklin, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach and Williamsburg, the town of Smithfield, and the counties of Gloucester, Isle of Wight, James City, Southampton, Surry, and York.

POQUOSON

PORTSMOUTH

The HRPDC's unified statement of regional support for these applications demonstrates the tremendous opportunities these proposals offer for the Hampton Roads regional economy. The HRPDC strongly encourages the GO Virginia Regional Council and State GO Virginia Board to support these exciting initiatives.

SMITHFIELD

SOUTHAMPTON

The HRPDC is pleased to endorse both of these GO Virginia applications and will work with the partnering jurisdictions to ensure that these proposals are submitted by the October 31 GO Virginia application deadline.

SUFFOLK

SURRY

Thank you in advance for your positive consideration of these proposals. If you have any questions, please contact HRPDC Executive Director Bob Crum at rccrum@hrpdcva.gov or 757-420-8300.

VIRGINIA BEACH

Sincerely,

WILLIAMSBURG

Dr. Ella Ward, Chair
Hampton Roads Planning District Commission

YORK

Attachment 10.4

Letters of Support

Colleges & Universities

Hampton Roads Planning District Commission
October 31, 2017





Office of the Chief Information Officer

700 Park Avenue, Norfolk, Virginia 23504-8060

Tel: (757) 823-2916, Fax: (757) 823-2128

Web: <http://www.nsu.edu>

wadavis@nsu.edu

October 23, 2017

Reinvent Hampton Roads
101 W Main St #4500
Norfolk, VA 23510
ATTN: Go Virginia Regional Council

Re: **Letter of Participation** in Hampton Roads Broadband Initiative

Dear Program Review Officers:

Norfolk State University is pleased to confirm participation as a partner in the Go Virginia Hampton Roads Broadband Initiative. Norfolk State University recognizes the great need for broadband connectivity in the region for economic development, jobs, and increased access for higher education that can ensure sharing of research data while hosted on shared computing infrastructures. This capability will enable a multitude of research activities, research training, and collaborations for our institution. Furthermore, this investment aligns well with Norfolk State University's cyberinfrastructure strategic planning to enhance research cyberinfrastructure, and is, therefore, given priority at the institutional level. As such, we are fully committed to partnership with the collaborative, and to participate in the effort as described in the proposal.

Norfolk State University recognizes the strength of this collaboration and potential impact for our community of researchers, those across the state, and broadly in the research community. Norfolk State University strongly supports this effort and is pleased to participate in this innovative collaboration.

Sincerely,

A handwritten signature in dark ink, reading "Wayne A. Davis". The signature is written in a cursive, flowing style.



October 25, 2017

Robert A. Crum
Executive Director
Hampton Roads Planning District Commission

Re: Support for Ignite Hampton Roads GO Virginia Proposal

We are writing to demonstrate Old Dominion University's support for the Ignite Hampton Roads GO Virginia proposal. Old Dominion University shares the vision of the Hampton Roads municipalities to significantly improve broadband capacities, capabilities, and cost to help build a sustainable ecosystem that can accelerate research and innovation for economic development, healthy and smart communities, and connected government services.

It has become increasingly important for us to continue and expand our partnerships with local municipalities, local and federal research facilities, and regional organizations to meet our own broadband capacity demands and be competitive for federal funding in key target industries and sectors to support both regional and state economic development. This middle mile fiber infrastructure will enable ODU and our region to enhance cybersecurity research and workforce development initiatives like HRCyber, advance telehealth practices, build flood resiliency strategies and plans, and leverage data, computation, and simulation for new discoveries and innovation.

Old Dominion University is committed to work with the Hampton Roads communities to develop this vital infrastructure resource. The ODU-led regional research and education network connecting ODU, The College of William & Mary, The Jefferson Lab, and ODU's Virginia Modeling, Analysis and Simulation Center at 100Gbps to the national Internet2 network is a great example of building capacity through collaboration. We must find ways to enhance this type of infrastructure adding greater flexibility and improved costs. Our ability as a region to recruit, develop, and retain businesses and a skilled workforce requires us to work collaboratively and invest in new approaches for sustained economic growth.

Sincerely,

Austin Agho
Provost & Vice President for Academic Affairs
Old Dominion University

Morris Foster
Vice President for Research
Old Dominion University



TIDEWATER COMMUNITY COLLEGE

From here, go anywhere.™

OFFICE OF THE PRESIDENT

October 16, 2017

Reinvent Hampton Roads
101 West Main Street, Suite 4500
Norfolk, VA 23510

ATTENTION: GO Virginia Regional Council

Dear Council Members:

It is a pleasure to write this letter of support for the Hampton Roads Region's application to the GO Virginia Council for a regional broadband.

In an unprecedented move all 17 of the Hampton Roads Planning District Commission (HRPDC) jurisdictions endorsed this regional broadband initiative. The HRPDC's unified statement of regional support demonstrates the tremendous opportunities an affordable broadband will offer for the Hampton Roads regional economy.

What started out as a cost saving endeavor by Tidewater Community College in 2014 for its five campus' internet connections has become the drive for a high speed backbone around the Hampton Roads region.

This backbone will connect all higher education institutions, public sector K-12 school divisions, and public services within the 17 cities of the Planning District. A Hampton Roads' regional broadband, easily connected to the transatlantic cables in Virginia Beach, will also result in providing on-and off-ramps to the State's largest healthcare centers, an emerging bio-medical research park in Virginia Beach, and various national defense and research labs.

This fiber backbone will be the key to attracting high paying jobs, invigorating critical education, public safety and health projects and place Hampton Roads in a competitive position to be the digital port to the world.

TCC is one of the few Department of Defense designated Centers of Excellence for cyber security in Virginia, and in this region, the only higher education institution with such designation. Having a high speed internet connection is critically important for this growing education and industry need. It is equally important for the region's primary industry sectors, such as the maritime and advanced manufacturing sectors, for which TCC provides global training. Through such efforts the college addresses the human talent resource needs of all regional industries.

CHESAPEAKE

NORFOLK

PORTSMOUTH

SUFFOLK

VIRGINIA BEACH

Reinvent Hampton Roads
101 West Main Street, Suite 4500
Norfolk, VA 23510
October 16, 2017
Page Two

The backbone is to be built in 3 phases, with Year 1 looping to all five Tidewater Community College Sites, Year 2 to the Peninsula, and Year 3 the remaining counties of the HRPDC. From there all cities and services, colleges and universities can easily connect in a middle mile strategy to the backbone.

As is evident from the cost analysis with regards to high speed access of this metro area versus other metro areas, there is a significant cost/capacity disadvantage against Hampton Roads businesses and the public sector. The fiber backbone will virtually eliminate these barriers.

In addition, the High Speed Wireless Plan will also enable the Hampton Roads Region to eradicate the digital divide for our citizens, both within the cities as well as the rural areas.

None of this can be accomplished without the backbone first.

Tidewater Community College, along with our K-12 and higher education colleagues, strongly encourages the GO Virginia Council to support this game changing initiative.

Sincerely,

A handwritten signature in black ink, appearing to read "Edna V. Baehre-Kolovani". The signature is fluid and cursive, with the first name "Edna" being more prominent.

Edna V. Baehre-Kolovani, Ph.D.
President



October 24, 2017

Dear GoVirginia Review Committee,

Please accept this endorsement on behalf of Virginia Wesleyan University in support of the Ignite Hampton Roads GoVirginia proposal. As a member of the educational sector, we stand with our respective municipal bodies and educational institutions in our belief that this initiative will have a critical impact to the future of this area.

As we move forward, technology will play a greater role in education, business, manufacturing and sciences. Having an expanded high-speed capable infrastructure can only better serve this area and make it more competitive. High availability with low cost connections to these entities will be the key factor in securing our future here in Hampton Roads.

As an educational institution, our partnerships in the nation and around the globe will bring to bear increasing demands on our capacity for bandwidth. The local infrastructure for fiber is always a challenge – the so-called last mile from central distribution to end point. Now is the time to start thinking about how we wish to impact future technology and innovation. Forward intuitive thinking – building the infrastructure to keep ahead of demand.

Thank you for your consideration in this critical opportunity.

Sincerely,

Robert Leitgeb
Chief Information Officer
Virginia Wesleyan University

Attachment 10.5

Letters of Support

Business

Hampton Roads Planning District Commission
October 31, 2017





October 16, 2017

Bull & Company MediaWorks is an Internet Marketing company established in 2003. We focus on Internet Marketing: website building, website maintenance, social experiences (Facebook, Twitter, etc), e-newsletters, etc. Since our business is Internet focused and our primary tool you can imagine fast Internet is of utmost importance for us and our clients!

We are aware that during the summer of 2017, City Council members from various municipalities met with the regional Colleges and City Chief Information Officers to initiate a project for Go Virginia that will bring a regional fiber backbone to Hampton Roads. Thankfully they unanimously endorsed the project to receive Go Virginia funding to make the fiber backbone a reality.

We agree that this effort is to have a state of the art digital infrastructure in place that will act as a catalyst for national private broadband companies to invest in Hampton Roads marketplace of 1.7 million.

Our belief is that this fiber backbone will be the key to continue to attract high paying jobs, invigorating critical education, public safety and health projects. We also believe that it will place Hampton Roads in a better competitive position to be the digital port to the world.

Given the direct economic impact of establishing a Next Generation Network to the region, Bull & Company MediaWorks strongly endorses the project to receive Go Virginia funding.

Sincerely,

A handwritten signature in dark ink that reads 'Aaron L. Bull'. The signature is fluid and cursive, with the first letters of each word being capitalized and prominent.

Aaron L. Bull
Founder/CEO
Bull & Company MediaWorks

October 17, 2017

Reinvent Hampton Roads
101 W Main St #4500
Norfolk, VA 23510
Attention: Go Virginia Regional Council

RE: Hampton Roads Regional Broadband Initiative

Greetings,

Cetan Corp is an information technology solution provider headquartered in Chesapeake, VA. We primarily serve Fortune 500 companies in 40+ states.

Following local IT trends, I became aware that during the summer of 2017, City Council members from various municipalities met with all the regional Colleges and City Chief Information Officers to initiate a project for Go Virginia that will bring a regional fiber backbone to Hampton Roads.

These colleges and municipalities have now unanimously endorsed the project to receive Go Virginia funding.

I agree that this effort is to have a state of the art digital infrastructure in place that will act as a catalyst for national private broadband companies to invest in Hampton Roads marketplace of 1.7 million.

Our belief is that this fiber backbone foundation will be the key to attracting high paying jobs, invigorating critical education, public safety and health projects and place Hampton Roads in a competitive position to be the digital port to the world.

Given the direct economic impact of establishing a Next Generation Network to the region, Cetan Corp strongly endorses the project to receive Go Virginia funding. Please do not hesitate to contact me directly if you need further clarification of my endorsement.

Sincerely,



Brad Scott
President & CEO
757.548.6420
brad.scott@cetancorp.com

October 17, 2017

Clark Nexsen is a transdisciplinary architecture and engineering firm recognized for partnering with our clients to develop innovative design solutions. With 10 offices spanning Virginia, North Carolina, Georgia, and Texas, our people work to shape the future by discovering opportunities to transform the way we live in and experience our world. We believe that by providing exceptional design services and collaborating closely with our clients, we can deliver high-performing, sustainable projects. Today, the firm has nearly 400 employees and a list of projects that covers the entire United States and more than 41 countries around the world.

We are aware that during the summer of 2017, City Council members from various municipalities met with all the regional Colleges and City Chief Information Officers to initiate a project for Go Virginia that will bring a regional fiber backbone to Hampton Roads.


These colleges and municipalities have now unanimously endorsed the project to receive Go Virginia funding.

We agree that this effort is to have a state of the art digital infrastructure in place that will act as a catalyst for national private broadband companies to invest in Hampton Roads marketplace of 1.7 million.

Our belief is that this high-speed fiber internet backbone will become the foundation for attracting high paying jobs, invigorating critical education, public safety and health projects and place Hampton Roads in a competitive position to be the digital port to the world.

Given the direct economic impact of establishing a Next Generation Network to the region, Clark Nexsen strongly endorses the project to receive Go Virginia funding.

Sincerely,

A handwritten signature in black ink, appearing to be 'C. B.', written over a horizontal line.

Director, Information Technology | Associate

Clark Nexsen

October 16, 2017

Reinvent Hampton Roads
101 W. Main Street
4500
Norfolk, VA 23510

To whom it may concern;

As a born and raised Hampton Roads native and working for a business whose livelihood depends a great deal on technology decisions made by other businesses, municipalities, and educational institutions, I wanted to write today in support of Go Virginia funding for the Hampton Roads Broadband Initiative. This Initiative will bring critically needed high speed broadband to an area that lags behind its peers in other large metropolitan areas.

This initiative would serve to provide the type of high speed connectivity that we need as a region to affect in a positive manner the following things:

- 1) The region's ability maintain our competitive status as we seek to attract and retain businesses to this area in order to maintain our economic prosperity and diversity.
- 2) Improvement in the cost structure for broadband related services in this area where prices are higher and speeds are slower than comparable markets.
- 3) Provide a strategic advantage to our learning institutions in the area ensuring a highly educated and skilled workforce to be developed.
- 4) Allow for future buildout of low and no-cost wireless connectivity in underserved areas allowing Hampton Roads to bridge the digital divide.

It is unprecedented in our area to have an endorsement from all local municipalities on a single project such as this one. That alone should be a strong signal of the importance placed on this Initiative. It is our hope that the Go Virginia committee realizes this importance too.

Sincerely,



Brandon Shewbridge
VP Sales
Creative Office Environments



Joe Fuller

VP/CIO

October 23, 2017

Reinvent Hampton Roads
101 West Main Street Suite 4500
Norfolk, VA 23510
Attn: Go Virginia Regional Council

To Whom It May Concern:

I am writing to encourage the GO Virginia Regional Council to support the Hampton Roads Broadband Initiative.

Dominion Enterprises hosts web sites in Norfolk that serve 30 million web visitors each month. The data we deliver to those visitors consumes a great deal of Internet bandwidth and as CIO I am responsible for acquiring that bandwidth. During our twenty years here, we've been told by vendors that Hampton Roads is an Internet Cul-de-sac. Competition among Internet providers has been low and prices have been high. It has made operating here expensive and made it harder to attract the millennial workers. We wholeheartedly endorse the efforts to make high speed bandwidth in Hampton Roads more prevalent and inexpensive through the Hampton Roads Broadband Initiative.

I asked fellow members of the Hampton Roads CIO Roundtable how important broadband access was to the economic development of the area. Deborah Cassidy of PRA Group said two of her developers chose to live in Norfolk without cars and high speed Internet is critical to them. She applauds the fact this regional broadband initiative is supported by all the localities. Creighton Barnes of Clark Nexsen told me he inquired about Internet service when looking at homes 2 years ago and fast Internet was an important selling point. In researching pricing for Internet service to their 9 offices, he was disappointed at the high cost of slow bandwidth in Hampton Roads. Chuck Williams with the City of Chesapeake is enthusiastic about the unprecedented public/private cooperation for this Regional Broadband Initiative. All of the members I communicated with agreed that high speed bandwidth was critical for the region to continue attracting technical businesses and technical talent.

I applaud the efforts of the GO Virginia Regional Council and recommend investment in the Hampton Roads Broadband Initiative.

Sincerely,

A handwritten signature in black ink, appearing to read 'Joe Fuller', with a stylized flourish at the end.

Joe Fuller

October 20, 2017

Reinvent Hampton Roads
101 W Main St #4500
Norfolk VA 23510

Dear GO Virginia Council members:

With appreciation for your service, I write in support of the Hampton Roads Broadband Initiative and the promise it holds as an equal-opportunity catalyst for regional economic development. As has been well-documented, our region lags in economic growth and job expansion. Yet numerous and well-intentioned initiatives of the past have yet to deliver the Hampton Roads economy from its over-reliance on federal spending. This one holds great promise for a better outcome.

My company's industry, real estate, is defined by economic cycles that can roil the budgets of citizens and cities alike. A stronger and more varied number of legs on our economic stool would help smooth these ups and downs, creating the certainty and predictability that underpins investment and opportunity. My work in other sectors often takes me to Richmond and Northern Virginia, regions where the type, number and scale of companies, the vibrancy of arts, dining, and cultural offerings, and personal income and education levels contrast sharply with ours. The Broadband Initiative can help jumpstart Hampton Roads into a virtuous cycle where growth in every standard and pleasure of living can become self-perpetuating.

Affordable high-speed broadband will also provide greater and less costly access to higher education, a growing concern amid rising costs for students at our public colleges and universities. Enabling job skill development, vocational certification, and online learning is a powerful strategy for developing a workforce that can meet employers' and employees' needs alike. Affordable pathways to higher education can liberate students from excessive student loan debt and free them to take risks on starting small businesses—the historical lifeblood of economic growth in our country.

Please note that this initiative is garnering truly regional support; it is rare to find such unity among the municipalities of Hampton Roads. I hope that the Council will throw its full support behind this initiative, and guide it to swift fruition. Thank you for your kind consideration.

With kind regards,

Helen E. Dragas
President and CEO

October 19, 2017

Reinvent Hampton Roads
101 W. Main Street
#4500
Norfolk, VA 23510

To whom it may concern:

I am pleased to provide this letter of support for the Go Virginia Hampton Roads Regional Broadband Initiative. Digital transformation is upon us and will leave many behind if we are not proactive in securing a robust foundation of diversified options to provide access well into the future.

Health care is also affected by this transformation. The patients and communities that Chesapeake Regional Healthcare serves will benefit from affordable access to broadband services in areas that have limited or non-existent services. Innovation is ever-changing and enhanced broadband connectivity, coupled with health-related information technology, can simultaneously enable better outcomes and ultimately lower costs for our patients.

Everything from electronic health records and telehealth technology to wearable devices such as Fitbits and Apple watches are all part of the health care eco-system. Each component leverages the power of broadband to connect health care to what matters most, the patients.

For rural clinics and small physician offices, a broadband infrastructure is often priced beyond their means or altogether insufficient and unreliable to support their information technology needs. This initiative will bridge the "connectivity gap" to ensure that the Hampton Roads communities we serve receive the health care services and technology at competitive prices.

I fully support this initiative and hope the Go Virginia Committee will see fit to also support and advocate for it as well.

Sincerely,



Reese Jackson
President & CEO
Chesapeake Regional Healthcare



October 20, 2017

Reinvent Hampton Roads
101 W Main St #4500,
Norfolk, VA 23510
Attention: GO Virginia Regional Council

To Whom It May Concern,

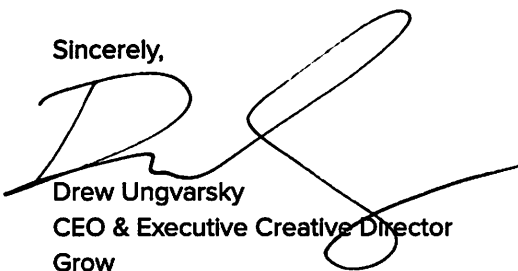
My name is Drew Ungvarsky, and I am the CEO and executive creative director of Grow, a digital marketing agency headquartered in Downtown Norfolk, VA. We create internationally awarded, technology-based marketing projects for clients like Google, Nike, Spotify, NBCUniversal, and Burberry. Our company and its work have been recognized in the New York Times, USA Today, Fast Company, Entrepreneur, and Advertising Age. Grow currently employs 42 full time employees, with plans to expand above 50 in the next year.

I'm writing to express my wholehearted endorsement for the regional initiative to connect fiber broadband across Hampton Roads. The lack of a competitive market for super high speed internet service has been damaging and disruptive to our business, and puts us at a disadvantage nationally amongst our competition. We are aware that we pay as much as 10-20x more than some competitors for similar internet connection speeds. In fact, even today our internet is considerably slower than most of our competitors.

Further, our region's reputation for slow and expensive internet impacts our ability to attract and retain world-class talent. We hear repeatedly from our employees, as well as prospective ones, that the lack of affordable fiber internet options impacts their consideration of living and working in the Hampton Roads market.

Please accept this letter with my strongest support for this important effort and its associated grant application. Both are critically important to our regional economy, as well as our national and global competitiveness.

Sincerely,



Drew Ungvarsky
CEO & Executive Creative Director
Grow



We Put You First

October 17, 2017

Reinvent Hampton Roads
101 W. Main Street #4500
Norfolk, Virginia 23510

Attn: GO Virginia Regional Council

To Whom It May Concern:

Being a business owner in Hampton Roads I would like to offer my support and belief that the project "GO Virginia" will bring a regional fiber backbone to our area one that is needed for private companies to invest in the Hampton Roads marketplace. I agree that the Red Fiber Backbone will attract high paying jobs, invigorate critical education, public safety and health projects and place Hampton Roads in a competitive position to be the digital port to the world.

Sincerely,

A handwritten signature in black ink, appearing to read "D. M. Ellmer", written over a horizontal line.

Dennis Ellmer
President/Owner
Priority Automotive



October 15, 2017

TechArk Solutions is an award-winning and nationally recognized digital consulting and development company based in the Hampton Roads area of southeastern Virginia.

We are aware that during the summer of 2017, City Council members from various municipalities met with all the regional Colleges and City Chief Information Officers to initiate a project for Go Virginia that will bring a regional fiber backbone to Hampton Roads. These colleges and municipalities have now unanimously endorsed the project to receive Go Virginia funding.

We agree that this effort is to have a state of the art digital infrastructure in place that will act as a catalyst for national private broadband companies to invest in Hampton Roads marketplace of 1.7 million.

Our belief is that this fiber backbone foundation will be the key to attracting high paying jobs, invigorating critical education, public safety and health projects and place Hampton Roads in a competitive position to be the digital port to the world.

Given the direct economic impact of establishing a Next Generation Network to the region, TechArk Solutions strongly endorses the project to receive Go Virginia funding.

Sincerely,

A handwritten signature in black ink that reads "Pratik Kothari". The signature is fluid and cursive, with the first letters of each name being capitalized and prominent.

Founder & CEO
TechArk Solutions



October 19, 2017

Bob Crum
Executive Director
Hampton Roads Planning District Commission
The Regional Building
723 Woodlake Drive
Chesapeake, VA 23320

Dear Mr. Crum:

The purpose of this letter is to lend TFC Recycling's strong support to the Hampton Roads Regional Broadband Project. As the largest recycler in Virginia, with a long and storied history and an exciting future as a leader in the recycling industry, we recognize that this GO Virginia initiative offers a tremendous opportunity to the Hampton Roads regional economy and that better and faster connectivity will allow us to grow our business and be more productive.

Founded in 1973 and headquartered in Chesapeake, VA, TFC Recycling is a privately held and family-operated business. Because of our partnerships and agreements with local and municipal governments, and public service authorities, we recognize the significance and impact that all 17 Hampton Roads municipalities are resolute in their unanimous endorsement of this broadband project. As a pioneer in our industry, we fully embrace the spirit of innovation that a project of this magnitude requires, placing Hampton Roads at the epicenter of the Regional Broadband Initiative.

Thank you for considering TFC Recycling's endorsement of the Hampton Roads Regional Broadband Initiative.

Respectfully,

Michael Benedetto
President/Owner
TFC Recycling

Attachment 10.6

Letters of Support

Community Stakeholders

Hampton Roads Planning District Commission
October 31, 2017





October 14, 2017

The Hampton Roads Innovation Collaborative is an all-volunteer non-profit technology council established in 1996 to support and promote technology and innovation initiatives within the region of Hampton Roads, Virginia.

We are aware that during the summer of 2017, City Council members from various municipalities met with all the regional Colleges and City Chief Information Officers to initiate a project for Go Virginia that will bring a regional fiber backbone to Hampton Roads.

These colleges and municipalities have now unanimously endorsed the project to receive Go Virginia funding.

We agree that this effort is to have a state of the art digital infrastructure in place that will act as a catalyst for national private broadband companies to invest in Hampton Roads marketplace of 1.7 million.

Our belief is that this fiber backbone foundation will be the key to attracting high paying jobs, invigorating critical education, public safety and health projects and place Hampton Roads in a competitive position to be the digital port to the world.

Given the direct economic impact of establishing a Next Generation Network to the region, the Hampton Roads Innovation Collaborative strongly endorses the project to receive Go Virginia funding.

Sincerely,

Dan G. Bell

President

Hampton Roads Innovation Collaborative

To Whom It May Concern,

Subject

The Norfolk Military Economic Development Advisory Committee (MEDAC) backing for the GO Virginia grant to support the Regional Broadband Strategy for Hampton Roads.

Background

Broadband is the indispensable infrastructure of the 21st century digital economy. Study after study has pointed to the anemic growth of Hampton Roads' economy, and its over dependence on federal and military spending. Development of strong private sector economic growth with associated high-salary job creation is more crucial than ever if Hampton Roads is to diversify its economic portfolio and be competitive in the 21st century digital economy.

Hampton Roads' economy is underperforming those of similar size regions at both the national and neighboring state level. To rekindle strong economic growth within Hampton Roads, a regional approach to affordable, accessible broadband for the business community, for higher education plus residential users is an infrastructure necessity.

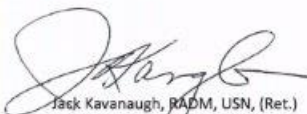
Local government leaders are now focused on moving forward a Regional Broadband Strategy, with the initial steps being development of a **regional fiber infrastructure** with connectivity to meet smart region capabilities. The vision is to continue developing Hampton Roads as a nationally connected, 21st century digital community able to attract new businesses and high-paying jobs.

Endorsement

The Norfolk Military Economic Development Advisory Committee (MEDAC) **strongly endorses and supports** the award of a GO Virginia Grant to support a Regional Broadband Strategy for Hampton Roads. It is the consensus of MEDAC membership that a robust private sector economy with a modern digital infrastructure is a necessity for the continued viability of a strong military presence within Hampton Roads.

Sustaining the current set of military missions and identifying when and where future growth is possible requires Hampton Roads to continually evaluate and plan to improve/modernize defense-related infrastructure.

As earlier stated, broadband is the indispensable infrastructure of the 21st century, and Hampton Roads must be a nationally connected 21st century community and international gateway if it is to remain a strategic partner to our military services.



Jack Kavanaugh, RADM, USN, (Ret.)

Vice Chairman, Norfolk Military Economic Development Advisory Committee

October 24, 2017

ReInvent Hampton Roads
101 West Main Street, Suite 4500
Norfolk, VA 23510

ATTENTION: GO Virginia Regional Council

Dear Council Members,

It is with pleasure to write this letter of support for the Hampton Roads Region's application to the GO Virginia Council for regional broadband.

THRIVE is a regional young professional group that cultivates regional awareness and community development by providing a platform to empower young professionals, give them a voice, and invest in the future of our region. We represent 1,763 young professionals in Hampton Roads from numerous industries on the Southside and Peninsula. In a recent poll to our members we asked the question, "Do you believe expanding Hampton Roads' broadband infrastructure is vital to the region's economic growth?" Out of 152 responses, 113 individuals answered "yes".

Broadband is a key component to regional growth within Hampton Roads. Providing our region with affordable and high speed internet is crucial for helping industries such as cyber security, healthcare, education, and maritime to grow and prosper. Having the proper broadband infrastructure in place will position Hampton Roads to have a competitive advantage in attracting new businesses and developing our existing industries.

Thank you in advance for your consideration of this proposal. If you have any questions please don't hesitate to contact, Julia Rust at info@yptHRive.org or 757-664-2518.

Sincerely,

Julia Rust,
Chair of THRIVE

October 27, 2017

Subject: GO Virginia Regional Broadband Initiative Application

To Whom It May Concern:

The Virginia Beach Military Economic Development Advisory Committee (MEDAC) was established to enhance the coordination with the local military, various installation tenants, and area federal facilities. The MEDAC members are appointed by the Virginia Beach City Council and the membership consists of retired senior officers and senior enlisted personnel.

MEDAC has received several briefings on broadband over the past months and we completely understand the importance of accessibility to ultra-high speed (in excess of 1 GIG) internet service. This will be very important to the future of the Hampton Roads military installations, the extensive Federal laboratories and research installations, the numerous universities and colleges, and area businesses. MEDAC agrees the availability of increased internet service will create healthy competition which will further enhance the options available to Hampton Roads institutions and individual citizens. The future of Hampton Roads' economic vitality is highly dependent on the success of our businesses, the continued presence of its military installations, an increase in higher education and research, and the ongoing research and activities at all Federal installations.

The Virginia Beach MEDAC supports the Hampton Roads regional application focused on broadband that will be considered by GO Virginia. The successful awarding of the grant will start all of Hampton Roads on a collaborative approach for the digital age.

A handwritten signature in dark ink, appearing to read 'Mark Gemmill', followed by a small flourish.

Mark Gemmill, Rear Admiral, U.S. Navy (Ret.)

Chair

Virginia Beach Military Economic Development Advisory Committee

4525 Main Street, Suite 700
Virginia Beach, VA 23462

Attachment 10.7

Chronology of HRPDC Discussion of GO Virginia Program

Hampton Roads Planning District Commission
October 31, 2017



HRPDC Timeline on the GO Virginia Program

<i>Date</i>	<i>Action</i>
October 2015	Mr. John “Dubby” Wynne briefs the HRPDC on the GO Virginia initiative.
January 2016	Mr. Jim Spore briefs the HRPDC on economic challenges facing Hampton Roads and opportunities for regional collaboration with ReInvent Hampton Roads and the GO Virginia Program.
June 2016	The HRPDC CAO Committee is briefed on the City of Virginia Beach Broadband Initiative. The CAOs direct their Chief Information Officers (CIOs) to investigate opportunities for regional collaboration on broadband and the potential for GO Virginia funding.
February 2017	The HRPDC CAO Committee is updated by their CIOs on the status of a regional broadband initiative.
April 2017	The HRPDC CAO Committee is updated on the status of a regional broadband initiative and the GO Virginia Program.
July 2017	Mr. Jim Spore and Dr. Larry Filer update the HRPDC on the GO Virginia Program and the Economic Growth and Diversification Plan. The Commissioners provide input on the plan via survey.
August 2017	The HRPDC CAO Committee is updated by their CIOs on the status of a regional broadband initiative.
September 2017	The HRPDC CAO Committee endorses two regional projects for GO Virginia program funds: the Hampton Roads Regional Broadband Strategy and the Hampton Roads Unmanned Systems Facility.
September 2017	The HRPDC endorses the same two regional projects for application to the GO Virginia program for grant funds: the Hampton Roads Regional Broadband Strategy and the Hampton Roads Unmanned Systems Facility.
October 2017	The HRPDC CAO committee is updated on the GO Virginia grant applications process and on a potential grant application by ODU.

