

Date of Meeting: July 18, 2019

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**BOARD OF SUPERVISORS
BUSINESS MEETING
ACTION ITEM**

SUBJECT: **FINANCE/GOVERNMENT OPERATIONS AND
ECONOMIC DEVELOPMENT COMMITTEE REPORT:
Columbia Telecommunication Corporation's Study
Findings and Recommendations for Broadband for
Loudoun County**

ELECTION DISTRICT: Countywide

CRITICAL ACTION DATE: At the pleasure of the Board

STAFF CONTACTS: John Sandy, County Administration
Wendy Wickens, Director, Information Technology
Zenon Dragosz, Administrator, Information Technology

PURPOSE: To provide the Board with an overview of the findings and recommendations for broadband included in the Columbia Telecommunications Corporation (CTC) Study completed in February 2019. The study includes information regarding the potential costs for connecting County facilities with a private Wide-Area-Network (PWAN) to reduce costs for the provision of Internet access, and for the identification of costs, alternatives, and funding options, for the provision of broadband internet services to unserved and underserved areas of western Loudoun County in support of the Board's adopted Broadband Strategic Plan.

RECOMMENDATIONS:

Finance/Government Operations and Economic Development Committee (FGOEDC): At the FGOEDC meeting on July 9, 2019, the FGOEDC recommended (5-0) the Board of Supervisors direct staff to work through the FY 2021 budget process to identify funding needs for the deployment of such a network. The FGOEDC further recommended the Board of Supervisors (Board) work through the County procurement process to identify procurement options through either a cooperative agreement or Request for Proposal (RFP), for the deployment of a middle mile fiber network to key County facilities using a private 3rd party entity who would own and operate the network as recommended by Columbia Telecommunications Corporation.

Staff: Staff concurs with the FGOEDC recommendation.

BACKGROUND: At the June 21, 2018, Board Business Meeting, staff communicated that the Department of Information Technology (DIT) had entered into an agreement with Columbia Telecommunications Corporation (CTC) to provide broadband network design, review of the Loudoun County Public Schools (LCPS) fiber build and to review possible opportunities for commercial, private investment in accordance with the Commonwealth's guidelines for local government funded broadband networks at a cost of approximately \$130,000.

Additionally, at the June 21, 2018, Board Business Meeting, the Board unanimously adopted the County's Proposed Broadband Strategic Plan (Plan)¹. This Plan resulted from the Board's November 1, 2016, adopted Strategic Plan's focus area for Economic Development², which is to increase broadband and cellular access in western Loudoun County. The Plan, identified connectivity issues facing Loudoun County departments and residents in the near, and long-term, due to the lack of high-speed broadband services in western Loudoun County, and proposed next steps to alleviate those issues. The second goal within the Plan was for DIT to work with a vendor, such as CTC, to identify potential areas of overlap between the current LCPS proposed fiber expansion project and County facilities and to identify opportunities for cooperative network infrastructure buildout. When completed, the CTC Broadband study was to identify possible opportunities to leverage the LCPS fiber investment to improve County facility broadband as well as identify opportunities for private investment expansion into unserved and underserved areas of Loudoun County. This item provides a synopsis of the findings of the CTC study and recommendations going forward.

CTC Study Approach

Per the Board's adopted strategic plan, the CTC study's focus was with regard to expanding broadband in the western areas of Loudoun County. The study's approach was toward helping close the broadband gap through the build of a PWAN. The study also contemplated that the County would include additional fibers that could be used to provide an open-access network for residential broadband expansion where the County could lease the unused fibers to Internet Service Providers (ISPs) that could provide the last mile solution for broadband expansion.

A fundamental principle of the study was that the County would not own, operate, maintain, or manage a fiber optic network for the County and/or residential expansion. The analysis was based upon the premise that the County would operate as an anchor tenant as part of a fiber network and would build such a network to reduce connectivity costs to County facilities while providing options for reducing the overall entry costs for ISP's to expand services into rural localities.

The CTC analysis includes estimated costs that could be incurred should the County decide to fund a PWAN to interconnect County government facilities, with a focus on those facilities located in western Loudoun. It also provides estimated costs that might be incurred for the expansion of broadband to the rural localities of the Catoctin and Blue Ridge Districts. Additionally, the study

¹ [June 21, 2018, Board Business Meeting Item 9, Loudoun County Proposed Broadband Strategic Plan](#)

² [November 1, 2016, Board Business Meeting Item 7, Strategic Plan Follow-Up/Workplan](#)

identifies potential funding options and evaluates possible government grant funds available for broadband expansion.

The study also did the following:

- evaluated the retail broadband market in western Loudoun County to identify the types of services available and their related pricing;
- conducted residential market research to identify broadband needs;
- facilitated discussions with internet service providers operating in western Loudoun to learn what market forces or County support might enable them to expand their service offerings;
- prepared a high-level network design, cost estimate, and financial analysis for a middle mile fiber optic network deployment that might help ISPs fill broadband gaps in the western portion of the County;
- prepared a high-level cost estimate for a fiber-to-the-premises (FTTP) network that would bring western Loudoun to broadband infrastructure parity with the eastern County; and
- analyzed federal funding opportunities to identify potential sources of grants or loans (to the County or to ISPs) that might support the expansion of broadband services in western Loudoun.

CTC Findings

PWAN: The creation of a PWAN, or middle-mile network to connect County facilities, would require the construction of roughly 140 route miles of fiber interconnecting sixty (60) County facilities at a cost estimated at approximately \$16.1 million. Over the course of 20 years, should the County decide to own, operate, maintain, and manage the network, estimated network operations, maintenance, and financing would cost the equivalent of approximately \$2,290 per site, per month, or a total of \$1.65 million annually. These costs would escalate in subsequent years. It is important to note that staff does not recommend County ownership, maintenance and management of the PWAN, or middle-mile network. These assumptions and costs were developed by CTC for illustrative and comparative purposes.

