Powhatan County
Broadband Recommendations

Funding options, strategies, and recommendations

Funded by the Virginia Department of Housing
and Community Development

Prepared for
Powhatan County, VA

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DESIGN NINE
we build networks that perform

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The telecommunications business is continually evolving. We have made our best effort to apply our experience and knowledge to the business and technical information contained herein. We believe the data we have presented at this point in time to be accurate and to be representative of the current state of the telecommunications industry. Market changes and new technology breakthroughs may affect our recommendations over time.

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Executive Summary

Design Nine has worked with the Virginia Department of Housing and Community Development and Powhatan County since early 2011 to identify what investments are needed to accelerate economic development and job opportunities in Powhatan County.

A broadband survey of residents was conducted online, and it received the highest response rate we have seen for a county of this size. More than 350 residents responded to the survey, with some of the key results listed below.

96% of residents answered that they did have an Internet connection. [This is the highest number we have ever seen, and much higher than the national average of about 75%]

80% of residents want better Internet/data service.

65% of residents are somewhat or very willing to pay more for better Internet access.

95% of residents felt the Internet is very important to their household.

26% of residents are already working part or full time from their home, and an additional 46% need evening and weekend access to their place of work.

49% of residents have VPN access to their place of work, meaning a significant number of workers already need business class broadband access from home.

The very high response rate of the survey, coupled with the data that shows Powhatan residents make heavy use of the Internet for business, education, and pleasure, illustrates that the need exists for improved access to affordable high performance broadband services like Internet, phone, TV, business videoconferencing, data backup, and telemedicine/telehealth applications.

Increased affordability and availability of broadband delivered services has the potential to increase job creation in the county, help retain existing businesses, and improve the county's ability to attract new businesses and entrepreneurs.

- Powhatan has experienced significant new business and residential growth over the past decade, yet access to affordable high performance broadband is still extremely limited. Powhatan County needs more affordable broadband, more choice in broadband providers, and higher speed broadband services to retain existing businesses and to attract new businesses and entrepreneurs to the county.
- Powhatan businesses on the eastern end of the county remain constrained by a lack of choice in providers. The limited competition also keeps the cost of services high compared to the cost of services in

other parts of Virginia where competition has created sharp reductions in telecom costs for businesses.

- There is a growing trend of more people working from home, in two distinct groups. The survey data shows that Powhatan County has attracted established business professionals who want to run a business from their home, but they expect business class broadband services. There are also growing opportunities for residents to work full-time from home, and to qualify for these jobs, reliable and affordable broadband must be available.
- Many future job and work opportunities will be created in areas of the county outside traditional economic development zones (e.g. town centers and business parks). Powhatan County needs a long term strategy of being able to locate businesses and workers anywhere in the county, and that means widespread availability of business class broadband services.
- The trend of increasing energy costs is already making long commutes to work more difficult for Powhatan residents. Work from home options have the potential to substantially reduce or eliminate commuting costs, and can reduce the number of residents who have to travel to jobs located outside the county. ***Perhaps the most important data collected from the broadband survey is that 26% of respondents are already working part time or full time from home--highlighting the need for a modern broadband infrastructure that supports work from home business and job opportunities.***
- Powhatan County has excellent quality of life, a relatively low cost of living, substantial economic activity, and superb recreational activities. The area is also located within commuting distance of Richmond. Having the right broadband infrastructure will give the county an important tool in its economic development toolkit to create jobs and business opportunities while preserving a great quality of life and without the risks of over-urbanization.

Over the next thirty years, the businesses, residents, and institutions of Powhatan County will spend, very conservatively, more than $537 million on telecommunications services (voice, video, and data). This estimate (see the Costs section of this chapter) is based on current average expenditures, and does not consider what is expected to be rapid growth in new kinds of services (e.g., tele-medicine, tele-health, IP-based security applications, video on demand, online games, and many other emerging business applications and services). If these future services were included as part of the financial projection, the total spent on telecommunications in the county would probably exceed $700 million (over 30 years).

The most evident recommendation that emerges from this study is that if the county is to meet its longer term economic and community development goals, wider (universal) access to broadband services with a wide choice of services at affordable price points must be available to institutions, businesses and homes.

The fundamental challenge for the county is to ensure that businesses, government, and residents have a modern, twenty-first century digital transport system. In the twentieth century, communities devoted much time and effort to the development of transportation systems needed to support growth in jobs and commerce. These transportation systems included railroads, highways, and airports. The Internet has rapidly changed the fundamental nature of many kinds of products and services--whole industry segments no longer need the same kind of transportation systems.

As an example, the Kindle, an ebook reader being sold by Amazon, is getting rave reviews, and Amazon has released a version for the iPhone. The surging popularity of this new device suggests that we may be seeing the beginning of the end of the era of the book as we know it--a paper-based item. As devices like the Kindle mature, books will become less expensive and more accessible--if book users have affordable access to a broadband network.

The Internet is a transport system that is making many other information transport systems obsolete. First it was music; vinyl records and CDs are not about the music itself, they are simply a transport system to get the music to the buyer. Video stores are on the way out, as Netflix and Blockbuster, by using the Internet, are making the video cassette and DVD transport system obsolete. Newspapers are beginning to collapse, as the news-PAPER is just a transport system for reporting the news itself.

The news and journalism business, like the music and movie business, will survive and even prosper, but the underlying business models are collapsing because we don't need four different transport systems: one for music, one for movies, one for news, and one for books. The old-style analog telephone and TV “transport systems” are not needed either. So there is a total of six separate telecom transport systems we no longer need. A single, modern, shared broadband transportation systems handles all of those products and services efficiently and at very low cost.

And that's why every home and every business needs a high performance broadband connection; without it, residents and businesses of Powhatan County might as well be living in 1400--before books, before newspapers, before any information distribution systems existed.

A shared digital transportation system will not do away with private sector providers--these firms are vitally needed to continue providing the services they already offer--telephone, video, news, Internet access, business class services, and other residential and business services. The focus of this study has been to analyze the potential for stakeholders in the county to collaborate on the development and deployment of a

modern, world class digital transport system that will meet the needs of the county's residents and businesses for the next twenty to thirty years.

In the past several months, we have spoken to and received comments from a wide variety of area businesses, residents, educational institutions, local governments, and civic organizations.

Powhatan County has significant assets and advantages. These include:

- Excellent prospects for economic growth – The county's proximity to the Richmond metro area, combined with an excellent quality of life afforded by the rural character of the area, suggests that the right broadband infrastructure should be a significant business attractor, especially in the eastern part of the county along Route 60.
- Picturesque small towns and rural neighborhoods – The county offers a wide range of residential living, ranging from traditional farmsteads to new sub-divisions. This wide range of housing choices is also likely to be a jobs and business attractor, and the residential survey shows many residents already working part or full time from home (26%).
- Regional network connectivity – The MBC (Mid-Atlantic Broadband Coop) fiber extension planned for the county solves the backhaul and service provider problem that is often a difficult challenge for other similar rural areas. The ability to tap the wide range of providers already on the MBC network by adding some local last mile fiber extensions is a significant advantage for the county.

In our meetings with the county, we heard a real commitment to maintain the quality of life in the county and to improve and enhance the ability of businesses and residents to communicate effectively via affordable, high performance broadband services.

Next Steps

Next steps include:

- Read and review the two reports (Needs Assessment and this report).
- Identify key ideas and concepts that may be important to future economic development initiatives.
- Meet with elected and community leaders to discuss these key ideas and concepts in more detail.
- Consider allocating funds for a fiber pilot project in Powhatan that would reduce telephone and Internet costs for the County government and extend use to businesses and residents along the fiber route.
- Connect the Powhatan Courthouse fiber to the planned MBC fiber on Old Buckingham Road.

- If leaders and stakeholders believe that telecom and broadband investments are needed to support the long term goals of the county, a project team should be assembled to move the effort forward.

Key recommendations include:

- ***The county government must play a key leadership role*** to make infrastructure improvements.
- The proposed effort to construct ***fiber to link county administrative buildings and offices*** can become a cornerstone pilot project to expand broadband access to local businesses as well as sharply reduce the cost of telecommunications for county government–especially with a link to the planned MBC fiber.
- Fiber along the entire length of Route 60 will be needed to expand competitive services into the rest of the county. This fiber will need to be designed to support last mile Fiber To The Home (FTTH) and Fiber To The Business (FTTB), unlike existing fiber along that route.
- ***Local government should not compete with the private sector.*** All broadband services should be sold directly to residents and businesses by existing and new private sector service providers. The county could accelerate economic development, especially in downtown Powhatan, by modest investments in duct and fiber. Downtown buildings with fiber connections will be seen as very desirable, especially for professional businesses (e.g. law offices, medical offices, accountants, etc.).
- ***These modest initial investments can be owned and managed by the county.*** A separate entity like a broadband authority is needed at this time unless the county decides to partner with another locality.
- When ***water, sewer, and road improvement projects*** are undertaken by the county, telecom duct and/or fiber cable should be included as part of the project.

Why Invest?

The promised impacts of broadband on communities have yet to be fully realized; widespread access to affordable, high performance broadband services in communities has the potential to transform work life by providing more flexibility and control over when and where work is done. Fiber-delivered, business class broadband services can be a powerful economic development strategy that can help retain existing Powhatan County area businesses as well as attract new ones.

A broadband survey was made available to businesses and residents for two months during the spring/winter of 2011. The two surveys were available online, and the Broadband Management Team promoted the availability of the surveys at public meetings and events.

The heavy response from the community (more than 350 residential surveys were completed) in Powhatan County show that there is a very savvy group of residents, business people and entrepreneurs, and that the Internet has become an essential business tool, even for small businesses.

With so many people working from home, business class services need to be available everywhere, not just in downtowns and business parks. Work from home is going to continue to rise as more people try to work from home to reduce the cost of driving long distances to work.