Attachment 10.8

Maps: Population & Employment Density

Hampton Roads Planning District Commission
October 31, 2017



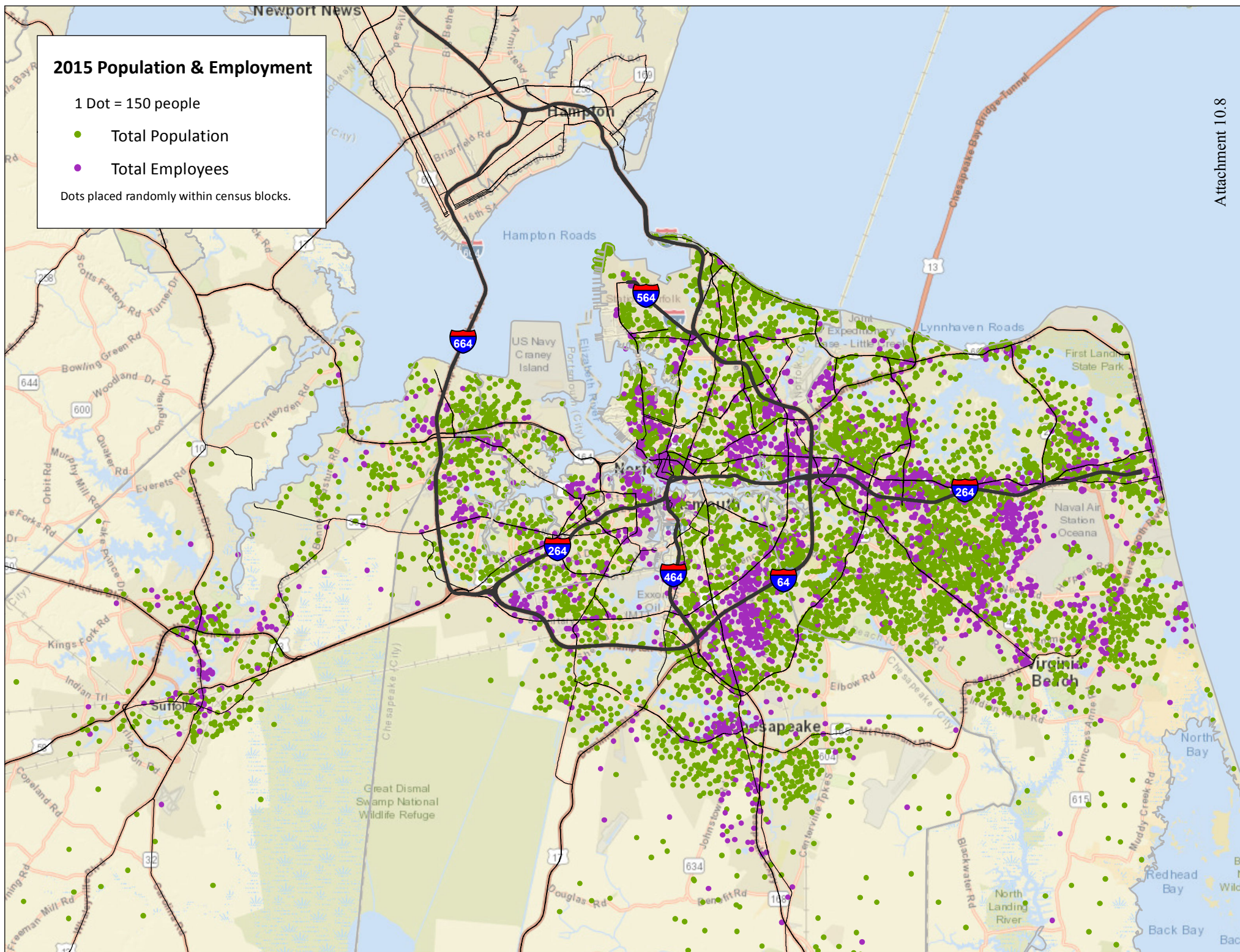
2015 Population & Employment

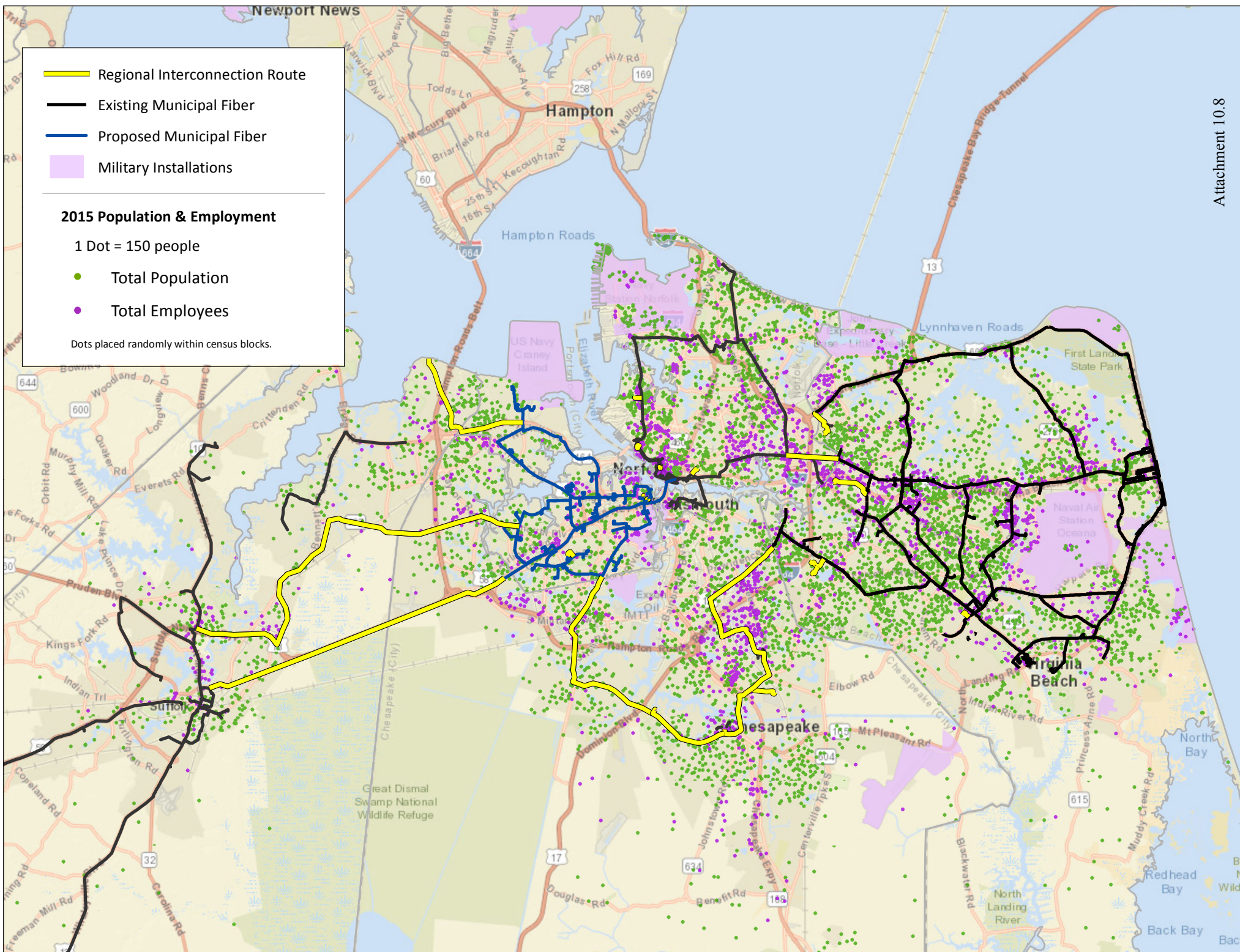
1 Dot = 150 people

● Total Population

● Total Employees

Dots placed randomly within census blocks.





Attachment 10.9

Map: 4-Phase Approach for Hampton Roads Broadband Strategy


Hampton Roads Planning District Commission
October 31, 2017

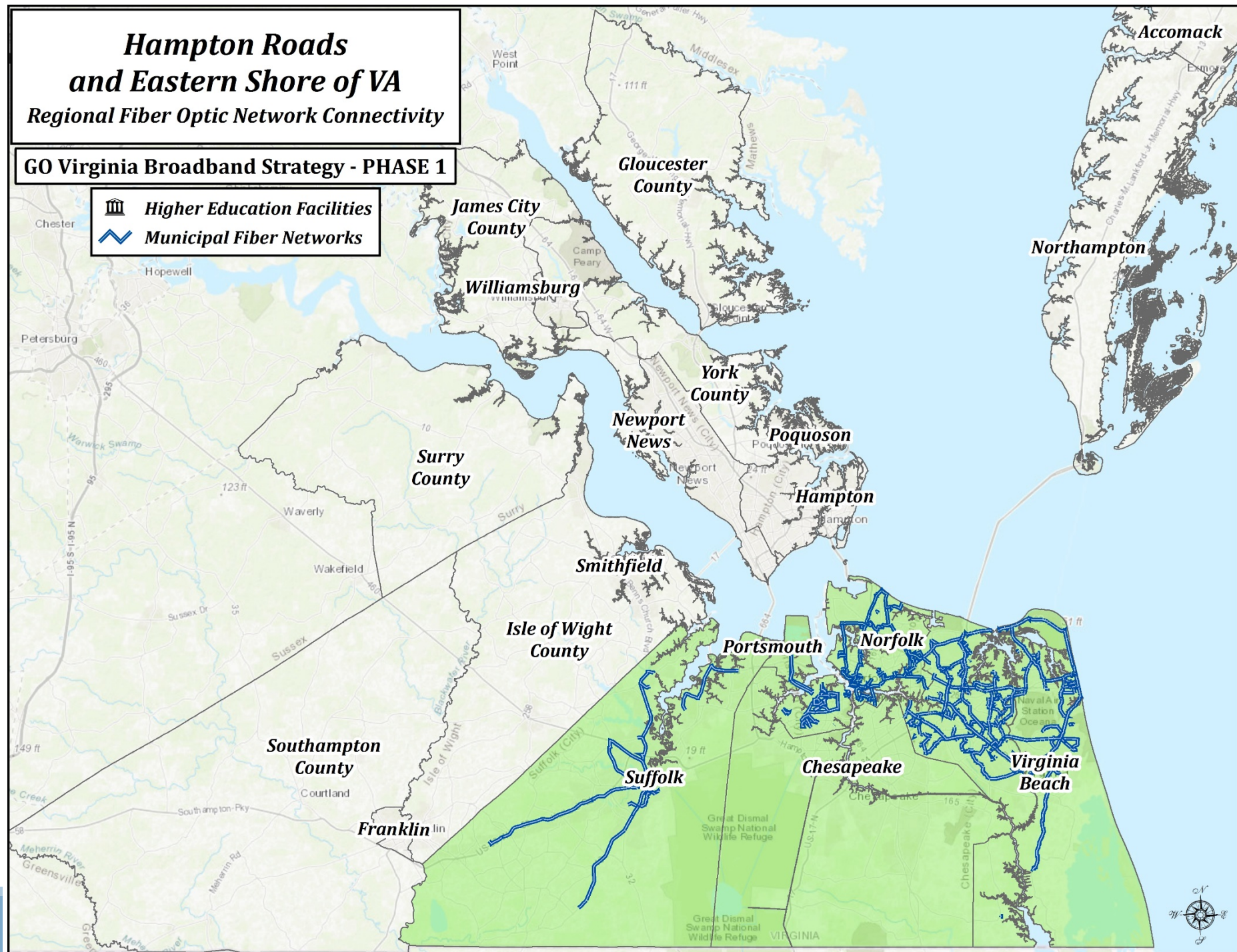


Hampton Roads and Eastern Shore of VA

Regional Fiber Optic Network Connectivity

GO Virginia Broadband Strategy - PHASE 1

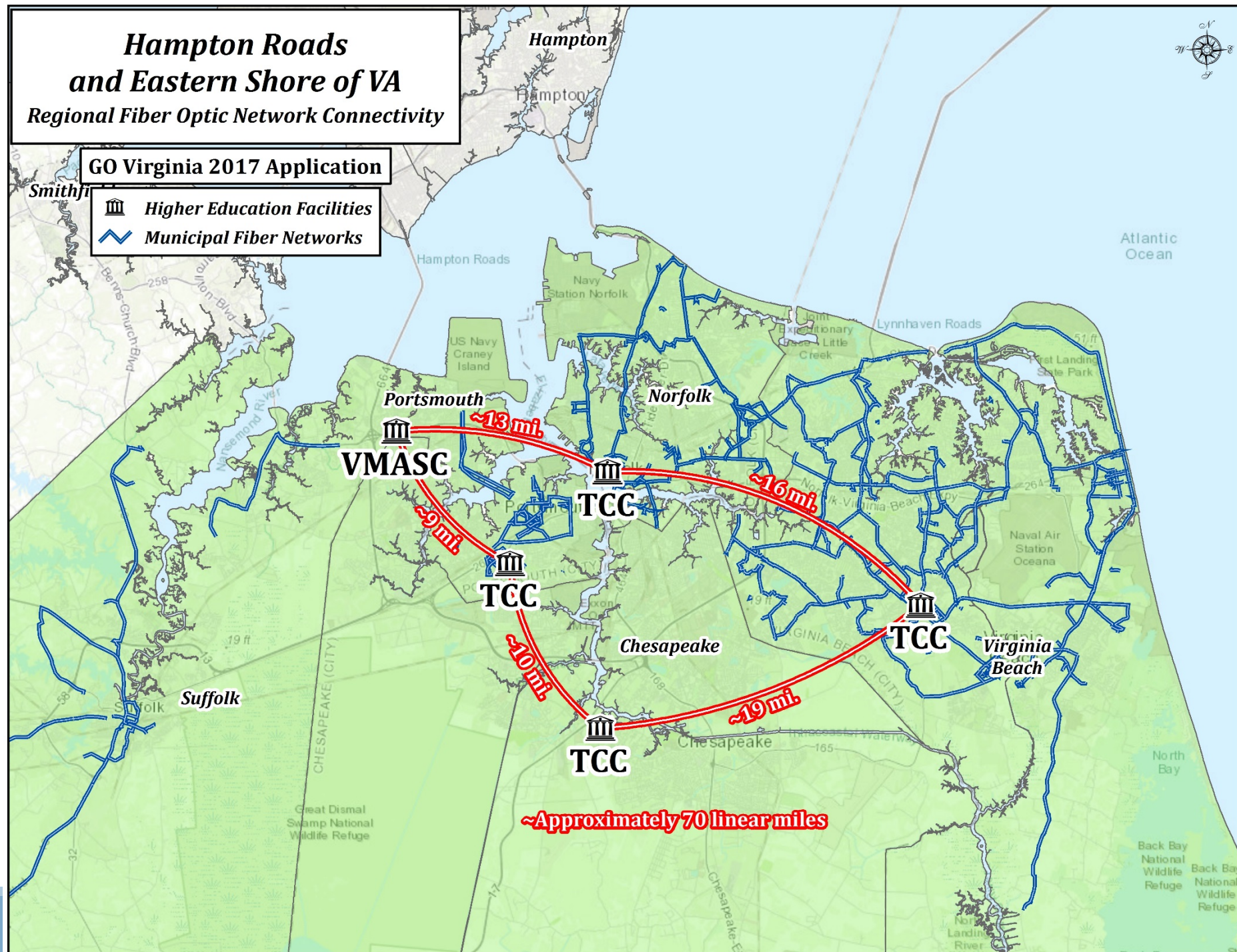
-  Higher Education Facilities
-  Municipal Fiber Networks



Hampton Roads and Eastern Shore of VA Regional Fiber Optic Network Connectivity

GO Virginia 2017 Application


-  Higher Education Facilities
-  Municipal Fiber Networks

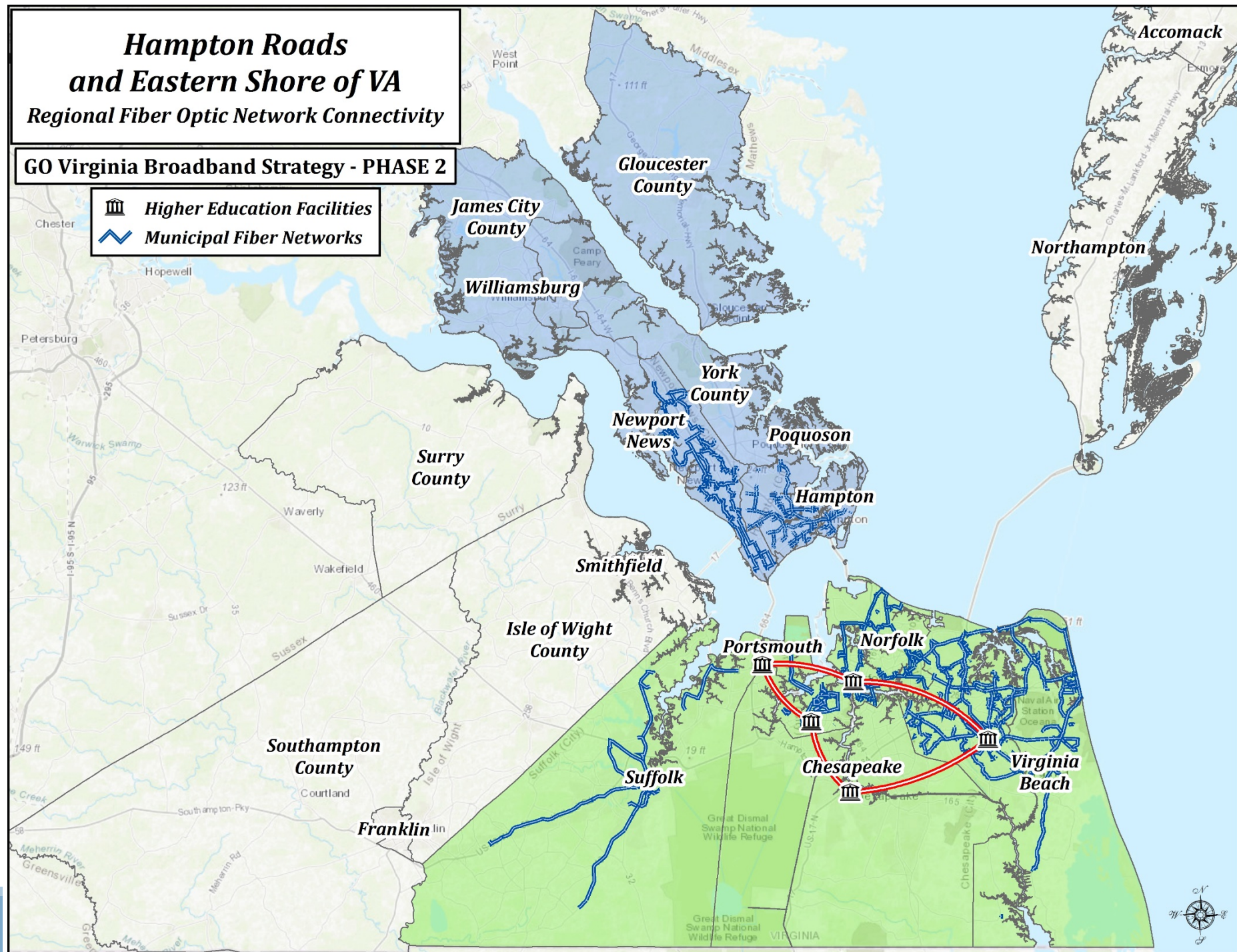


Hampton Roads and Eastern Shore of VA

Regional Fiber Optic Network Connectivity

GO Virginia Broadband Strategy - PHASE 2

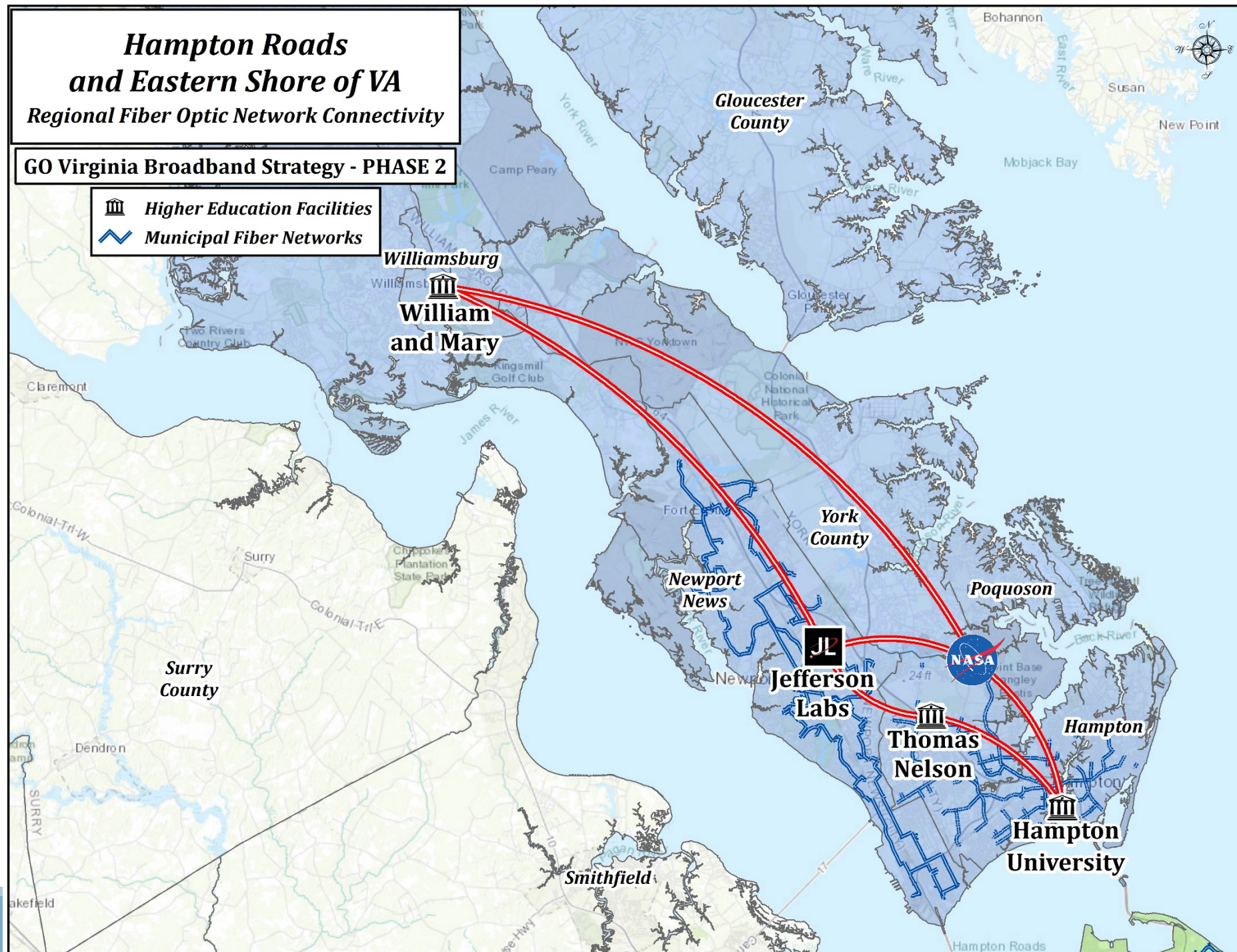
-  Higher Education Facilities
-  Municipal Fiber Networks