FTTP: Bringing broadband infrastructure parity to western Loudoun would require the construction of a robust wireline connection to every home and business. The analysis suggests that deploying an FTTP network in western Loudoun would cost up to \$130 million or more for capital costs alone, not including operating expenses. The CTC analysis estimated the average cost per passing to build fiber along all roads in rural western Loudoun, such that all premises have the potential for services in the Blue Ridge and Catoctin districts to be in parity with the eastern districts, based on the size, density, and topographical conditions of each. At the low end, that cost might be estimated at \$6,000. Realistically, it would likely be \$7,500 to \$9,000 per passing.

By comparison, in eastern Loudoun, the per passing cost would be estimated in the \$1,500 to \$2,500 range, depending on the population density and the amount of underground construction, among other factors. CTC believes that the construction costs may be reduced modestly if it is possible to leverage existing infrastructure in pockets of high-density developments in western

Loudoun. But the fact remains that the cost to build FTTP in western Loudoun is likely to be at least four times that of many metropolitan areas on a per premises basis. It is important to note that staff does not recommend the FTTP solution due to prohibitive cost and the fact that subscribership does not support such an effort.

Outreach to ISPs: Notwithstanding all these challenges, the competitive ISP industry in western Loudoun County has voiced interest in creative partnerships with the County (i.e., County support of various options) to reach the most remote areas of western Loudoun. Over the course of the field work for this Study, CTC analysts reached out to many (and subsequently spoke with a majority of) ISPs that are active in western Loudoun. While the larger incumbents did not respond to their requests for meetings, many of the smaller competitors were willing and helpful in sharing data and ideas. Per the Study, CTC spoke extensively with a range of providers that have deployed wireless technologies—and, in a few cases, fiber. CTC found that there clearly is a vibrant community of competing smaller, entrepreneurial ISPs in the western part of the County. They range across the full geography of the west—some focused further north with corresponding holdings in Pennsylvania or Maryland, and others in the central or southern part of western Loudoun with further operations in West Virginia or other parts of Virginia.

Without exception, these ISPs in the past have indicated a willingness to partner with the County—with the expectation that the County could facilitate and support better and more extensive service in western Loudoun. All of the ISPs signaled some interest in access to County-owned fiber where feasible, both to supplement existing fiber and to provide more viable pricing than is frequently available on the commercial market, where high costs may make some existing fiber infeasible for use by a small provider.

Grant Funding: Also, without exception, the ISPs signaled interest in collaborative efforts to leverage federal grant funding such as the U.S. Department of Agriculture's (USDA) emerging ReConnect program. But all noted that the paperwork-intensive, costly federal grant application process was burdensome for small companies—and that County support would be a necessary prerequisite to any ISP grant application. CTC noted that even absent parity with the east, the level of existing fixed wireless and other services in the western portion of the County effectively precludes the possibility of significant federal grant funding to support the expansion of broadband infrastructure there. That is because, in significant parts of the west, there is internet service that meets or exceeds 10 Mbps/ download, 1 Mbps/ upload speed—which is generally the metric used as a minimum requirement for state or federal broadband funding eligibility. According to CTC, with the exception of some unserved pockets, there does not exist a federal funding strategy for addressing the entirety of western Loudoun. While the available broadband services in that area may not be comparable to the services available in eastern Loudoun, the level of existing fixed wireless service is sufficient enough that it disqualifies western Loudoun with respect to significant state or federal grant and subsidy programs.

Options: CTC presented four options for Loudoun County:

1. Consider, with caution, deploying a FTTP network to rural western Loudoun districts to provide parity with the more densely populated eastern districts;
2. Consider deploying middle-mile fiber to key County facilities (*staff recommendation*);

3. Consider deploying middle-mile fiber to County facilities through a public-private-partnership (*staff recommendation*); and
 4. Support ISP federal, and state, grant applications (*staff recommendation*)
- The Executive Summary is provided as Attachment 1 and the [full report Business Case Analysis from CTC](#) is linked due to file size.

LCPS Fiber Expansion Project Status

In an effort to meet the near and long-term needs of LCPS to provide connectivity and services for each campus, LCPS initiated a RFP for a fiber-based, WAN solution that would provide a scalable, reliable and managed network infrastructure that will allow additions or deletions of facilities without disrupting the network operations of the district. The objective of the proposal³ was for a high-speed broadband data network for the following:

- 1) all LCPS campuses and facilities to a ringed fiber backbone with aggregation sites (hubs);
- 2) the Backbone Hubs to the Network Service Points of Presence or Network Aggregation Sites, and
- 3) an option to provide connectivity from the Aggregation Site and Administration Building to the contracted Data Center within LCPS boundary area in the Ashburn Data Center Corridor.

The RFP was awarded to Lumos Networks, Inc. at the LCPS Finance and Facilities Committee meeting on February 26, 2019⁴. DIT staff, have met with Lumos Networks (Lumos) staff, LCPS Digital Innovation and Procurement staff as well as County Procurement staff, and is currently examining the possibility of leveraging the LCPS fiber construction contract to identify if it can be used as a cooperative procurement. DIT staff is also meeting with Lumos staff to identify potential colocation opportunities and analyze costs should the County connect its facilities with a separate fiber optic PWAN that could be constructed simultaneously with the LCPS build.

ISSUES: To avoid potential legal issues presented by such a wide ranging construction project, as well as the substantial ongoing, operational requirements for such a network, staff maintains that the County should not own, operate, maintain, or manage the PWAN County facility fiber interconnect infrastructure, or the fiber associated with the expansion of residential/commercial fiber to western Loudoun.

Staff recommends the County explore Options 2 or 3 provided within the CTC study; and whereby the County would serve as an anchor tenant on a private provider's network and receive reduced recurring monthly service costs for internet connectivity in exchange for the County providing the construction funding assistance to connect County Government facilities (PWAN). This approach is not new and has been used successfully in other areas of the United States. Staff also

³ [LCPS Lit or Dark Fiber Wide Area Network Solution RFP #R19202](#)

⁴ [LCPS Finance and Facilities Committee: Business and Financial Services: RFP #R19202, Lit or Dark Fiber Wide Area Network Services](#)

recommends that the commercial broadband expansion to western Loudoun be the responsibility of the private partner with no additional costs, or responsibilities, extended to or expected from the County. In this scenario, the private fiber provider would own the fiber and the County would pay recurring operational costs for the use, maintenance and management of the fiber.