Written comments were extensive, and ***Powhatan County not only broke the record for the most comments, but we have never seen such long and detailed comments***. Some of the remarks included:

> *Urgent Need for Cable and/or Fiber options in Powhatan County.*
>
> *There are limited options for quality service in Powhatan county, all of which I consider to be very expensive.*
>
> *We pay a huge amount of money for these services but cannot stream a movie either on the TV or laptop. It is too slow. We just want higher speed. We are not picky people.*
>
> *I would like more options. I feel like Verizon has a monopoly on these types of services in the area and as such can charge whatever they like and we have to pay it*
>
> *We simply need better coverage and less costly options . . . PLEASE!!!*

World class network infrastructure in Powhatan County will provide local businesses with unlimited bandwidth at affordable rates, enabling them to compete aggressively in the Global Knowledge Economy. The county would be able to offer:

- A future-proof network infrastructure that offers abundant, affordable bandwidth.
- Adequate broadband connections to the rest of the world (e.g. improved access to MBC providers).
- Interoperability and support for a wide variety of information devices, including tablet and laptop computers, HD videoconferencing systems, converged home and business media systems, and support for wireless phones and next generation mobile devices.
- The potential to diversify the local economy by attracting more knowledge worker and knowledge economy businesses to complement the current strong manufacturing base in the region.

In addition to serving the employment base already in the area, Powhatan County will be attractive to an emerging new group of business-people that typically are well-educated, own their own businesses, and are making choices about where they live

based on family needs and interests and the availability of affordable, high performance broadband.

This new breed of entrepreneurs place a high value on the kinds of amenities that are already part of the region: mild climate, superb recreational activities, great small towns, good schools, and a sense of place.

Businesspeople and their families make decisions to stay in a community or to relocate based on quality of life and the availability of abundant and affordable broadband, because broadband is the enabler of these new Knowledge Economy businesses. Our discussions with local businesses and leaders suggests strong business support for a improved access to broadband and more affordable telecom services.

Area businesses and residents will face a substantial gap in network capacity and performance over the next five years. While other countries already are seeing congestion in 100 megabit fiber networks to the home and to businesses, the average bandwidth available to most businesses and homes in the U.S. is still hovering around 1 megabit.

Services

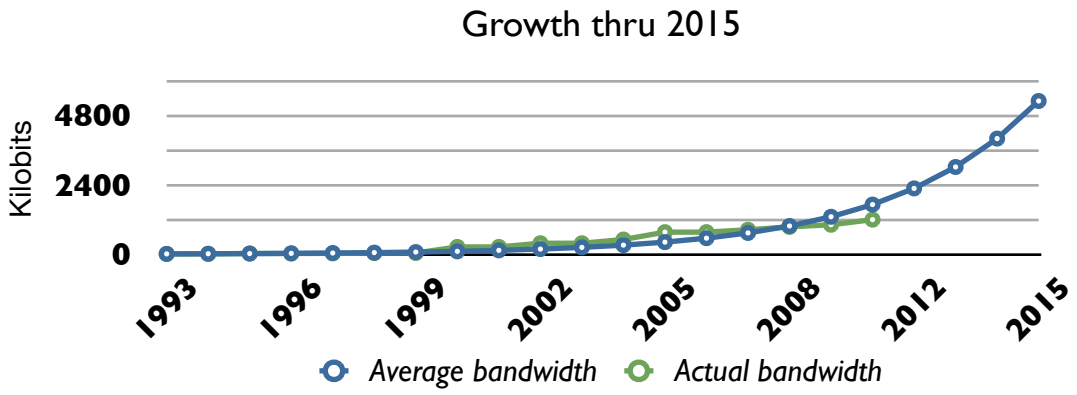
Numerous data-based analyses have shown a consistent doubling of bandwidth every two years, which means the average home and business in Powhatan County will want a minimum of 50 megabit symmetric connections by 2014. In the next three to five years, wireless access in the more remote areas of the county will be critical to achieving 100% broadband coverage. Over the long term, only fiber to the home and to the business will be able to provide the bandwidth that will be demanded by residents and businesses. The legacy copper-based networks have reached their limits and are already saturated–calls for network neutrality and "Internet toll gates" reflect a growing inability of current providers to meet current demand.

Bandwidth needs for the past decade have been growing by 25% to 50% per year, and show no sign of slowing. As computers and associated hardware (e.g. video cameras, audio equipment, VoIP phones) become more powerful and less expensive, new applications and services are continually emerging that drive demand for more bandwidth. The table below indicates the likely growth in bandwidth, based on current uses, emerging high end equipment, and research lab/university/government networks already deployed and in use. Lightpaths refer to placing multiple wavelengths (paths) of light on a single fiber. High end commercial equipment already in production is routinely placing 20+ lightpaths on a single fiber, with each lightpath capable of carrying data at gigabit speeds. This technology will move down to ordinary business and residential network equipment over the next ten to fifteen years. Current fiber being installed will require only a relatively inexpensive equipment upgrade to increase carrying capacity over the same fibers.

From a report by the Information Technology and Innovation Foundation (March, 2009), listed below are the bandwidth requirements for services already commonly in use and for emerging services like telepresence business videoconferencing.

Application/Service	Upstream Bandwidth Requirement	Downstream Bandwidth Requirement
Medium resolution videoconferencing	1.2 megabits	1.2 megabits
Streaming video (720p)	0	1.2 megabits
Standard definition TV	0	4 megabits
Basic HD videoconferencing (720p)	1.2 to 4 megabits	1.2 to 4 megabits
Telepresence high resolution HD videoconferencing	5 megabits	5 megabits
Video home security service	10 megabits	
HD digital television (1080p)		15 megabits
Telepresence very high resolution HD videoconferencing (1080p)	15 megabits	15 megabits

Note that the business videoconferencing services all require symmetric bandwidth. This is a critically important issue, as current incumbent "little broadband" services like DSL and cable modem systems do not offer symmetric bandwidth (where the upstream and downstream bandwidth is equal). Using this information we can project what Powhatan County homes and businesses will need in the coming years.



	Next 2-4 years	Next decade	Twenty years
Small business needs (1-9 employees)	10-25 megabits of symmetric bandwidth and 5-10 megabits of Internet access	100 megabits of symmetric bandwidth and 20-40 megabits of Internet access	Gigabit+ symmetric bandwidth and 50 to 100 megabits of Internet access
Medium-sized business needs (10-100 employees)	50-100 megabits of symmetric bandwidth and 10-20 megabits of Internet access	Gigabit symmetric bandwidth and 50 to 100 megabits of Internet access	Multiple gigabit symmetric circuits and lightpaths and 100+ megabits of Internet access
Large business needs (100-1000+ employees)	Gigabit+ symmetric bandwidth and 100+ megabits of Internet access	Multiple gigabit symmetric connections and 250 to 500 megabits of Internet access	Multiple gigabit symmetric circuits and lightpaths and 1 Gigabit+ of Internet access
Residential needs	25-50 megabits of symmetric bandwidth and 4-8 megabits of Internet access	100 megabits of symmetric bandwidth and 20-30 megabits of Internet access	A Gigabit symmetric circuit and/or lightpaths, with 50 to 100 megabits of Internet access

Businesses and residents will use this bandwidth for a wide variety of services, and the business survey indicated that area businesses are already using their broadband connections for these services, which include:

- Full support for HDTV for business and residential use (10 to 15 megabits per channel)
- Streaming video for business and marketing purposes
- Voice telephone services (multiple lines) and other VoIP-enabled applications
- Desktop management of business computers over the network
- Backup over the network of business data
- Worldwide flat rate local and long distance calls
- Business security services
- Business video conferencing, including the capacity to support HD quality videoconference sessions
- Business Web servers and services
- Telemedicine and telehealth services
- Delivery of business information and services from local servers

Costs

Over the next thirty years, the businesses, residents, and institutions of Powhatan County will spend, very conservatively, more than $537 million on telecommunications services (voice, video, and data). This estimate (see the table below) is based on current average expenditures, and does not consider what is expected to be rapid growth in new kinds of services (e.g., tele-medicine, tele-health, IP-based security applications,

video on demand, online games, and many other emerging business applications and services). If these future services were included as part of the financial projection, the total spent on telecommunications in the county would probably exceed $700 million (over 30 years).

The very conservative estimates of expenditures included in the table below indicate that there are substantial funds available for investment in a world class, high performance broadband network (the expenditures are not adjusted for inflation or for typical price increases). It would take less than 6% of those expenditures to build the world's best network connecting every business in Powhatan County, and much of that cost would be financed by revenue derived from the users of the network.

Powhatan 30 Year Telecom Expenditure Analysis			
	Households still on dial-up	Households with "little" broadband cable modem/DSL	Households with no Internet
Total households	9,875		
Total businesses	767		
Percentage of households	15%	59%	26%
Number of households	1,481	5,826	2,568
Average monthly telecom expenditures	Local phone: $25 Long distance: $25 Cable/satellite TV: $55 Dial up Internet: $20	Local phone: $25 Long distance: $25 Cable/satellite TV: $65 Broadband Internet: $40	Local phone: $25 Long distance: $25 Cable/satellite TV: $55
Annual telecom cost/ household	$1,500	$1,860	$1,260
30 year telecom expenditure	$66,656,250	$325,104,750	$97,051,500
Total residential expenditures	$488,812,500		
Total telecom expenditures[1]	$537,693,750		
Estimated residential savings of 15%	$73,321,875		
Estimated business, government and institutional savings of 50%	$40,327,031		
Total economic benefit over thirty years (funds retained for jobs, lower taxes, investment)	$113,648,906		

[1] Business, schools, institutions, and government costs estimated conservatively at 10% of residential expenditures

Service Provider Analysis

Local Providers

- 54% of residents receive Internet service from Verizon.
- Another 28% receive Internet service from Comcast. Together, these two providers serve more than 82% of county residents who responded to the survey.
- DirecTV provides 50% of the cable or satellite TV services in Powhatan County.
- Comcast serves an additional 31% of residents with cable or satellite TV. Together, these two providers serve more than 81% of county residents who responded to the survey.
- Verizon provides 84% of the local phone services.
- Verizon also provides a majority (69%) of the long distance telephone service in Powhatan County.

These numbers indicate a situation where only one or two national service providers are providing a supermajority of the services in the county.