Hampton Roads and Eastern Shore of VA Regional Fiber Optic Network Connectivity

GO Virginia Broadband Strategy - PHASE 2

-  Higher Education Facilities
-  Municipal Fiber Networks

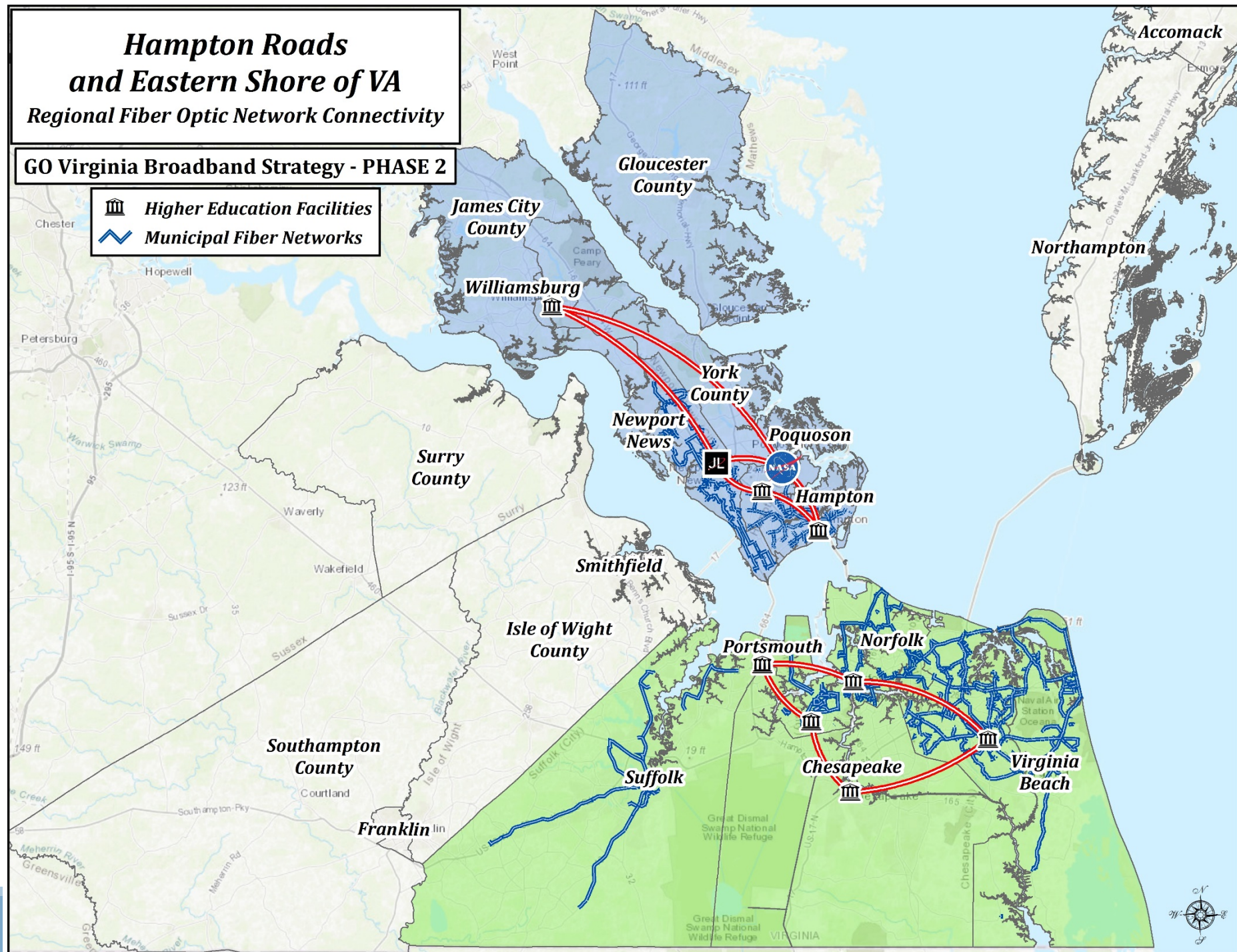


Hampton Roads and Eastern Shore of VA

Regional Fiber Optic Network Connectivity

GO Virginia Broadband Strategy - PHASE 2

-  Higher Education Facilities
-  Municipal Fiber Networks

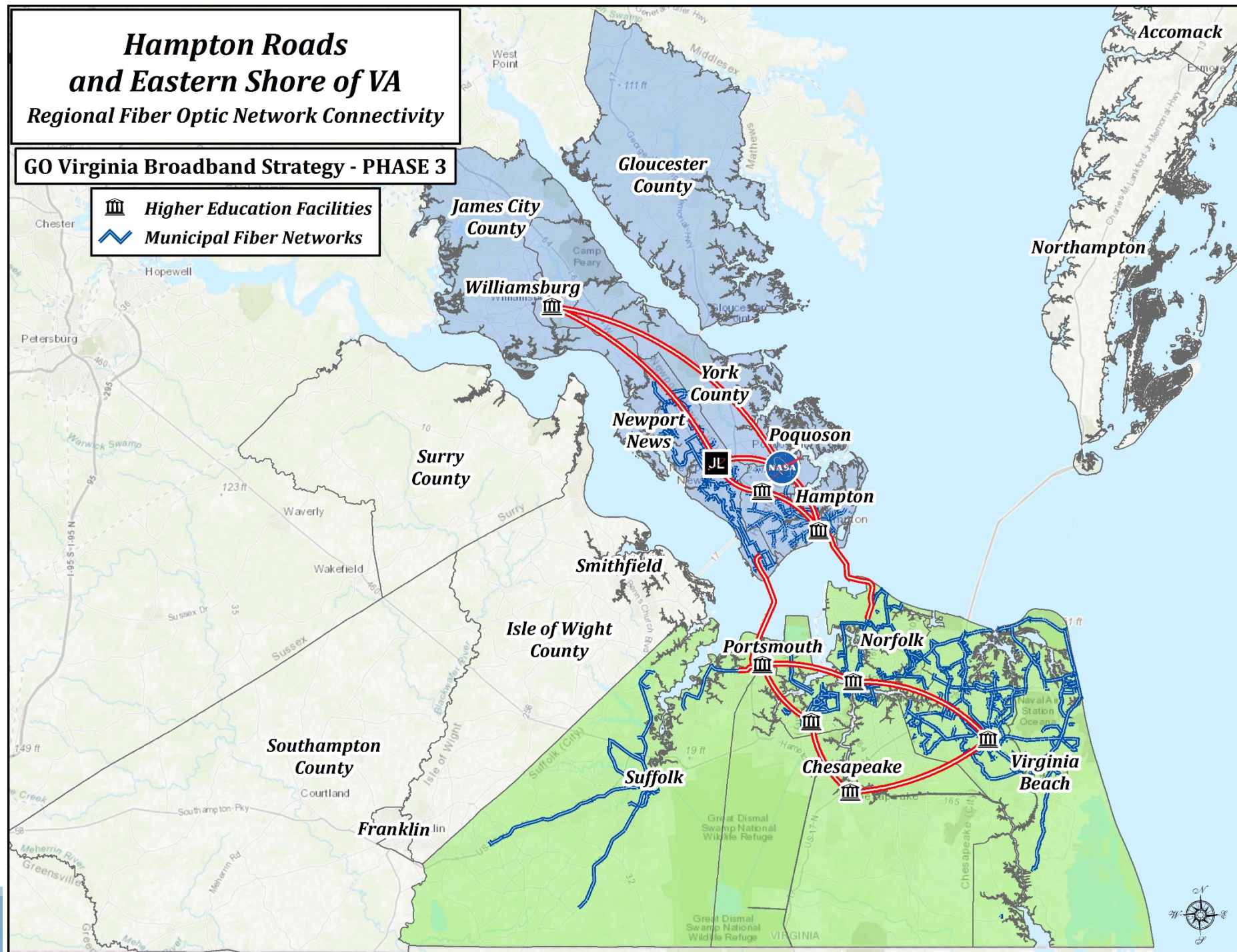


Hampton Roads and Eastern Shore of VA

Regional Fiber Optic Network Connectivity

GO Virginia Broadband Strategy - PHASE 3

-  Higher Education Facilities
-  Municipal Fiber Networks

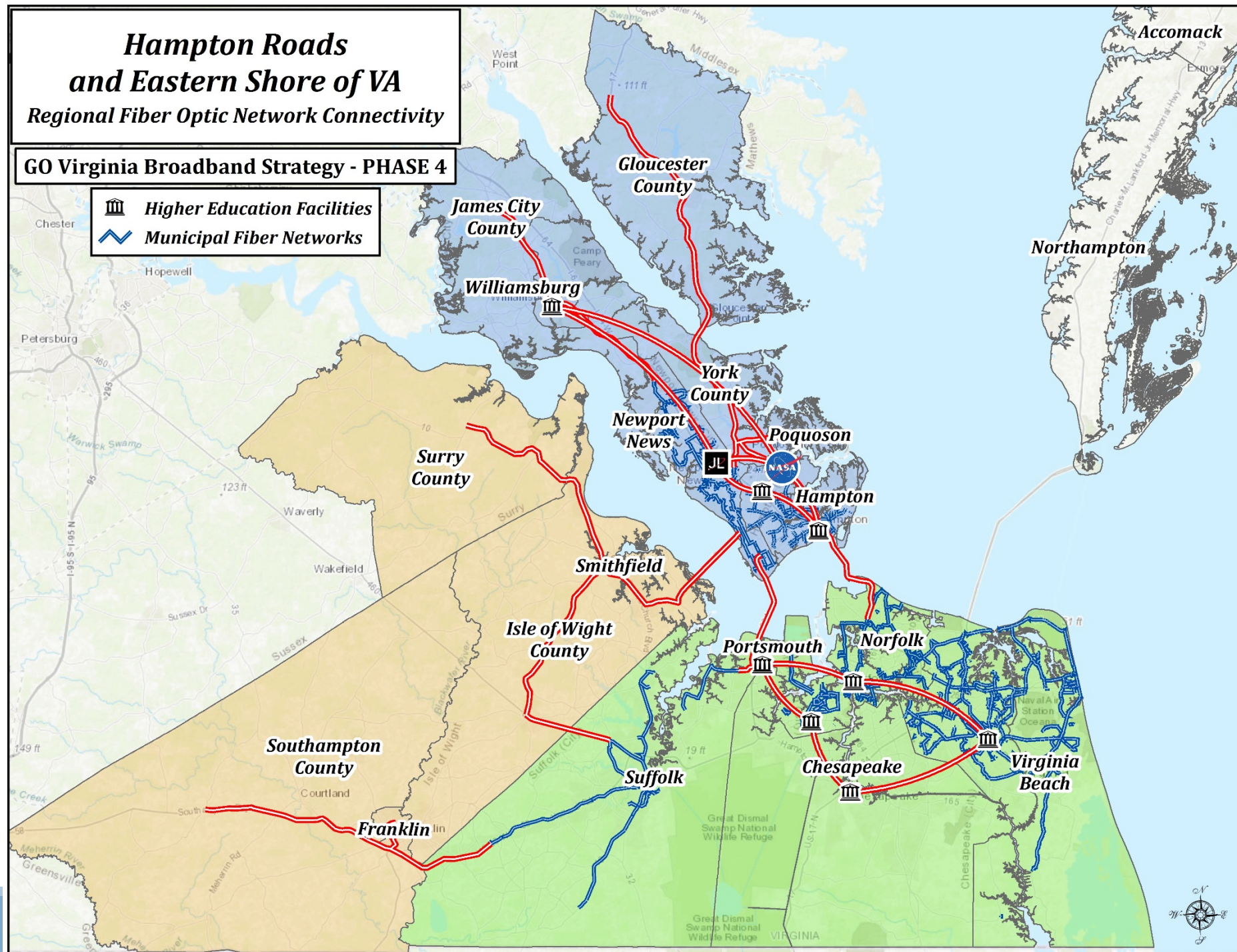


Hampton Roads and Eastern Shore of VA

Regional Fiber Optic Network Connectivity

GO Virginia Broadband Strategy - PHASE 4




-  Higher Education Facilities
-  Municipal Fiber Networks

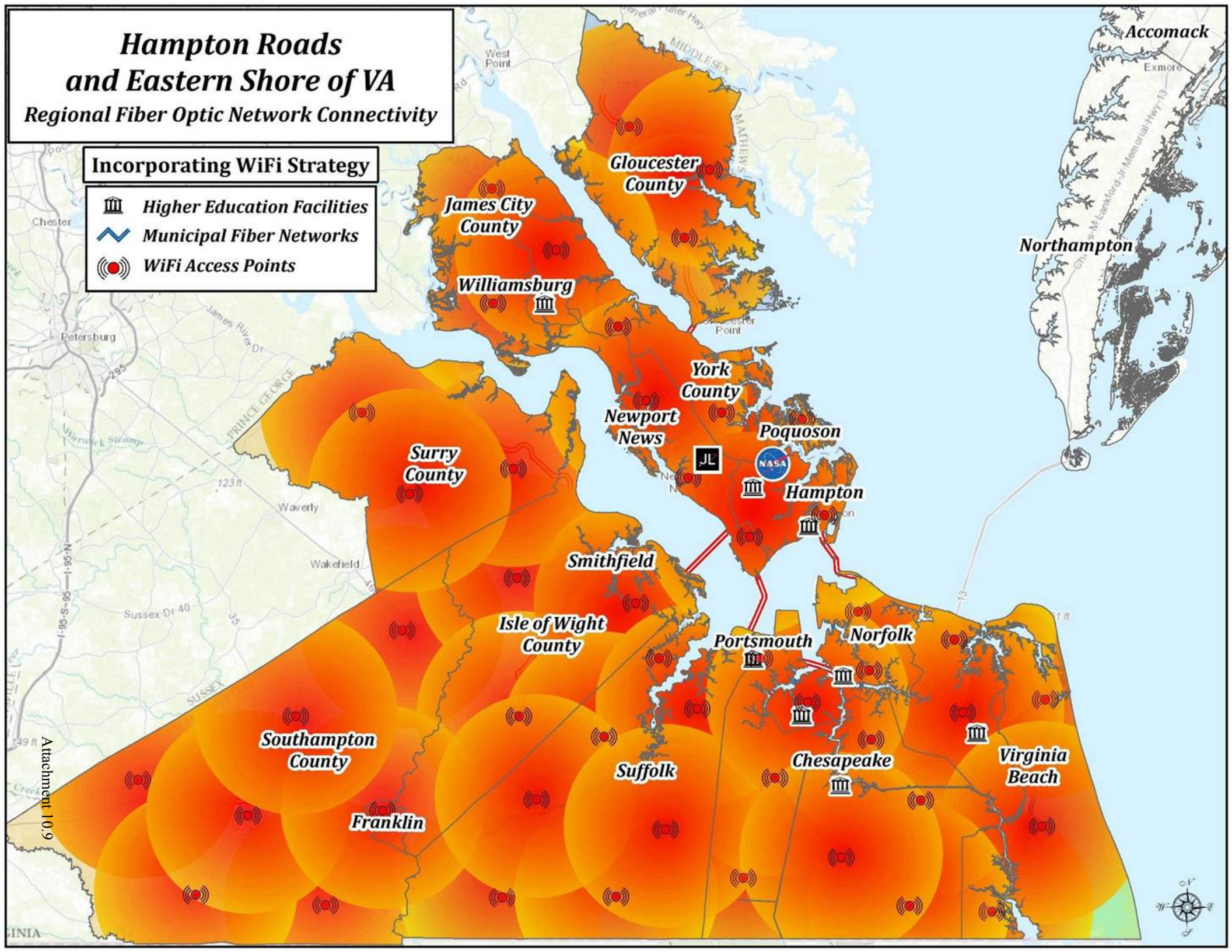


Hampton Roads and Eastern Shore of VA

Regional Fiber Optic Network Connectivity

Incorporating WiFi Strategy

-  Higher Education Facilities
-  Municipal Fiber Networks
-  WiFi Access Points



Attachment 10.10 CTC Regional Fiber Optic Interconnection Pre-Engineering Study

Hampton Roads Planning District Commission
October 31, 2017



ctc technology & energy

engineering & business consulting



Regional Fiber Optic Interconnection Pre-Engineering Study

Prepared for the City of Virginia Beach
For CIO Review | October 2017

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1 Executive Summary

1.1 Introduction and Background

Regional stakeholders have realized the promise of economic and population growth in the area and the opportunities presented by recent developments such as the cable landing in Virginia Beach, which brings high-speed transatlantic cable to the U.S. They also recognize the tremendous potential and necessity of broadband initiatives to both support and spur economic growth.

The stakeholders recognized that such an initiative has a lot to leverage. The region already is well integrated with existing economic development frameworks that take a regional approach and a long robust history of regional governments to collaborate with each other and with private partners. In addition, the regional governments have their own fiber optic government networks and assets to draw on for building out a more robust regional infrastructure.

While regional development will require a broader regional infrastructure, the stakeholders recognized that a staged approach will be necessary, starting with the five Southside cities of Portsmouth, Norfolk, Suffolk, Chesapeake, and Virginia Beach and then expanding regional connectivity, foot print, and strategic scope both to the broader region and to additional key sites and future partners.

1.2 Scope of This Report

This report is the result of an initiative sponsored by the City of Virginia Beach on behalf of the communities in the Southside area and, more generally, the Hampton Roads region. The report lays the foundations for an interconnection framework that would expand with subsequent stages, and would support regional economic development objectives and public-private partnerships, in addition to those of inter-governmental and higher educational institution collaboration.

The report provides a pre-engineering analysis; it develops a conceptual design and cost estimates for interconnecting the fiber optic networks of five Southside Cities in the Hampton Roads region in a first stage and the higher educational institutions in a second stage. The objective for these two first stages is to interconnect the regional governments of the five Southside cities to facilitate regional collaboration, and to facilitate both higher educational collaboration and collaborative partnerships between the governments and the educational institutions.

This report concludes with detailed analyses of the potential benefits of fiber interconnection to the regional governments and the region's higher education institutions.

1.2.1 Requirements Collection Methodology

To develop the data to support the analysis in this report, CTC conducted interviews and collected documentation, including GIS maps, from each of the five participating jurisdictions and higher education institutions for the scoped stages. The GIS maps captured essential information regarding current and planned fiber for each participant as well as method of installation (aerial vs underground), and whether it was owned or leased by the City. The jurisdictions also provided GIS information on designated economic development areas, as well as other relevant information related to the objectives of this study.

1.2.2 Key Assumptions and Guidelines

The conceptual interconnection design adopted a number of key assumptions to ensure feasibility and cost effectiveness:

- Leverage existing and planned City fiber assets to reduce overall construction costs
- Provide redundant connections between Cities to increase network availability for critical regional collaboration applications, and improve overall resilience
- Interconnect to key regional sites in the five-city area that would benefit the resilience, quality, and ongoing costs of network and data services in the region
- The sites include the regional data center in the Norfolk Granby Municipal Building, the Corporate Landing transoceanic cable site in Virginia Beach, and the Public Safety Operations Building approaching completion in Chesapeake
- Where feasible and cost effective, design the interconnection routing to pick up indicated economic development areas opportunistically
- Connect the region's higher education facilities to promote collaboration between entities, facilitate research and educational opportunities, and allow the higher educational institutions to connect with local businesses
- Extend the region's fiber optic network, which will allow the Southside Cities to further leverage the fiber optic networks to provide broadband services for economic development, digital divide, and other community benefits

While the resulting design is limited in scope at this initial stage, the framework allows individual cities to further build on the interconnection platform through their own individual efforts. Where they are not yet connected, the individual jurisdictions can extend their own fiber optic network to its economic development areas, and leverage the regional interconnect to tie such area into the regional network.

The report incorporates jurisdictional maps to show both where such economic development areas would be tied in by virtue of this interconnection, and where the individual jurisdiction or later regional effort would need to extend connectivity to tap into the potential of the infrastructure for serving such areas specifically. While the focus is on the interconnection segments to tie the Southside Cities together, with robust electronics and sufficient excess fiber strands to support future objectives, subsequent or parallel efforts by the individual partners could be undertaken to enable leasing of fiber or partnerships with private entities by overbuilding current scarce city fiber assets with additional strands.

1.3 Network Design and Costs

The resulting design proposes 144-strand-count fiber backbone interconnections leveraging existing city and higher education fiber for traversal. Costs were calculated using assumptions of mostly underground construction matching most of the existing government fiber installations, with industry standards adopted for labor cost estimate, conduit type and size, and handhole as well as other materials needed for building entry. Appropriate for a pre-engineering study, the proposed routes were examined through desktop and GIS mapping and examinations of the rights-of-way to determine if underground drilling would be feasible.

The design incorporates a flexible Dense Wave Division Multiplexing (DWDM) electronic infrastructure that will allow up to 100 Gbps backbone and aggregate speeds with physically separate rings for a Cities' ring and for a higher educational institutions' ring. The DWDM architecture allows for a high degree of flexibility for partners to provision layer 2 and layer 3 services because it works at the physical optical level. Other routing and network segmentation capabilities can be added and upgraded as needed ensuring the platform is flexible and scalable. In particular, the design makes it relatively easy to add a site and peer with additional networks at later stages.

The physical layer, or outside plant (OSP), is both the most expensive part of the network and the longest lasting. We estimate a total OSP cost of \$10 million to \$12.4 million. Cost estimates are inclusive of all engineering, project management, quality assurance, and construction labor anticipated to be necessary to implement the network on a turnkey basis, and are based on relatively conservative pricing assumptions.

Network electronic costs would be around \$4.9 million and include the DWDM and router equipment at each of the five city backbone nodes and a switch at each of the educational institutions.

Network operations would amount to about \$800,000 to \$964,000 per year. This cost estimate covers operations and maintenance, including fiber repairs and relocations, electronics

maintenance and service, monitoring, and engineering staffing of one-half a full-time equivalent (FTE).

1.4 Financial and Business Case Analysis

The business case for the regional interconnection fiber network is based on the wide range of operational benefits and enhanced functions described in Section 5 and Section 6, including significant new service opportunities for Southside Cities and higher education institutions, the critical needs that can be met over the Cities' own infrastructure, the benefits of City control and management of their own networks, and the potential economic development benefits of building a communications infrastructure of this capacity in the region. In summary, this initiative can support the economic development goals developed by Region 5¹ in the following ways, among others:

- Support innovation districts for high-tech incubator programs, linking higher education institutions and labs with such districts for on-site development, internships, and partnerships
- Support specific clusters that are geographically concentrated in business parks and incubator districts
- Lower costs of the fiber infrastructure for all entities and create opportunities for local last mile providers
- Increase the region's public profile and support the region's innovation branding, with the goal of attracting technology workers and subject-matter experts (SME)
- Enable the more rural and urban areas of the region to support each other through interconnection
- Enable connectivity among training academies or university satellite campuses to provide onsite, as well as remotely accessed, resources and education for addressing the skills gap and transitioning military personnel to high-tech civilian jobs

¹ Region 5 has developed a set of specific economic development goals on which to focus, and is currently developing a strategic plan for achieving these goals known as the "Growth and Diversification Plan." The four goals are: Build regional capacity for innovation in key cluster competencies; Increase the pace of Small and Medium Enterprise (SME) creation through the expansion of existing firms and the attraction of out-of-region SMEs; Increase the share of the 25+ population with a bachelor's degree or higher; Better assimilate existing military into the private sector clusters in the region.

1.4.1 Platform for Economic Development Opportunities

This initiative builds on the national best practice in which a wide range of American communities are making their core fiber rings available to the private sector in the hopes that private investment will build from public “middle mile” fiber out to the “last mile” to businesses and residential premises. The idea is that, by making middle-mile capacity available where it does not otherwise exist, and at very reasonable cost, the Cities will reduce the barriers to investment for entrepreneurial companies (and non-profits) that want to build last-mile capacity. In this model, those companies’ lease arrangements would lead to not only modest revenues for the government, but also stimulate private investment and the extension of broadband service to customers that otherwise would not have it, or would not have the benefits of competition.

In addition to tactically creating a platform for last-mile fiber deployment by the private sector (and the environment for economic development that such deployment would foster), a robust fiber ring in the Southside region would be a key strategic step toward building an ecosystem that supports the region’s long-term vitality as a technology and business hub. Together, the undersea cable and a potential Southside regional fiber ring initiative are part of building a profile and culture for the region as technology savvy and welcoming to businesses across a range of sectors, including both established companies and startups.

Indeed, the proposed fiber can play a key role in supporting the entrepreneurial ecosystem. Access to affordable, high-bandwidth connections is especially important for startups and innovative, early-stage companies. The Southside network discussed in this report includes routing to key economic development target locations selected by the Cities to help attract technology companies and startups.

Transforming the region into a fiber-ready region could also support potential public–private partnerships and prepare the region for innovations around autonomous vehicles, smart cities, connected communities, and related innovations.

1.4.2 Platform for Wireless Innovation and Opportunity

The regional interconnection fiber network will also serve as a platform for the Cities’ innovation in wireless. At the same time as connecting the Cities to each other for operational benefits, the fiber will support new wireless deployments for such potential initiatives as, for example, (1) providing free service around government buildings, (2) providing free services for digital inclusion purposes in selected lower-income neighborhoods, and (3) providing Wi-Fi as an attractor and differentiator in economic development target areas such as historic downtowns or revitalization zones. Using the fiber as a platform, the Cities will be able to very inexpensively deploy off-the-shelf Wi-Fi equipment to create free public hotspots to serve such goals as economic vitality, digital inclusion, and tourism support.

The fiber can further serve as a platform for wireless technologies that support innovative government functions such as smart cities applications and the Civic Internet of Things (in which the public sector utilizes the potential of the machine-based internet to collect data, realize efficiencies, and improve government services).

The fiber can also serve as a platform for private sector wireless deployment. Fiber's capacity is so extensive that private sector wireless internet service providers (WISPs) can use it to maximize the potential of last mile wireless technologies, including the potential emerging 5G class of high-speed fixed wireless products. In this way, the fiber can serve to create new private-sector opportunity to the broader economic benefit of the region.

1.4.3 Platform for Higher Education Innovation and Local Job Creation

The proposed fiber interconnection network also has the potential to support higher education innovation and collaboration in a range of ways. For example, the network would make the region more competitive for federal grants and major collaborative research by allowing researchers to work with faculty from nearby institutions on large research collaborations involving the analysis of huge data sets. The network could help to grow the higher education footprint in the region by making local institutions more attractive to faculty and students and providing an incentive for faculty and students to live nearby. Further, the capacity provided by fiber would allow institutions to store more data locally, giving users more control over their data and keeping the associated IT support jobs in the local community. And on the programmatic side, the fiber can enable local campuses to serve as business and research incubators, enable advanced telemedicine applications, and enable remote training of health care professionals and shared, collaborative efforts in the medical and nursing fields.

1.4.4 Operational Benefits

The network will also create a range of benefits for government operations and programs, as well as public safety. For example, the network can support cybersecurity operations, as well as workforce training programs and workforce development. It can enable the Cities to share services and aggregate buying power to secure better pricing in technology procurement. It can deliver public safety grade communications while also securing government data and operations by providing affordable connectivity to remote backup sites.

A regional fiber collaboration among the localities in the Southside area could also be extended over time to include the Peninsula and other jurisdictions within the Commonwealth.

1.4.5 Cost Savings and Hedge Against Cost Increases Over Time

The network will enable the Cities to control their long-term costs for communications services while still enabling them to efficiently increase capacity and functionality. The proposed

network will provide the Cities and higher education institutions with reliable, resilient, high-speed connections on the highest-end of what is available from the commercial marketplace.

Indeed, market pricing for services comparable to those that the network will deliver is between \$1.4 and \$2.1 million, far in excess of the \$804,000 of annual operating expenses estimated for both stages of the proposed network, which the Cities will own and control.²

Further, the proposed network provides a mechanism to meet increasing bandwidth needs without drastic increases in capital or operating costs, thus hedging against the risk that the Cities and higher education institutions will face large cost increases in the future.

² This analysis compares the cost of leased services to the Cities' likely operating costs, on the assumption that the capital cost to build the network will be covered by grant funding, per the expectations of this engagement. The analysis thus does not include analysis of a scenario in which the Cities issue bonds to finance the fiber construction and then also have the ongoing operating cost of debt service. Inclusion of debt service costs would reduce the annual savings of the fiber strategy relative to a leased commercial scenario, but would still result in savings over that more costly, less scalable scenario.

2 Design and Cost Estimate for an Interconnection Fiber Network to Connect Southside Cities and Higher Education Institutions

Construction of a fiber optic network designed specifically to connect Southside Cities (the “Cities”) and higher education institutions provides opportunities for regional collaboration and relative to commercial services, may offer long-term cost savings and provide technical advantages. We developed a candidate network design that builds on each City’s existing fiber and network resources, and adds fiber and network electronics as needed to interconnect the Southside communities and the higher education institutions. In this section, we provide an overview of a technical approach and cost estimate developed to examine the feasibility of constructing the interconnection network.

2.1 Technical Approach

CTC developed a system-level design for a fiber optic network to serve as the basis for estimating costs. Design priorities targeted by this conceptual design include:

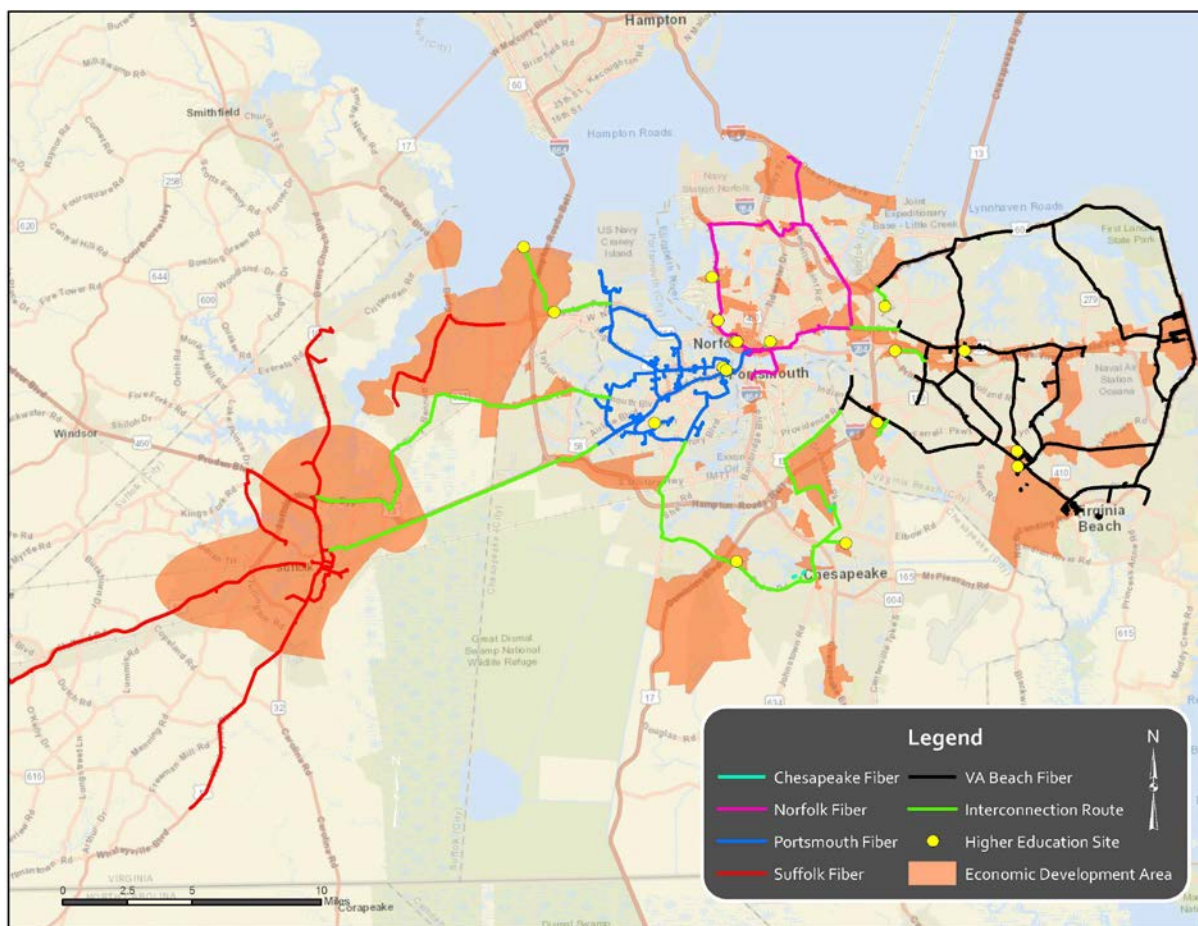
- Connecting the five Southside Cities to facilitate regional collaboration in a design that leverages existing and planned City fiber assets to reduce overall construction costs;
- Providing redundant connections between Cities to increase network availability for critical regional collaboration applications—including potential sharing of public safety and government software platforms—as well as interconnection of the Cities to the regional data center in the Norfolk Granby Municipal Building, the Corporate Landing transoceanic cable site in Virginia Beach, and the Public Safety Operations Building approaching completion in Chesapeake—all of which can sharply improve the resilience, quality, and ongoing costs of network and data services in the region;
- Connecting the region’s higher education facilities to promote collaboration between entities, facilitate research and educational opportunities, and allow the higher educational institutions to connect with local businesses; and
- Extending the region’s fiber optic network, which will allow the Southside Cities to further leverage the fiber optic networks to provide broadband services for economic development, digital divide, and other community benefits.

The resulting network architecture, illustrated in Figure 1, comprises approximately 61 route miles of proposed fiber (green) connecting the Southside Cities and higher educational institutions.

We have separated the fiber routing into two stages. Stage 1 is 46 miles of fiber construction that connects the Southside Cities. Stage 2 is 15 miles of fiber that connects the higher educational institutions.

While not including permitting and blueprint level construction drawings, this fiber optic design was closely reviewed by CTC's outside plant engineer and approximates a final design meeting the stated objectives and provides a sufficiently accurate cost for planning purposes.

Figure 1: System-Level Fiber Network Architecture



A wide range of options is feasible given the physical architecture of the proposed network. Depending on how the fiber strands are spliced, single or ringed connections can be established over the backbone routes, and it is possible to provide direct “express” connections from one end of the network to another without the need for patching between intermediate sites.

With the exception of Suffolk, where some aerial fiber is in use, municipal fiber infrastructure within the Cities is almost exclusively underground. Acting essentially as an extension of the existing fiber, this design places the new fiber underground.

The cost estimates are based on a one 3-inch conduit constructed using directional boring as the primary construction methodology. The construction cost estimate assumes one 144-strand cable. However, the conduit has capacity for future expansion, up to two-288-strand cables.

The cost estimates are provided as a range covering best case and worst-case scenarios in construction and materials unit costs.

Beyond the physical fiber optic cable routing, there are several elements of the cost. These are presented here in detail:

- **Fiber strand count:** The number of individual fiber strands provided in a single cable correlates to the capacity of the cable. Due to the vast effective bandwidth of fiber, it is feasible to scale the rate of data transmission carried by even a single fiber strand to meet all of the Southside Cities' needs indefinitely; however, the cost of network electronics increases sharply with higher speeds and more complex protocols. We recommend that the network design strike a balance between providing for scalability through using additional fiber strands, and scaling of electronics capacity.

The material cost of fiber strands represents a very minor component of the overall cost of fiber construction (about \$0.01 per strand per foot, compared to \$20 to \$30 per foot for the total cost of typical construction in the area). It is thus prudent to install a cable of sufficient size to meet any conceivable requirements to ensure these needs can be met with cost-effective electronics and to foresee needs for setting aside strands for other uses in the future. For example, it may be practically and technically a better arrangement to set aside separate fiber strands for private sector users, economic development, and other non-public uses.

- **Underground construction:** The cost estimates anticipates underground construction of the fiber, with fiber cables placed in a 3-inch conduit. Our review of the candidate interconnection routes indicates that most of the routes have sufficient space in the right-of-way (ROW) for conduit to be constructed. In areas where there is not sufficient space in the ROW, because of their design or because of congestion from existing utilities, routes may have to be constructed under the sidewalks or within the roadways at a higher construction cost. Therefore, the cost estimate has been provided as a range, with the high-end estimate accounting for the potential additional costs of more expensive and complex construction methodologies.

Furthermore, given the topography of the region, there are many crossings of bodies of water, interstates, and railroads that will require special crossings. The cost of these special crossings is described below and are taken into account in the cost estimates.

- **Conduit size and quantity:** Using industry best practices, cost estimates are based on the installation of fiber in a flexible plastic conduit that provides a path into which fiber cable can be installed, allowing for cable slack to be pulled to accommodate repairs, or for new cable to be installed to expand capacity.

We assume underground construction will consist primarily of horizontal, directional drilling to minimize ROW impact and to provide greater flexibility to navigate around other utilities. While cost estimates are based on the placement of a single 3-inch, flexible, High-Density Polyethylene (HDPE) conduit it should be noted that placing additional conduits simultaneously may be done with relatively minor increases in cost. Depending on material prices, 3-inch conduit is preferable along backbone routes, as it can accommodate one or more additional large-strand-count fiber cables in each, with sufficient space for installing additional smaller cables to for purposes of making “lateral” connections to future locations.

- **Handhole placement and size:** Handholes are enclosures installed underground in which conduit terminates for the purpose of providing access to conduit for installing cable, as well as to house cable splice enclosures and cable slack loops required for future repairs. Handholes generally must be placed at intersections of multiple conduit paths, or where the conduit path makes a sharp change in direction. Handholes provide important access points to underground conduit, enabling expansion of the conduit infrastructure (i.e., installation of a lateral connection to a new network location) without disrupting conduit or installed cables.

While cable can be pulled upwards of several thousand feet at a time, cost estimates for the interconnection network assume installation of handholes every 500 feet on average, ensuring that the infrastructure supports cost-effective expansion to new sites, including access to businesses that might be targets of commercial network operators seeking to lease fiber.

- **Special crossings and surface restoration:** The network cost estimates assume that the Southside Cities may have to pay encroachment fees for construction along or under State roads, bridges crossings bodies of water, and for railroad crossing application and licensing fees. Railroad crossing fees can total upwards of \$15,000 per crossing, not including special construction costs (e.g., for steel encasement of conduit).