The construction of a PWAN would replace existing County Institutional Network (I Net) fiber infrastructure that is nearing the end of its useable life expectancy, and will provide the County with a robust network to its other leased circuit facilities that would allow expansion for future network bandwidth requirements, while reducing connectivity costs. The backbone network would also provide a cost savings to a third party, private partner by including additional fiber in the trench that would reduce the construction costs for expanding high speed broadband into rural Loudoun County as envisioned in the Board's Strategic Work Plan for Economic Development.

DIT staff have been working closely with LCPS to identify if there could be potential cost efficiencies derived by utilizing the LCPS contract award to coordinate construction to LCPS/Loudoun County Government (LCG) facilities that are in close proximity to one another and co-locating infrastructure where possible, while also being mindful of federal funding guidelines so as to not jeopardize LCPS capabilities to secure any federal eRate funding. In this scenario, both LCPS and LCG would leverage Lumos to build, own, operate, maintain and manage a network that could serve to connect both LCPS and LCG facilities.

This scenario could also include the installation of excess fiber (as part of the build out of the anchor tenant network) to western Loudoun County, to allow Lumos to expand fiber to private providers such as WISP's and cable carriers. Lumos would be responsible for attracting, and contracting with, potential ISPs willing to lease fiber access for the expansion of broadband to rural residences and businesses.

FISCAL IMPACT: Should the County wish to pursue Options 2 and 3 of the CTC Study and build a fiber optic middle-mile/backbone network to provide connectivity to sixty (60) County facilities in Western Loudoun, the estimated construction costs would be roughly \$16.1 million. The Department of Finance and Procurement (DFP) analyzed the data and information provided by CTC and were able to independently calculate estimated costs. The analysis performed evaluated the data provided by CTC for the private network, compared to the projected cost of maintaining current service contracts with the existing service providers (Verizon, NOVEC, Comcast) at current and expanded sites in the county. DFP staff evaluated the return on investment based on the data and assumptions provided on site expansions, cost escalations, and debt service interest rate. On a net present value basis, the private network becomes less expensive by year ten (10) than the current service model.

DIT staff are currently working with LCPS staff and Lumos to determine opportunities for cost efficiencies by combining efforts to build out WAN connectivity in Loudoun County. Thus far, it is clear that some County facilities are not in the vicinity of existing LCPS facilities in western Loudoun County. For example, the Loudoun Heights Fire Station is a great distance away from the nearest LCPS facility. However, it is also clear that there may be enough facility commonality

that providing fiber to facilities that are in close proximity could reduce the middle mile estimated cost of \$16.1 million. DIT staff will continue to meet with Lumos to determine if there are opportunities to leverage a PWAN to provide excess fiber to WISPs, or private cable carriers through a separate agreement between private entities.

Should the County decide to own, operate, maintain, and manage a FTTP network to provide internet connectivity to residents, and businesses, of rural western Loudoun County, the estimated cost of construction would be roughly \$130 million, not including ongoing maintenance and operational costs. County staff does not recommend this approach due to size, scope and ongoing operational requirements of building such a PWAN and the fact that there will not be enough subscribership to support such an effort.

ALTERNATIVES:

1. The Board may choose not pursue the identification of procurement options or appropriations for deployment of a FTTP or middle mile network.
2. The Board may choose the deployment of a FTTP network to rural western Loudoun districts to provide parity with the more densely populated eastern districts at a cost of approximately \$130 million. The FTTP network option is not recommended by staff.

DRAFT MOTIONS:

1. I move the recommendation of the Finance/Government Operations and Economic Development Committee that the Board of Supervisors direct staff to work through the FY 2021 budget process to identify funding needs for the deployment of such a network.

I further move the recommendation of the Finance/Government Operations and Economic Development Committee that the Board of Supervisors direct staff to work through the County procurement process to identify procurement options through either a cooperative agreement or RFP, for the deployment of a middle mile fiber network to key County facilities using a private 3rd party entity who would own and operate the network as recommended by Columbia Telecommunications Inc.

OR

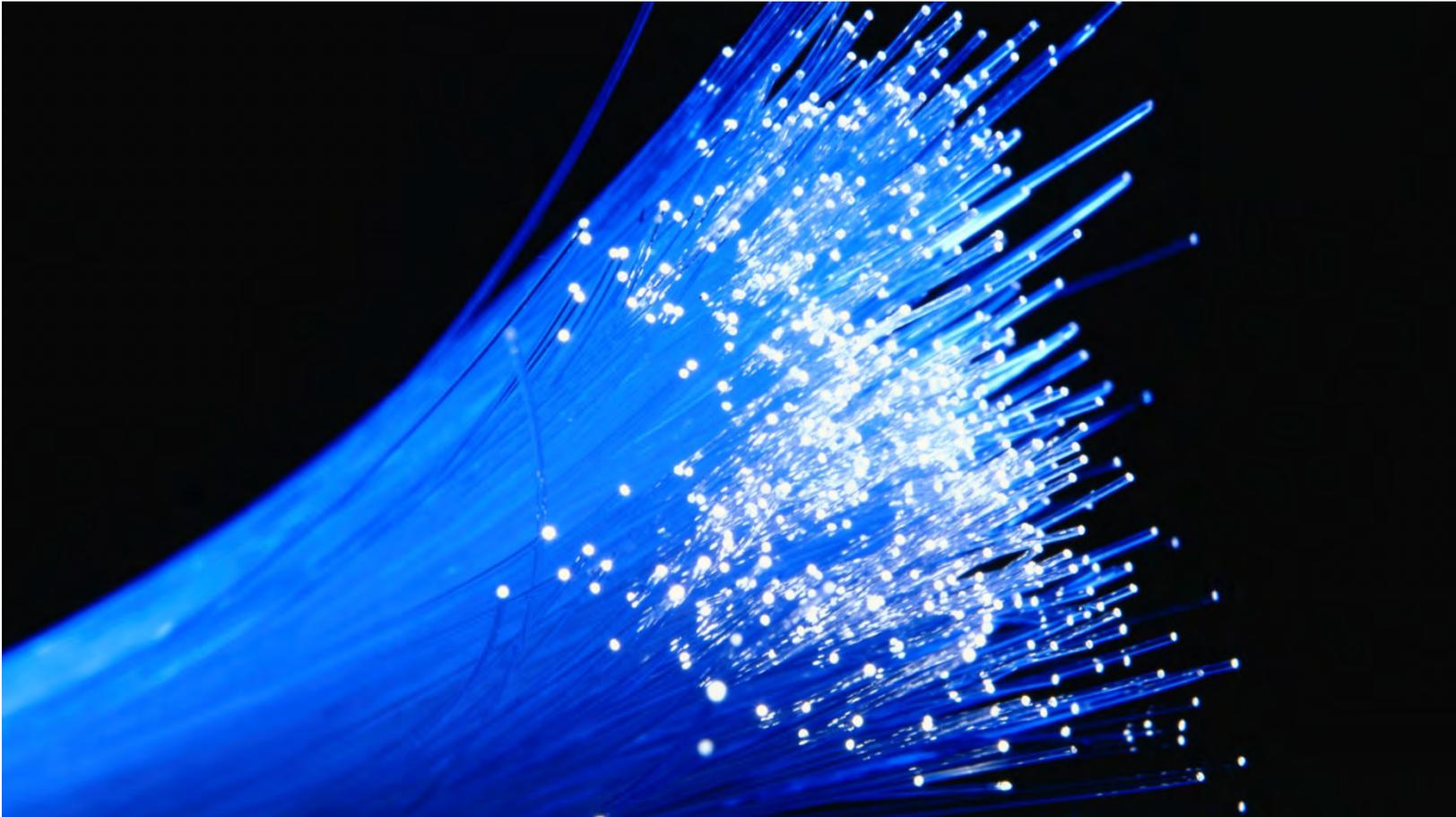
2. I move an alternate motion.