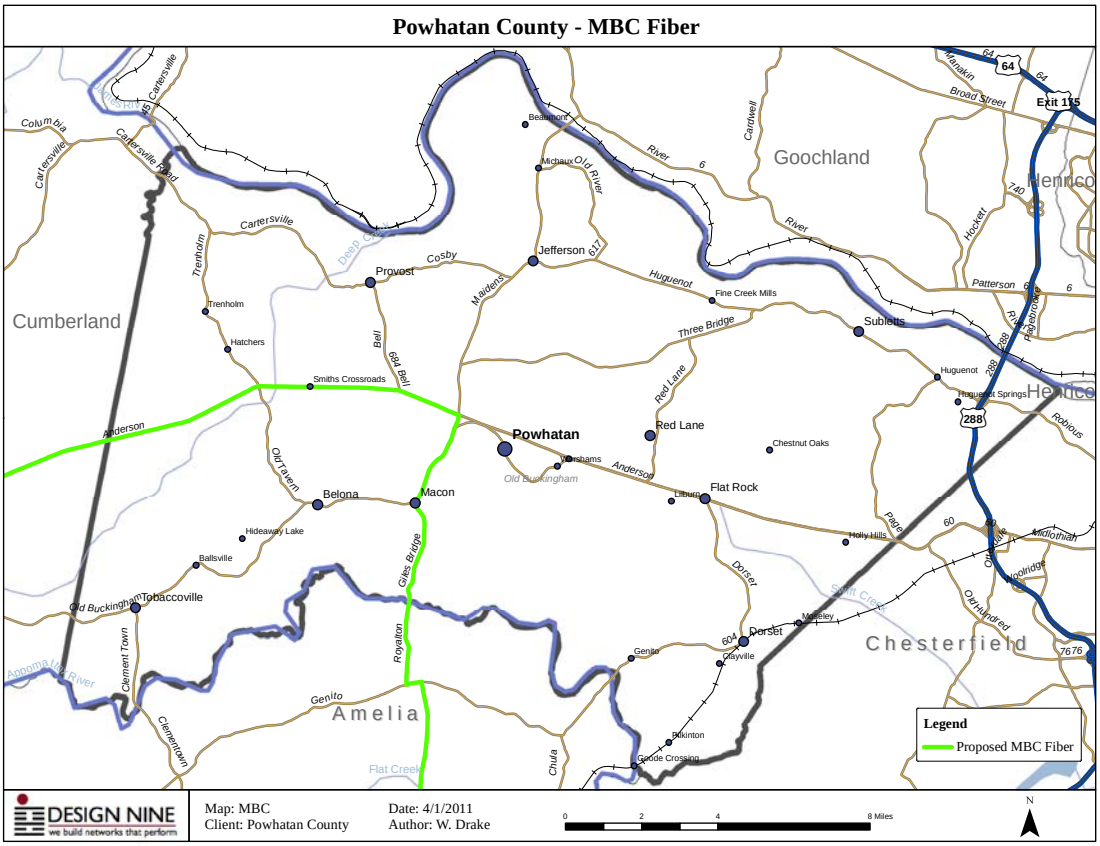
Mid-Atlantic Broadband Cooperative (MBC)

The Mid-Atlantic Broadband Cooperative (MBC) is an independently managed broadband cooperative in Southern and Central Virginia. The mission of this cooperative is to promote economic development in rural Southern Virginia by deploying a world-class fiber-optic backbone network.

Funded by grants from the U.S. Department of Commerce's Economic Development Administration and the Virginia Tobacco Commission, MBC was officially formed in 2003. Today, the MBC network includes over 800 miles of fiber through Southern Virginia, providing a state-of-the-art technology incentive for businesses requiring large amounts of broadband access.

MBC has plans to build fiber through Powhatan, but access to MBC providers ("last mile fiber") is very limited. MBC was contacted as part of this analysis and provided up to date maps with planned fiber in Powhatan and the surrounding area.

If a modest fiber network was constructed in Powhatan Courthouse and a cross connection meet point was designed to connect the two networks (a relatively simple process), any provider on the MBC network would be able to offer services to businesses and institutions connected to the Powhatan fiber. The pilot project proposed later in this report includes a meet point for the MBC fiber.



MBC Opportunities and Service Providers

Below is a list of service providers on the Mid-Atlantic Broadband Cooperative (MBC) network that may be interested in providing service to business customers in the Powhatan area. Service providers on the MBC network can provide services anywhere that MBC has access points. MBC fiber may be near many businesses and entities in Powhatan, but the number of access points are limited. A modest Powhatan-owned fiber network in the Powhatan Courthouse area would offer local businesses and institutions a choice of a wide variety of services at very attractive prices.

In other communities in Virginia that have made modest local investments in fiber infrastructure, business and institutions costs for telephone and Internet services have declined sharply, with 50% reductions and/or increased bandwidth typical.

AboveNet Communications, Inc 	**Matt Johns** **mjohns@above.net** **(703) 657-7141** AboveNet Communications provides a full range of broadband services to businesses and carriers in 15 metro markets.
BIT Communications (formerly Buggs.net) 	**Mikey L. Sims** **msims@buggs.net** **(434) 636-2274** BIT Communications provides Internet and telephone service to both residential customers and businesses.
Cavalier Telephone LLC 	**(888) 612-7383** Cavalier Telephone provides Internet, telephone, and DirectTV service to residential customers and businesses with options for enhanced services for businesses.
CenturyLink (formerly Embarq) 	**Richard Schollmann** **richard.a.schollmann@embarq.com** **(804) 780-1397** CenturyLink is an incumbent service provider that provides service to residences and businesses throughout Virginia.
Comcast Corporation 	Comcast is an incumbent service provider offering services throughout Virginia.

County Breeze Internet	**Brandon Neal** **bneal@countrybreezeinternet.com** **(434) 385.8998** Country Breeze Internet provides wireless Internet service to customers in Pittsylvania County.
DataCare Computer Sales & Service, Inc DATACARE COMPUTER SALES & SERVICES	**Robert Williams** **rwilliams@datacareonline.net** **(434) 696-3519** Datacare offers Internet services in South-central Virginia.
DigitalBridge Communications DIGITALBRIDGE COMMUNICATIONS	**Kelley Dunne** **kelly.dunne@dbcmail.com** **(703) 723-3566** Digital Bridge Communications (DBC) is a wisp that currently offers residential wireless service in Appomattox Virginia, and has service areas in other states.
FiberLight, LLC FiberLight	**(678) 366-0027** FiberLight provides carrier, and large enterprise-based broadband and network operations services.
Gamewood, Inc. Gamewood	**Robert Taylor** **(434) 792-2253** Gamewood provides residential dial up and wireless in Danville and the surrounding areas.

GCR Telecommunications 	**Glen Ratliff** **gcr@gcrcompany.com** **(434) 572-1765** GCR provides business and residential services to Southside Virginia.
Global Telecom & Technology (GTT) 	**Rich Barish** **rich.barish@gt-t.net** **(703) 442-5592** GTT provides ethernet and wireless broadband services to businesses.
Guaranteed Network Services, Inc 	**Dennis Hunt** **dhunt@gnsnetworks.com** **(434) 993-3709** GNS offers network installation and repair services.
Host.net 	**Deron Gabbert** **dgabbert@bboi.net** **(561) 869-3309** Host.net provides cloud computing, colocation, business Internet, network security, and VoIP services.
KDL of Virginia Inc (Windstream)	**Mark Hagood** **mhagood@kdinc.com** **(804) 590-2770** Windstream provides local access and long haul wholesale fiber.

Kimbanet 	**John Wolchko** **john@kimbanet.net** **(276) 666-9209** Kimbanet provides residential dial-up, DSL, and wireless Internet service in Martinsville, Danville, Roanoke and Henry, Patrick, Franklin, and Pittsylvania counties.
Kinex 	**Jim Garrett** **jgarrett@corp.kinex.net** **(434) 392.4804** Kinex provides business and residential wireless in Farmville, Clover, Halifax, South Boston, and Victoria Virginia.
Level 3 Communications, Inc 	**John Reid** **John.reid2@level3.com** **(704) 644-8418** Level 3 Communications provides Internet, voice, video and data services over the MBC Network.
Lynchburg Computer Systems, Inc 	**(434) 237-8300** Lynchburg Computer Systems offers computer repair and internet in Lynchburg, VA.
NationsLine, Inc 	**Steve Fralin** **sfralin@nationsline.com** **(540) 444-2112** NationsLine provides voice, data, phone, and DSL services to residences and businesses.

Neon Optica, Inc RCN METRO Optical Networks	**Patrick Coughlin** **Off-netsolutions@rcnmetro.com** **(508) 616-7800** RCN Metro offers Internet, video, and phone for residences and businesses, including bundle packs.
nTelos nTelos true blue wireless	**Rod Davis** **davisrc@ntelos.net** **(540) 941-4879** nTelos is an incumbent service provider that offers wireless Internet and DSL to businesses and residents in Virginia.
Pure Internet pure INTERNET inc.	**Kelly Shaw** **kelly@pure.net** **(434) 476-8800** Pure Internet dial-up, DSL, wireless Internet, and some business services throughout Halifax County Virginia.
RAF Wireless LLC got wi-fi? RAFwireless.com	**Chris Crosby** **shortwaves@gmail.com** **(434) 210-1149** RAF Wireless provides wireless Internet to the Baskerville Virginia area.
Sunset Digital Communications SUNSET DIGITAL COMMUNICATIONS	**Paul Elswick** **paul@sunsetcom.net** **(276) 870-5473** Sunset Digital Communications offers Internet and broadband options to residences, businesses, and carriers in Virginia.

Telpage Inc Telpage.net	**Mark Novey** **mnovey@telpage.net** **(434) 634-5100** Telpage offers DSL, Wireless, and fiber broadband to Southeast Virginia.
Tiamet Communications	**Dave House** **dave@tiametcomm.com** **(434) 374-3104** Tiamet offers wireless Internet to Mecklenburg and surrounding counties.

Representative Pricing from Municipal and Open Access Networks

The data below provides actual pricing available on other community-owned fiber infrastructure, and offers an excellent illustration of the kind of decreased cost and increased performance that results from targeted infrastructure investments.