The cost estimates assume that the Cities will incur typical costs for permanent asphalt and concrete restoration required for utility “test pitting” necessary to verify the location of other utilities in the path of the fiber; generally this consists of excavation within small areas of less than 2 feet in diameter.

2.2 Review of Candidate Fiber Routes

CTC outside plant engineers reviewed the candidate interconnection routes to determine the feasibility of constructing conduit and fiber along the routes by performing a desk survey using online mapping tools and reviewing the routes via onsite field surveys. Full engineering surveys need to be performed as part of the detailed design process of the outside plant construction and the routes should be subject to change based on local conditions. The cost even after these detail design-stage modifications should still fall within the range of the estimates in this report.

In general, we found that the routes look suitable for the construction of an additional conduit and fiber route along the roadways. Figure 2 illustrates one such path.

Figure 2: Proposed Path with Suitable Underground ROW



Given the region's topography there are many bodies of water, interstates, and railroads that the interconnection routes will have to traverse requiring special crossings. These special crossings may require additional engineering, permitting, and/or easements as well as more expensive construction than traditional directional boring. However, depending on the crossings, the Cities may already have conduit being utilized for traffic or other applications or VDOT may already have conduit that can be leveraged to eliminate the need for further construction. Figure 3 illustrates existing conduit on a bridge crossing.

Figure 3: Existing Conduit on Bridge Crossing



For example, the proposed interconnection routes must traverse two drawbridges. One of the drawbridges is across the Dismal Swamp Canal. The existing utilities are either directionally bored under the canal or lay on the bottom of the canal. The interconnection route would also have to bore or lay on the bottom of the Canal if VDOT does not have exiting conduit that is available for use. One other opportunity is that the drawbridge is slated for replacement in the near future. As part of the bridge replacement conduit could be added to the project for far less than the cost of constructing conduit independently of the bridge replacement. The Cities should leverage capital construction projects such as the replacement of the Dismal Swamp Canal drawbridge to expand their conduit and fiber optic footprint.

In other areas along the interconnection routes there may be areas where the ROW is congested with other existing utilities, which may make it more difficult or costly to install conduit (Figure 4). Where this occurs, the Cities should look into using existing conduit from VDOT or other providers. Where existing conduit is not available, the routes may have to be constructed under the sidewalks or within the roadways at a higher construction cost. However, many issues of ROW congestion can be mitigated by constructing on the other side of a roadway. The cost estimate has been provided as a range, with the low end representing the ability to utilize existing conduit where feasible to avoid expensive construction scenarios, and the high end assuming that congestion cannot be mitigated and expensive construction methodologies are required.

Figure 4: Congested ROW



Sites that are to be added as part of the network can be connected several ways. Candidate buildings that have existing conduit allow for fiber to be placed directly to the site's fiber telecommunications room with no additional construction. Sites that do not have existing conduit require construction of a new building entrance. A new building entrance for fiber optic purposes includes core drilling the exterior wall and placing innerduct/electrical metallic tubing (EMT) along a path from the point of entry to the building's telecommunications room (see Figure 5). The cost estimates assume new building entrances are required at each site, though the Cities should look to utilize existing building entrances where possible to reduce construction expense.

Figure 5: Candidate Location for New Building Entry



2.3 Cost Estimates

CTC estimates the cost to construct and activate the fiber network described in the previous sections to be \$14.9 to \$17.3 million. The cost estimate is itemized between construction scenarios and includes network site electronics and lateral and fiber termination costs at City facilities.

Table 1 provides the cost estimate for the network construction. Stage 1, shown in Figure 6, interconnects the five Southside Cities and expands the footprint of the network. Stage 2, shown in Figure 7, adds the higher education sites to the network.

Table 1: Estimated Network Costs

Cost Component	Stage 1 Interconnection Backbone	Stage 2 Higher Education Sites	Total
Sites	5	16	21
Miles of Fiber	46	15	61
OSP Construction Costs	\$7.7-9.5 million	\$2.3-2.9 million	\$10-12.4 million
Network Electronics Costs	\$4.6 million	\$.3 million	\$4.9 million
Total Costs	\$12.3-14.1 million	\$2.6-3.2 million	\$14.9-17.3 million

Figure 6: Stage 1 Interconnection Backbone

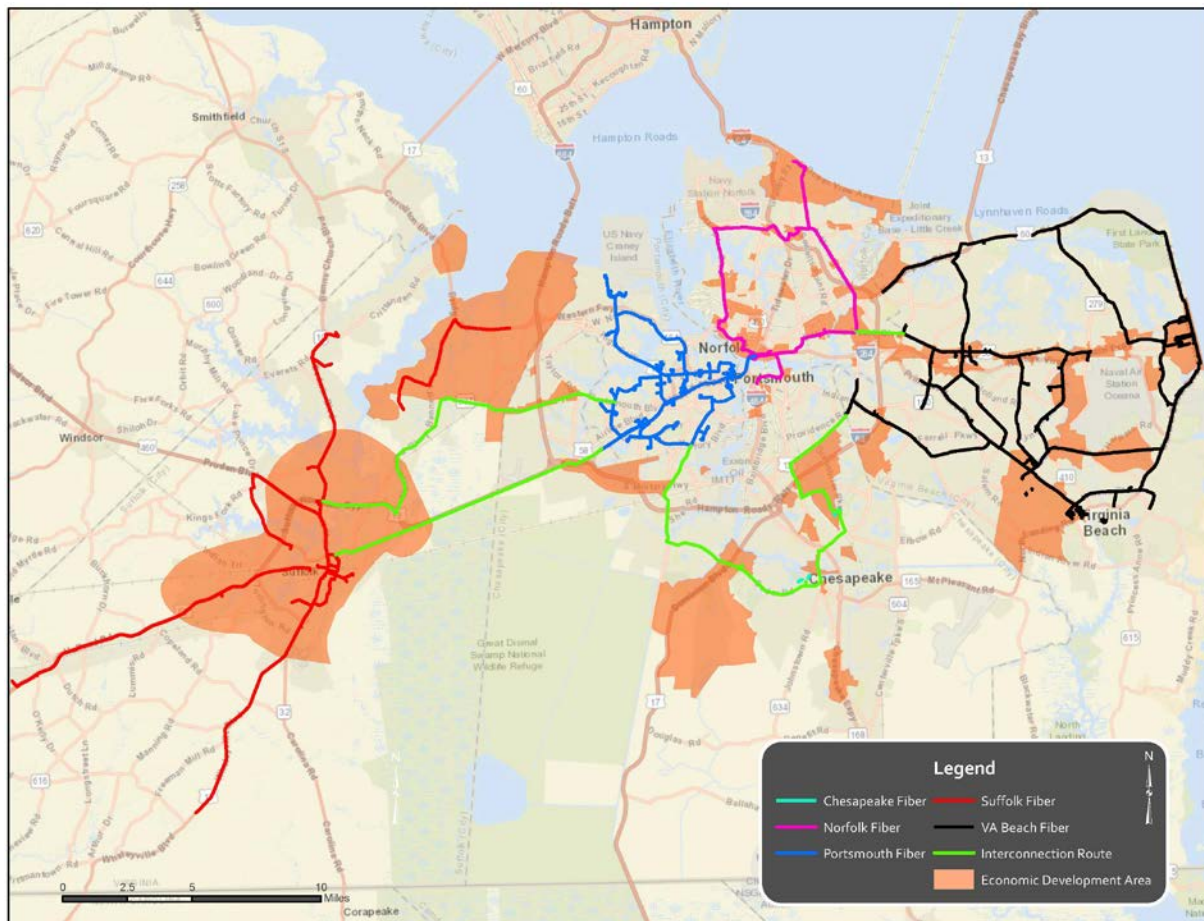
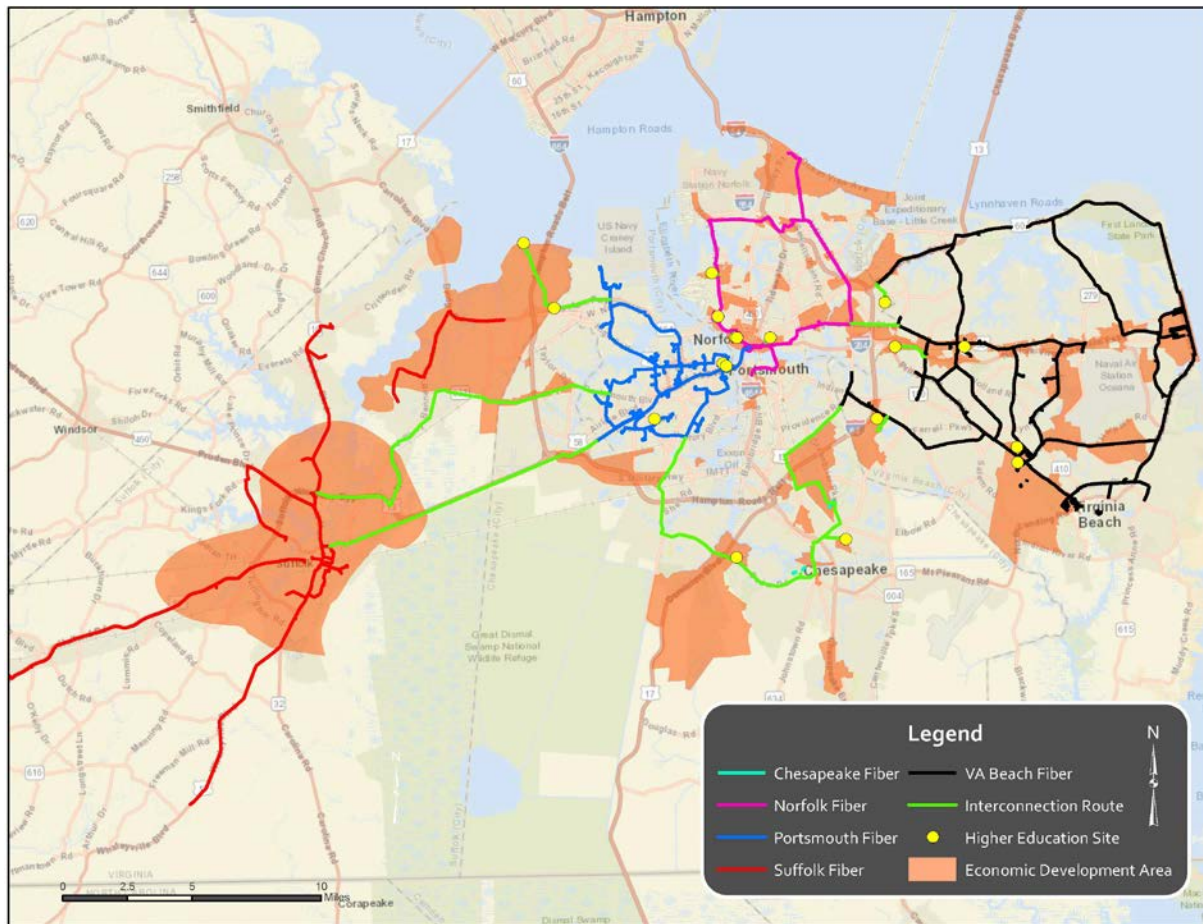


Figure 7: Stage 2 Higher Education Sites



2.3.1 Outside Plant (OSP)

OSP (layer 1, also referred to as the physical layer) is both the most expensive part of the network and the longest lasting. We estimate a total OSP cost of \$10 million to \$12.4 million. Cost estimates are inclusive of all engineering, project management, quality assurance, and construction labor anticipated to be necessary to implement the network on a turnkey basis, and are based on relatively conservative pricing assumptions. The following summarizes the cost components that are included in the cost estimate:

- **Engineering:** Includes system level architecture planning, preliminary designs and engineering field walk-outs to determine candidate fiber routing; development of detailed engineering prints and preparation of permit applications; and post-construction “as-built” revisions to engineering design materials
- **Project Management / Quality Assurance:** Includes expert quality assurance field review of final construction for acceptance, review of invoices, tracking progress, and coordination of field changes

- **OSP Construction:** Consists of all labor and materials related to “typical” underground OSP construction, including conduit placement, utility pole make-ready construction, fiber installation, and surface restoration; includes all work area protection and traffic control measures inherent to all roadway construction activities
- **Railroad, Bridge, and Interstate Crossings:** Consists of specialized engineering, permitting, and incremental construction (material and labor) costs associated with crossings of railroads, bridges, and interstate/controlled access highways
- **OSP Fiber Splicing:** Includes all labor related to fiber splicing of outdoor fiber optic cables
- **Fiber Termination/Building Entrance:** Consists of all costs related to fiber lateral installation into network sites, including OSP construction on private property, building penetration, inside plant construction to a typical backbone network service “demarcation” point, fiber termination, and fiber testing

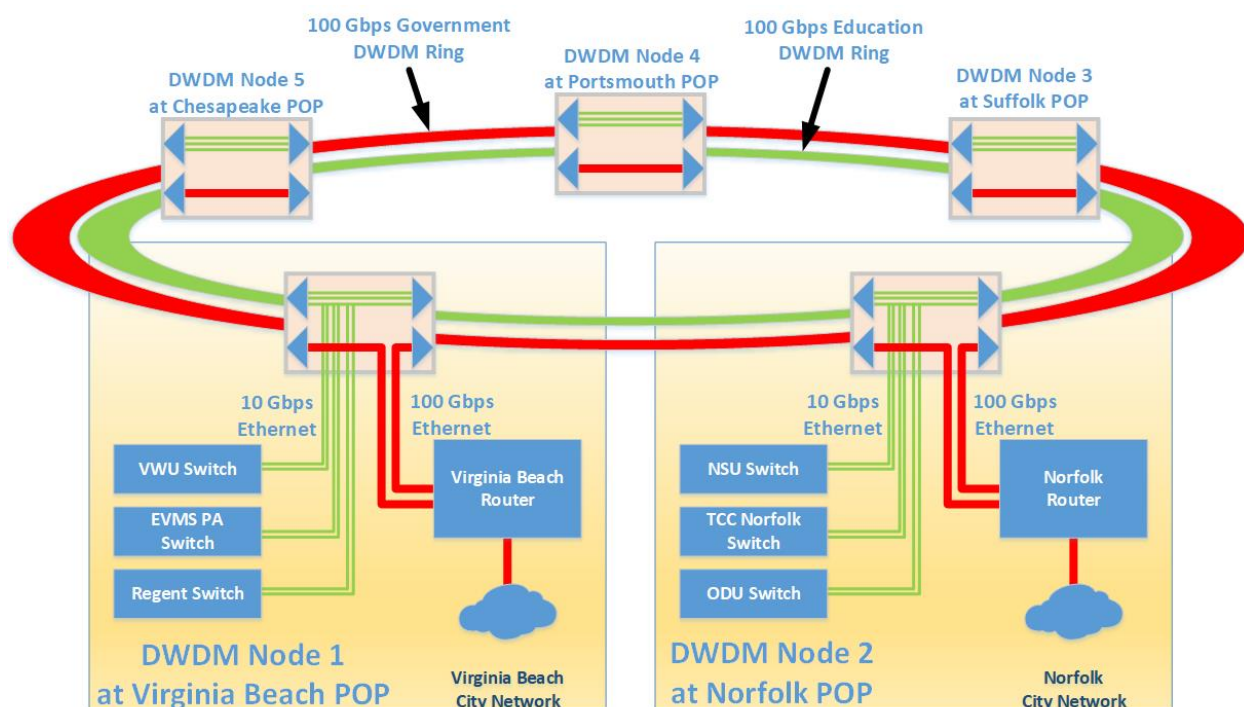
Actual costs may vary due to unknown factors, including: 1) costs of private easements, 2) congestion in the ROW, 3) variations in labor and material costs, and 4) subsurface hard rock.

Costs for underground placement were estimated using available unit cost data for materials and estimates on the labor costs for placing, pulling, and boring fiber based on pricing from fiber construction projects in the region, as well as competitively bid projects in similar markets. The material costs were generally known apart from unknown economies of scale and inflation rates, and barring any sort of phenomenon restricting material availability and costs.

2.3.2 Network Electronics

The network electronics provide redundant connections among the Southside Cities and higher-education sites. We estimate the network electronics will cost \$4.9 million. The cost is inclusive of design and integration costs and takes into account the likely discounts the region would receive. The proposed network uses Dense Wave Division Multiplexing (DWDM) technology to create two rings of fiber that pass through each of the five Cities—a government ring to interconnect the city government networks and a higher-education ring to interconnect the education sites (see Figure 8). Each ring provides 100 Gbps aggregate bandwidth site-to-site and allows city and higher education networks to connect to the rings at an “add/drop node” at a point of presence (POP) in each of the five city networks. Each city network will connect to the government ring at 100 Gbps and each higher education site will connect to the higher education ring at 10 Gbps with an aggregate of 100 Gbps possible between each city’s DWDM node.

Figure 8: A DWDM Ring with Five Sites – Sites 1 and 2 Shown in Detail



This design allows a variety of layer 2 and layer 3 services to be provisioned across the sites using standard networking protocols such as Ethernet, IP, and MPLS. Connections among participating institutions, including between non-adjacent sites, can be created by reconfiguring or adding interfaces at each DWDM site, though optical amplifiers may be required depending on the distance and characteristics of the fiber between the two sites. The ring architecture allows communications to continue uninterrupted if one side of the ring is broken.

It should be noted that this cost estimate falls in the high cost range of network architecture options that could be deployed in this network, but provides a highly scalable solution and will not require capacity upgrades for many years.

The DWDM platform can grow both in terms of capacity and in the number of connected sites without the need for additional fiber in the ring. The economical use of fiber is especially important over the many miles of existing fiber operated by the cities, where the fiber count is already fixed and many strands are already in use or planned for other purposes. Rather, a DWDM system will allow for the addition of networks within networks simply by adding modules to the DWDM equipment. This capability of segmentation provides the capability of flexibly adding future users, including economic development users who may need to be kept separate from the government and educational users, not only for security and management purposes but also to provide a clear allocation of capacity to those users. Similarly, the network

can grow to allow speeds greater than 100 Gbps by upgrading the electronics at each applicable site on the ring, making the DWDM platform a very long-life investment.

DWDM networks can place dozens of discrete wavelengths of light on the same fiber strand and separate them out at any of the add/drop nodes. Each of these wavelengths (“lambdas”) acts as a separate, high-capacity network. Not only does this allow capacity to be added as-needed, but also increases security. Each of the connections into the ring are on completely separate channels from the other connections and the traffic does not use the same routers, switches, or addresses. This is the most secure type of separation, short of using entirely separate fiber strands, and makes it possible for a single fiber strand to carry Internet traffic, secure communications, sensitive information, and leased circuits from private sector service providers along private channels.

2.3.3 Network Operations

We developed a model for operating the fiber network that assumes the network will use third-party contractors to perform many of the maintenance and repair functions needed on the fiber network. The network size is small compared to commercial communications networks, so maintenance costs should be kept to a minimum. Table 2 outlines the estimated annual cost of operating the network under the two construction scenarios.

Table 2: Summary of Estimated Annual Network Operating Costs

Cost Component	Stage 1	Stage 2	Total
Fiber Maintenance	\$82,000 – \$98,000	\$27,000 – \$32,000	\$109,000 – \$130,000
Adds, Moves, Changes	\$95,000 – \$114,000	\$29,000 – \$35,000	\$124,000 – \$149,000
Equipment Maintenance	\$496,000 – \$595,000	\$15,000 – \$18,000	\$511,000 – \$613,000
Network Staffing (1/2 FTE)	\$60,000 – \$72,000	N/A*	\$60,000 – \$72,000
<i>Total Annual Operating Costs:</i>	<i>\$733,000 – \$880,000</i>	<i>\$71,000 – \$85,000</i>	<i>\$804,000 – \$964,000</i>

**assumes no additional staffing required to operate the stage 2 additions*

The following summarizes the scope anticipated by each of the operating cost components itemized in the table above:

- Fiber Maintenance:** Includes costs for fiber optic contractors that have the necessary expertise and equipment available to repair the fiber network in the event of an outage. The contracts should specify the service level agreements the City needs from the fiber optic contractors to ensure that the City receives timely repairs. The fiber optic contractors should be available 24x7 and have a process in place for activating emergency service requests. We estimate a cost range of \$1,800 to \$2,125 per mile per year for fiber repairs.

- **Adds, Moves, Changes:** Includes adds, moves, and changes associated with the network as well as standard plant maintenance. These items may include adding or changing fiber configurations (patching or splicing) in the field, extending laterals to new buildings or economic developments areas, relocating fiber paths due to changes such as the widening of roadways, participating in the moving of utilities due to pole replacement projects, and tree trimming along the aerial fiber optic path. We assumed the cost of performing adds, moves, and changes to be roughly 1 percent of the construction cost per year.
- **Equipment Maintenance:** Includes software updates, hardware replacement, 24x7 on call technical support. These items may include 2-hour, 4-hour, and next day response times for troubleshooting network issues as well as expedited equipment delivery and installation.
- **Network Staffing:** Includes City staff time to oversee and operate the network. We anticipate this role requiring a one-half full-time-equivalent (FTE) network engineer with a salary ranging from \$120,000 to \$144,000 per year.

2.4 Cost Estimates per Jurisdiction and Higher Education Facility

In addition to itemizing the cost estimate between the two construction scenarios, CTC further separated the estimated costs by jurisdictional boundary and higher education institution to provide a rough breakdown of the costs of construction within the jurisdictional boundaries of the various entities. The subsections below detail the estimated OSP costs of each Higher Education lateral and each portion of a given governmental interconnection route that falls within the jurisdiction's geographical boundaries. For the purposes of assigning costs in each jurisdiction, we assumed each City would build and own the section of interconnection route that is within its own geographical boundaries. In addition to the OSP costs, we estimate the equipment costs at each Cities' POP location to be approximately \$900,000 and the equipment cost at each Higher Education location to be approximately \$22,500. These costs would need to be added to the tables below to capture both the fiber construction and the network electronic costs that would fall within each jurisdiction.

2.4.1 Virginia Beach

Figure 9: Virginia Beach Jurisdictional Fiber Map

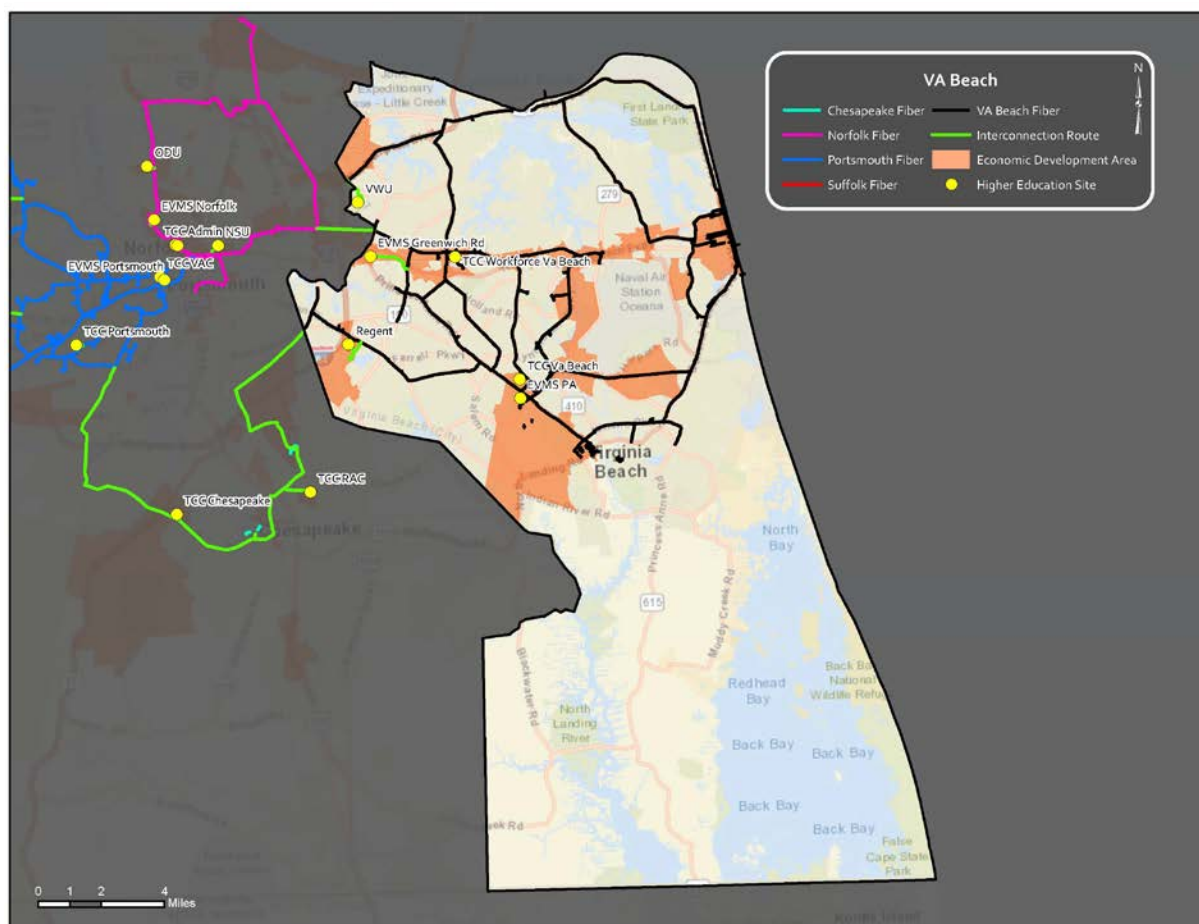


Table 3: Estimated OSP Costs by Network Segment in Virginia Beach

Network Segment	Low End Cost	High End Cost
Virginia Beach to Chesapeake Interconnection**	\$0	\$0
Virginia Beach to Norfolk Interconnection**	\$0	\$0
Virginia Wesleyan University Lateral	\$167,000	\$209,000
Regent Lateral	\$190,000	\$237,000
TCC VA Beach Lateral*	\$0	\$0
TCC Workforce VA Beach Lateral *	\$0	\$0
EVMS PA Lateral	\$58,000	\$73,000
EVMS Greenwich Road Lateral	\$222,000	\$278,000
Total:	\$637,000	\$797,000

* Location is already on the City's network // **Virginia Beach's existing network extends to Jurisdictional boundaries

2.4.2 Norfolk

Figure 10: Norfolk Jurisdictional Fiber Map

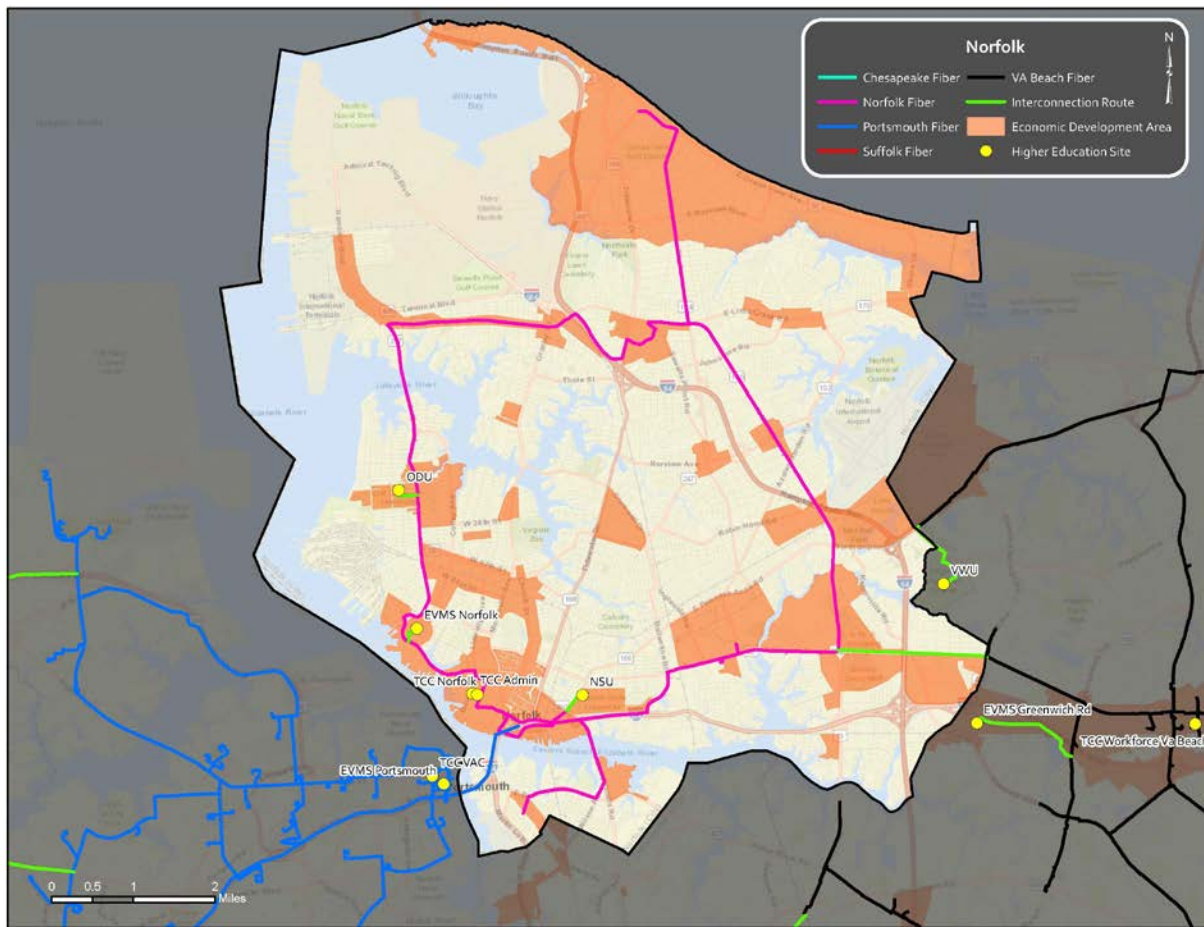


Table 4: Estimated OSP Costs by Network Segment in Norfolk

Network Segment	Low End Cost	High End Cost
Norfolk to Virginia Beach Interconnection	\$284,000	\$355,000
Old Dominion University Lateral	\$48,000	\$60,000
NSU Lateral	\$49,000	\$61,000
TCC Norfolk Lateral	\$6,000	\$8,000
TCC Admin Lateral	\$21,000	\$26,000
EVMS Norfolk Lateral	\$40,000	\$50,000
Total:	\$448,000	\$560,000