ATTACHMENTS:

1. CTC Executive Summary
2. CTC Middle Mile Solution Return on Investment

ctc technology & energy

engineering & business consulting



Executive Report: Broadband Network Design and Business Case

**Prepared for Loudoun County, Virginia
February 2019**

Attachment 1

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1 Introduction

This summary report discussed options for Loudoun County, Virginia for bringing broadband service in western Loudoun to parity with the services available in the more densely populated eastern portions of the County.

This document summarizes the comprehensive report commissioned in spring 2018 by Loudoun County government. It reflects the County's ongoing efforts to ensure that all residents and businesses have access to high-speed, affordable broadband services—including in the Blue Ridge and Catoctin election districts in the rural western portion of the County.

As the County's consultant, CTC Technology & Energy (CTC) performed the following tasks at the County's direction:

- Conducted residential market research to identify broadband needs
- Evaluated the retail broadband market in western Loudoun County to identify the types of services available and their related pricing
- Facilitated discussions with internet service providers operating in western Loudoun to learn what market forces or County support might enable them to expand their service offerings
- Prepared a high-level network design, cost estimate, and financial analysis for a middle-mile fiber optic network deployment that might help ISPs fill broadband gaps in the western portion of the County¹
- Prepared a high-level cost estimate for a fiber-to-the-premises (FTTP) network that would bring western Loudoun to broadband infrastructure parity with the eastern County
- Analyzed federal funding opportunities to identify potential sources of grants or loans (to the County or to ISPs) that might support the expansion of broadband services in western Loudoun

¹ The scope of work (SOW) for this study included a middle-mile fiber conceptual design connecting the Catoctin and Blue Ridge election districts (which make up the western part of the County), Leesburg, and certain identified data centers.

2 Project Findings

Residents of western Loudoun County have access to a mix of internet and broadband² services, but robust broadband services are not uniformly available there—as they are in the more densely populated eastern portion of the County.

Because of the challenging economics of broadband deployment in rural areas, private ISPs will not invest in ubiquitous broadband infrastructure in western Loudoun. And because current federal grant opportunities generally apply only to completely unserved areas, federal funding is not an option for a comprehensive broadband solution, either.

Bringing western Loudoun to parity with eastern Loudoun would thus require the County to invest an estimated \$130 million in a fiber-to-the-premises (FTTP) network. Absent that investment, though, the County could pursue less costly strategies that might move the needle in important ways—such as through County investment in middle-mile fiber to support ISPs that seek to expand their services.

2.1 Internet access is available to most residents in western Loudoun—but true broadband is only unevenly available

Our analysis of available fiber, cable, digital subscriber line (DSL), fixed and mobile wireless, and satellite services demonstrates that **very uneven patterns of internet access exist in most of the western County**. Some of the services (e.g., DSL, satellite, some fixed wireless services) are insufficient to meet the federal definition of broadband. The services that do meet that 25 Mbps/3 Mbps threshold are available in many parts of Western Loudoun but are not ubiquitous.

This assessment demonstrates that the broadband picture in western Loudoun is not quite as dire as perhaps had been anticipated. More importantly, the wide but uneven availability of broadband services in western Loudoun indicates that **the County's ongoing efforts to promote broadband deployment, and particularly its encouragement of the wireless ISP (WISP) industry, have been effective in expanding the availability of fixed wireless in the west**.

The availability of broadband service to most portions of western Loudoun is testament to the County's friendliness toward internet businesses, the County's very productive pro-internet development policies, and County staff's ongoing efforts to support broadband availability.

That said, **the availability of broadband options for individual residences and businesses depends on location**. For example, while Comcast is the primary provider of residential wired service in the County, Comcast is less likely to provide service to sparsely populated areas. Several

² Defined by the Federal Communications Commission as a service delivering speeds of 25 Mbps download/3 Mbps upload. ("2018 Broadband Deployment Report," FCC, Feb. 2, 2018, <https://www.fcc.gov/reports-research/reports/broadband-progress-reports/2018-broadband-deployment-report>.)