FiberNet Monticello

Business Services

Basic phone	$43.85
10 Mbps symmetric	$41.95/mo.
20 Mbps symmetric	$69.95/mo.
30 Mbps symmetric	$99.95/mo.
100 Mbps symmetric	$199.95/mo

Residential

Internet	
10 Mbps symmetric	$29.95/mo.
20 Mbps symmetric	$34.95/mo.
30 Mbps symmetric	$52.95/mo.
50 Mbps symmetric	$93.35/mo
Telephone	
Standard line	$21.20 (most features are $1/feature per month; e.g. call forwarding is $1/month)
TV	
Basic	$13.80
Expanded	$46.85
Expanded Plus	$56.80

Palm Coast FiberNET

Business Services	
2 Meg symmetric	$175
3 Meg symmetric	$270
4 Meg symmetric	$360
10 Meg symmetric	$625
2 Meg plus 2 phone lines	$199

Chattanooga

Residential

Internet	
30 mbps fiber	$57.99
50 mbps fiber	$69.99
100 mbps fiber	$139.99
1,000 mbps fiber	$349.99
TV	
Basic	$11.99 (local channels)
Expanded	$54.99 (80+ channels)
HDTV	$65.99 (180+ channels)
Basic triple play	$80.82

30 mbps, unlimited phone, TV	$120.52 (180+ channels)

Phone	
Basic	$22.99
Unlimited local/long distance	$39.99

The Wired Road

Residential

Internet	
2/1 Meg wireless	$34.95

Business Services

Internet	
2 Meg symmetric	$207
5 Meg symmetric	$425
10 Meg symmetric	$750
15 Meg symmetric	$975

Powell, Wyoming

Residential

Telephone local/long distance	$24.95
Online backup	$2.50/Gig
Basic TV/phone	$24.95 (40+ channels)
Value TV/phone	$42.95 (80+ channels)
Expanded TV/phone	$49.95 (150+ channels)

Lafayette, Louisiana

Residential

Internet	
10 Meg symmetric	$28.95
30 Meg symmetric	$44.95
50 Meg symmetric	$57.95
100 Meg symmetric	$199.95

Phone	
Basic line	$15.95 (Includes 3-Way Calling, Call Waiting, and 5 cents per minute long distance)
Unlimited long distance	$15
Phone features package	$5 (Adds: Automatic Recall, Various Call Forwarding, Do Not Disturb, Outgoing Call Blocking, Selective Call Rejection, Selective Call Acceptance, Speed Dial)

TV	
Basic	$17
Expanded Basic	$46.95 (80+ channels)
Digital Access	$54.95 (150+ channels)
Digital Plus	$67.82 (250+ channels)

Broadband Education Strategies

Powhatan County has an excellent school system with many accomplishments, but the county is below the state and national average when it comes to workers with a college degree. As factory jobs move off-shore, more jobs are being created--before the economic downturn some estimates suggested three new jobs for every job lost. However, the lost jobs usually require only a high school degree at most, and the replacement jobs typically require one to two years of college education. Powhatan County faces some challenges to ensure that it has a workforce with the right skills, education, and training needed by employers in the next five to ten years.

County investments in broadband and telecom may not have the expected economic development impact if the area does not have the right mix of skilled workers. It will be important for county leaders to ensure that high school graduation rates stay high and that a higher percentage of students acquire some college education.

According to a report from the Department of Commerce Census Bureau, education pays off. Workers who stay in school, complete high school, and get some college and/or attain a college degree will earn much more than those workers who do not attain basic levels of education. Over an adult's working life, high school graduates can expect, on average, to earn $1.2 million; those with a bachelor's degree, $2.1 million; and people with a master's degree, $2.5 million.

The estimates of work-life earnings are based on 1999 earnings projected over a typical work life, defined as the period from ages 25 through 64. In 2000, 84 percent of American adults age 25 and over had at least completed high school and 26 percent had a bachelor's degree or higher.

In the 1999 study, the differences in average annual earnings can be striking, depending upon how far a worker has advanced in terms of education. Wages ranged from $18,900 for high school dropouts to $25,900 for high school graduates, $45,400 for college graduates and $99,300 for the holders of professional degrees (medical doctors, dentists, veterinarians and lawyers).

New Job Opportunities

New kinds of job and work from opportunities are developing, but virtually all work from home job opportunities require reliable and affordable broadband service. In particular, many work from home employers require both a land line telephone (i.e. cellphones are not permitted) and a landline broadband connection (i.e. WiFi wireless is discouraged or not permitted).

The “virtual call center” is rapidly becoming a popular alternative to bricks and mortar call centers. A variety of companies are now employing tens of thousands of workers; these employers work full or part time from their own homes, with wages typically

starting at $9 to $10 per hour and can exceed $20 per hour for more specialized work. These jobs require basic literacy skills and basic computer/technology skills to qualify, and some specialized training is also usually required. Without affordable broadband available in homes in the region, even workers with the right skills and education will not be able to take advantage of these new opportunities.

While not everyone can or will want to work from home, the jobs can be an attractive alternative to working outside the area where long commutes and high fuel prices put stress on the workers themselves and their families.

Education Partners and Opportunities

There are several organizations in Powhatan County and the surrounding area that should be involved in the county's continued economic development efforts. These partners and programs can help to assist with Powhatan County's education and training goals.

- **John Tyler Community College -** In many rural areas the community college is the center for both degree earning and non degree earning educational activities. The John Tyler-Midlothian campus-offers Computer Short Courses designed to deliver technology-related professional development materials. The community college also offers associate degree programs in Information Technology (IT) and Business Management as well as Career Studies Certificates in Business Information Management, Cisco Networking, Computer Applications, Small Business Management, Network Support, and Web Design.
- **Centura College-Richmond Main Campus -** offers academic degree programs in Business Management, Network Technician, and Computer Network Management. The college also makes these programs available through its web-based distance learning campus.
- **J Sargeant Reynolds Community College -** J Sargeant Reynolds offers campus locations in Goochland and Richmond. Program offerings include computer programming, network management, Web design, network engineering, and legal office technology. J Sargeant Reynolds also offers degrees in small business management and management development.
- **Powhatan County Library -** The local library is usually a prominent educational center for small and growing communities. Public libraries often serve as not only a workforce development hub, but an educational center for pre-school aged children and the elderly. The National Broadband Plan focuses on public libraries as educational centers for digital literacy. The county library currently features 17 computers on T-1 lines offering public access to the Internet.

- **Career Readiness Certificate -** Virginia's Career Readiness Certificate (CRC) is an assessment-based credential that gives employers and career seekers a uniform measure of key workplace skills. Businesses have trouble finding and hiring people who have basic employable skills and who are therefore trainable for specific jobs. The CRC gives workers a skills credential that assures employers that the job applicant actually has the basic skills they seek. The CRC helps close the gap that exists between the skills required in today's workplace and those exhibited by new and existing employees. The CRC and a Career Readiness Program are offered at John Tyler Community College.

Capital Region Workforce Investment Board (WIB) – Area 9

Service Area Nine includes Powhatan County. They serve low-income and low-skilled adults, people who have been laid off, and youth (both in and out of school). Services include:

- Incumbent Worker Training, where the WIB pays up to 50% of the cost to train an employee;
- On-the-job training (the WIB pays up to 50% of a worker's salary while they're in training);
- Basic and advanced skills training; and youth programs. The WIB has a contract with Virginia Community Colleges to operate the youth programs;
- Training for older workers age 55 and up; and
- They are starting up a program to assist people with disabilities to find jobs.

According to Debra Crowder, Executive Director of the WIB, high-speed telecommunications would allow them to expand their service offerings by allowing them to provide distance learning and training.

John Tyler Community College (JTCC)

JTCC has campuses in Midlothian and they serve Powhatan County. In addition to the typical Community College programs, and a nursing program, they offer services for students that include:

- Workforce development training, in conjunction with J. Sargeant Reynolds Community College, through a program called Community College Workforce Alliance. This program provides workforce training services, and also provides periodic classes (Excel, OSHA requirements, etc.) which are offered electronically.
- JTCC will contract with businesses, when requested, to offer classes to employees (for a fee). These classes can cover topics like computer training (Excel) or accounting.

- Degree programs are offered on line. Students enrolled in these classes would only have to travel to campus when they have a test, need to meet with an instructor, or need to access materials at the Library.
- JTCC does not currently have a location in Powhatan County. However, they offer Dual Enrollment courses for High School students in Powhatan (where the student takes college level courses and received college credits). The courses are typically taught at the High School, either by High School faculty (if they are certified to teach the course) or by JTCC faculty. JTCC is starting to use the Internet for Dual Enrollment classes.

Dr. Marshall Smith, President of JTCC, advised that the on line classes are available in some parts of their service area but wasn't sure if they were available in Powhatan County at this time. However, he said students in Powhatan will be able to take Internet classes soon if they can't already. Dr. Smith added that high-speed telecommunications would definitely help, saying they definitely endorse anything – including improved telecommunications – that would help the school expand their services or offer them to more students (or provide them more efficiently)

First Mile Connectivity Options

Telephone/DSL

DSL (Digital Subscriber Loop) technology utilizes existing copper twisted pair telephone lines to provide broadband services. There are many variants of DSL, and the differences among them are primarily bandwidth and distance. Most DSL systems are limited to a maximum of 18,000 cable feet from a telephone switch or remote access module (DSLAM). Faster variants of DSL are limited to as little as a few thousand feet, making the service areas inconsistent from a subscriber perspective. A neighbor a few houses away from a home with DSL service may be told that no DSL service is available (because of the cable limitations). Current low cost DSL residential service offerings are priced competitively compared to cable modem service, but also tend to be much slower.

Because of the requirement to deploy DSL equipment close to subscribers, rural areas are at a distinct disadvantage for DSL. It is not uncommon in rural areas to have cable runs of many miles (from a telephone switch), making DSL impractical without substantial equipment upgrades. Another problem in rural areas is the age of the telephone cable plant. Even if a home or business is located within the prescribed distance to DSL equipment, older copper twisted pair cable may not be capable of handling the DSL signal properly. In some cases, speed of the service is degraded, and in other cases, DSL may not work at all.

The primary problem with DSL is the lack of capacity over the long term. In an optimum DSL situation, with high quality cable plant and subscribers close to DSL switches, the fastest DSL is limited to 15 to 20 megabits under these optimum conditions. Most homes will never be able to receive DSL services at those speeds because of sub-optimal service conditions. DSL cannot provide the capacity needed by businesses and residents in the near future.

In Powhatan County, DSL at low to moderate speeds is available in many locations in the county. Verizon appears to be making improvements in the availability of DSL services in the area. Verizon offers FiOS (fiber to the premises) in a very limited portion of the eastern side of the county. There appears to be no plans to extend that to larger parts of the county at this time.