2.4.3 Portsmouth

Figure 11: Portsmouth Jurisdictional Fiber Map

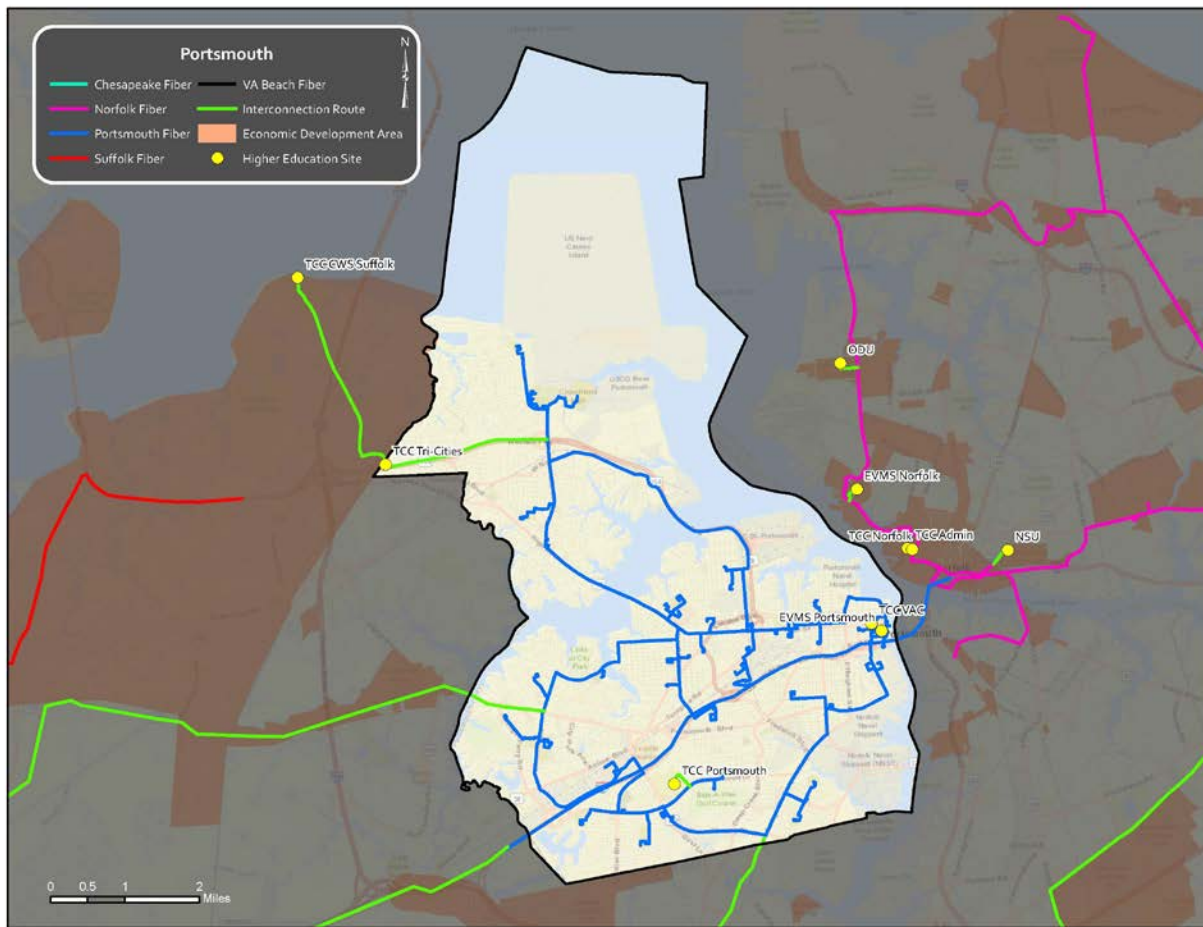


Table 5: Estimated OSP Costs by Network Segment in Portsmouth

Higher Education Lateral	Low End Cost	High End Cost
Portsmouth to Suffolk North Interconnection	\$155,000	\$194,000
Portsmouth to Suffolk South Interconnection*	\$0	\$0
Portsmouth to Chesapeake Interconnection	\$16,000	\$20,000
TCC Tri Cities	\$353,000	\$451,000
TCC VAC	\$9,000	\$11,000
TCC Portsmouth	\$63,000	\$79,000
EVMS Portsmouth	\$11,000	\$14,000
Total:	\$596,000	\$755,000

*Portsmouth's existing network extends beyond Jurisdictional boundaries

2.4.4 Suffolk

Figure 12: Suffolk Jurisdictional Fiber Map

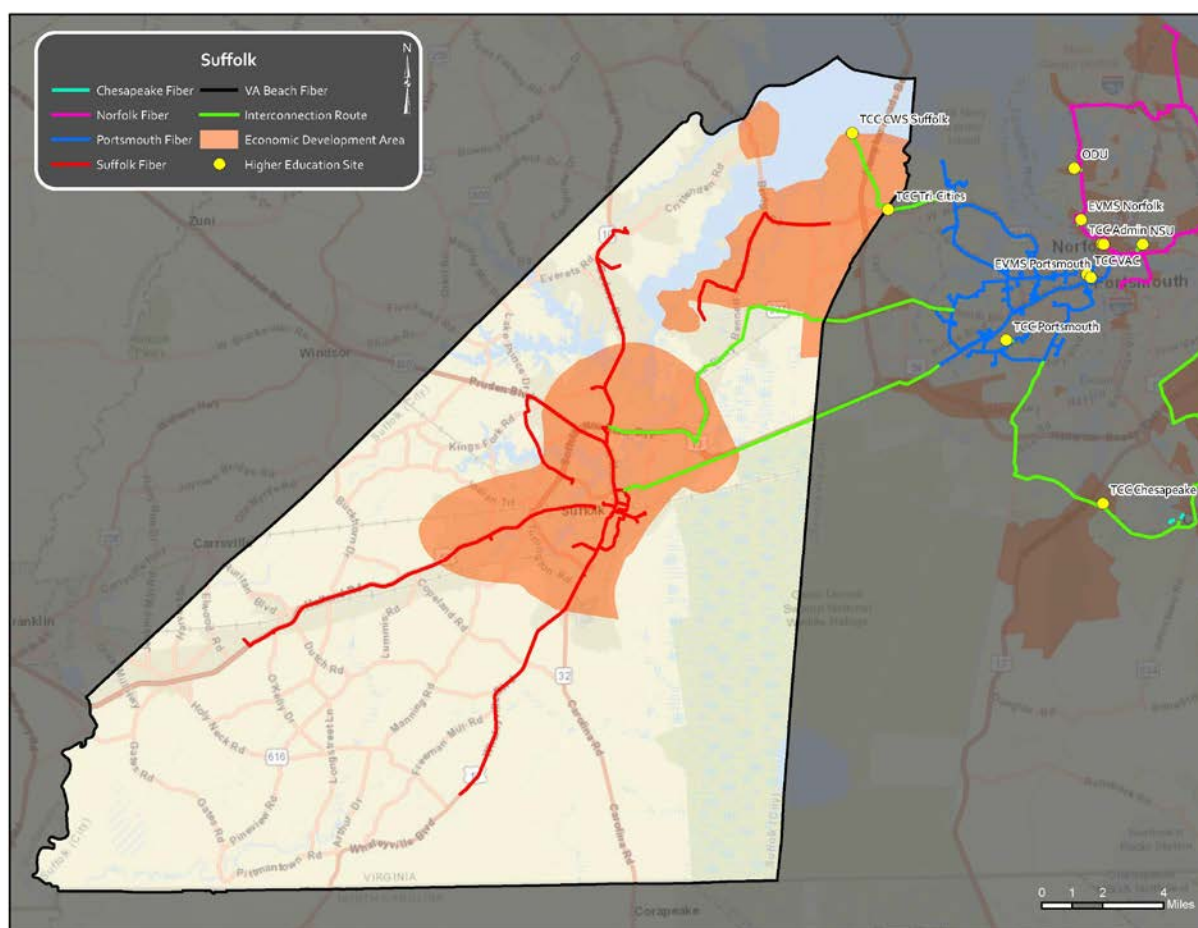


Table 6: Estimated OSP Costs by Network Segment in Suffolk

Network Segment	Low End Cost	High End Cost
Suffolk to Portsmouth North Interconnection	\$1,690,000	\$2,113,000
Suffolk to Portsmouth South Interconnection	\$1,039,000	\$1,299,000
TCC CWS Suffolk	\$466,000	\$583,000
Total:	\$3,195,000	\$3,995,000

2.4.5 Chesapeake

Figure 13: Chesapeake Jurisdictional Fiber Map

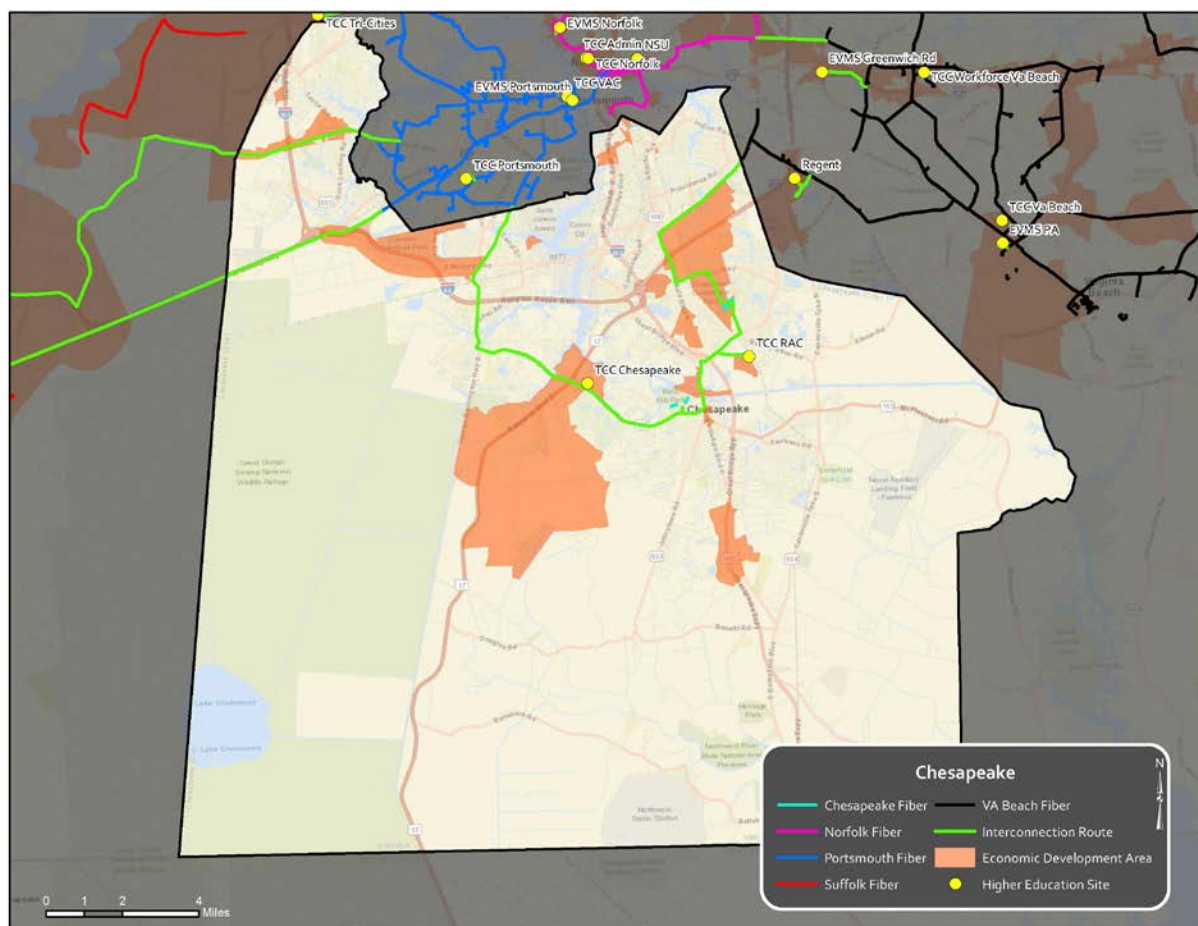


Table 7: Estimated OSP Costs by Network Segment in Chesapeake

Network Segment	Low End Cost	High End Cost
Suffolk to Portsmouth South Interconnection*	\$698,000	\$873,000
Suffolk to Portsmouth North Interconnection*	\$512,000	\$640,000
Chesapeake to Virginia Beach Interconnection	\$1,903,000	\$2,310,000
Chesapeake to Portsmouth Interconnection	\$1,395,000	\$1,675,000
TCC Chesapeake	\$146,000	\$183,000
TCC RAC	\$487,000	\$609,000
Total:	\$5,141,000	\$6,290,000

*A portion of Suffolk to Portsmouth interconnection is within Chesapeake's Jurisdictional boundaries

3 Business Case Analysis

The business case for building the regional interconnection fiber network is based on the wide range of operational benefits and enhanced functions described in Section 5 and Section 6, including significant new service opportunities for Southside Cities and higher education institutions, the critical needs that can be met over the Cities' own infrastructure, the benefits of City control and management of their own networks, and the potential economic development benefits of building a communications infrastructure of this capacity in the region.

The business case is further enhanced by the fact that the network will enable the Cities to control their long-term costs for communications services while still enabling them to efficiently increase capacity and functionality. This section of the report analyzes the benefits to the Cities of the fiber network relative to the costs they would otherwise incur for leased services to attempt to achieve comparable functionality.

3.1 City-Owned Regional Interconnection Reduces the Risk of Rising Costs

There is no dispute that the cost to build and operate a regional interconnect network is significant. However, the proposed network will provide the Cities and higher education institutions with reliable, resilient, high-speed connections on the highest-end of what is available from the commercial marketplace. The cost of purchasing comparable services from private providers would be prohibitively high for many of the participating Cities and higher-education institutions and, indeed, some of the services enabled by the fiber cannot be purchased at any price on the commercial market.

As the engineering sections of this report discuss, the interconnection backbone between all five cities, or Stage 1 of the proposed network, would require capital costs ranging from \$12.3 million³ to \$14.1 million⁴ (fiber buildout and electronics) and annual operating expenses (including staffing, maintenance and equipment replacement, but excluding debt service) of \$733,000. Connecting the 16 higher education sites, or Stage 2 of the proposed network, would require capital costs ranging from \$2.6 million⁵ to \$3.2 million⁶ and annual operating expenses of \$71,000. The total estimated capital cost of both stages of the proposed network will be between \$14.9 million to \$17.3 million, and annual operating expenses will be approximately \$804,000.

³ The low estimate includes \$7.7 million in fiber buildout and \$4.6 million for network electronics.

⁴ The high estimate includes \$9.5 million in fiber buildout and \$4.6 million for network electronics.

⁵ The low estimate includes \$2.3 million in fiber buildout and \$.3 million for network electronics.

⁶ The high estimate includes \$2.9 million in fiber buildouts and \$.3 million for network electronics.

Two decades of public sector experience demonstrate, however, that municipal ownership of fiber networks will enable the Cities and higher education institutions to better meet growing demands for communications capacity and functionality, while reducing risk by hedging against private sector price increases for managed communications services. By owning its infrastructure, the Cities can determine how much they will pay for the initial infrastructure, and also manage ongoing operating expenses, keeping them relatively constant—even as the network’s capabilities increase over time.

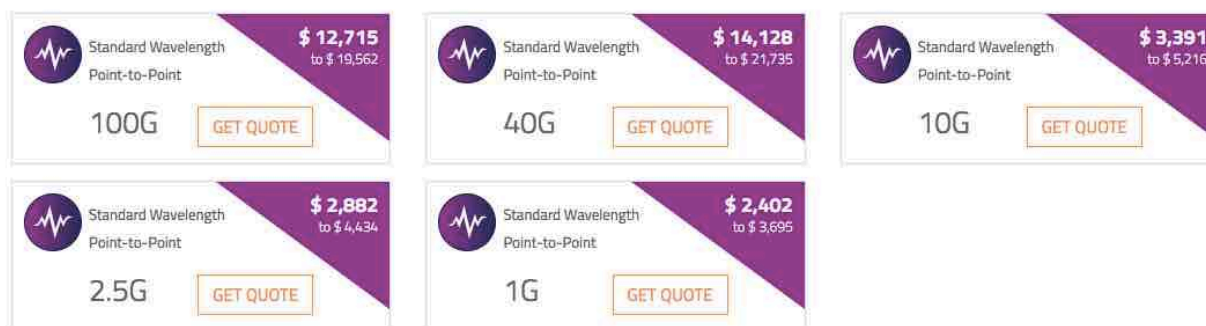
Without control over their own networks, the Cities and higher education institutions’ costs for carrier-provided communications services may increase significantly with time—both because of carriers increasing their pricing and because the Cities and higher education institutions’ communications needs will grow enormously in the decades ahead.

3.1.1 Operating a Fiber Network Is Likely Less Expensive than a Leased Alternative

The capacity and reliability of the proposed network is on the highest-end of what is available on the commercial market for data transport services. To obtain a comparable level of service from a private provider, the higher education institutions would need to connect to the nearest municipal Point of Presence (POP) with a 10Gbps point-to-point wavelength service, and the Cities would need to connect to one another through a 100Gbps point-to-point wavelength service.

To obtain a conservative estimate of what such services would cost on the commercial marketplace, we looked at the cost of wavelength services from Zayo, one of the most entrepreneurial and innovative of the enterprise service providers, for two on-network locations, six miles away from one another, in Richmond, VA. The price range estimates for this Zayo product in the Richmond market, as is made publicly available on the Zayo website, are illustrated in Figure 14.

Figure 14: Zayo Price Estimates for Wavelength Service between Two On-Network Locations in Richmond, VA



Given Richmond’s relatively competitive fiber market, we expect the cost of these services in Southside Cities to be higher. However, even if the Cities’ were able to negotiate prices for

wavelength services similar to what Zayo charges for these services in Richmond, the cost of purchasing these services from a private provider would be substantially higher than the cost of operating their own fiber network.

For the Cities to obtain a level of service comparable to the interconnection backbone, or Stage 1 of the proposed network, they would need to procure from a commercial provider such as Zayo a 100 Gbps point-to-point wavelength connection to an adjacent municipality. Taken together, these connections would create a high-capacity ring that would allow each municipal network to connect to one another, and to the regional data center in the Norfolk Granby Municipal Building. The cost of this level of service from Zayo between two on-net locations in Richmond is between \$12,715 to \$19,562 per month. Five such connections would cost between \$63,575 and \$97,810 per month, or between \$762,900 and \$1,173,720 per year—and the functionality of the commercial option may not be comparable to that of what the Cities plan to build as part of this initiative.

To add the higher education institutions to the network, there would be an additional need to procure 10 Gbps point-to-point wavelength connections between the 16 higher education sites and the nearest municipal network. The cost of this level of service from Zayo between two on-net locations in Richmond is between \$3,391 and \$5,216 per month. Sixteen such connections would cost between \$54,256 and \$83,456 per month or \$651,072 and \$1,001,472 per year.

The combined annual cost of these leased services would be between \$1,413,972 and \$2,175,192, far in excess of the \$804,000 of annual operating expenses that we expect for both stages of the proposed network, which the Cities will own and control.⁷

3.1.2 A Leased Alternative May Still Require Cities to Pay for New Fiber Construction

It is important to note that the estimated prices quoted above are between two locations already located on Zayo's (or a comparable provider's) existing fiber network. In order to provide service to a location that is not already on a provider's existing fiber network, the provider generally requires its customers to pay a new construction fee to cover much of the capital cost associated with extending the network to the new location.

⁷ This analysis compares the cost of leased services to the Cities' likely operating costs, on the assumption that the capital cost to build the network will be covered by grant funding, per the expectations of this engagement. The analysis thus does not include analysis of a scenario in which the Cities issue bonds to finance the fiber construction and then also have the ongoing operating cost of debt service. Inclusion of debt service costs would reduce the annual savings of the fiber strategy relative to a leased commercial scenario, but would still result in savings over that more costly, less scalable scenario.

Lumos Networks and Level3 Communications both have fiber assets in the region, and may be willing to offer point-to-point wavelength services. However, many of the Cities and higher education institutions would likely need to pay substantial new construction fees prior to establishing service. Unlike the capital costs associated with municipally-owned networks, these new construction fees will not provide the Cities with any kind of ownership stake in the network expansions that they pay for.

3.1.3 A Leased Alternative Forecloses Economic Development and Revenue Potential of Dark Fiber

The proposed network is purposefully designed with excess strands of fiber, well beyond what the Cities and higher education institutions will need for internal use. As is explained in more detail in Section 4 below, the Cities can use this excess fiber to support their economic development goals, and to earn revenue that can help offset the costs associated with operating the network.

If the Cities opt to purchase comparable services from a private provider, they forfeit both the potential revenue and economic development impact that the excess capacity of the proposed network could provide. The network was designed to pass through a number of key economic development areas. If the Cities build and operate the network themselves, they can use the availability of affordable dark fiber services to help attract new companies to these priority areas.

The potential revenues from dark fiber leasing will likely be somewhat modest, at least in the short term. And in the long term, it is very difficult to predict revenue potential. But we do not build a business case on the revenue from leasing excess fiber. Rather, the dark fiber's real value is in enabling competition and economic development.

3.1.4 City-Owned Fiber Networks Provide Vast Scalability to Meet Growing Demands for Bandwidth

With capacity demands likely to increase with time, the proposed network provides a mechanism to meet these demands without drastic increases in capital or operating costs, thus containing exposure to the risk that the Cities and higher education institutions will not be able to afford to meet their future communication needs.

Smart City applications and next generation 911 services will depend on high speed connections to the regional data center in the Norfolk Granby Municipal Building and the Public Safety Operations Building in Chesapeake. As these applications and services continue to develop, the Cities may require connection speeds far in excess of what is required today. The proposed network allows the Cities to increase connection speeds at a relatively low cost, by upgrading network electronics over existing fiber optics that the Cities will themselves own.

Having the Regional Interconnection in place may also help the Cities and higher education institutions access lower rates for data transport services. In our interviews with the jurisdictions, for example, we found that Norfolk currently pays significantly less for a symmetrical 1Gbps internet connection than do other Southside Cities. The Cities and higher education institutions could use the regional interconnection to get transport to a meeting point that offers more affordable rates, or could achieve economies of scale by purchasing communication services together.

4 Potential Dark Fiber Leasing Framework

This section of the report discusses some of the leasing opportunities and considerations for the Cities to include in their analysis of whether and how to proceed with the proposed network.

This analysis recognizes that the Cities, in keeping with best practices, will build a robust set of fiber connections and that the design calls for installation of a 144-count cable along newly constructed segments of the interconnection network. This fiber count will ensure sufficient capacity for any conceivable expansion of internal needs, while also allowing Southside Cities to lease excess capacity to private entities for economic development purposes.

Leasing of excess fiber capacity could enable private Internet Service Providers to reach areas of the region that they cannot currently reach inexpensively and to then build further into residential and small business areas. In this way, the Cities' interconnection network can serve as a platform for private investment in broadband, thus facilitating the Cities' economic development goals.

Indeed, the regional interconnect network makes the excess capacity of each individual city's network more valuable. Collaborating on a dark fiber leasing strategy will allow the Cities to offer diverse, contiguous routes across the region, and decrease the associated transaction costs.

We offer the following considerations to serve as a guide for developing fiber lease pricing and a policy framework, tailored based on our knowledge of the Cities' operations and strategic objectives around promoting economic development.

4.1 Background Regarding Dark Fiber Licenses/Leases and IRUs

Dark fiber consists of fiber strands that are unused or "un-lit" and not connected to electronics, which "light" the fiber. Dark fiber is also referred to as fiber that is provided in a "dark" state to be connected and "lit" by the customer.

Dark fiber pricing is typically based on two approaches:

- **Fixed-term license⁸ pricing:** This structure has the benefit of delivering to the fiber owner a steady annual income stream over time, but it does not deliver large front-loaded payments

⁸ This document uses the terms "license" and "lease" interchangeably to refer to a business arrangement in which one entity pays for use of fiber owned by another. We note that the form of that business arrangement will be determined by the Cities' legal counsel based on state and local law, and that CTC does not use these terms to suggest a particular legal approach. Rather, we use them to refer colloquially to a business arrangement only.

that could serve to bridge a difficult budget year or to finance new investment. This model is more achievable if the dark fiber licensee is unable to make a large front-loaded payment but can pay for the fiber on a recurring annual or monthly basis. As a result, this model potentially increases the number of potential dark fiber customers.

Over the same period of time, net pricing over the term of the license tends to be considerably higher than in the upfront payment model. This model is often used for licenses with terms of one, three, and five years, and can deliver substantial revenues for a short time. This model is appropriate for private ISPs and businesses that prefer agreements for 10 years or less.

This is the most common dark fiber approach.

- **Up-front payment, plus maintenance:** Dark fiber is often conveyed as a 10- to 20-year (most often 20) Indefeasible Right of Use (IRU). The customer pays upfront for the IRU in advance or in the early years of the term of the IRU, and pays on an ongoing, periodic basis for maintenance (typically, on an annual basis). The maintenance fee is calculated on the basis of route miles, not strand miles (i.e., based on the number of miles traversed by the fiber cable rather than on the number of miles traversed multiplied by the number of strands leased). The annual maintenance fee has a flat per mile fee for low strand count IRUs, and increases slightly for higher strand count IRUs. The early IRU payment covers the entire term of the IRU, while the maintenance provisions of the agreement allow for cost adjustments based on a fixed inflation factor or a Consumer Price Index (CPI).

The benefit of this model is the substantial inflow of funds early in the IRU agreement term. These funds can help bridge any potential early-year cash shortfall while an entity is beginning operations. On the other hand, the model will not result in recurring annual revenues over the long-term, beyond the payment for maintenance costs. Long-term institutional customers, such as school districts, are good candidates for IRU agreements.

4.2 Dark Fiber Prices

Dark fiber pricing varies greatly among markets and even among carriers in the same market. Pricing is typically specific to route and location, and at times can seem arbitrary in the marketplace. Commercial pricing is typically based on a mix of factors including market competition, market demand, and the cost of building. Pricing by non-profit entities will frequently take the same factors into account but require less or no margin. For example, some of the higher education networks around the country base their fiber pricing on a construction and operations cost-recovery model.

Generally, one can divide all fiber in the market into two categories for purposes of pricing, with some sub-categories: (1) long-haul fiber and (2) metro-area fiber.

Metro-area prices are almost always considerably higher (on a per-mile basis) than long-haul fiber, which is less costly to build. Within the metro-area category, urban routes will generally be priced significantly higher than routes in suburban and exurban areas, depending on the desirability of the market. Occasionally, an urban market will be surprisingly cost-effective, usually because a glut of fiber in the market leads to competition and drives the prices down.

4.2.1 Fixed-Term Dark Fiber Prices

Fixed-term dark fiber licenses are the most common offering. They provide customers the benefit of having dark fiber access without a large one-time investment. Pricing is typically based on a per strand, per mile, per month fee that includes both fiber access and maintenance. At times, an additional per-access site or demarcation fee is applied (i.e., for the handoff between the Town and the customer).

We have seen monthly license fees ranging from \$40 per month per strand to over \$1,000 per month per strand. For example, pricing that a national carrier, Zayo, charges for point-to-point dark fiber connectivity between on-net locations in the region (summarized in Table 8):

- Zayo offers point-to-point dark fiber between two on-net locations in Alexandria, Virginia for a monthly charge of \$308.50 for a five-year term.
- Zayo offers point-to-point dark fiber between two on-net locations in Ashburn, Virginia for a monthly charge of \$687 for a five-year term.
- Zayo offers point-to-point dark fiber between two on-net locations in Charlotte, North Carolina, for a monthly charge of \$509 for a five-year term.

Table 8: National Carrier Dark Fiber Monthly License Pricing in the Region⁹

Location	Term (years)	Price per month per strand mile	Price per year per strand mile
Ashburn, VA	5	\$687	\$8,244
Charlotte, NC	5	\$509	\$6,108
Alexandria, VA	5	\$308.50	\$3,702

⁹ Zayo prices on-net fiber at monthly fee, based on a quote rather than a rate card. The per mile prices above are calculated based on a quoted monthly fee divided by the estimated route miles to connect the facilities selected to obtain the quote.

4.2.2 Dark Fiber Prices

IRU pricing typically has two key components: (1) A one-time payment (or front-loaded payments in the early years) based on the total strand miles (total route miles times the number of strands) and (2) an annual maintenance charge based upon the total number of route miles (not dependent upon number of strands). The annual maintenance charge is subject to an annual increase based upon a Consumer Price Index (CPI) or a negotiated fixed percentage. These rates can also vary based on other factors, such as construction costs, length of the term of the agreement, quality of service, competitive discounts, and economic development incentives.

In major urban areas, commercial pricing for IRUs can range from a \$2,000 to an over \$50,000 per-mile-per-strand up-front payment for a 20-year term, depending on the provider and on whether complex routing is necessary. Annual maintenance charges range from \$200 to over \$300 per strand, per mile.

In the dark fiber market, most IRUs require that the grantee obtain a minimum number of strands.

The education and research network in North Carolina, MCNC (Microelectronics Center of North Carolina), offers an upfront dark fiber IRU price starting at \$750 per fiber per mile, based on a 20-year term, plus the proportional cost of maintenance, set at \$250 per strand mile. The fee drops as the number of strands leased increases. For example, the price is \$325 per strand per mile when 12 or more strands over an entire ring are included in the IRU. These prices are extremely low when compared to more typical IRU fees. In suburban areas, typical IRU pricing is in excess of \$2,000 per fiber per mile.

4.3 Leasing Structures

Below, we recommend two options for leasing structures for the excess interconnection fiber, with associated considerations. We note, however, that a wide range of structures could work in this regard, assuming that two key goals are met:

1. It is essential that the entity authorized to lease fiber to private entities have the ability to act fast and without extensive bureaucratic delays. The private sector will often lease fiber where it sees an immediate business opportunity and requires speed to market. If every fiber lease or contract requires approval by multiple city councils, private sector lessees may lose interest in utilizing the Cities' assets. For this reason, authority to act based on pre-determined parameters should be given to the entity acting on the Cities' behalf.
2. The leasing entity should also be in a position to act on behalf of all the Southside Cities. Ideally, the Cities' excess fiber assets would be offered to the market through a single

product and process, in order to benefit from the added value derived from marketing fiber on a regional rather than jurisdictional basis. Lessees of fiber optics will be far more interested in a single-stop shop for leasing at which they can obtain access to contiguous assets on a regional basis rather than having to approach multiple jurisdictions and go through multiple leasing processes and then stitch together shorter runs of fiber into a larger, contiguous whole. In this way, collaboration and cooperation among the Cities would increase the value of their fiber assets, both with respect to potential leasing revenues and with respect to the potential economic development benefits of investment by private ISPs.