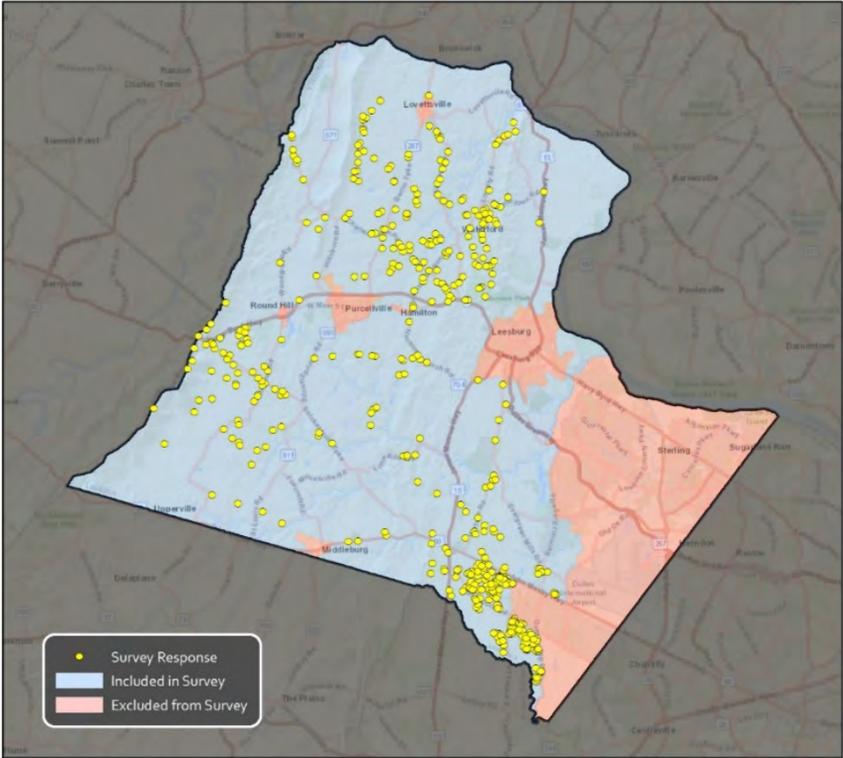
fixed wireless providers offer service, filling in some gaps, and DSL and mobile wireless services are also available. In some areas, there is limited FTTP coverage. Satellite services are generally available throughout the two districts.

2.2 Broadband services in western Loudoun are not at parity with services available in the eastern County

Analysis of survey data indicates that residents in western Loudoun have a high level of internet connectivity—though not necessarily at broadband speeds—and that many residents have deep concerns regarding the speed and reliability of their services.

The County surveyed residents in western areas of the County in 2018 to gain insight into residents’ experience with broadband and internet services. The map below illustrates the locations of responses.

Map of Survey Responses



Survey results match the market assessment’s findings; they indicate **that residents in the overall survey area are highly connected, with 96 percent of households having some form of internet connection.** Specifically, 85 percent of residents have home internet service, 84 percent have a cellular/mobile telephone with internet, and 72 percent have both.

However, despite this generally high level of internet use in western Loudoun, the survey results indicate that **one-half of internet subscribers in western Loudoun have only low to moderate satisfaction with the speed and reliability of their services**. These results match anecdotal reports the County has received about poor internet service.

A sizeable segment (nearly one-fourth of all subscribers) has very low satisfaction and perceives their connection speed to be slow or very slow. This segment is concentrated more in the Catoctin District, where there is less use of fiber internet connections and greater use of fixed wireless or other internet connection types.

2.3 The economics of rural broadband—and the nature of federal funding opportunities—mean that a County investment would be required to achieve parity

There does not exist a federal grant or a private sector investment strategy that will support the investment needed to create infrastructure parity in western Loudoun.

For the private sector, the area is too costly to build on a per-customer basis (given the low population density) to merit extensive investment in the types of broadband available in eastern Loudoun. For federal grant-makers, the area does not generally qualify for funding programs because, even though the internet service is not satisfactory to many residents, the availability of 10 Mbps/1 Mbps means the area is not eligible for funding (other than in small pockets where no service exists).

2.3.1 Sparsely populated areas like western Loudoun do not offer ISPs enough customers to justify ubiquitous fiber deployment

Western Loudoun County faces the same challenges as other rural communities in terms of attracting broadband infrastructure investment. Even in the most affluent rural and semi-rural areas—from the horse farms around Lexington, Kentucky, to the ski communities outside of Aspen and Telluride, Colorado, to the resort areas on Maryland's Eastern Shore—the economics simply do not exist for rural broadband deployment absent substantial government funding. The private sector will not build costly wireline infrastructure to reach all homes and businesses in rural areas simply because the potential return on investment is insufficient to justify the investment.

The same dynamics apply to virtually all areas of rural infrastructure development. In the case of broadband, the issues are more stark because broadband is traditionally thought of as an area of private investment, rather than public investment. And yet the economics do not exist for private investment. The challenging economics result from the lack of density of homes—and, in many cases, the fact that homes are located on large parcels of land; long driveways or setbacks from the road greatly increase the cost to deploy wired infrastructure to those homes.

2.3.2 Federal funding programs generally focus on completely unserved communities

Even absent parity with the east, the level of existing fixed wireless and other services in the western portion of the County effectively precludes the possibility of significant federal grant funding to support the expansion of broadband infrastructure there. That is because, in significant parts of the west, there is internet service that exceeds 10 Mbps/1 Mbps—which is generally the metric used as a minimum requirement for federal broadband funding eligibility.

With the exception of some unserved pockets, there does not exist a federal funding strategy for addressing the entirety of western Loudoun. While the available broadband services in that area may not be comparable to the services available in eastern Loudoun, the level of existing fixed wireless service is sufficient that it disqualifies western Loudoun with respect to significant federal grant and subsidy programs.

2.4 Creating parity would require a roughly \$130 million capital investment

Bringing broadband infrastructure parity to western Loudoun would require the construction of a robust wireline connection to every home and business. Our analysis suggests that deploying an FTTP network in western Loudoun would cost up to \$130 million or more for capital costs alone, not including operating expenses.

We developed this estimate—which assumes a relatively high, 50 percent take rate (or the percentage of residences and businesses that choose to buy service)—based on high-level engineering that considered a range of factors that might affect fiber deployment costs, from the availability of utility poles to the number of fiber route miles necessary to reach every home and business in the two western Loudoun districts. The costs would be higher if more than 50 percent of the households and businesses chose to purchase service, given that there would be additional costs to connect all those homes with fiber from the road as well as electronics.