Cable Systems

Cable systems that provide broadband in most U.S. communities use what is called HFC systems, or Hybrid Fiber Coaxial systems. Typically, fiber delivers television and broadband signals to equipment located in or near a neighborhood, and copper coaxial cable is used to connect the subscriber's home or business with the equipment fed by fiber. Cable systems have never been widely deployed outside community boundaries

(residential neighborhoods and business districts) because of the high cost of placing equipment near subscribers. In this regard, cable systems are limited in the same way that DSL systems are limited, and rural communities are at a distinct disadvantage because of the lower density of homes and businesses.

Cable systems also cannot provide the future capacity that will be required by homes and businesses in the near future. Some cable companies have begun to announce pilot projects offering Internet access at speeds "up to 50 megabits." While this is an improvement over current offerings advertised typically at bandwidth "up to 6 megabits," this bandwidth is always shared among all users on a node. It is not unusual to have between 100 and 500 users (typically residential homes) on a single node. The advertised bandwidth (e.g. "up to 6 megabits") is shared among all users on a node, meaning that the usable per household bandwidth during peak use times like early evening is much lower.

Cable modem service also typically has asymmetric bandwidth, meaning that the advertised bandwidth ("up to 6 megabits," or "up to 50 megabits") is only available on the downstream side, coming into a home. The upstream bandwidth available to users to send data and content is often 1/10th of the downstream capacity. This makes most cable modem systems unsatisfactory for many kinds of work from home services and applications that require more balanced upstream and downstream bandwidth, like videoconferencing, which works best if the bandwidth is symmetric (the same capacity in both directions). This issue of symmetric bandwidth will become increasingly important as the cost of fuel changes commuting patterns and more people want to work from home part or full time.

Cable TV availability in Powhatan varies widely with location in the county.

Satellite

Satellite broadband is a wireless technology, and to avoid confusion, systems like WiFi are often referred to as terrestrial wireless. Satellite broadband uses geostationary satellites located 22,500 miles above the earth, and data traversing a satellite system has a 45,000 mile loop (up and down). As fast as radio signals are, this distance still introduces latency (time delays) that can cause problems with real time transmission of telephone (VoIP) and videoconferencing. Bandwidth is generally less than what is available from DSL or cable systems, with a typical residential service offering 700 kilobits/second downstream and 128 kilobits upstream for between $55 and $65 per month. Higher speeds (e.g. 1 megabit/second downstream and 200 kilobits upstream) are also available for $10 or $20 per month additional.

If a home or business already has satellite television service, a second small dish antenna is needed for broadband service. Some companies have tried combining both services on a single dish, but this has usually had poor results because of signal and

satellite position issues. Inclement weather (e.g. heavy rain, snow) can degrade or temporarily cut off satellite signals.

There are two primary providers of satellite broadband in the United States: Hughes Network Services and Wild Blue. Wild Blue has partnered with many rural electric co-ops, with the co-ops acting as sales agents and installers. Hughes uses independent small businesses as installers and resellers. Despite some limitations, satellite is an excellent broadband service option in underserved areas; no major infrastructure investments are required to obtain service, and speeds are much better than dial up, and in some cases may be equal to or better than entry level DSL service packages.

Satellite is not a business class service option for Powhatan County, and satellite still remains relatively expensive compared to wired or terrestrial wireless service.

BPL

Broadband over Power Lines (BPL) has been available for several years and can be used in several different ways. Some BPL equipment is designed for in home use, where a broadband signal delivered by DSL or cable is delivered to different rooms in a home or business using the electric wiring. To provide service to a neighborhood, some electric companies use a system similar to cable systems, where fiber is used to get broadband near a cluster of homes, and then the signal is carried over electric lines for the last few hundred yards or last mile or two. In some other systems, the signal is carried via electric cables all the way from a broadband head end.

BPL has many of the same limitations as DSL and cable modem services. It is copper-based, and is limited in the amount of bandwidth that the technology can deliver. It requires technicians who have extensive training and experience working with high voltage systems, since special bridges are installed at every neighborhood transformer (which also makes it a relatively expensive service). Some electric co-ops are considering BPL as a way to quickly provide some form of broadband to their rural customers. BPL's main advantage is that no new cable must be laid to deliver the service to a home or business. However, like DSL and cable systems, BPL is not a long term solution.

In a recent conversation with a rural electric co-op that has been "experimenting" with BPL for more than two years, the co-op representative shared that they were only able to achieve about 250 kilobits of throughput over distances of twelve miles. While 250 kilobits is better than dial up, it will not meet the long term needs of rural residents and businesses.

Fiber

Fiber is a future proof investment. The upper limit of fiber capacity has not yet been found, and off the shelf hardware can handle thousands of times the needs of an average

home or business well into the future. Fiber has a life expectancy of thirty to forty years, and may last much longer than that; every year, the number goes up as fiber systems installed in the 1970s continue to perform adequately. A single fiber can carry all the traffic and services needed by a home or business, including voice telephone service, television programming, live videoconferencing, and HD television.

Fiber's primary drawback is its apparent high cost compared to other systems. Fiber is often unfairly compared to wireless, with the misleading conclusion that wireless is much cheaper. Regrettably, most fiber versus wireless studies compare the start up costs for wireless to the thirty year life cycle costs of fiber infrastructure. During a thirty year period, fiber is installed just once, while wireless systems will have to be replaced entirely several times. Properly costed over a thirty year period, fiber is actually less expensive than wireless, with many times the capacity.

Metro Ethernet is a point-to-point service provided over two fiber optic strands (single fiber technology is available but the hardware is quite expensive and still relatively unused). Metro Ethernet networks can deliver service as far as 25 miles from network element locations in speeds up to 10 Gigabits per second (10GB Metro Ethernet circuits may be available from some providers).

SONET or Synchronous Optical Network is a point-to-point technology usually deployed in a bi-directional redundant ring. Most carrier and tier 1 service provider backbones are configured in a redundant ring. A SONET ring is self healing (provided that only one link is cut). SONET circuits are considered expensive and are usually a last resort if other fiber optic services are not available.

A Passive Optical Network, or PON, is a fiber optic network based upon a splitter technology. A single PON port can support up to 64 customers utilizing either daisy chained splitters or a central splitter location. For service providers PON is cost effective as it allows the service providers to create "fiber light" networks and fewer network elements. However, PON has many drawbacks including bandwidth limitations due to the shared nature of the feeder fibers as all customers fed from a splitter share bandwidth over a single fiber (or single pair in some networks). A major drawback of PON is the upgradeability of the network which usually requires additional feeder fiber to be deployed which is costly as it is considered a "forklift upgrade."

Every business in Powhatan will eventually want fiber connections. Without ubiquitous fiber infrastructure, communities will not be economically competitive. Communities that already worry about losing too many young people to other areas have much more to worry about. In a recent college class, a professor asked 30 students how many would live in a community without broadband, and not a single student raised a hand. Fiber is the only transmission system that will be able to deliver all the services businesses and residents will expect and demand in just a few years. Communities that choose to delay fiber infrastructure investments will be at a severe disadvantage in the next several years when trying to attract and retain businesses and workers.

The Wireless Broadband Debate

We do not subscribe to the wireless vs. fiber debate. We believe both wireless and fiber systems are required in communities. Virtually everyone,within a few years, will have a very capable wireless device that supports phone service, email, Web browsing, gaming, TV, music and a host of other services. Residents and businesspeople will expect these devices to work everywhere; this means communities will need a well-designed wireless network of towers, antennas, and related systems, including fiber backhaul (fiber backhaul--some connection is needed to get the wireless signals onto the Internet from local wireless access points; fiber can be used to dramatically improve wireless performance by providing a very fast connection from the wireless radios to the rest of the network). Wireless systems work best when supported by a fiber backbone to carry traffic to and from its destinations. Fiber and wireless systems are complementary, not competitive.

Wireless is often touted as a broadband panacea. Across the country, many communities are rushing to offer some kind of wireless system. These municipal wireless systems often lack sustainable business plans, and many well publicized projects are beginning to have problems. St. Cloud, Florida offers free wireless broadband throughout the city, but the quality of the service tends to be inconsistent, and many residents have refused to give up paid cable and DSL service. Philadelphia's well known project found that more access points are needed than originally anticipated, and the private firm that promised to operate and maintain the network pulled out, forcing the City government to take over an expensive system that was not able to deliver the connectivity that residents expected.

Current wireless systems lack the capacity to handle high bandwidth services like video when more than a few people are using the same access point. Systems like WiMax are very expensive, and while prices will decline, when costed over a reasonable life cycle, wireless systems are relatively expensive. Wireless systems are inherently less secure than cable based systems, and we never recommend that a business uses a wireless connection for its primary access unless no other alternative exists. The primary future use of wireless will be for mobile access to services, rather than fixed point access. In under-served areas, properly designed wireless systems are an excellent first step, but are not a complete solution over the long term. In Powhatan, wireless will be important over the next three to five years as a primary delivery system for broadband services in many parts of the county. Over time, wireless to the home will have to be replaced with fiber connections to meet demand, but wireless will remain important for mobile access to broadband (e.g. access to the Internet and email from mobile phones and laptops).

Wireless Technology Trends and Issues

Over the past several years, numerous communities large and small have attempted to build and operate municipal wireless Internet services. Large cities like San Francisco

and Philadelphia announced ambitious plans to build WiFi “blankets” to provide wireless Internet access to most homes and businesses. Smaller cities like St. Cloud, Florida and Sandoval County, New Mexico have also built municipal WiFi systems. There is now a wealth of lessons learned from these early efforts:

- WiFi is expensive if you truly want total coverage. Many WiFi projects have underestimated the number of access points that are needed--something that is causing problems with the much touted Philadelphia WiFi effort. Some contractors and vendors may be underestimating the number of access points to keep costs lower, so it is important to be realistic during planning stages about what a community can afford to do in terms of deployment of access points.
- WiFi is not a first choice for business class services. Few businesses of any size are willing to run their business on a WiFi connection unless the only other option is dial-up. It may be adequate for small one or two person businesses, but most businesses want a more secure and more reliable wired connection.
- Wireless vendors have to be selected carefully. Sandoval County, New Mexico experienced severe problems with two different wireless firms hired to build a wireless Internet system--both firms were unable to provide a working system and within budget.
- WiFi has reliability problems. Even if you are in range of an access point, foliage on trees, building walls, rain, snow, and other access points can degrade the signal. Because WiFi is an unlicensed service, anyone can run an access point. The popular and very common home wireless routers can cause interference and slow down other access points.
- WiFi, even the newer G and N services, can't handle video very well, and this limits the potential of such a service to be financially viable. A community broadband system has to have a solid business model that is financially sustainable, and that means being able to carry business and residential video services.
- WiMax is a newer set of frequencies and power standards that are widely advertised as a silver bullet for broadband, but there is nothing magic about WiMax. It uses many of the same frequencies that WiFi does, meaning that it still requires clear line of sight to get an adequate signal. WiMax radios can use both licensed and unlicensed frequencies, and the unlicensed frequencies will suffer from the very same interference problems from which WiFi suffers. WiMax has not been widely deployed and is likely to be superseded in some areas by LTE (Long Term Evolution), a cellular wireless technology that offers

equivalent bandwidth and has the advantage of supporting traditional cellular voice services.