4.3.1 City Consortium Leasing

One strategy for establishing a leasing structure would be for the Cities to create an entity with authority to enter into leasing arrangements on their behalf, or delegate this authority to an already-existing entity. The tasks of this entity would include:

1. Marketing and sales
2. Contract (lease) negotiation, execution, and enforcement
3. Interaction with staff of all the Cities to ensure smooth technical processes and access to fiber for lessees

4.3.2 Using a Broker to Maximize Economic Impact of Fiber

While the excess capacity of the regional interconnection and municipal network constitutes a valuable resource that can be used in service of the Cities' economic development goals, the realization of its value depends on a successful marketing and sales effort. We recommend that the Cities consider contracting an experienced broker to market, lease and manage the available fiber, creating a single point of contact and streamlining the leasing process for fiber across the region. The broker can be selected through a competitive RFP process, and compensation can be based on a revenue sharing agreement. Taking this approach will limit the Cities' operating costs and take advantage of the existing private sector business sector that specializes in dark fiber leasing.

A vibrant broker industry exists for commercial fiber and lit services, but brokers have not traditionally been used by localities. We recommend the Cities consider following the owner/broker model that is widely used in the commercial market, but with compensation structured to incent the contractor to maximize the Cities' economic development as a primary goal and revenue as a secondary goal. The contractor can be incentivized and compensated through a revenue-sharing mechanism, with premium incentives for accomplishing the Cities' economic development goals.

5 The Benefits of Regional Fiber for Government Collaboration and Building an Innovation Ecosystem

Constructing a fiber ring that connects Hampton Roads' government facilities and economic development target areas to a high-capacity network will potentially create a range of benefits for government operations, public safety, higher education institutions, and local economies.

This section presents an overview of some of the benefits that a regional fiber optic network connecting localities could deliver.

In brief, the creation of a regional fiber optic ring could benefit the region by:

1. Supporting cybersecurity operations
2. Enabling workforce training programs and workforce development
3. Supporting higher education institutions
4. Enabling interconnectivity, shared services, and aggregated purchasing
5. Enabling regional collaboration
6. Supporting public safety grade communications
7. Enabling long-term cost savings and protecting against rising costs of connectivity
8. Enabling segmentation
9. Promoting local data centers—and affordable connectivity to remote backup sites
10. Improving potential for incubators, technology parks, and start-up clusters
11. Serving as a platform for economic development

A regional fiber collaboration among the localities in the Southside area could also be extended over time to include the Peninsula and other jurisdictions within the Commonwealth.

Furthermore, a regional fiber initiative will support the economic development goals developed by Region 5¹⁰ in the following ways, among others:

¹⁰ Region 5 has developed a set of specific economic development goals on which to focus, and is currently developing a strategic plan for achieving these goals known as the "Growth and Diversification Plan." The four goals are: Build regional capacity for innovation in key cluster competencies; Increase the pace of Small and Medium Enterprise (SME) creation through the expansion of existing firms and the attraction of out-of-region

- Support innovation districts for high-tech incubator programs, linking higher education institutions and labs with such districts for on-site development, internships, and partnerships
- Support specific clusters that are geographically concentrated in business parks and incubator districts
- Lower costs of the fiber infrastructure for all entities and also create opportunities for local last mile providers
- Increase the region's public profile and support the region's innovation branding, with the goal of attracting technology workers and SMEs
- Enable the more rural and urban areas of the region to support each other through interconnection
- Enable connectivity among training academies or university satellite campuses to provide onsite, as well as remotely accessed, resources and education for addressing the skills gap and transitioning military personnel to high-tech civilian jobs

5.1 Supporting cybersecurity operations

Implementation of network security on a leased circuit typically occurs at the edge of the network. Many leased networks use end-to-end encryption to securely transmit data over networks that share a core network with public users. Frequently, the provider of a leased circuit may dictate what types of end-to-end security are allowed on a leased circuit (IP managed services, for example).

In contrast, on a government-owned fiber network, the government can control end-to-end security throughout the network infrastructure. The government can offer layers that makes the network robust and secure.

In addition to data security, a government-owned network allows the government to manage physical security as well as network security. This includes:

- Access to facilities and networking rooms
- Passwords to edge equipment and firewalls
- Network access and authentication

SMEs; Increase the share of the 25+ population with a bachelor's degree or higher; Better assimilate existing military into the private sector clusters in the region.

- Monitoring of networking rooms, including security alarms, surveillance cameras, etc.
- Desktop security
- Equipment placement and provisioning

Because of these layers of control on a government-owned network, a robust public sector fiber ring in the Southside region would support cybersecurity operations by:

- Enabling localities to understand the entire physical and electronic topology for both business continuity in general and cybersecurity in particular.
- Enabling cities to ensure transparency into their own communications operations, rather than accepting the risk of vendors refusing to provide transparent access to their underlying physical and electronic infrastructures.

5.2 Enabling Workforce Training Programs and Workforce Development

Just as fiber networks enable K-12 schools and higher education institutions to access applications and resources for educating students, a robust government-owned network could enable workforce training programs and other workforce development initiatives for adults—whether they are unemployed, seeking mid-career education, or seeking to develop new skills that would allow them to start a new career.

As a complement to the region’s strong educational resources, robust fiber to training sites could enable new training—by government, non-profit, or for-profit entities—in specialized areas not currently offered at regional colleges or schools.

For example, in Albuquerque, New Mexico, a membership organization focused on continuing education for commercial construction professionals—Associated General Contractors New Mexico (AGC-NM)—built a state-of-the-art training facility. The AGC-NM’s Career and Training Center’s fiber connection enables its users—mid-career professionals in the field—to better collaborate with outside entities, such as the University of New Mexico. The center is capable of supporting videoconferencing and collaboration meetings, including sessions for large groups remotely attending an event hosted by another entity. In this way, a single fiber connection enables a group of adult learners to access workforce training that would otherwise require costly and time-consuming travel.

Regional, government-owned fiber could also enable Southside localities to support efforts to train local workers in high-demand jobs associated with the deployment and operations of network infrastructure and electronics. Such an approach would create a multiplier effect for the investment in a regional fiber network—creating a pool of well-trained applicants for the types of jobs that the regional network might support.

5.3 Supporting Higher Education Institutions

Higher education institutions typically have well-developed campus networks. Their concern tends to be connections between campuses, service centers, and extension service locations. For research-intensive science and technology focused institutions, these target locations may include technology parks and economic development centers, especially if the institutions have partnerships with the private sectors.

For such needs, the bandwidth and required quality of connectivity can be quite large. There are no real alternatives to fiber for such needs, and the distances to be bridged can be large and costly to construct without collaboration. The availability of a regional fiber network would potentially ameliorate these institutions' fiber challenges.

See Section 6 for more details on the benefits of regional fiber for higher education.

5.4 Enabling Interconnectivity, Shared Services, and Aggregated Purchasing

A robust fiber connection among Southside regional governments would enable a number of significant operational and financial benefits for those governments. We discuss a number of these benefits below, then present a brief case study to illustrate the experiences of another region.

5.4.1 Removing Distance Constraints Between Local Governments

One of the most immediate benefits of interconnecting city government networks is to allow for more frequent and efficient collaboration using telepresence and telecommunications tools while avoiding wasted travel time. This is especially desirable for multi-government meetings where full participation is essential. Scheduling around multiple jurisdictions that also need to take into account travel times often proves a barrier too high and disincentivizes such opportunities for collaboration and mutual learning.

5.4.2 Supporting Regional Public Safety Communications and Interoperability

Putting public safety applications on fiber allows governments to dedicate the bandwidth they need, to quickly intervene if there are issues, to better manage the security, and to quickly restore operation with staff that know the physical layout, the electronics, and the support staffs that need to be mobilized.

By comparison, alternative public safety networking solutions have significant drawbacks. Using internet VPNs, for example, force public safety applications to compete with Facebook and other less urgent application traffic for bandwidth, and make them vulnerable to internet outages at either end. Using dedicated leased lines from telecommunications companies improves business continuity, but still leaves such traffic at the mercy of the priorities of those

commercial companies. And such leased solutions are costly and typically do not scale well with increased needs.

Leased services are also a poor fit—from a design perspective—for regional government collaboration around public safety. Each time a facility, application server, or user needs to be connected to a network, the network operator needs to extend a line that goes back to a hub and then to one or more central nodes where its core electronic provision the network. A signal may have to travel through multiple points of failure along the way, far from the actual source and destination (which may be very close to each other). And public safety administrators are unable to assess actual risks because commercial operators are proprietary about their actual physical details and underlying design.

In contrast, relying on internal government networks that already connect all necessary facilities, servers, and users, and interconnecting with other governments, allows for much more efficient designs with traffic running along known paths, with known risks that can be properly mitigated, and that can be designed to have path diversity, avoid single points of failure, and serve multiple applications and purposes.

The interconnection of government fiber optic networks also promotes a culture of interoperability—allowing public safety users to communicate with each other without the need for translation or intervention. Interconnecting fiber optic networks allow governments to adopt a single standard for interconnection with clear demarcations and roles, governance to oversee the interconnecting infrastructure, and an infrastructure that will accept any data packet traveling the infrastructure regardless of the specific application or system to which it belongs—so long as those overarching rules have been followed.

5.4.3 Enabling Resource Sharing and Shared Services

Through regional fiber networks, governments can share services more easily, creating efficiencies and providing better services. Joint training over the network, sharing development of applications, and collaborative Wi-Fi initiatives are just some examples of what can be achieved. Duplicating specially equipped command vehicles for each jurisdiction is not necessary if an efficient dispatch system running over a regional network can enable a regional approach to dispatching shared resources. Some regional governments already dispatch for each other or provide data backup services for each other; a fiber optic network provides an effective infrastructure for supporting such initiatives.

5.4.4 Enabling Aggregated Purchases of Remote Data Center Space and Internet Bandwidth, Thus Achieving Better Pricing

Governments need diversely sourced internet bandwidth, cloud access, and data center space. Procuring such services is costly and could involve each locality provisioning its own physical

connection to such key infrastructures. In an interconnected regional network, however, a single (or redundant, if the service is critical) connection to one of the participating localities may be all that is needed. Not only can an individual government now reach such services cheaply, but governments can act collaboratively to take advantage of a combined economy of scale.

5.4.5 Case Study: Portland, Oregon, Region

Portland, Oregon's Integrated Regional Network Enterprise ("IRNE") is a fiber network designed to carry all of the voice, video and data communications traffic for the City, public schools, and other strategic partners. IRNE features a high-capacity, highly reliable design that costs less and offers more than conventional telecommunications services available in the region.

5.4.5.1 History

Before the advent of IRNE, the City spent over \$8 million annually on private telephone services to serve roughly 7,000 telephone extensions. The City also had a limited data communications budget that provided T-1 services at major city buildings (like the 911 Center) but only 56 Kbps Frame Relay services at most other locations. The City's limited budget prevented it from providing high-speed broadband service to public schools and most other public buildings.

In response to these growing needs and limited resources, the City launched IRNE in 2002 as a shared communications backbone. IRNE leverages funds, expertise and infrastructure—and circumvents the exorbitant rates by private telecom companies for phone lines and high-speed Internet connections.

IRNE was financed through the City's franchising authority over the rights-of-way for telecommunications and public utilities. The City required any telecommunications carrier who wanted to place conduit in City streets for their network to build additional conduit for the City as a condition of receiving a franchise and permit. Such construction was credited as partial payment for use of the City's rights-of-way. The incremental cost of this construction was minimal, particularly when compared to the potential cost of providing the capacity as a stand-alone project at a future date. Such simultaneous construction thus worked to benefit both parties.

Portland later designed a fiber plan that would take advantage of these conduit resources and create a wide-area network for use by the City. This is particularly evident in the Institutional Net ("I-Net"), which relies on fiber that is owned and maintained by Comcast but extends to IRNE. In this way, the I-Net allows circuits to originate on one network and terminate on another, in effect extending the reach of both networks. The I-Net provides high-speed transmission services to 17 public organizations, including eight school districts (all of the surrounding county's K-12 institutions, totaling 272 sites), a regional educational service

district, four local governments, the county libraries (17 sites), two community colleges (at eight sites), the Housing Authority of Portland, the State of Oregon and one large, non-profit, social service organization.

The I-Net produces these wide-ranging public benefits at a fraction of the cost of leased services. The City also realizes significant cost savings by using the same staff to support both networks (i.e., IRNE and I-Net). In particular, the dual management of both networks preserves resources that would otherwise have to be invested in technicians, tools, and fiber equipment.

Today, the \$14 million system links K-12 schools and other educational entities, regional transportation and public safety agencies, municipal offices, and government agencies outside the City to a network of fiber-optic cable that carries City phone calls, enterprise data, utility monitoring (SCADA), and Internet traffic.

5.4.5.2 Benefits

Portland created IRNE as a low-cost fiber optic network to reduce the City's telecommunications' expenses and to boost economic development. It has saved local governments and public schools in the Portland region millions of dollars in networking costs as compared to leased alternatives. It has also saved money by preventing redundancy in network development and the related duplication of investment between various government entities. In fact, the City of Portland has eliminated 90 percent of the leased data circuits that were in place at the time of construction. The City has used some of these savings to lease data circuits in previously under-served areas, expanding connectivity to areas that were not previously cost-effective. This was done in a cost-neutral financial package where no new money was necessary.

At the same time, IRNE has dramatically increased speed. The City formerly leased circuits for low-density uses (e.g., fire stations) with a 56 Kbps Frame-Relay service connection. Today, these facilities have a dedicated T-1 connection. Overall, the City estimates that IRNE has increased bandwidth per site an average of 500% with no increase in monthly cost.

5.4.5.3 Partners

IRNE serves as a network for government and education institutions in the region. It provides service to City of Portland governmental entities and provides optional services to other governmental jurisdictions, including K-12 and higher education institutions with a need to interconnect with local government and each other. IRNE links the State Office Building, Portland Public Schools, the Multnomah Educational Service District, and Metro to a central location where high-speed connections may be made to any Internet service provider. Today, over 400 schools, libraries, fire stations, police precincts and other small and large public sector locations receive low-cost, high-speed, reliable broadband voice, video and data from the IRNE.

Partners include BTS (Portland's Bureau of Technology Services), Portland Public Schools, Portland State University, Multnomah County, Multnomah Education Service District, and Portland Community College.

5.4.5.4 Viability

Although it required a considerable (\$14 million) infrastructure investment, the costs per participating organization are low, given the large number of partners that benefit from the network. By sharing the network among a larger number of public sector users, average costs are lowered and savings accrue not only to the City, but also to other public entities using the network. Moreover, IRNE streamlines costs by leveraging federal transportation dollars and initiatives along with cable and telecommunications provider assets.

5.4.5.5 Network Efficiencies

IRNE is an engineering collaboration among public sector agencies leveraging multiple sources of funds and telecommunications plans to form a well-engineered, well-executed network architecture and service operation. This collaboration has led to dramatic network efficiencies.

Efficiencies are also realized through demand aggregation. Absent IRNE, the school districts and other beneficiaries would have had to independently acquire the necessary data circuits. IRNE has allowed the City to aggregate demand by using the same infrastructure and negotiating on behalf of each of these entities. Thus, IRNE satisfies the demand of a wide range of beneficiaries through a single network.

5.5 Enabling Regional Collaboration

Interconnecting government networks with fiber would enable regional collaboration in multiple ways. As previously mentioned, intergovernmental collaboration is enhanced by such interconnection by facilitating shared services and resources, allowing for cooperative purchasing of technology services, and enhancing technical coordination.

But regional fiber would enable collaboration to extend far beyond the local governments. Governments and educational institutions do not do their work in isolation. From economic development and transportation to business incubators, redevelopment initiatives, and workforce training, the public and private sectors work together. Virginia Beach and the larger Southside region have developed a coordinated strategy for economic development that requires a technological communications infrastructure to support it.

Incubators and business parks need higher education collaboration—and therefore fiber connections between such sites and, in turn, out to data centers, big data applications, and the cloud. Taking advantage of the cable landing at Virginia Beach requires an infrastructure that links the immediate landing area with remote, regional, and local aggregation points where

data centers and technology companies can locate and connect. This means not just interconnection to enable collaboration, but smart interconnection that targets such areas.

Likewise, developing small businesses and allowing them to grow requires more competitive offerings for last mile connectivity services from internet service providers. For its size and importance, the region suffers from high cost per Mbps due to lack of competition and localized monopolies and duopolies. Smart interconnection that thinks long-term about providing access to a middle mile infrastructure, either in fiber or conduit, would increase competition and provide benefits for all the regional participants.

Workforce development and education likewise requires infrastructure connecting educational and commercial training entities to locations where workers are, including at-home distant learning options. Workers, workplaces, and educational centers are located throughout the region—so a strategy for connecting them with each other is therefore required to support such goals.

5.6 Supporting Public Safety-Grade Communications

Local governments that meet their public safety communications networking needs with leased circuits enjoy a number of operational benefits. For example, they do not require internal staff to operate and maintain the portion of the network outside their facilities.

Constructing a government-owned and operated fiber network, however, offers some critical functional and technical benefits over leased circuits—making that approach a much more desirable long-term strategy.

For example, local governments cannot fully evaluate the reliability or availability of a leased circuit because they have no knowledge of the service provider’s proprietary network or physical infrastructure, and no control or management of the services. In contrast, a government-owned fiber network is completely under the government’s control.

In addition, leased services are not independent of the networks used by the public and are therefore less secure and reliable. A government-owned network is independent of the public infrastructure—and enables control over network security between endpoints.

These and a number of related factors are addressed in detail below, followed by a case study describing the public safety network in the National Capital Region surrounding Washington, D.C.

5.6.1 Removing Public Safety Operations from the Public Internet

A privately owned communications network does not rely on physical infrastructure, equipment, or other resources that also carry public traffic for residents and businesses. Shared

resources are used by a managed network service provider to reduce their cost by taking advantage of the statistical nature of communications traffic. In other words, commercial carriers intentionally oversubscribe their networks to minimize costs (maximize profits), because all of their customers are not likely (statistically speaking) to simultaneously use their services to full capacity all of the time. The advantage of an independent network is that increases in public traffic on the network or public network outages do not affect privately owned networks.

Additionally, the only way to ensure that there is adequate bandwidth is to overbuild a network to support maximum capacity demand, not average utilization (while absorbing the cost even if the bandwidth is not used). Some leased managed services will charge only for the bandwidth that is used—but capacity is limited. Typically, these services are only cost-effective when institutions have a specific understanding of their applications' bandwidth requirements. A Town-owned fiber network will provide a more reliable, higher capacity, flexible network infrastructure because it is designed to support a broad range of initiatives and to easily and seamlessly scale to meet new bandwidth requirements.

As is the case in many major public safety incidents, public networks such as the Public Switched Telephone Network (PSTN) and the Internet are often overloaded by the amount of traffic on the network. This can lead to busy signals on the PSTN and a lack of connectivity on the Internet. Privately owned networks typically do not experience the same traffic increases and can be designed to handle any expected traffic increase during a major incident.

Many public networks are in the planning and early implementation stages of providing priority and preemption capabilities for most managed service providers and will not be universally available, however in the event of a crisis, priority and preemption is critical for public safety networks.

A government-owned fiber network can prioritize bandwidth both in the core and at the edge. This capability allows the government to prioritize by location and to preempt all traffic other than public safety traffic, if necessary. More importantly, the government-owned infrastructure can be allocated so that sensitive traffic always has dedicated capacity, because capacity can be readily scaled as needed for other applications.

5.6.2 Enabling End-to-End Control of Local Public Safety Networks

A network built upon leased network services obtained from a service provider cannot provide the control and management that is available in a Town-owned and operated network.

Leased network services are in essence a “black box” in terms of control and management. The government is forced to rely on the provider (usually the phone company) to maintain and

operate the core equipment of a leased service (these tasks include configuring the equipment, monitoring the hardware and physical infrastructure, and performing routine maintenance).

The Southside regional governments' internal capacity requirements include video, voice, and data communications. Both voice and video services usually require dedicated bandwidth. Two-way voice and video services require dedicated bandwidth and very predictable transmission delay properties.

In other words, linking two-way radio communications systems or supporting videoconferencing over IP or using TDM connections requires the ability to manage bandwidth across the entire network. Although this functionality can be provisioned on the edge device when using a managed service provider for connectivity, if the government owns and operates its own fiber network, it will have control and capability to increase bandwidth based on the government's time frame (which will in turn allow the government to properly plan for integration of new applications without an increase in cost for provisioning of new bandwidth). Further, it offers the ability to implement advanced Quality of Service mechanisms that are enforced on a network-wide, end-to-end basis.

Under the leased model, the government must request (and pay for) the private company to make changes in the core of the network for a new application, increase bandwidth, or to implement new policies for enhanced Quality of Service.

Under the leased model, the government is also not able to control who manages and maintains the core of the network. The knowledge, skill set, and security background of those operating the network is often beyond the control of the government.

With a private fiber optic network, each piece of the communications network is controlled and managed by the government. The government may choose to operate the network on its own with its own staff, or it may outsource the operations to a contractor of its choosing. Either way, choices regarding the management of the network are in the hands of the government—not the phone company.

5.6.3 Ensuring That Government Services Are First to Be Restored in Event of Outage, Rather Than Waiting in Commercial Lines

The availability of a communications link is derived from the probability of a failure within the network between two points. In a leased circuit network, the end user is not aware of all of the potential risks to availability of the network. Several key factors that affect availability and cannot be determined by the government include:

- Physical redundancy in the plant

- Physical redundancy in the building entrances
- Physical redundancy in the networking equipment
- Ensuring network equipment is properly configured and regularly tested to take advantage of hardware and link redundancy
- Redundancy for power and HVAC
- How many facilities the circuit crosses between endpoints
- Whether the plant is located underground or aerial
- Who has access to the core networking equipment and plant
- The core equipment's age and maintenance
- How the system is monitored and maintained
- The single points of failure in the communications link

Many of the factors can be approximated or relative numbers may be obtained from the leased circuit provider; however for critical government services such as public safety, the approximations and availability estimates from leased network services may not meet the availability requirements of a critical traffic network. In the case of physical architecture issues, such as the physical routes of cabling, approximations are not sufficient, and detailed maps are usually considered proprietary and confidential to a commercial provider.

In addition, lessees such as local governments are subject to the lessor's schedule for repair and maintenance of the circuit. Although it may be possible to include provisions in the service level agreement (SLA) for special priority service restoration, it is possible that SLAs will not be adhered to during major disaster events. Further, there may be no way to ensure that a leased circuit for public safety is the first link to be repaired during a major disaster.

A similar problem can arise in both scheduled and unscheduled maintenance of a leased circuit. The timing of these maintenance downtimes may not correspond to available downtimes in a public safety network. In a government-owned fiber network, maintenance downtimes can be coordinated to minimize downtime and the government can prepare for an outage by adapting operational procedures.

SLAs often guarantee availability and repair time, but typically are not reliable in the event of a major disaster. In addition, service providers usually rely on cash rebates to compensate for

network outages to the network—an unacceptable solution in the case of public safety, where cash cannot compensate for lost service.

5.6.4 Enabling Transparency to Understand Network Routing and Configuration

Commercially obtained connectivity, whether dedicated leased options or simple internet access, traverses physical routes and electronics that are almost never disclosed to clients. Some clients have learned the hard way that obtaining services from competing providers as redundant backup did them little good because it turned out both providers had leased physical lines in the same fiber optic bundle that was cut. Likewise, how traffic is routed in a network matters. If it is all routed to the same central hub where there is a failure, even two government sites physically close to each other may be unable to communicate through such dedicated lines.

Such vulnerabilities can usually be easily designed to mitigate when one understands and controls one's network, but that is the control that disappears when other providers light and manage one's connectivity needs. For proper risk assessment and risk mitigation—truly essential functions of any network manager—the transparency of such information is key.

Having your own fiber and electronics allows not just such transparency, but better ability to quickly scale capacity and offer services based on needs. If it is your own fiber you can physically split the light into multiple wavelengths allow different electronics for each, essentially creating multiple physically separable and routable networks. This is especially useful where fiber counts are scarce and in mixed network environments—some can be for open access commercial partner use, others for federal partners, and some for internal use. Likewise, separation and capacity can be managed electronically with separate VPNs, each with its own rules and uses.

Such flexibility is rarely possible when you do not own the network and the time it takes to turn up such services can be very long as the provider often needs to do their own internal management with multiple internal partners, and a long procurement process may be necessary. In contrast, governments can turn up such services relatively quickly when needed as they understand and control all aspects of the infrastructure.

5.6.5 Case Study: National Capital Region (NCR)

NCRnet is a public safety oriented network that interconnects more than 20 jurisdictions in the Washington, D.C., metro area. A business case and feasibility study were developed under the supervision of the region's CIO group within the structure of the metro Council of Governments. Funding was available through the Department of Homeland Security's Urban Areas Security Initiative (UASI) to build the interconnection fiber that would link existing local governments together. The local governments typically had limited fiber strands available as

part of their cable franchise agreements and agreed to dedicate a fiber pair from each of their hub locations for NCRnet.

The network participants include all of the surrounding counties and most of the autonomous city governments in the D.C. metro area. Because all their public safety agencies are already connected to their own jurisdictional network, all the local public safety agencies are on NCRnet. In addition, the airport and metro rail public safety agencies are connected as well, as are several federal partners.

The partner agencies use several critical applications over NCRnet. These include CCTV (used primarily by transportation and law enforcement, but also emergency management and fire), ISSI for mutual roaming on public safety radio networks, CAD2CAD for mutual dispatch of fire, and several law enforcement applications such as mugshots, fingerprints, and license plate readers.

Other applications include video and teleconferencing, GIS data exchange, and CAD data exchange for law enforcement and other public safety user groups, as well as a regionally integrated Identity and Access Management System, for single sign-on and authentication into public safety applications.

NCRnet allows these applications to take advantage of a secure, reliable, and resilient network in a cost-effective manner, and has replaced or displaced the need for costly leased lines for each application.

In the initial builds, local franchise agreements were leveraged to cost-effectively build the links with the cable companies. Under such agreements, the number of strands installed was typically low and restricted to government and public safety purposes. Switches were placed at hubsites for the NCRnet network and managed by a dedicated engineering team. Subsequently, further federal funding was made available to upgrade the electronics to meet public safety needs for traffic segmentation, and high reliability, and resilience.

The current MPLS routers are deployed in self-healing rings, and typically provide 10 Gbps on the backbone with separate circuits provisioned for sensitive law enforcement applications, radio backhaul that allows neighboring jurisdictional P25 radios to roam on each other's networks and radio towers, and for classes of applications.

The network is currently entirely devoted to public safety and is segmented off from direct interconnection with the internet. It also has sophisticated electronics monitoring for security incidents and unauthorized traffic. The control of local governments on all aspects of the infrastructure, which relies on their own sites, fiber, and electronics, allows for effective risk management, prioritization, and change management to meet public safety needs and restore

services. The MPLS-based segmentation, coupled with the security architecture and tools, also allows the network operations team to quickly isolate and remedy suspicious traffic with minimal impact to other public safety applications.

5.7 Enabling Long-Term Cost Savings and Protecting Against Rising Cost of Connectivity

Government entities of all sizes are major consumers of connectivity services, to support internal operations, public safety functions, and a range of other applications. Typically, government facilities lease circuits from a phone company or similar provider, and for that privilege they pay rates that sometimes represent many hundreds if not thousands of percent profit for the phone companies. Worse, the circuits are usually relatively low-bandwidth connections, because the retail costs of very high bandwidth services make those connections simply unaffordable.

A regional fiber optic network that links all of the Southside governmental operations eliminates the jurisdiction's ongoing cost of leasing circuits, which represents an easily quantifiable present value on the financial statement. These are as close to "guaranteed" line items as possible: Build the network and you will shave this amount from your accounts payable.

In fact, because a government network can deliver far higher-capacity connectivity than the jurisdiction had previously leased, the value is even greater than the simple cost-avoidance measure. When you own your own network, for example, you can accomplish gigabit speeds among and between the facilities on your network using inexpensive, off-the-shelf equipment and at no cost for bandwidth (because the traffic is "on network", *i.e.* on your Intranet, not going out to the Internet). You can also deliver to these facilities connections to the Internet at much lower per-unit cost, because you can aggregate the needs of all your departments to more cost-effectively purchase commodity bandwidth. This is particularly true if you are able to develop a partnership that benefits the wholesaler from which you're buying.

The cost savings generated by a government network will grow over time, too. The very lowest estimates would value that growth in lockstep with the expected inflation of retail service prices. But in reality, the government network will deliver even more value because it can inexpensively scale to meet the jurisdiction's future needs for more capacity (which are likely to grow exponentially) and connectivity to additional sites—which would be financially impossible using leased circuits.

Whether creating a business case for a new network or developing budget projections for the status quo, it is incredibly important for communities to understand how greatly their governmental bandwidth needs will grow. Capacity requirements for government

operations have grown exponentially over the past 15 years, and there is nothing to suggest that the pace of growth will abate over the next 15 years. In addition, most governmental operations and community anchors are already overtaxed in terms of their broadband capacity—meaning that they already require much more bandwidth today, let alone tomorrow. (In practical terms, that means that absent a government-owned network, governments will continue to be unable to deliver the capacity they need to adequately support their internal operations and those of community anchors—and that they will lack the bandwidth to undertake all kinds of future innovations, even if they have the necessary hardware, software, and ideas.)

With a government-owned fiber network, the cost to scale up to meet needs like this is far lower than if you are buying circuits from someone else—not just because they have a profit motive, but because they may not have the infrastructure where you need it. If the phone company has only low-speed twisted-pair copper in your footprint, the only way to get the capacity you need is to pay them to build fiber to you—and then to pay them to deliver services over the fiber you just financed for them. Viewed in that light, a government-owned network becomes even more compelling.

5.8 Enabling Segmentation

Good security with smart segmentation capabilities—from fiber and physical electronics, to virtual network segmentation—is critical to both internal government operations and working with a wide variety of partners and user groups. A regional fiber infrastructure would offer the ability to segment traffic—either allocating strands of fiber, or segmenting the light within a strand—which maximizes the potential uses and benefits of the fiber across a range of users.

Physical separation with different strands of fiber is appropriate and desirable when partnering with private sector or higher education partners who are able to light the fiber and provision their own networks with electronic equipment. Allocating different strands to different entities allows those entities to assume their own risk and liability for network operations.

For governmental uses of the network, segmentation of the light in a fiber strand into discrete frequencies (a technology called multiplexing) allows for further physical segmentation. This requires optical equipment at each end, which imposes a burden of responsibility to keep the signal going (including ensuring power and protection of the equipment), but the burden is rather small and this method is often used as alternative to building costly additional strands.