The capital costs include outside plant construction to pass all premises, the electronics necessary to operate the network, and fiber drop connections to individual subscribers.

Our engineers estimated the average cost per passing (to build fiber along all roads in western Loudoun, such that all premises have the potential for services in the Blue Ridge and Catoclin districts, based on the size, density, and topographical conditions of each. At the low end, that cost might be \$6,000. Realistically speaking, it would likely be \$7,500 to \$9,000 per passing. By comparison, in eastern Loudoun, the per passing cost would be in the \$1,500 to \$2,500 range, depending on the population density and the amount of underground construction, among other factors.

The construction costs may be reduced modestly if it is possible to leverage existing infrastructure in pockets of high-density developments in western Loudoun. But the fact remains

that the cost to build FTTP in western Loudoun is likely to be at least four times that of many metropolitan areas on a per premises basis.

Even though the market is attractive, there simply are not enough customers in western Loudoun for revenues to cover the costs of debt service and operations, which will be considerable. In the event that the County were to build and operate FTTP throughout the west, our expectation for a best-case scenario is that consumer revenues would cover approximately half of the debt service, and none of the operating costs.

In another scenario we have considered, in which the County would build the fiber and lease it to a private provider that would then purchase equipment and operate the network, we think that the return to the County would be similarly low. In similar projects we have negotiated in recent years, even the most flexible of private partners have offered lease fees to the government entity that that would be less than 25 percent of the County's likely debt service. Although the County's operating costs would be lower because the ISP would purchase equipment and operate the network, the County would still incur operating costs related to maintaining and managing the fiber infrastructure that would not be recovered.

This analysis is consistent with everything we know of the challenges of deploying rural infrastructure—and highlights the enormity of the challenge of bringing parity to western Loudoun relative to eastern Loudoun, absent a willingness by the federal government to help fund these kinds of initiatives.

2.5 The ISP industry's interest in creative partnerships with the County suggests that less costly, incremental improvements are possible

Notwithstanding all these challenges, the competitive ISP industry in western Loudoun County is very interested in creative partnerships with the County (i.e., County support of various sorts) to reach the most remote areas of western Loudoun.

Over the course of the field work for this project, CTC analysts reached out to all (and subsequently spoke with a majority of) ISPs that are active in western Loudoun. While the larger incumbents did not respond to our requests for meetings, many of the smaller competitors were very willing and helpful in sharing data and ideas. We spoke extensively with a range of providers that have deployed wireless technologies—and, in a few cases, fiber.

There clearly is a vibrant community of competing smaller, entrepreneurial ISPs in the western part of the County. They range across the full geography of the west—some focused further north with corresponding holdings in Pennsylvania or Maryland, and others in the central or southern part of western Loudoun with further operations in West Virginia or other parts of Virginia.

Without exception, these ISPs indicated a willingness to partner with the County—with the expectation that the County could facilitate and support better and more extensive service in western Loudoun. All of the ISPs signaled some interest in access to County-owned fiber where feasible, both to supplement existing fiber and to provide more viable pricing than is frequently available on the commercial market, where high costs may make some existing fiber infeasible for use by a small provider.

Also, without exception, the ISPs signaled interest in collaborative efforts to leverage federal grant funding such as the U.S. Department of Agriculture's (USDA) emerging ReConnect program. But all noted that the paperwork-intensive, costly federal grant application process was burdensome for small companies—and that County support would be a necessary prerequisite to any ISP grant application.

In one case, a WISP's representative suggested the County should consider removing all permitting and process requirements for placement of wireless towers of up to 100 feet. One other WISP suggested a more streamlined process for towers of up to 50 feet. None of the other WISPs interviewed raised this particular consideration or flagged the tower permitting process as creating challenges. Generally, the consensus was that the sheer capital cost to build to low-density areas in the west, as well as the challenges of using wireless technology in areas where foliage and geographical features reduce the functionality of wireless signals, are the core problems faced.

2.6 A middle-mile fiber deployment to key County facilities and towers would cost \$16 million—and would offer the County government operational benefits while lowering barriers to ISP investment

If the County were to construct a middle-mile fiber optic network to connect key government facilities in western Loudoun, it could replace the existing I-Net fiber in Leesburg and connect to third-party data centers to meet the County's internal connectivity needs. This approach would offer the County improved internal services to these facilities.

At the same time, for purposes of addressing the County's interest in achieving broadband parity between eastern and western Loudoun, this middle-mile approach might enable the County to lease excess fiber to ISPs, which would lower their barriers to deploying broadband services. In addition, the middle mile fiber, given that it is designed to come to or near certain critical tower locations, could enable significant new wireless deployment (in new spectrum bands like the 3.5 GHz band that is being made available by the FCC) to enable better wireless service in the west.