- Licensed WiMax frequencies perform better because there is less interference, but this presumes the licensed frequencies are available (some other private or public entity may have licensed the frequencies for a particular geographic area). The licenses, if available, may cost several thousand dollars to purchase and then there is an annual renewal fee.
- WiMax and LTE capacities and distances are widely exaggerated. It is very common to see promises of "up to 80-100 megabits" of capacity and distances of "10 to 20 miles." With respect to bandwidth, that 100 megabits of capacity will be shared among all connected users, so if 100 households are trying to access the network via a single WiMax access point, the usable bandwidth may be more like 2-4 megabits per household or per user. Distances are limited by line of sight. Both WiFi and WiMax signals will work over many miles, but only with narrow angle antennas and clear line of sight. While WiFi can easily reach ten miles or more with clear line of sight, and WiMax can reach twenty miles with clear line of sight, in practice these optimum distances are rarely achieved; it is more realistic to consider WiFi usable over 2-4 miles and WiMax over 4-8 miles. Tree cover is particularly problematic, and it is often necessary to remove tree limbs, an entire tree, or to relocate the antenna in order to get a good signal.
- LTE and television "white space" systems are emerging standards that can provide connectivity at much longer distances (five to ten miles is possible under ideal circumstances) and the radio frequencies used are better able to penetrate at least some foliage. Bandwidth of several megabits will be possible, and will compare very favorably with copper-based systems like DSL. But even these systems will have a very limited ability to handle TV programming, interactive videoconferencing, and other business class services.

Wireless services will be important in Powhatan. And wireless is not going away; it will remain as an important component of a well-designed community broadband system--as a mobility solution. As we travel around the community, we want to be able to access the Web, check email, make phone calls, and do other sorts of things. Wireless services enable that, and in rural areas, wireless services are an important step up from dial-up.

Communities need to regard telecom as essential public infrastructure, critical to community and economic development. And that well-designed community infrastructure includes both wireless access and eventually fiber to every home and business. With the right business and financial planning, such systems can pay for

themselves and provide new revenue streams to local government, while lowering the cost of telecom services.

Fixed Point Access Wireless

Fixed point wireless Internet access via some private sector providers is already available throughout central Virginia. Community investments should be limited to tower sites and towers, which can be leased to the private sector. Cellular data service (e.g. 3G, 4G, and the newer LTE-based services) are a substantial improvement over dial up, and while prices are not cheap (the typical monthly fee for a data plan is $25 to $40), it is likely many residents and businesses would be happy to pay more to get off dial up.

This kind of service can introduce additional competition for Internet access customers, which can lower prices and create incentives to offer better customer service from the providers. Over time, most fixed point Internet users (five to seven years out) will want to migrate to fiber connections which will have the capacity to provide a much wider range of services, including HD TV, telemedicine, and tele-health, among other applications.

Fixed point wireless infrastructure investments (e.g. locations for towers, towers, fiber and duct backhaul connections) can be re-used over time to support mobile wireless services and long term public safety voice and data services. If Powhatan County makes investments, it should be in close coordination with public safety and rescue services to ensure that public safety voice communications benefit as well.

A well-designed regional fiber network will help increase the availability and affordability of wireless broadband services, especially if existing wireless providers are included early in the planning process. The goal would be to identify existing tower sites that could be reached affordably with fiber. Fiber access to these towers will lower the cost of backhaul for local wireless broadband providers while simultaneously allowing them to increase bandwidth and overall performance.

Mobile Access Wireless

Wireless access to the Internet and other mobile services like cellular telephone providers is a long term need that will not be replaced by fiber access. In fact, over the next five to seven years, the most common use for wireless Internet access will be for mobility--casual business, personal, and government access away from the home or office.

In Powhatan, mobile wireless access to the Internet will probably be provided entirely by the private sector cellular providers. In any community, wireless investments should be made with care as there is some risk of spending too much too quickly; wireless systems, frequencies, and capacities change quickly, and there is always some danger of

making a commitment to a protocol (e.g. WiFi, WiMax) that is superseded by another set of incompatible protocols and equipment. If investments are made, risk can be reduced by investing primarily in tower sites (real estate), towers, equipment shelters, and other passive network facilities that require little maintenance and that have long life spans. Space on towers can be leased to private sector service providers, which will provide a revenue stream to support ongoing maintenance costs.

We note reports that some residents and businesses that subscribed to cellular data services (e.g. air cards) have dropped the service and returned to landline-based broadband access because of the poor quality and high cost of the service. In rural areas, this pattern is typical: the first subscribers to cellular data service in an area with a brand new tower experience excellent service, but as more customers subscribe, the available bandwidth is shared among more and more customers, and the service can degrade rapidly. All of the major cellular data providers have, within the past year, introduced data caps and overage charges that make using the service for work from home or watching TV and movies impractically expensive.

Case Studies

Other communities across the United States are already actively pursuing new and innovative public/private partnerships to improve the access and affordability of telecom services delivered via broadband. In September (2008) the Fiber To The Home Council provided some statistics on the growth of residential fiber in the United States. Over 1.6 million homes were connected with fiber in the past twelve months, but only about 10% of American homes have fiber connections at this time. The deployment of fiber is highly dependent upon location, so some densely populated urban areas, primarily on the East Coast, are getting fiber much more rapidly than other areas of the country.

Communities that have affordable broadband are enjoying a faster rate of economic growth than communities that lack broadband, based on a CMU/MIT study (Measuring the Economic Impact of Broadband Deployment, Sirbu and Gillett, 2006).

A Brookings Institution study (Crandall, Lehr, and Litan) in 2009 found that for every 1% increase in the availability of broadband in a community, the level of employment increases correspondingly by 0.3% annually. The study also found that as the level of Internet users increased in a community, there was a corresponding increase in economic growth, with a 10% increase in Internet use yielding a 1.3% increase in the economy.

A new digital divide is emerging, with fiber as a differentiator. Communities with affordable broadband infrastructure and the ability (i.e. fiber) to expand capacity as demand grows over the next seven to ten years should enjoy a measurable economic development advantage over communities that lack such infrastructure.

Danville, Virginia

The City of Danville, Virginia is operating an open access, open services network (www.ndanville.net) focused on creating the right kind of economic development incentives and accompanying infrastructure that will help retain existing businesses and help attract new ones. Danville has a City-owned electric utility, and the growing fiber network is being managed as part of the electric utility operations.

Using a multi-phase approach, the City first hooked up government offices and local schools in 2004, and in 2006 began planning for extending the high performance all fiber network to local businesses and residents throughout the electric service area, which includes a large part of very rural Pittsylvania county. The first businesses began to get hooked up in late 2007, and Danville had fiber passing parcel in its business parks before the end of 2008. The City-County business incubator was one of the first locations to receive the fiber services. The City has completed the planning for taking

fiber to some of its residential neighborhoods (a total of about 1600 premises), and construction for this Fiber To The Home initiative is expected to start in the fall of 2010.

The City is not selling any services to businesses or residents; all services are offered by private sector service providers that use the network and pay the City for the use of the network via a revenue sharing agreement.

Danville recently sold (2009) an abandoned textile mill to a firm that is renovating it to create a state of the art data with 200,000 square feet of colocation space. The new data center is bringing 400 new jobs to the city, and the availability of an open community-owned peering point (the Danville MSAP) and nDanville fiber at the location was essential to the deal. The data center will be a significant boost to the downtown area of Danville, as the building is within walking distance of the Main Street commercial area of town. Local businesses expect to benefit from the increased foot traffic.

A second major business announced that it was opening a high tech manufacturing plant in Danville in 2010, which is bringing an additional 150 jobs to the City, and fiber was also a factor in the relocation decision.

Attribute	Description
Governance	nDanville is part of the City of Danville Utilities Department.
Funding	The City of Danville Utilities Department has used a combination of loans and revenue to fund the construction of the network. Revenue from key institutions like the City and County schools have been a significant factor in the development of the network.
Business Model	nDanville is an open access, open services network. All services provided to residents and businesses are offered by private sector providers.
Management	Network operations are managed by the City. Some outside plant maintenance is performed by City utility crews, and some work is outsourced to qualified private sector firms (e.g. splicing, some construction work).
Technology	nDanville is an active Ethernet fiber network, providing a 100 megabit symmetric connection as the standard service. Gigabit and 10Gigabit point to point connections are also available. nDanville has two colocation facilities available to businesses and providers, and the nDanville MSAP (Multimedia Services Access Point) provides access to more than twenty-five local, regional, and national service providers.

Lafayette, Louisiana

Lafayette, Louisiana is perhaps one of the best known community broadband projects in the United States. The City announced its intentions to go into the broadband business in 2004, and was promptly sued by the incumbent cable provider. The court case ground on slowly, and it was not until the City had spent nearly $4 million on legal fees that the Louisiana Supreme Court decided that the City had the right to compete directly with private sector telecom companies.

Since then, thousands of customers have been connected and Lafayette is now famous for having some of the lowest rates for Internet access in the United States, with a 50 megabit symmetric package of Internet access for only $58/month. The network has now been operational since early 2009.

Cox Communications, famous in Louisiana for regular rate increases, froze its rates in Lafayette for several years following the city's initial announcement that it would offer telecommunications services. Meanwhile Cox continued to raise its rates in other parts of the state. The result was that even before Lafayette's system began operating it had saved its residents and businesses nearly $4 million.