Multiplexing can maximize the cost-effective use of even a single pair of fiber. For example, up to 70 percent of all global internet traffic goes through Northern Virginia’s data centers and internet exchange points around Ashburn, but entering the Equinix campus to connect directly to any of the many services requires costly per-fiber fees. Constructing or securing a large fiber

count for a government that cannot monetize its access is therefore cost-prohibitive. Instead, one or more interconnected partners can secure a single pair and use multiplexing to simulate each entity having its own fiber optic access.

For internal separation among public safety, financial, and regular internal traffic, segmentation is typically implemented with electronics. More robust equipment allows for segmentation that can allocate bandwidth and prioritization to specific classes so public safety can be prioritized. Other methods allow for encryption and simulation of separate virtual networks. Segmentation is critical to managing the different policies that attach to traffic (e.g., how sensitive is the data? What quality of service does it need?) More interconnection and more partnerships require more options in terms of fiber and electronics to facilitate communications.

Segmentation and isolation are also critical for supporting innovative technology initiatives such as smart cities and integration of transportation traffic sensors using Internet of Things (IoT). Such devices pose challenges on both bandwidth and security, and require systems isolation to manage both. A robust and plentiful fiber-rich infrastructure on which wireless technologies can be implemented is a must to meet these challenges.

The different types of segmentation are key to managing security. Sometimes such decisions are explicitly stated as requirements. For example, some sensitive federal data require total physical isolation of systems. But in most cases, segmentation is a matter of risk management. Segmenting traffic allows network and security managers to better isolate traffic, to quarantine threats without affecting other critical communications functions, and to more quickly restore services.

5.9 Promoting Local Data Centers and Enabling Connectivity to Remote Backup

In conjunction with the undersea cable landing in Virginia Beach, which has already attracted long haul fiber connecting to remote sites in other areas as well as at least one data center, a regional fiber network may attract development of additional local data centers (and the associated creation of local jobs in IT, network engineering, data center support, and so on).

In this scenario, the regional fiber present local governments and enterprise users the option to choose the best solution in terms of cost-effectiveness, redundancy, or other factors.

Even without the creation of new data centers, the fiber might enable local governments to back up on each other's sites via their interconnection, or leverage it to reach such local sites.

5.9.1 Remote Data Storage

The drive for bandwidth and direct connections to cloud and data services grows ever larger. To become more efficient, governments will expand communications infrastructure to deliver their

services. That means they need ever faster speeds to reach competitively priced internet, application, and platform services. Each government can go it alone, paying a high sticker price to get there, or they can band together and do it at a lower cost.

Robust fiber would allow the region to share connectivity to remote backup sites where data can be mirrored in case of emergency. Advanced cloud services and storage options in Ashburn or other areas could be reached by any of the participating interconnected governments and universities as long as they have a shared link to such sites.

As we discuss in Section 11, a regional fiber network would not just meet internal requirements, but would also create an infrastructure platform and ecosystem for innovation and economic development. In particular, the fiber infrastructure could enable local users to connect to local and regional data centers and switch points such as Equinix-Ashburn.

5.9.2 Disaster Recovery and Business Continuity

Both local and remote connectivity to data centers and cloud services, and connections to each other's networks, would allow regional governments to build better business continuity operations and create more flexibility for private cloud, hybrid cloud, and standard cloud services. Governments may prefer each other's sites for critical and sensitive data that need to be quickly restored, while using other flexible strategies for less critical data, or data with more relaxed retention policies.

5.10 Supporting Incubators, Technology Parks, and Start-Up Clusters

The availability of abundant bandwidth is critical for businesses of all shapes and sizes, but access to affordable, symmetrical gigabit-per-second (1 Gbps) connections is especially important for startups and innovative, early-stage companies. Regional, government-owned fiber can be routed to key economic development target locations where technology companies and startups, are clustered to improve their access to fiber-based services—and improve their potential.

The first few cities to offer Gbps connections have managed to attract a flock of entrepreneurial spirits, eager to harness the ability to quickly send and receive huge data sets, develop new business processes, and disrupt the status quo.

Even though only a small minority of Americans currently enjoy a symmetrical Gbps connection, the companies of tomorrow have already begun to figure out how to leverage abundant bandwidth to improve the delivery of all kinds of goods and services, from medical care to the food we eat. Having fiber to business districts and office parks is critical for economic development, because the next generation of successful startups will need a fiber connection to enable the types of high-speed data transfer and real-time collaboration with remote team members that will be fundamental for the businesses of the future.

5.10.1 Lessons from the First Communities to Get Gbps Service

The widespread availability of an affordable, symmetrical Gbps connection is still limited to a handful of markets, and, as a result, there is a lack of causation analysis on the impact these services have on different sectors of the economy. However, anecdotal observation suggests that the availability of Gbps connections to incubators can provide an economic boost that is especially pronounced among early-growth startups.

In Chattanooga, TN, for example,¹¹ there has been a remarkable surge of technology startups over the past few years since fiber began connecting incubators and technology centers. An independent study from the University of Tennessee estimated that, of the 2,832 to 5,228 jobs that the fiber-network added to the Chattanooga area between 2009 and 2014, at least 1,024 of those new jobs were part of the City's thriving technology startup scene,¹² much of which is centered on a cluster of incubators.

Although the City has taken a number of additional steps to make itself an attractive place for early-stage businesses, the fiber infrastructure has been an important lure to attract those entrepreneurial spirits that crave a less cutthroat and more affordable alternative to set up shop than Silicon Valley or New York City.

Similarly, Kansas City, the first place to enjoy Google Fiber service, saw a rapid proliferation of startups in the wake of the Gbps services becoming available in late 2012. Since then, the City's 'Startup Village' alone has served as a home to 48 new startups, 10 of which have outgrown the Village (and five of which have failed).¹³

5.10.2 Opportunities for Innovation

At least some of the enthusiasm that fueled the startup boom in two previous examples stemmed from the fact that they were two of the first cities in the country where symmetrical Gbps services were widely available at an affordable price. As comparable services become available in more and more markets, we expect that having a symmetrical Gbps will become less of a lightning-rod to attract entrepreneurs and more of a necessary table-stake that cities will need to appeal to innovative, early-stage businesses.

¹¹ Jason Koebler, "The City That Was Saved by the Internet," *Motherboard*, October 27, 2016, https://motherboard.vice.com/en_us/article/chattanooga-gigabit-fiber-network

¹² Dr. Bento Lobo, "The Realized Value of Fiber Infrastructure in Hamilton County, TN," *The University of Tennessee at Chattanooga*, June 18, 2015, <http://ftpcontent2.worldnow.com/wrcb/pdf/091515EPBFiberStudy.pdf>

¹³ Bobby Burch, "How Kansas City Startup Village Grew from the Arrival of Google Fiber to Thriving innovation District," *EQ*, December 12, 2016, <http://eqstl.com/kansas-city-startup-village-grew-arrival-google-fiber-thriving-innovation-district/>

The ability to quickly transfer huge data sets from place to place creates a huge range of new possibilities, and entrepreneurs in every sector of the economy have begun to take advantage of the opportunities that symmetrical Gbps connections enable. Nowhere is this clearer than in industries that stand to benefit from the rapid analysis of genetic data. The human genome, as it comes off the sequencer, is roughly 200 GB of data.¹⁴ The new businesses that emerge to analyze this data will cluster around areas with abundant bandwidth. For example, Tute Genomics, a company that provides rapid and accurate analysis of human genomic data to assist with genetic diagnosis, launched in Provo, Utah, another one of the earliest cities to have Google Fiber service.¹⁵

Analyzing genetic information is quickly becoming part of standard researching procedures for a wide range of business endeavors, from developing more personalized pharmaceutical solutions,¹⁶ to breeding more resilient varieties of food crops and domesticated animals.¹⁷ While some of this innovation will take place within large companies, there is ample opportunity for entrepreneurs to use cutting edge technologies to create disruptive new business models. However, given the size of genetic data sets, innovations in these fields will tend to emerge companies that have access to an abundance of bandwidth.

Genetic information is just one of numerous large data sets that businesses are in the early stages of learning how to analyze in order to improve decision making and boost performance. From retailing and manufacturing to finance and insurance, businesses are collecting more data than ever before. Now they are faced with the challenge of how to use these enormous data stores to improve efficiency and productivity.¹⁸ The amount that companies spend on data analytics is set to surge in the coming years,¹⁹ creating new opportunities for individuals with the skills and robust, reliable broadband connections necessary to make sense of huge data sets.

¹⁴ Dr. Reid Robinson, "How big is the human genome?" *Medium*, January 6, 2014, <https://medium.com/precision-medicine/how-big-is-the-human-genome-e90caa3409b0>

¹⁵ Jamie McGee, "In Kansas City, Google Fiber has changed workers' lives," *The Tennessean*, <http://www.tennessean.com/story/money/tech/2015/02/01/kansas-city-google-fiber-changed-workers-lives/22601915/>

¹⁶ Andrew Ward, "Drug Companies Unite to Mine Genetic Data," *Financial Times*, March 25, 2015, <https://www.ft.com/content/4d1792fe-d2f1-11e4-b7a8-00144feab7de>

¹⁷ Dyllan Furness, "From corn to cattle, gene editing is about to supercharge agriculture," *Digital Trends*, April 17, 2017, <http://www.digitaltrends.com/cool-tech/crispr-gene-editing-and-the-dna-of-future-food/>

¹⁸ Nicolaus Henke, et al. "The age of analytics: Competing in a data-driven world," McKinsey & Company, December 2016, <http://www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/the-age-of-analytics-competing-in-a-data-driven-world>

¹⁹ "Big Data Spending Set to Surge," *IT Online*, March 31, 2017, <https://it-online.co.za/2017/03/31/big-data-spending-set-to-surge/>

5.10.3 Fiber's Role in Supporting the Entrepreneurial Ecosystem

Individuals are already discovering new ways to harness symmetrical Gbps connections to improve businesses and society. The underlying fiber network makes these advances possible, and determines where innovation can happen. If the only place to enjoy abundant bandwidth in a region is in huge office parks and major research universities, then innovation will likely be concentrated in these large, established institutions.

Startups tend to be nimble, often operating on a shoe-string budget for their first few years. Having fiber-based broadband in an incubator or office park ensures that there is sufficient bandwidth for data-intensive applications. Fiber connections ensure that time is spent getting work done instead of waiting for files to load. Fiber connections are especially important for enabling real-time collaboration with remote team members. Often startups lack the in-house expertise to complete every task themselves. If a team member needs to direct a team of software developers operating all over the world, it is critical that the team not lose time to dropped calls and lagging video conferences.

Ensuring access to affordable, symmetrical, Gigabit connections at key locations such as incubators will not transform an area into a hotbed of startups. However, coupled with other policies that encourage entrepreneurship and give early-stage companies access to growth capital, ubiquitous fiber may enable individuals to tinker with new technologies and allow entrepreneurs to develop innovative ideas into sustainable business models.

5.11 Serving as a Platform for Economic Development

A wide range of American communities are making their core fiber rings available to the private sector in the hopes that private investment will build from public “middle mile” fiber out to the “last mile” to businesses and residential premises. The idea is that, by making middle-mile capacity available where it does not otherwise exist, and at very reasonable cost, a community reduces the barriers to investment for entrepreneurial companies (and non-profits) that want to build last-mile capacity. In this model, those companies’ lease arrangements would lead to not only modest revenues for the government, but also stimulate private investment and the extension of broadband service to customers that otherwise would not have it, or would not have the benefits of competition.

5.11.1 Overview of Broadband's Impact on Economic Development

The literature on broadband and economic development suggests a causal relationship. High-speed broadband is an economic enabler for businesses. From the standpoint of most businesses, broadband has ceased to be a luxury and has become crucial to business functionality.

According to a 2011 survey of building owners and property managers, broadband access is one of the most important decision factors for commercial real estate siting—after price, parking, and location. Similarly, a national survey found that 77 percent of economic development professionals believe that to attract a new business, a community must have broadband of at least 100 Mbps; in other words, they believe that economic development without broadband is essentially inconceivable.

The high speeds that fiber provides can facilitate economic development by:

- Enabling job creation and the multiplied economic activity that accompanies new jobs
- Supporting businesses with very high bandwidth needs, such as digital media and software development
- Attracting and retaining businesses of all sizes
- Enabling workforce education
- Enabling telework and distributed work
- Stimulating economic activity
- Promoting major development initiatives such as revitalization zones

5.11.2 Implications for the Southside Region

In addition to tactically creating a platform for last-mile fiber deployment by the private sector (and the environment for economic development that such deployment would foster), a robust fiber ring in the Southside region would be a key strategic step toward building an ecosystem that supports the region's long-term vitality as a technology and business hub.

This type of fiber-rich ecosystem has been a focus of development for many years and is reflected in the public and private sector planning around the undersea cable coming in to Virginia Beach. Together, the undersea cable and a potential Southside regional fiber ring initiative are part of building a profile and culture for the region as technology savvy and welcoming to businesses across a range of sectors, including both established companies and startups.

Indeed, a regional commitment to fiber could ultimately position (not just the developed South side, but also expanding to the Peninsula) as an alternative to Ashburn. The region become Virginia's second hub for the mid-Atlantic area and the east coast with regard to infrastructure and technology.

Transforming the region into a fiber-ready region could also support potential public–private partnerships and prepare the region for innovations around autonomous vehicles, smart cities, connected communities, and related innovations. Local governments could also likely use a robust fiber ring to support emerging next-generation wireless deployments, which will depend on fiber backhaul to connect wireless facilities.

5.11.3 Case Study: Culver City, California

On a relatively small the scale, the efforts of the city of Culver City to use fiber as an economic development tool illustrate the potential benefits for the Southside area. In 2013, Culver City commissioned a detailed study of the potential for fiber network deployment to boost economic development efforts. The city’s objectives for the project centered on five large tracts of buildings in this urban center near Hollywood and the film industry. The overarching goal was to create the type of robust fiber connectivity options that would both attract and retain technology-centric businesses to these buildings.

5.11.3.1 Background

For the type of businesses that Culver City hoped to attract—small companies, often start-ups, and likely to be in the film and supporting industries because of the city’s proximity to the Hollywood studios—the availability, affordability, and reliability of high-capacity broadband connectivity is essential.

Culver City estimated that more than 80 percent of the buildings in the target tracts would have multiple tenants, which indicated that the market for broadband services in the tracts would comprise mostly small businesses. Despite the existing service options at some of those buildings, there were still connectivity issues in those areas as a whole—especially for small technology-centric businesses.

First, broadband availability was not ubiquitous (e.g., every building, every service). Second, where service was available, the cost of getting a new “drop” connection to an office or other facility was often excessive, even for a large business. And third, the types of available services were not well-suited to small businesses. Each tract had a range of available connectivity options, including services such as dark fiber, cable modem, DSL, Metro Ethernet, and MPLS (Multiprotocol Label Switching). But most of these services were tailored to either casual users (e.g., cable modem or DSL, which do not meet business performance needs) or large users (e.g., Metro Ethernet or MPLS, which meet business requirements but with unaffordable monthly costs that would represent a substantial portion of many business’ ongoing operating costs).

Taken together, these issues drove the City’s goal of expanding its communications infrastructure in these tracts to advance the availability, affordability, and reliability of retail

connectivity services tailored to the technology-centric small business market in the identified tracts.

5.11.3.2 Planning

Culver City's proposed fiber deployment plan comprised five phases:

1. Implementing a redundant open-access fiber backbone and an access point in each tract as the foundation for future connectivity. The proposed backbone would leverage the city's existing conduit, and was designed so that each tract could be added as needed once the backbone was completed.
2. Deploying fiber laterals in each tract to enable cost-effective connectivity to individual businesses. A key in the lateral design was to ensure that "taps" (where a fiber drop from a building connects to the lateral fiber) were located so that the drop costs were minimized.
3. Extending fiber to health care and educational facilities to create additional community benefits.
4. Extending fiber to additional office buildings and multiple-dwelling units near the backbone and lateral fiber routes to increase revenue and expand the benefits of the fiber availability.
5. Identifying private partners to offer services to the businesses over the open access fiber.

Culver City's next steps included:

1. Obtaining a connection into the carrier hotel (One Wilshire) in Los Angeles
2. Obtaining network operations center (NOC) monitoring and support
3. Obtaining a contract for fiber maintenance
4. Conducting focus group or other discussions with potential businesses and property owners in the identified tracts to help refine services (performance and price)
5. Reviewing proposed business models and finance plans with City legal counsel
6. Preparing a detailed fiber and network design that could be used to prepare bid and other procurement documents
7. Exploring with building owners the possibility of including a connection services contract with the owners' facility leases

8. Refining proposed service offerings, pricing, and performance attributes as discussions with potential ISPs unfolded.

5.11.3.3 Execution

The city created a “Municipal Fiber Network Enterprise Fund” in November 2015²⁰ and broke ground on fiber construction in August 2016. According to the city:

“The City will expand its existing fiber network to install approximately 21 route miles of fiber for a redundant network backbone. The network design includes three geographical network rings that are all interconnected and will also connect to the telecommunications hubs at One Wilshire and in El Segundo. The City’s goal for extending this network is to enhance economic development by facilitating the delivery of high speed internet access for Culver City businesses located within the target areas, as well as enhancing broadband connectivity to the Culver City Unified School District. The City will install an open access network, where it is envisioned that any ISP will have the opportunity to utilize the City’s fiber infrastructure to service the business community. This will result in the business community having more service options when selecting a broadband provider.”²¹

5.12 How Government Fiber Can Support Region 5 Economic Development Goals

Region 5 has developed a set of specific economic development goals on which to focus, and is currently developing a strategic plan for achieving these goals known as the “Growth and Diversification Plan.” The four goals are:

1. Build regional capacity for innovation in key cluster competencies.
2. Increase the pace of Small and Medium Enterprise (SME) creation through the expansion of existing firms and the attraction of out-of-region SMEs.
3. Increase the share of the 25+ population with a bachelor’s degree or higher.
4. Better assimilate existing military into the private sector clusters in the region.²²

²⁰ File 15-399, “Action Item,” City Council Meeting Agenda, City of Culver City, November 9, 2015, <https://culver-city.legistar.com/LegislationDetail.aspx?ID=2511600&GUID=46DF47E9-A9AF-4499-9ED2-24146E53D467&Options=&Search=>

²¹ “Groundbreaking for Municipal Fiber Network, Culver Connect,” Culver City website, August 30, 2016, <http://www.culvercity.org/Home/Components/News/News/246/722?backlist=%2F>. See also: <http://www.culvercity.org/how-do-i-/learn/municipal-fiber-network-project>

²² Source: Region 5 Draft Plan.

While the strategic initiatives recommended to meet these goals are not yet finalized, a regional fiber initiative will support these initiatives, and will greatly enhance the potential for many of them. A regional broadband initiative could support these goals in the following ways:

- Supporting innovation districts for high tech incubator programs frequently links higher education institutions and labs with such districts, for on-site development, internships, and partnerships. A regional interconnected network that links those institutions with such targeted districts and facilities will help make such programs more attractive.
- Supporting specific clusters that are geographically concentrated in business parks and incubator districts provides convenient aggregation points where fiber can be directed. Partnerships with universities and private entities can lower costs of the fiber infrastructure for all entities and also create opportunities for local last mile providers.
- The cable landing has already increased the public profile of the region as friendly to technology and innovation. A fiber infrastructure and fiber-related ecosystem will further increase that profile and support the branding, with the goal of attracting technology workers and SMEs. Early wins could include promoting satellite data centers around the landing, and innovation districts with fiber, as well as downtown incubators for start-ups. Over time, the value of the fiber will be further enhanced if excess fiber can be leveraged by the private sector to build lower cost, higher speed broadband options for residents.
- To support and attract talent and businesses, it is important to recognize that the more rural and urban areas of the region support each other. Some data centers and businesses will locate where space and real estate is more favorable, but need to be interconnected to the cable landing and high tech resources in central business areas. Conversely, people who work in high tech sectors in central business areas may prefer to live in areas with lower property prices and congestion. A regional network will support the full ecosystem.
- Addressing the skills gap and transitioning military personnel to high tech civilian jobs may involve joint programs with higher education, private business, and military institutions. Training academies or university satellite campuses can be excellent key locations to ensure fiber connectivity support such facilities, and provide onsite, and remotely accessed resources and education.

6 The Benefits of Robust Fiber Optics for Higher Education

Hampton Roads' institutions of higher education serve as foundational building blocks for south-eastern Virginia's regional economy. Constructing a fiber ring that connects these institutions to a high-capacity network will deepen their ability to collaborate and share resources, improving the competitiveness of each individual institution, as well as the region as a whole.

This section seeks to elucidate some of the benefits that a regional fiber optic network connecting localities and higher education facilities could bring to the region. It provides examples of how similar higher education networking efforts have fostered innovation and collaboration around the country, and proposes potential ways that existing partnerships and initiatives at local institutions could harness the capacity of the high-capacity network.

In brief, we believe the creation of a regional fiber optic ring could benefit the region in the following ways:

- **Improves ability of institutions to share services and resources.** The robust connection between institutions and campuses that the proposed network would create will improve remote instruction opportunities and facilitate the sharing of resources.
- **Enables regional research collaborations.** The proposed network will allow researchers to work with faculty from nearby institutions on large research collaborations involving the analysis of huge data sets.
- **Makes local institutions more attractive to grantors.** With the proposed network in place, local faculty will be ready to dive into research projects that involve the analysis and transport of large data sets. Grantors will not need to provide funds for additional network upgrades, or wait for the completion of network improvements before research can commence.
- **Makes local institutions more attractive to faculty and students.** Having more robust connections in place will make local campuses more desirable, providing an incentive for faculty and students to live nearby.
- **Protects institutions against the rising cost of connectivity.** With demand for bandwidth on the rapid rise, the cost of connectivity could become a budgetary burden if local institutions are forced to continue to rely on private service providers that only invest in network improvements when doing so promises a sufficient return on investment.

- **Allows for more data to be stored locally.** With a more robust connection, institutions can store more data locally, giving users more control over their data and keeping the associated IT support jobs in the local community.
- **Makes campuses better incubators.** Many high-growth sectors of the economy depend on robust data connections. The proposed network will allow local campuses to meet the needs of startups and freelancers in these sectors.
- **Improves the medical services and medical training available on local campuses.** The proposed network will enable advanced telemedicine applications, reducing the need for individuals on campuses to travel to medical facilities to receive care. At the same time, the network can enable remote training of health care professionals and shared, collaborative efforts in the medical and nursing fields.

These are some of the benefits that other communities have realized as a result of similar networking projects. But this is just the beginning. It's critical to note that multi-gigabit fiber connections are still in their infancy, and many of the most important ways these networks will be used have yet to be invented. Connecting the higher education institutions in the region to a high-capacity fiber ring will provide faculty, staff, and students with the bandwidth they need to help shape the future, and develop the research methods and advanced services on which tomorrow will be built.

6.1 Improve the Ability of Institutions to Share Services and Resources

Universities have been using data networks to share resources long before the commercial Internet ever took shape. After funding a handful of costly research computers, Advanced Research Projects Agency officials realized that no individual institution could take full advantage of the machine's potential, so they created ARPANET to facilitate the more efficient sharing of valuable resources.

Today, advances in networking technology allow institutions to share resources and services in ways that were never before possible, making the quality of an institution partially dependent on the quality of its connections to other high-caliber institutions. With abundant connectivity between schools, physical distance becomes less of a constraint. Students and faculty are not just able to access data, software and digital resources at partner institutions, but also mentors and peers with similar interests. Robust, reliable connections create new opportunities for remote instruction, and allows institutions to use resource sharing to free up room in their budgets.

In Vermont, a grant from the National Science Foundation helped build a fiber network between University of Vermont and all twenty-nine Vermont State Colleges campuses,

including twelve community colleges. The network was designed to allow smaller institutions across the state to “participate more fully in collaborative research with UVM scientists and educators.”²³ The fiber network increased the connection speed between institutions from 300 Mbps to 10Gbps. The increased bandwidth improves video conferencing capabilities and creates new curriculum options. Organizers of a bioinformatics class at Johnson State College were able to include instructors from other institutions, and open up the class to students across the state.²⁴

Similarly, in southeastern Michigan, a fiber education network is bringing university-level instruction to smaller community colleges. “Through high-definition, interactive videoconferencing across the fiber network, professors in East Lansing and Detroit can teach students in Clinton Township, providing them with advanced educational opportunities onsite at Macomb Community College.” Macomb Community College CIO reports, ““We have been exploring how to leverage our new network connection to share resources and reduce our operational expenses, including specific discussions with Oakland University about strategies that would lower our costs for both institutions while bolstering business continuity.”²⁵

Institutions in the Hampton Roads region have a long history of working together and sharing their strengths. A direct fiber connection will allow these partnerships to deepen, strengthening the educational offerings at each participating school. Institutions can use the network to take advantage of the resources and offerings of their neighbor institutions, freeing up capacity to allow each school to continue to develop their particular niches.

6.2 Enable Regional Research Collaborations

Research has always required dedicated team work, but as more and more fields require researchers to analyze large data sets, many important topics of inquiry demand more resources than a single institution can provide. Connecting universities and colleges to a common fiber network allows research teams to emerge from across traditional institutional boundaries. A fiber network enables the seamless transfer of large data files and guarantees reliable videoconferencing services.

For researchers working with instruments that generate terabytes of data, like DNA sequencers, 3D imaging microscopes or fluid dynamic modeling tools, collaboration is a must. The question

²³ Joshua Brown, “\$1 Million to Connect UVM and Vermont State Colleges,” *The University of Vermont; Office of Undergraduate Research*, September 26, 2011, <http://www.uvm.edu/ugresearch/?Page=news&storyID=12430&category=uvmresearch> (accessed July 2017).

²⁴ *ibid.*

²⁵ Brian Warkoczski, “Macomb Community College Leveraging Partnerships Through a Fiber-Optic Network Connection,” *Merit*, September 21, 2009, <https://www.merit.edu/macomb-community-college-leveraging-partnerships-through-a-fiber-optic-network-connection/> (accessed July 2017).

is whether they will be working with colleagues down the road or across the globe. Having the ability to supplement virtual collaborations with face to face meet-ups is certainly valuable, but researchers at Old Dominion working with large data sets will likely find it easier to work with colleagues at other institutions that also enjoy multi-gigabit connection to the Internet2 research network than with colleagues at universities and colleges nearby.

A regional fiber ring also multiplies the value of equipment that generates large data sets, making it accessible to a larger pool of potential users and allowing the burden of data analysis to be spread more broadly across Hampton Roads institutions. With a larger user base, instruments are used more efficiently, with less down time and more resources available to sort through resulting datasets. For example, if one of the colleges or universities in the region were to receive a grant for advanced ocean monitoring equipment, a regional fiber network would make the sensors an asset to schools across the region. Professors and students nearby could help with data analysis, or use the equipment for their own lines of inquiry.

The proposed networks' ability to increase access to costly instruments is particularly important for smaller institutions that are unlikely to have the resources to purchase such equipment themselves. Without a robust connection to equipment and faculty at larger institutions, many departments at these smaller institutions risk being left behind, shielded from the innovations that big data analysis are bringing to fields like engineering, physics, medicine and statistics.

6.3 Making Local Institutions More Attractive to Grantors

Connecting all of the higher education institutions to a robust fiber network will make each of these institutions more attractive to grantors, especially for projects that require researchers to work with large data sets. Such projects demand rapid data transmission rates, and with an increasing number of higher education institutions gaining access to abundant bandwidth, grantors will have little patience for institutions that have not made the effort to upgrade their network connections to meet the needs of 21st century research methodologies.

With the proposed network in place, higher education institutions in the region offer better value to grantors hoping to see the money they spend be put to the best possible use. Next-generation networks unleash research topics that would not be economically feasible if grantors were forced to pay for the necessary network upgrade themselves. For example, after University of Florida upgraded its research network from 20 Gbps to 200 Gbps, a number of new research initiatives became possible, including,

“a five-year project in the school’s College of Engineering to study compressible multiphase turbulent flow. This is an extremely demanding computational problem as it involves the motion of fluids, liquids and gases in a regime with turbulence, together with particles of a range of sizes. Think of describing the process of the collapse of a building: The concrete

turns into dust particles of varying sizes and the air is forced to move in many directions with shockwaves and vortices (turbulence). When that project received an \$8.5 million grant, reviewers at the U.S. Department of Energy’s Nuclear Security Agency commented that the network upgrade was partly responsible for the award. ‘Because we had put the infrastructure in place, the principal investigators could eliminate a lot of infrastructure costs from their budget,’ [Dr. Erik] Deumens, [director of research computing at UF,] says.

“The network upgrade also paved the way for a recent \$9.2 million grant from the National Institutes of Health to the Southeast Center for Integrated Metabolomics. “The principal investigator of that project told us they couldn’t have written that proposal two years ago,” Deumens says, “because they would have had to include too much money in the budget for infrastructure.”²⁶

Having the proposed network in place would also make Hampton Roads institutions more research ready. Even if grantors were willing to fund a necessary network upgrade for a local institution, they may be unwilling to wait around while necessary upgrades are completed, especially when there are researchers at other institutions ready to dive into the project as soon as funds are released. With more network capacity, researchers can avoid having to wait for large files to send or modeling tools to complete their tasks, allowing them to complete their tasks more quickly.

The proposed network will be built to be infinitely upgradeable, ensuring that researchers at local institutions have the bandwidth they need for many decades to come. Upgrading network capacity will be a relatively simple matter of switching out network electronics, ensuring that future research will not be held up as construction crews wade through the permitting process required to lay new cables.

Connecting higher education institutions to fiber also allows faculty to participate in major international research projects, like analyzing the data being generated from the European Organization for Nuclear Research’s Large Hadron Collider (LHC). Improving the ability of Hampton Roads-based faculty to participate in international research groups’ efforts to analyze enormous data sets creates new opportunities for prestige and funding to flow to local institutions.

6.4 Make Local Institutions More Attractive to Faculty and Students

The proposed network will make local campuses more attractive to both faculty and students alike, offering a reason to spend more time on campus and creating an incentive to live nearby.

²⁶ “100 Gigabit Ethernet: The Way Forward for Research Networks,” *Center for Digital Education*, 2014, <http://info.brocade.com/rs/brocade/images/CDE14%20100GbE%20BRIEF%20Brocade.PDF> (accessed July 2017).

With an increasing number of higher education courses moving online, physical campuses could start to seem like an anachronism. However, when campuses are connected to fiber, the abundant bandwidth they offer creates opportunities not possible on most home or small business connections, giving local institutions a competitive edge when attempting to recruit desirable faculty and students.

In addition to allowing faculty to participate in the growing number of research projects that involve working with big data sets, computationally intensive modeling tools and numerous high-resolution images, the improved connection speeds will also create new secondary income streams for professors at local institutions. Big data analysis skills are in high demand today,²⁷ and professors with related skills and a robust connection from their campus office are well positioned to supplement their income doing consulting with private sector clients.