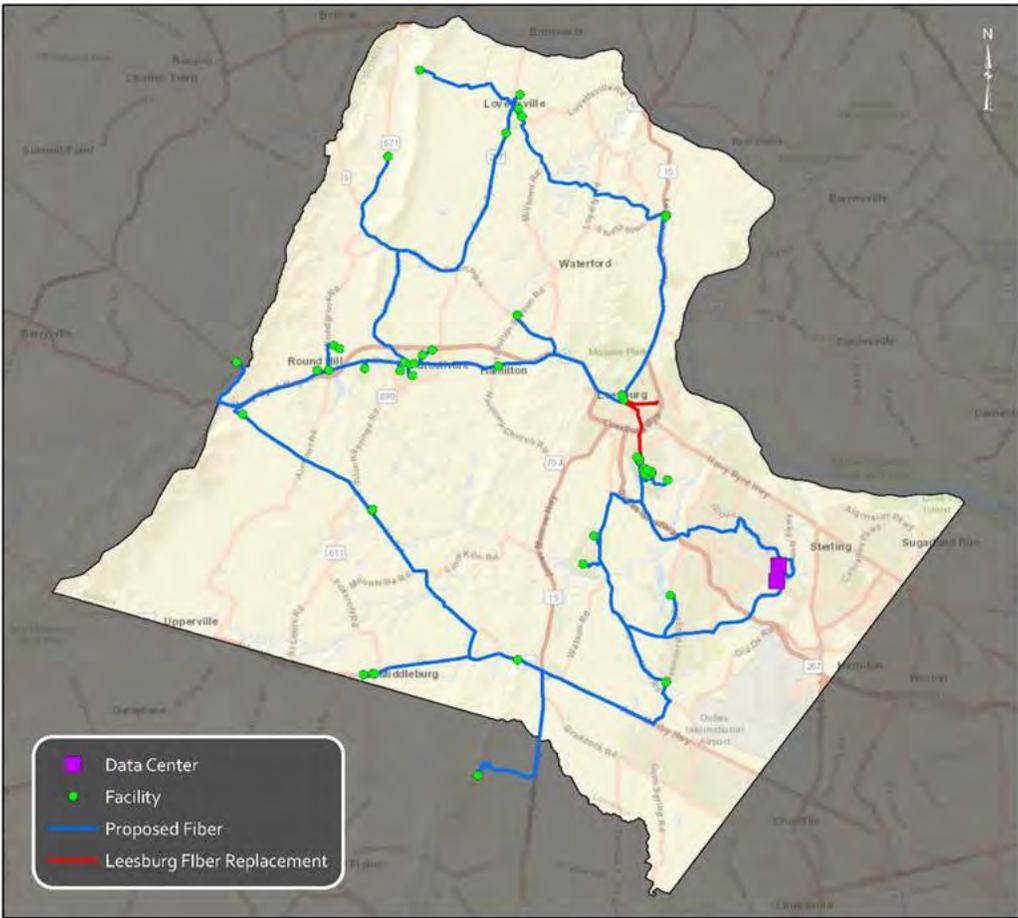
In sum, the network would be designed for the following priorities:

- Provide fiber connectivity to County facilities in western Loudoun

- Replace aging I-Net fiber in Leesburg with a high strand count fiber optic cable that is wholly owned by the County
- Provide fiber connectivity to two private datacenters in Ashburn where the County will lease space to host County servers and peer with the top-tier ISPs
- Provide sufficient fiber strand capacity so that private companies may lease strands to support their fiber or wireline deployments

The network would comprise approximately 140 route miles of fiber connecting a total of 60 sites, would cost approximately \$16.1 million to build. Over the course of 20 years, network operations, maintenance, and financing will cost the equivalent of approximately \$2,290 per site per month, or a total of \$1.65 million annually. The following map illustrates the routing of the network considered.

System-Level Middle-Mile Fiber Network Architecture



3 Recommendations

An FTTP deployment in western Loudoun would comprehensively address the issue of broadband parity in Loudoun. If the County chooses not to invest in FTTP, it has other, less costly options that could lead to consequential improvements in broadband options for the least well served residents and businesses in that part of the County.

3.1 Consider, with caution, deploying FTTP in western Loudoun

Because it is the only comprehensive way to create broadband infrastructure parity, the County could, in the long term, consider deploying an FTTP network to connect all residents and businesses in western Loudoun. This approach would, potentially, provide ubiquitous access to connectivity at the highest technically available speeds.

But constructing an FTTP infrastructure would involve significant financial risks for the County: It would require a large capital investment on the order of \$130 million and possibly considerably more—with no feasible payback strategy—and a long-term commitment to sustaining network operations.

3.2 Consider deploying middle-mile fiber to key County facilities in western Loudoun

Building the middle-mile fiber described above—for an estimated capital cost of \$16.1 million, and with ongoing annual operating costs of about \$1.65 million—would lower ISPs' financial barriers to improving and expanding their fixed wireless services in western Loudoun while also meeting the County's own communications needs at 60 facilities.

This middle-mile strategy would not pay for itself (i.e., the County would need to commit to the capital investment and ongoing operations), but it would achieve two types of benefits. First, the County would have robust fiber connections to its facilities. Second, the availability of the County's fiber would be a relatively low-cost, low-risk way to incent WISPs in western Loudoun.

Spending on middle-mile fiber does not guarantee last-mile outcomes, so there is real risk that this investment will not dramatically improve the last-mile environment. But feedback from some of the existing WISPs in western Loudoun indicates that the availability of fairly priced middle-mile fiber will be helpful to WISPs that have an interest in incrementally expanding their footprints.

3.3 Consider deploying middle-mile fiber to County facilities through a public-private partnership

The County can also consider preparing a procurement for a public-private partnership to deliver fiber-based capabilities to the government facilities in the west; such an approach might enable the County to benefit from private sector execution while securing the efficiency benefits

of a competitive process. In this model, the County would use a competitive process to procure service to the 60 County locations in the western part of the County. The goal would be to incent and catalyze private fiber deployment to those locations, with the excess fiber (that not used by the County) available for the vendor to lease either dark fiber or leased services to ISPs.

The City of Boston successfully completed a similar, multi-year process. The City chose a model in which it would use its buying power to incent private sector deployment of massive fiber capabilities, some of which would go to satisfy City needs, and the balance of which would then be available to private ISPs for services deeper into the community, for backhaul, and for other uses that will improve broadband outcomes in the City.

To effectuate all this, Boston used a competitive process to secure a long-term, \$10 million dark fiber lease with Crown Castle. Now all schools, public safety agencies, and other operations throughout the City will get what they need today—plus long-term control of scalability for potential future smart city applications and public Wi-Fi—at an affordable price.

Under the deal, Boston will have end-to-end control of the fiber it leases for up to 30 years—and the new private sector fiber capabilities will mean not only greater opportunity for private ISPs to extend their networks, but also the efficiencies and reduced disruption of a single major fiber deployment serving multiple users, including both the City and the carrier market. And all this has been accomplished at relatively modest cost, with a significant return to Boston on its investment, both with respect to City broadband needs and to enhancing broadband services more generally.

3.4 Support ISPs in applying for federal grants

Our primary and most urgent recommendation is that the County develop a grant collaboration and funding strategy to support private sector ISPs in western Loudoun with federal grant applications. In the next few months, the USDA will begin to accept grant and loan applications for the construction of broadband facilities in unserved areas of rural America. Pockets of western Loudoun will qualify for this program, which requires a showing that the area is currently unserved with 10 Mbps/1 Mbps (download/upload) service. This is not true across large swaths of western Loudoun, but it is true in many smaller pockets of one to a few square miles.