Attribute	Description
Governance	The network is owned and operated by the City of Lafayette and is part of the Lafayette Utilities Department.
Funding	The City raised $110 million in funding to build the network. The long term plan is to pass all 57,000 homes in the city.
Business Model	Services are sold directly by the City in a traditional triple play retail model.
Management	The City Utilities Department operates the network and handles outside plant maintenance.
Technology	LUSFiber is an active Ethernet system with a standard 100 megabit symmetric fiber connection. Gigabit connections are also available.

Accomack/Northampton Broadband

Accomack and Northampton counties, on the Eastern Shore of Virginia, have formed a broadband authority and are have just completed construction of a 60 mile high performance fiber backbone that will reach from the northern border of Maryland and will extend across the 17 mile Chesapeake Bay-Bridge Tunnel to meet other regional fiber networks in the Norfolk area.

The authority was formed in the spring of 2008, and construction on the fiber backbone began later in early fall, 2008. The region made the commitment to form the authority to provide fiber services to private sector firms that were demanding better connectivity to both the NASA Spaceport and Navy facilities in Chincoteague, Virginia and to provide higher performance and less expensive fiber routes off the Shore. The Authority is currently developing plans for the deployment of wireless and fiber services throughout the region. Construction of the northern and southern portions of the fiber backbone are planned for completion before the end of 2010, including a 17 mile link across the Chesapeake Bay Bridge-Tunnel to Norfolk, Virginia. The connection across the Chesapeake Bay will give users on the network access to a large number of commercial providers. On the northern end of the network, the ESVBA will connect with fiber in Maryland, enabling a completely redundant fiber loop around the entire

Chesapeake Bay. Businesses will be able to locate in the ESVBA service area and have carrier class network redundancy for essential business services.

Attribute	Description
Governance	The Eastern Shore of Virginia Broadband Authority (ESVBA) is a regional authority owned by the counties of Accomack and Northampton. The Authority has an independent, five person board of directors.
Funding	The U.S. Navy and NASA both have large installations on the Eastern Shore, and both agencies provided some seed funds for construction of the backbone. The Commonwealth of Virginia also provided additional start-up funds.
Business Model	The network is being operated as an open access network with an initial focus on business and institutional customers. Private sector service providers will offer all services to residents and businesses. Long term plans include expanding fiber services into the many small towns in the two counties, and several towns have begun planning for the effort.
Management	The Authority has one full time project manager and two part time staff providing administrative and some technical support. Network operations and outside plant maintenance will be outsourced to qualified private sector firms.
Technology	The ESVBA network uses active Ethernet and will provide symmetric 100 megabit, Gigabit, 10Gigabit, and DWDM connections. The Authority is also actively working with some wireless broadband providers to get fiber to some tower locations to improve access to broadband wireless services in the region.

Rockbridge Area Network Authority

Rockbridge County, Virginia and the two independent cities of Lexington and Buena Vista (both within the borders of the county) formed a broadband authority in 2009 after completing a DHCD-funded planning study. The authority consists of elected officials from each of the three localities, as well as representatives from the business community and Washington & Lee University. Rockbridge was able to build upon the study for the submission and successful award of a $7 million grant.

The grant, which includes $7 million in ARRA Federal stimulus funding and $3 million in local match, will construct 90 miles of backbone fiber and provide another 45 miles of last mile connections to 53 community anchor institutions and 175 homes and businesses. The project includes a state of the art data center and will also construct 29 DSL cabinets throughout the county, to help extend service into the underserved regions of Rockbridge County. Construction will begin in fall 2011 and the project will be complete by the summer of 2013.

Attribute	Description
Governance	The network and data center will be owned and operated by the Rockbridge Area Network Authority (RANA).
Funding	Approximately $400,000 in local match from the three local governments and $2.5 million in funding from Washington & Lee University helped get the project started. These local funds were used as match to obtain $7 million in Federal ARRA stimulus funds.
Business Model	Services are sold to business and residential customers by private sector service providers using the RANA network for transport
Management	The network will begin operating in the first half of 2012, and most operations and maintenance is expected to be outsourced.
Technology	The network is an active Ethernet system with a standard 100 megabit symmetric fiber connection. Gigabit connections are also available.

The Wired Road

The Wired Road is an open access, open service network jointly owned and managed by Carroll and Grayson counties and the City of Galax (Virginia). The three localities formed a regional broadband authority and began construction in September of 2007. The first institutional customers were added to the network (Carroll County Public Schools, Carroll County, Crossroads Institute) in March of 2008. The Wired Road is not selling any services to businesses or residents; all services are offered by private sector service providers that use the network and pay the Authority for the use of the network via a revenue sharing agreement. The three governments see the network investments as a way of differentiating the region and providing a valuable economic development marketing tool. The Wired Road is being designed as an integrated fiber and wireless network, with fiber in the three major towns and all business parks, and wireless services as the initial offering in under-served rural areas where many residents are still on dial up. The long term vision is to provide fiber to every home and business that requests it.

The Wired Road has installed fiber to 60 buildings in downtown Galax, the regional commercial and business community. Fiber availability and the open access business model have created a dramatic reduction in the cost of Internet and phone services for businesses using the Wired Road network--with the savings reaching 70% for some businesses. The Galax fiber was installed using City public works department staff and took only two weeks, including two days of training. City crews now routinely are able to extend fiber to additional buildings as needed, and 25 new jobs were brought to downtown just months after the fiber was installed. The new jobs were placed in a formerly empty building, and the jobs were moved there because of the fiber availability.

The project has attracted additional funding, and more than $2 million of additional middle mile and last mile fiber will be constructed in 2010. This work will include fiber to all lots in all three regional business parks, new fiber in Hillsville and Independence downtowns, and additional fiber in Galax.

Attribute	Description
Governance	The Wired Road Broadband Authority is a regional authority set up under Virginia law. It is owned by the counties of Grayson and Carroll and the City of Galax. It has a five member independent board of directors.
Funding	The first phase of The Wired Road (completed in 2008) was funded with a mix of local government funds, a grant from the Virginia Dept. of Housing and Community Development, and a substantial contribution from the Carroll County Public Schools. The Wired Road has since raised over $300,000 locally and received almost $2 million in state and Federal grants to fund additional fiber to businesses and fiber to the home in Grant, Virginia.
Business Model	The Wired Road uses an open access, open services model, with all services to homes and businesses provided by private sector providers. Two wholesale providers and three retail providers are currently competing for services.
Management	The Wired Road has one full time project manager, and the Authority has a contract with a private sector firm that provides network operations and outside plant maintenance and repairs.
Technology	The Wired Road is the first fully integrated fiber and wireless open access, open services network in the U.S. Fiber is deployed in the downtown commercial areas of Galax, Hillsville, Independence, and Grant, and The Wired Road has twenty-six wireless access points that covers about a third of the 1,000 square miles of mountainous terrain that comprises the service area. The standard fiber connection is a symmetric 100 megabit pipe, and wireless services vary, including 1, 3, and 5 megabit symmetric services.

Palm Coast, Florida

In 2008, the City of Palm Coast began exploring the potential of making existing City-owned fiber assets available for business and commercial use. Existing Palm Coast businesses were expressing concern to City leaders about the high cost of Internet access and the limited bandwidth available in the City. After a six month study of various business and financial options, the City decided to focus on developing the network as a “carrier class” commercial network capable of supporting virtually any level of business service that might be needed.

As of early 2010, three of four redundant fiber loops had been completed, with the final loop slated for completion in 2011. The City invested in a dedicated colocation facility with both shared rack space and private cages for service providers, and purchased “carrier class” network switches and routers to light up the fiber. Palm Coast FiberNET was made available for service in May, 2010 (http://www.ci.palm-coast.fl.us/

PalmCoastFiberNET/), and had three service providers committed on day one. At least one additional provider was expected before the end of 2010.

Palm Coast FiberNET provides service to City buildings and locations, and successfully won a bid to provide services to Flagler County Public Schools. The local hospital has also agreed to use the network to connect hospital medical records and data services with several local health clinics and medical offices. The City expect FiberNET to operate in the black in year one.

Attribute	Description
Governance	Palm Coast FiberNET is owned by the City of Palm Coast.
Funding	City enterprise funds were used to pay for the initial $2.5 million in fiber construction, equipment, and the colocation facility.
Business Model	FiberNET is operated as an open access network. Providers pay a monthly fee per customer, based on connection size.
Management	The City IT Department manages network operations, and private sector contractors are used for outside plant maintenance and construction work.
Technology	FiberNet is an active Ethernet network that provides symmetric 100 megabit, Gigabit, and 10Gigabit connections as standard. DWDM circuits can be provided upon request.

Powell, Wyoming

Powell, Wyoming has built a 100% fiber network throughout this city of 2,650 households and 5,500 people. Citizens supported the City-led effort because of poor service from the incumbent providers. The City government expects a financial return of more than $22 million over thirty years on the $4.9 million initial investment required to build the network. Powell is an electric city, which makes it easier to get started because the electric utility poles, equipment, and crews can be used to help install and maintain the system.

The network has been so popular with businesses and residents that in 2010, the Powell City Council authorized the buy back of $6.5 million in twenty year bonds used to build the system. At the same time, the City re-negotiated the exclusive use agreement with the local service provider (TCT West) on the network. The local company had exclusive (monopoly) access to the network in return for guaranteed fees paid to the City. This minimized financial risk to the City but did not create competition for services. Under the new arrangement, Powellink will be operated as a fully open access network, TCT will no longer be the exclusive provider, but TCT will no longer have to make guaranteed payments to the City. Instead TCT will pay for access to the network at the same rate as any other provider.

Attribute	Description
Governance	Powellink is owned by the City of Powell and is operated as one of the city's enterprise funds.
Funding	Revenue bonds were used to finance the $6.5 million build out.
Business Model	Started as a monopoly with a single provider, but has been converted to an open access network with each provider paying a share of costs.
Management	The City is contracting with a local provider to handle network operations. Some maintenance of outside plant is performed by City utility crews. New construction is contracted out.
Technology	Powellink is a fiber GPON (Gigabit Passive Optical Network).