Faculty working in fields like environmental science, biomedical research, geography, physics, meteorology, and others that increasingly work with large data sets, will likely spend more time on campus if the campus boasts a reliable, high-speed connection. Conversely, if an institutions network is over capacity with too much traffic, professors will likely find other places to get their work done. Slow connection speeds on campus may push faculty in big-data fields to take up part-time residence in nearby metropolitan areas, like Washington D.C. or Raleigh-Durham, where affordable gigabit connections are readily available.

Faster connection speeds will also help draw students to local campuses. For students in fields that work with large data sets, the network will allow them more exposure to cutting edge research methodologies that they will likely be required to learn if they wish to continue in the field. With an increasing amount of higher education instruction moving online, many students elect to complete degree programs remotely. Having abundant bandwidth on campus opens new opportunities for students that choose to move to the area and complete their coursework in person.

Even when the network is not being used for research purposes, it helps improve the quality of life for students living on campus. As long as bandwidth is abundant, researchers can have the network capacity they need and students can use excess capacity for recreational activities, like video chatting, streaming high-definition videos and playing video games. Students expect the applications they enjoy to work at least as well on campus as they do back at home, and administrators do not want to find themselves in the position of restricting recreational network use to ensure there is sufficient capacity for research purposes.

²⁷ S. Ransbotham, D. Kiron and P.K. Prentice, "The Talent Dividend: Analytics talent is driving competitive advantage at data-oriented companies," *MIT Sloan Management Review*, April 2015, <http://sloanreview.mit.edu/projects/analytics-talent-dividend/> (accessed July 2017).

And beyond recreational activities, a fiber ring could enable new opportunities for students who do not live on campus or who face long commutes to get to class. For example, for working students seeking advanced degrees on a part-time basis or at night, remote learning over robust fiber optics could enable students to spend their after-work hours studying, rather than driving long distances to get to class.

6.5 Protect Institutions Against the Rising Cost of Connectivity

Demand for bandwidth has grown steadily across the last decade, and shows no sign of slowing down any time soon. Institutions that rely entirely on private service providers may find that connectivity costs take up a growing portion of their annual budgets. Connecting higher education institutions to a fiber network that enables large increases in capacity at modest cost provides an important hedge against long-term increases in commercial carrier costs.

The proposed network will be built to allow massive increases in capacity at relatively modest incremental cost. The fiber optic cables themselves allow data to move at the speed of light, making them infinitely upgradeable. When an institution connected to the fiber network requires more bandwidth, they will only need to pay for new network electronics, rather than pay to put higher-capacity cables in the ground. Because the network will be designed to serve higher education institutions, rather than return a profit to investors, the price institutions pay for additional capacity will reflect the true cost of the upgrade.

Regional network members also aggregate demand, allowing each member to take advantage of economies of scale, both for in-network traffic and for outgoing connections to the public internet. Regional and statewide higher education networks, like North Carolina's MCNC and University of New Mexico's GigaPoP network allow participating institutions (and other participating partners, such as city and county governments, K-12 schools, and libraries) to enjoy better rates than they would receive if they tried to purchase bandwidth on their own.²⁸ The proposed network will guarantee that local institutions can keep up with growing demand for bandwidth without exhausting financial resources.

6.6 Allow for Data and Online Courses to Be Hosted Locally

Currently, bandwidth constraints effectively require some local institutions, such as Regent University, to place their massive amounts of data, curricula, and online services in the cloud. When data is sent into the cloud, all of the IT, network engineering and data center support jobs associated with keeping that data secure and accessible, move to wherever that data is physically stored. The proposed network could allow Regent University and other local

²⁸ Katie Remis, "High-Speed for higher ed," *University Business*, July 27, 2015, <https://www.universitybusiness.com/article/high-speed-higher-ed> (accessed July 2017).

institutions to store more of their data and online services on their home campuses in the region, bringing the associated support jobs (such as network engineering, IT services, and data center operations) into the region—rather than supporting jobs in the metaphorical cloud that are almost certainly located outside the region or Virginia.

Improving the ability to store data locally is especially important for individuals working in the cybersecurity field. Local storage gives users more control over exactly who and how their data is accessed. For example, as Old Dominion University continues to coordinate the Hampton Roads Cybersecurity Education, Workforce and Economic Development Alliance,²⁹ it is critical that researchers, professionals and students associated with the project can share relevant data across a secure network, without worrying who else may gain access to their data. Users could use the proposed network to store sensitive data locally, and only allow authorized users to access the data from campuses attached to the network.

6.7 Making Campuses Better Businesses Incubators

With big data poised to remake many sectors of the economy, from medicine,³⁰ to manufacturing,³¹ to finance,³² access to abundant bandwidth is critical to enabling innovation and entrepreneurialism. Unfortunately, startups working on a bootstrap budget often find it hard to afford the high-capacity connections needed to build new products and services based on multi-gigabit connections. This is part of the reason why startups have flocked to places like Chattanooga³³ and Kansas City,³⁴ two of the first cities in the U.S. to offer affordable gigabit connections. In order to take advantage of the new business opportunities that better broadband creates, entrepreneurs and their teams need affordable access to next-generation networks.

²⁹ Richard Walker, “Universities to benefit from new NIST grants to spur cybersecurity education,” *edscoop*, September 22, 2016, <http://edscoop.com/new-nist-grants-program-to-spur-regional-cybersecurity-education> (accessed July 2017).

³⁰ Jacqueline Vanacek, “How Will Big Data Remake Medicine,” *Forbes*, April 3, 2014, <https://www.forbes.com/sites/sap/2014/04/03/how-will-big-data-remake-medicine/#550e79f232ac> (accessed July 2017).

³¹ Ben Kerschberg, “How Big Data and Business Intelligence are Changing the Manufacturing Industry,” *Appirio*, December 1, 2014, <https://appirio.com/cloud-powered-blog/big-data-business-intelligence-changing-manufacturing-industry> (accessed July 2017).

³² Silvia Elaluf-Calderwood and Jonathan Liebenau, “How is big data transforming the financial sector,” *The London School of Economics and Political Science; LSE Business Review*, March 1, 2016, <http://blogs.lse.ac.uk/businessreview/2016/03/01/how-is-big-data-transforming-the-financial-sector/> (accessed July 2017).

³³ “Startups Boom in Gig City,” *Chattanooga Magazine*, June 14 2017, <http://chattmag.com/2017/06/startups-boom-in-gig-city/> (accessed July 2017).

³⁴ Marguerite Reardon, “Google Fiber spawns startup renaissance in Kansas City,” *CNET*, June 19, 2013, <https://www.cnet.com/news/google-fiber-spawns-startup-renaissance-in-kansas-city/> (accessed July 2017).

Campuses with abundant bandwidth can play an important role in filling the gaps in affordable access to high-speed connections for startups and small businesses. For example, Bucknell is using its speedy connection to the Pennsylvania Research and Education Network (PennREN) to offer high speed connections to the startups housed in its Entrepreneurs Incubator. Many of these businesses are technology based startups with a large demand for bandwidth. Without the ability to take advantage of the campus connection, these startups would likely be forced to relocate to a region with more affordable connectivity.³⁵

As faculty and students learn to harness the potential of the high-quality campus connections, they may identify business opportunities that better broadband connections create. The proposed network can help turn local campuses into hotbeds of innovation, where ideas can be nurtured and given the support they need to become sustainable businesses.

6.8 Improves the Medical Services and Inter-Campus Collaboration and Training Available on Local Campuses

Many local institutions have campus health centers on site, but when individuals come in with conditions beyond the expertise of the available staff, patients must be referred to an offsite hospital or medical specialist. Students and faculty managing a chronic condition may be forced to do so without much medical supervision. Connecting higher education institutions to a fiber network allows medical centers to expand the medical staff available on-site.

With the help of digital diagnostic equipment, high-speed broadband networks can allow health center staff to send high resolution images to qualified medical professionals, allowing the patient to avoid a costly, time-consuming doctor's visit. Telemedicine is already being used in public school districts that lack the resources to have a full-time nurse at every school³⁶. In some cases, trained but uncertified personnel are permitted to take on new tasks with the virtual supervision of qualified medical professionals.³⁷ For example, working with Eastern Virginia Medical School's Sentara Norfolk General Hospital, the proposed network could help distribute advanced medical services more widely across the region.

The proposed network could prove particularly important in the event of a regional crisis, such as a severe hurricane or a rapidly spreading epidemic. In such a case, local campuses may be forced to serve as emergency medical facilities, and the fiber network would ensure that each

³⁵ Matt Hughes, "The Benefits of Fiber," *Bucknell University*, August 19, 2014, [http://www.bucknell.edu/news-and-media/2014/august/the-benefits-of-fiber-\(optics\).html](http://www.bucknell.edu/news-and-media/2014/august/the-benefits-of-fiber-(optics).html) (accessed July 2017).

³⁶ Michael Ollove, "Telemedicine in Schools Helps Keeps Kids in the Classroom," *The PEW Charitable Trusts*, January 4, 2017, <http://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2017/01/04/telemedicine-in-schools-helps-keep-kids-in-the-classroom> (accessed July 2017).

³⁷ Neil Versel, "As school nurses disappear, telemedicine fills in the gaps," *MedCity News*, May 18, 2016, <http://medcitynews.com/2016/05/school-nurses-telemedicine/?rf=1> (accessed July 2017).

site can connect and send and receive information to appropriate medical personnel, both within the region and at large. The fiber ring could also allow for important innovations and efficiencies in collaboration and training of healthcare personnel. For example, nursing programs could conduct distance learning among campuses in the region, allowing for training of students at multiple and satellite campuses.

Appendix A: Summaries of Meeting Notes with Jurisdictions

During the summer of 2017, CTC engineers conducted in-person meetings with stakeholders from the cities of Portsmouth, Norfolk, Suffolk, and Chesapeake. The purpose of the meetings was to gain insight into each jurisdiction's existing fiber network, priorities for network expansion, and to better understand each jurisdiction's Right-of-Way regulations and assets. CTC has summarized the content provided by the jurisdictions below.

Portsmouth

Currently the City of Portsmouth has approximately six miles of fiber, most of which is leased from Cox as part of a franchise agreement. The City has developed a fiber master plan and intends to use CIP funds to build out its own fiber optic network, independent of the franchise fiber. Once implemented, the network will connect the City's departments and serve all municipal buildings. The City expects the fiber network will be constructed within the next five years. Portsmouth has a contract with the Virginia Information Technology Agency (VITA) for telecommunications services between its buildings. The buildout of a citywide fiber network as proposed in the master plan can replace many of the services purchased under this contract.

With the exception of historic neighborhoods, the City utilities are mostly underground, and it is expected the future fiber network will be constructed as an underground utility. The city has estimated costs of around \$23/foot for underground fiber construction, this based on previous projects in the region and pricing from Norfolk's contract vehicles, which the other jurisdictions are able to leverage for their own fiber construction. The City expects the majority of new fiber construction will occur in the City's Public Rights-of-Way (ROW), with some portion occurring in VDOT ROW as needed.

In addition to serving municipal buildings, the City would like for their network to provide connections to schools, libraries, better serve subsidized housing, and be used for economic development purposes such as fiber leasing.

The City can leverage its proposed fiber network to become the starting point for regional connectivity. By adding fiber from locations on the Citywide fiber network to points in the neighboring cities, the city can seamlessly become part of a regional network.

The City pays Cox \$4000/month for 200 Mbps symmetrical internet service. The city would like to reduce this cost, potentially by purchasing internet services as part of a larger regional group of cities, and by purchasing them more cheaply at a major interconnection point, eliminating the cost of transporting the internet capacity to Portsmouth.

The City sees many other potential uses for regional interconnection including the following:

- Interconnection of base stations of the regional LMR Orion Network
- Providing access from Portsmouth to the cable landing site in Virginia Beach
- Leasing fiber to 5G providers who require it to connect antenna sites in Portsmouth
- Procure internet as a region at lower prices
- Support future IoT devices and applications
- Development of a regional 9-1-1 public service answering point (PSAP) (currently each jurisdiction in the region operates their own)

Norfolk

The City is pursuing a \$4.1 million project to build their own fiber, where they expect to build between 30 and 50 miles of fiber. The planned network will utilize a 96-count cable for the backbone and is being designed to providing speeds up to 40 Gbps.

Norfolk will have their construction vendor, Secured Network Solutions (SNS), maintain the new network. Norfolk's contract with SNS has contains collaborative language allowing for other jurisdictions to utilize their pricing. The City pays approximately \$25/foot for underground construction and \$15/foot for aerial construction. The City's fiber will have no restrictions when leasing for economic development.

The City uses dark fiber from Cox and intends to continue leasing Cox fiber for lower speed connections to facilities, like recreation centers. The City pays \$4500/month for symmetrical 1 Gbps Internet from Cox.

Norfolk Traffic owns and operates its own dark fiber. There are currently no constraints restricting use of fiber for "traffic related" purposes. There are some instances in which Norfolk fiber is located in VDOT conduit as part of a one-for-one trade with VDOT getting equivalent access to Norfolk fiber assets. The City of Norfolk's existing fiber network is 99% underground, they have one aerial railroad crossing.

Additionally, the Navy would like Norfolk to have good internet connectivity. The Navy has its own systems for military purposes, but they want their service personnel, civilian employees, and contractors to benefit from the improved quality of life offered by City having better broadband.

The City sees many potentials uses for regional interconnection including the following:

- Purchasing internet as part of a bulk regional arrangement
- Backhaul for a regional LMR Network
- Higher education interconnection
- Interconnection to ESVBA and Mid-Atlantic Broadband Coop (MDBC) for broader regional connectivity and diverse internet connectivity

- Public safety applications, such as mutual aid coordination and improving joint police coordination in the Tri-City area
- Shared Services
- Interface between jurisdiction CAD systems
- Sharing network planning tools regionally, such as Virginia Beach's Schneider Electric tool

Higher educational institutions in the City include Old Dominion University (ODU), Norfolk State, Tidewater Community College (TCC), and Southern Crossroads Joint Forces Staff College at ODU.

The Granby Municipal Building data center across from TCC is both a key internet connection point in the region and the City's main network location. Many entities use the data center including NOAA, public schools, Norfolk State, and TCC. Placing Granby on the regional network would serve the purposes of interconnecting Norfolk to the region and creating a connection from Granby to all the higher educational facilities, economic development facilities, and the cable landing in Virginia Beach.

Chesapeake

The City currently has no fiber outside of its main campus location and uses Cox leased services. They pay Cox \$430,000/year to connect 47 remote facilities. These sites are a mixture of fiber and cable modem connections, with the smaller facilities tend to be connected via cable modem.

The City is in discussions with Lumos to get 18 strands of dark fiber over routes where Lumos is building new fiber infrastructure. Lumos will most likely allow regional interconnection over their fibers, although any use for economic development will not be allowed. Additionally, CenturyLink is building a 144-fiber backbone path to Virginia Beach on Providence and the City will have some access to this route through its own handhole locations. These routes were discussed verbally with the City, but the routings were not included as part of the mapping provided by the City.

The City is building a hardened data center which will be constructed by the end of 2017. The facility will serve as a public safety operations center with a 2-stories for EOC, 311, PSAP, and training. This data center will have regional role also serving the State, U.S. DHS, the military, and VDOT.

Existing City assets include a 500-foot tower which the City uses for LMR. The City of Portsmouth and Regent University also have access to the tower for their P25 LMR use.

Chesapeake owns its rights-of-way, VDOT only owns the interstate ROW. All streetlights in the City are owned by Dominion Power, but the City does own the traffic light poles. City owns 200 pump stations.

The City sees many potential uses for regional interconnection including the following:

- sharing asset management software, real estate assessment, ESRI, CAD system interconnection
- Interconnection of Chesapeake-based businesses to the VA Beach fiber landing to for a low-latency connection for applications such as currency trading
- Application of WHRO's (NPR affiliate) licensing on software for all school districts, allowing for the 60% savings to be leveraged by multiple jurisdictions
- Service to TCC campus near Chesapeake fire station, who are currently on Cox
- Connection to a Smart City site near the VA/NC border along US-17

It typically costs the City \$40/foot to construct fiber using Norfolk contract.

Suffolk

The City has approximately 100 miles of fiber. The fiber serves separate networks: Suffolk traffic, internal city government, and the schools. The City owns about half of the fiber mileage, while the other half is provided by Charter under a franchise agreement. Charter typically provides four strands per site, while the fiber that serves the City and traffic range from six strands up to 144 strands per cable. The fiber is evenly split between aerial and underground installations.

The City manages its own network electronics, and has the ability to test fiber as needed but have a time and materials contract with their outside plant contractor.

The City currently has contracts with three different internet service providers. The largest contract is with Charter, and provides Internet service for the City-owned fiber. The Charter contract is around \$1200/month. The City pays around \$500-\$600/month for a backup circuit with Cox, and pays Charter around \$500-\$600/month for a circuit serving the City Emergency Operations Center.

The City government only interconnects with a few external entities. These include the court building which houses state employees, and the regional jail which uses Suffolk's phone system. Additionally, Suffolk shares a couple of sites with the school system. There are no current plans for Suffolk to connect to an external data center for its own needs, but the City is interested in mutual backup/recovery with other jurisdictions. The City shares traffic video with VDOT with whom it interconnects at US-15 and Route 10. Suffolk indicated that TCC has expressed interest in connecting its facilities to the City fiber optic network. The City sees many potentials

beneficial uses for a regional interconnection, including regional applications serving transportation and law enforcement.

Suffolk City provides Wi-Fi in every public facility for public use, but this service is routed through a Charter cable modem and does not rely on its fiber optic infrastructure. There are discussions for delivering Wi-Fi to the City's Main Street, but this initiative is still in the early planning stage, and not part of any formal plan.

The City considers building out its internal network to address gaps a higher priority than regional interconnectivity. For now, the City sees benefit in participating in the regional interconnection project as more fiber in the region is always beneficial. Suffolk would be more interested in the initiative if clear goals driving the interconnection could be articulated. Furthermore, security, demarcations, and responsibilities for managing the interconnections and fiber segments would have to be developed to ensure the success of the interconnection network.

In terms of where Suffolk sees gaps in its network, the northern part of Suffolk is currently seeing tremendous growth and the City is reliant on Charter to serve that area. In particular, the City would like to extend its network to areas around Mansway Parkway in NE & East Suffolk. Fire and Police in the area are currently served by Charter. Suffolk would like Fire Station 5 to become a distribution site, but the City is currently limited by available strands serving that site.

While the City pushes to have fiber installed whenever new capital projects are undertaken, there is no formal process for requesting that fiber be incorporated into the building project. On the other hand, the interviewees reported that they rarely experience pushback when requesting that fiber be included.

Suffolk has rights to attach on power utility poles per its franchise agreement with the power utility, but the City does not have any agreements regarding access to utility conduits with any utility. Joint ROW policies are currently being developed as part of franchise agreement negotiations and are expected to be included in any future agreements.

Hampton

Hampton estimates it has some 65+ miles of fiber serving its own purposes. The IT department is aware that the schools have sent out an RFI for connectivity to potential providers, but the schools are not currently integrated with City fiber infrastructure.

The City's fiber support two main networks. The dedicated data fiber is mostly downtown and underground; it serves social services as well as other government data communications handled by the City's IT department. The traffic fiber serves transportation as well as a few

public safety locations. Unlike the data fiber, the traffic fiber is mostly aerial on Dominion and Verizon poles. Initially the installation of this fiber was due to VDOT's traffic management needs, which required the pole owners to grant pole attachment for the fiber. While the aerial fiber is restricted, it does belong to the City, so it owns all its fiber.

The City is working on procuring fiber in the future, but it stated that it has a number of big challenges it is working to overcome. Hampton does not have the necessary staffing to support such an effort and to build internal expertise. The City has also experienced turnover that makes such efforts even more difficult—in part because it is not always easy to capture documentation that would facilitate training replacement staff.

Sometimes getting to a location can be cost-prohibitive, as when the City was trying recently to build out to a library that is remote from current fiber infrastructure. The City ultimately reached an 80 percent/20 percent E-Rate reimbursement solution with Lumos.

Hampton is collaborating with Newport News on an interconnection this summer to share CAD data, but otherwise is not interconnected with other regional entities. The cities are planning other application sharing as part of that effort, and are planning to share a 911 Center, for which they are currently working on a CIP. The City is colocated with VODT, but there are no plans to interconnect with each other.

The City uses two ISPs: Cox and Lumos. It pays about \$28,000 annually for 200 Mbps service from Lumos, and \$39,000 for a 200 Mbps circuit from Cox. But the City needs to expand those speeds.

For new builds, the City puts everything underground. This avoids restrictions on aerial deployments, which are granted only with the stipulation that the fiber be used for traffic. The City has no such restrictions when it deploys underground. City fiber is typically 12 to 36 strands, but there are places there the strand count is 148, especially on newer builds.

Hampton is aware that there is a lot physical fiber plant in Fort Monroe, but not certain where and how it would play into future economic redevelopment plans for that area. There are other sites on the City's wish list, including a steam plant and a fire station at a NASA facility. In terms of the later, the city did discuss some collaboration projects, but NASA has high security requirements that make it difficult. Langley also offered to do some sharing. There are also libraries and fire stations it would like to connect.

There are also areas to which it may be cost-prohibitive or unnecessary to connect. The business park is already set up with Verizon, so there is no clear business case for going there. Hampton does a lot of redevelopment, so infrastructure is largely there already. The Granview

area, on the other hand, is too remote and costly to reach and there is not much density there to justify City-implemented connectivity.

The larger issue may not be that there are current critical unmet needs. Rather, if it is just a question of faster speeds at lower costs to existing government sites, perhaps there is a business case—but it would be because there are no current options. On the other hand, regular citizens cannot afford current rates for high-speed broadband. A similar story exists for affordable business tiers to serve the business community.

Documentation of their fiber infrastructure is always a challenge, but the City is working with a consultant to bring the documentation up to date, and is evaluating a couple of different software solutions for this effort. In general, Hampton expressed that its largest concern is managing what it currently has before an aggressive expansion. Customers expect a high level of service, so the City needs to scale up with skills, resources, and capabilities to meet those expectation. This has to start with an internal review of its own capabilities and expertise, especially among the traffic signal engineers who are used to dealing with fiber.

The City is concerned about expanding critical services, including to business and economic development partners. If internal traffic signaling resources are used for that, it could affect operations of traffic, so it needs to be thought out carefully.

The City is planning to revisit its franchise agreement to see if there are ways to expand utilizing that agreement.

In terms of public-facing communications, the City does provide Wi-Fi at its City Hall and is planning to roll it out in its recreation centers. It also has a partnership for downtown Wi-Fi, but neither of these initiatives ride on the City's fiber optic network.

For future uses, the City is seeing expansion of cloud application, and is exploring how to conduct off-site backups. Replication is currently done on the fiber network, but the City still backs up to tape for now.

Newport News

The City has extensive fiber covering much of its footprint. About 15 years ago, a joint school and City effort installed fiber in underground conduit to most of its facilities. The City owns not only the fiber, but also all of the conduit. Of the bundle installed, 48 strands are the City's while the rest, about 10 times more, was allocated to the schools. The fiber optic plant is maintained under a contract that covers both physical networks, but the networks are separate and independent of each other. The City's fiber infrastructure now covers around 80 miles.

Most of the City's facilities are on fiber, with a few outliers on wireless. Since several extensions have been made, there are areas, especially in the Southern loop, where only a couple of unused strands of the City's allocation are available. It is possible the City could negotiate with the schools for access to some of its unused allocation, especially since some of the fiber does not go to any school facilities. The other option the City is considering is to implement DWDM technology to split the signals into more wavelengths. There is also plenty of spare capacity in the conduits for pulling additional fiber.

Because the fiber is underground in a fairly dense, urban environment, the City experiences frequent fiber cuts requiring repairs.

Newport News does not currently have any non-government entities on or interconnecting with its fiber infrastructure, but it would like to be able to partner for such projects. The City is especially interested in economic development and helping the business community get affordable broadband, although it is not sure how to structure such an initiative so it does not run afoul of any laws or regulations. There are also underserved areas in the lower-income southern part of Newport News where the City would like to leverage its infrastructure to offer free or subsidized wireless solutions.

The City is working with a very active business development community that sees affordable fiber as a key goal. They are especially interested in getting broadband out to the business parks, mid-town, and the technology park.

The challenge for filling that gap is that Cox is not currently providing fiber optic solutions, and Verizon only covers about 40 percent of Newport News, and neither seems interested in expanding. These two are the primary providers; there are two smaller providers as well, with a fairly small existing footprint.

The City contracts for ISP service at \$55,000 annually for 400 Mbps, which it considers expensive and slow.

Besides the interconnection project with Hampton for public safety, Newport News has no current interconnections. The City approached VDOT for access to its fiber, and traffic engineering received four strands for camera and signal control, but the use of that fiber is highly restricted.

The City is in the process of exploring cloud services. It is exploring an IP circuit with a cloud exchange partner for that purpose.

The City is providing public-facing Wi-Fi at City facilities split between separate public and guest networks, and is also providing service at public libraries. It is exploring installing more hotspots

in key areas. Because of the lack of affordable broadband many people, especially young people from lower-income areas, drive up to library parking lots at night to get internet access.

For a regional interconnection strategy, public safety really is an important driver, and the region has put some thought into collaborative public safety communications that could be expanded. There are a lot of opportunities in that regard, such as supporting regional and state message boards, increasing the infrastructure of traffic and CCTV cameras, and the expansion of WebEOC as a platform for emergency management adopted by many of the jurisdictions in the region.

Appendix B: Summaries of Meeting Notes with Higher Education and Further Data Collection

CTC conducted in person meetings in July 2017 with CIOs of various higher education institutions invited to participate in this initiative. The purpose of the meeting was to gain insight into each institution's existing fiber and assets and to determine priorities for network expansion. We have briefly summarized the content of the conversations with the institutions below.

Tidewater Community College

Tidewater Community College (TCC) has campuses in all five cities. They have eight locations in total, which are comprised of four comprehensive campuses and four remote centers for learning. TCC is strictly a teaching institution; they do not conduct research.

TCC's current connectivity to other higher education institutions is limited. They do not have a direct fiber connection to Old Dominion University (ODU), but have placed a request for a future connection. All of TCC's campuses are connected via redundant connections provided by either Verizon or Cox. TCC has no issue with the current bandwidth, though it expects a need to upgrade capacity in the future. TCC's main connectivity issues relate to the high cost and low reliability of their current service.

Lumos has approached TCC with an offer for better reliability at an attractive price point, but TCC has not followed up on this offer and expects that if they do improve their connections they would need to involve Verizon as well. TCC can terminate their Verizon contract at any point. If they were to switch to Lumos they would be required to sign a three-year commitment.

The college has to contract through a competitive procurement process.

TCC views the regional interconnection as an alternative higher bandwidth option for them. TCC owns their Wide Area Network (WAN) and would allow a regional initiative to utilize it.

TCC has some need for higher bandwidth. It provides training for industry support and have telehealth operations that occasionally require higher bandwidth. Additionally, TCC's Virginia Beach campus has a Bio Accelerator and they have two small R&D companies located on campus space that would benefit from higher bandwidth.

Regent University

Regent University is a singular institution that attracts students from all over the world. Campus growth is an important focus of the University. Enrollment has grown from 2,000 students to 10,000 students in the last 10 years. With their current growth model, they expect to reach

40,000 students within the next 10 years. Seventy percent of enrollment is online. Regional interconnection could support campus growth, both with respect to educational and residential needs. Robust fiber-based regional interconnection could enable the University to host more content locally rather than in the cloud.

Regent's service is provided by Cox, which offers custom services on two separate rings. Lumos has approached Regent about switching service providers.

Regent is developing a cybersecurity center and has purchased software called Cyber Range to support that initiative. The University is looking to commercialize cybersecurity services. Regent also operates a 200 person call center that receives 500 to 6,000 calls per day.

The average age of students at Regent University is 34. It is important for the institution to be able to contact students after business hours.

Old Dominion University

Old Dominion University (ODU) owns 14 strands of fiber all around the region. Additionally, they have a 100 Gbps connection to the Equinix data center in Ashburn, a 100 Gbps connection with Virginia Tech University, and a 10Gbps connection to the City of Atlanta. They use their connection to Ashburn to peer with Internet2 and obtain commodity Internet. ODU uses Cox DWDM to peer with other universities and the Jefferson Lab.

Currently the National Oceanic and Atmospheric Administration (NOAA) has six sites they want to connect to ODU's network in order to take advantage of the 100G connection to Ashburn.

ODU has a strong partnership with Mid-Atlantic Broadband Communities Corporation (formally Mid-Atlantic Broadband Co-op). The university also partners with WHRO, a locally based radio station.

ODU has a 10-year IRU from Suffolk for fiber to connect to its southern campus location.

ODU plans to have future connections to Washington, DC and the Corporate Landing business park in Virginia Beach.

Robust fiber-based regional interconnection could enable ODU to host more content locally.

Norfolk State University

Norfolk State operates its network on a 10 Gbps backbone provided by Level3. Currently, they only use 1 Gbps of capacity due to the high costs associated with the larger capacity. The University was approached by Lumos who offered to provide 2 Gbps service to their main

campus location. Norfolk State's Virginia Beach campus has two 200 Mbps connections, but that is not enough bandwidth for their needs. The University is unable to support research with the current capacity, they would like to have 10 Gbps speeds and a connection to Old Dominion University.

In collaboration with ODU, Norfolk State operates the Center of Excellence in Cybersecurity which requires significant bandwidth to operate.

The University is required to contract through a competitive procurement process.

CTC Data Request Template for Higher Education Institutions

The City of Virginia Beach provided CTC with a contact list for higher education institutions participating in this initial scope of the regional interconnection. The list provided to CTC included contacts for Tidewater Community College, Old Dominion University, Regent University, Virginia Wesleyan University, Norfolk State University, and Eastern Virginia Medical School (EVMS). As part of the data collection process, CTC reached out to each to the contact for each institution to obtain campus location information and building locations for where current internet and data connections are located. Each of the higher education institutions responded to the request. Below is the template CTC used for the data request to the higher education institutions.

Dear Recipient,

As you know, the Virginia Beach government is leading a project to develop a plan to interconnect and expand fiber optic networks in the region for economic development and educational and government purposes. I am leading the CTC Technology and Energy team performing the technical feasibility analysis. Joanne Hovis from our team spoke with you earlier. As part of the pre-engineering task, I have a short request for information.

The vision for the first stage is to interconnect the local communities and higher educational institutions in the South, and for subsequent phases to target the peninsula and the remaining Hampton Roads communities.

In order to complete the technical and cost analysis, we are requesting the location of each of your campuses, and the street address where the current internet and data connections to the campuses are connected.

Best regards,