The benefit of this program is that the federal government will bear the cost and the effort of evaluating grant and loan applications, and then administering and enforcing their requirements. Our recommendation is that Loudoun County leverage that federal effort in two ways.

First, we recommend that the County commit funds to provide the matching amount necessary to enable western Loudoun ISPs to apply for the ReConnect program. For example, the grant program will require a 25 percent match to unlock a 75 percent federal award. The County can

encourage and incent providers to apply for these grants to serve areas of western Loudoun by committing to pay some or all of the 25 percent match for successful grantees. This commitment will make the grant applications more competitive and viable—and will likely increase the number of applications filed for western Loudoun.

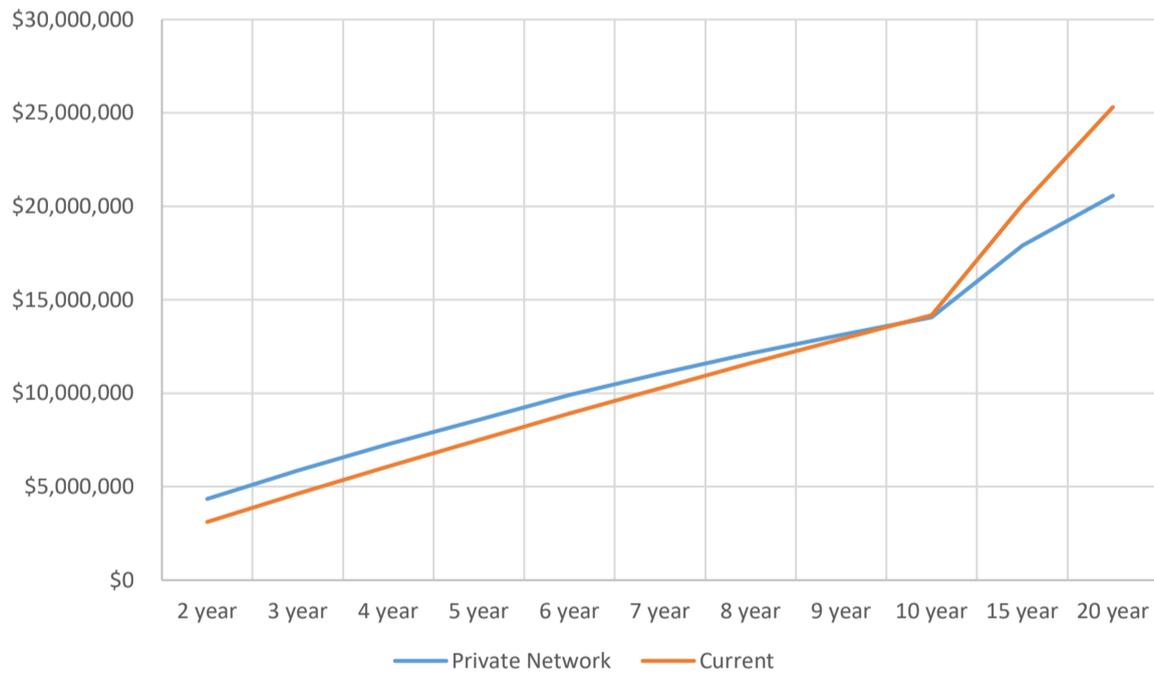
Committing to fund the match on any successful application will also enable the County to avoid having to pick and choose among ISPs, as it would effectively be committing to fund all ISPs in the event the ISPs' applications are successful. Given that the federal government will only fund a single project in any given geography—and will very carefully vet those geographies to ensure that the area is indeed unserved—the County has a built-in set of protections against the risk of having to fund too many projects, or projects that are not focused on unserved areas.

The second way we recommend the County leverage the federal effort is to help private ISPs prepare grant and loan applications focused on western Loudoun. As we learned in our interviews of the smaller competitive ISPs in the west, they tend not to compete for federal funds because the cost and burden of preparing an application is very high for smaller companies.

Our recommendation is that the County support these ISPs with GIS data, engineering support, business planning help, and other tasks that will be part of preparing a competitive grant application. There is cost to the County associated with this approach, but the payoff could be considerable in terms of leveraging the investment to bring federal funds to western Loudoun.

Lease Space Analysis Assumptions:	Option 1	Option 2	Assumptions:
	Private Network	Current	
	See 2019-01-18 Broadband Design Business Case provided by CTC. Assumes 2 yr construction period.	Assumes maintaining current service contracts with Verizon, NOVEC, COMCAST at current and expanded sites.	
Anchor sites	60	60	
Analysis years	20	20	
Maint & repair / mile	\$600	\$922,200	Verizon TLS/yr
Maint & repair miles	140	53	Verizon TLS sites
Locates & ticket/mile	\$150	\$186,604	NOVEC / yr
locates & tickets miles	684	5	NOVEC sites
Contingency / yr	\$10,000	\$546,000	COMCAST/yr
Legal & Consulting Yr1 only	\$20,000	6	COMCAST sites
Operating Exp per site	\$5.50		
Labor expense / yr	\$52,000		
Labor escalation	2.50%	2.50%	cost escalation
Training (2% of labor)	\$1,100		
Insurance/year	\$25,000		
Attachment fees / yr	\$43,600		
Support Equip /6 yrs	\$105,000		
Inflation	5.00%	5.00%	

NPV of Private Network vs. Current



NPV of Cash Flow	Private Network	Current	Variance
2 year	\$4,347,264	\$3,114,484	(\$1,232,780)
3 year	\$5,858,721	\$4,616,333	(\$1,242,388)
4 year	\$7,271,046	\$6,082,424	(\$1,188,622)
5 year	\$8,590,280	\$7,513,608	(\$1,076,671)
6 year	\$9,900,465	\$8,910,717	(\$989,748)
7 year	\$11,050,256	\$10,274,561	(\$775,695)
8 year	\$12,123,050	\$11,605,932	(\$517,118)
9 year	\$13,123,598	\$12,905,604	(\$217,993)
10 year	\$14,056,371	\$14,174,332	\$117,961
15 year	\$17,901,045	\$20,078,983	\$2,177,938
20 year	\$20,572,517	\$25,313,384	\$4,740,868