Risk Factors

Market Size

Market size is a key consideration for evaluating risk. Market size (called "addressable market," or the number of potential customers) determines the level of interest of service providers, who are the primary customers of an open network. Certain kinds of services are essential to the financial viability of a community network, especially TV and telephone services. While telephone services can be offered affordably in even very small markets, the overhead costs of establishing a local or remote TV head end (equipment that manages and distributes the channels available from a provider) is still relatively expensive compared to providing other services like Internet access. A rule of thumb for evaluating market size is that a minimum of four to five thousand potential residential customers (households) are needed to attract an IP TV provider. Note that fiber is required for adequate TV package offerings.

Powhatan County has a residential market of 5,109 households (2010 estimate) and a business market size of approximately 443 establishments. With many households and home-based businesses still using dial-up, this represents a business opportunity for service providers who can make a business case for providing services like Internet access and VoIP telephone service. Alternatives to existing cable and satellite TV offerings will not become available until fiber connections are more widely available.

Take Rate

Take rate refers to the number of customers that actually subscribe to one or more services. Take rate targets are established in a detailed financial projection, and are adjusted over time as actual take rate data becomes available once the network is in operation. If the take rate is too low, revenues will not meet goals, and lowered revenues may affect the project's ability to pay its bills and maintain and operate the network.

Take rate projections are a significant risk factor in any project of any size, and must be considered carefully. Take rate risk can be managed by only building in areas where businesses have made a threshold commitment to buy a minimum dollar value of services (e.g. 40% of businesses in a defined area must commit in advance before build out would commence).

Funding

Excellent leadership and hard-nosed business management of the enterprise are essential to the project's ability to obtain necessary funding. Although the network will be operated as a local government effort, it must be managed with the same attention to costs, revenue, and financial administration as any private sector business. The project

must be able to develop and maintain "investment quality" financial reports and business models to attract private sector sources of funding like revenue bonds, municipal leases, commercial loans, and business contributions.

If investments are restricted to basic infrastructure like tower sites, fiber, towers, and equipment shelters, maintenance costs will be relatively low and it should be possible to structure attractive dark fiber leases and tower space lease rates to cover routine maintenance, which would minimize financial risk and require limited external funding.

Service Providers

While in many respects a community broadband network shares many similarities with other public utilities (e.g. roads, water, sewer) there is one fundamental difference. Other public utilities like water and sewer have a captive audience and the utility is able to operate as a monopoly–meaning the customer base can be taken for granted. Early discussions with service providers have been positive, with at least two providers making requests for additional information about the effort.

A community broadband network is a public/private enterprise, and service providers are the primary customers of the network. Service providers cannot be taken for granted. Instead, a fair fee structure, a high quality network, excellent maintenance and operations processes, and organizational flexibility will be required to recruit and retain service providers.

Projects that are not successful in attracting service providers will fail. Affordable lease rates for tower space and/or fiber connections will attract service providers. Other open access projects in Virginia (Danville, The Wired Road) have not had any difficulty getting service providers to use the infrastructure. Powhatan has a built in advantage with an MBC fiber presence already in the county.

Technology

A question that often dominates early discussions of community broadband projects is, "Are we picking the right technology and systems?" Everyone has experienced the rapid obsolescence of computers, cellphones, printers and other IT equipment.

There is always some risk associated with making modest investments in network infrastructure. However the risk can be managed. In a predominantly fiber network, a large portion of the investment will be dedicated to getting fiber in the ground or on poles throughout the community. Properly installed fiber has a minimum 25 to 30 year useful life, and fiber installed by the telephone companies in the seventies is still in use today. Fiber also has a useful property not shared with other public systems like water, roads, and sewers. The capacity of fiber can be increased without replacing the fiber or adding additional fiber. Instead, fiber capacity can be increased indefinitely by replacing the electronics at each end of the fiber. This means that a community

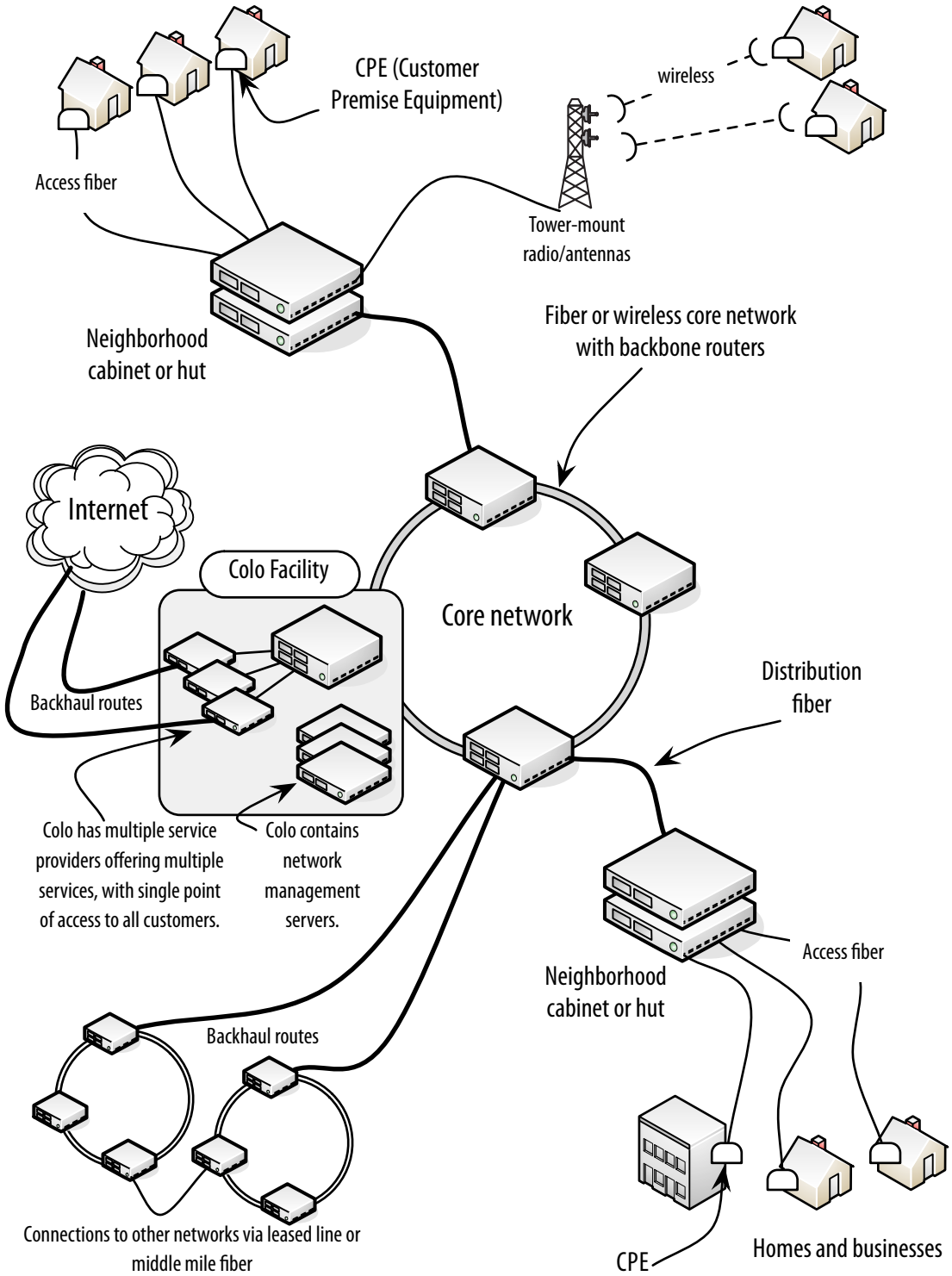
investment in fiber creates a stable, long term asset for the community with long lasting value.

The equipment used to light the fiber has a shorter useful life, and is usually depreciated over a period of 7 to 9 years. Some equipment may remain useful longer than that. Wireless equipment must be replaced much more often (typically 2 to 4 years of useful life) because it is typically exposed to much harsher conditions (extreme heat and cold, lightning strikes, ice, snow, rain, wind).

The primary technology risk is selecting a vendor who provides equipment that does not perform as advertised. This risk can be managed by a careful procurement process which would include a careful analysis of network capacity and features, detailed RFPs that specify equipment features and functions explicitly, and a thorough RFP evaluation process.

Risk in this area will be relatively low if investments are confined primarily to passive infrastructure in the early pilot projects. Our recommendation for Powhatan is to make only investments in passive infrastructure to minimize initial costs and especially to minimize ongoing cost of management and repairs.

Community Broadband Network Components



Core Network

The core network is often referred to as the "backbone" network. It is a high capacity route or set of routes throughout a community or region that provides transport between towns, neighborhoods, business districts, and other major facilities.

Ideally, the core network is designed as a redundant fiber ring, which provides both capacity and gives the network the ability to continue operating even if the fiber is cut or damaged in one location. A fully redundant ring can be expensive to construct, and so the "ring" feature may be a long term design goal.

Distribution Network

Distribution networks are connected to the core network, and provide primary network paths through a town, neighborhood or business district. Distribution networks are generally part of what is called "middle mile." Fiber-based distribution networks generally are built along most streets and roads, and can be aerial fiber (mounted on utility poles) or underground fiber (installed in underground duct or fiber cable that is buried directly without duct).

The distribution network connects the core network (the network backbone) with the individual connections within a neighborhood or business district that connect to home and businesses. This portion of the network can be fiber-based or wireless, but fiber will be required over the long term to support video services and other kinds of high bandwidth applications like telemedicine

Access Network

The access network is what is commonly called "the last mile," although "the first mile" might be more appropriate, since customers should be a primary consideration when designing a network.

The access network is a direct fiber link between a fiber switch located within a neighborhood or business district, or it may also be a direct point to point wireless link from a wireless access point on a tower or building and the home or business. Network subscribers have to have Customer Premise Equipment (CPE) to get a network connection, and this is simply a small box that looks like a hub or switch. In a fiber network, the fiber cable is connected to one port, and one or more copper Ethernet RJ45 ports allow users to connect computers, phones, and TV set top boxes to it. In a wireless portion of the network, a small box with a radio and possibly an external antenna is mounted on a side of the home or business with clear line of sight to a nearby tower or building where the access radio is mounted.

Colocation Facilities

A colocation facility is a controlled environment (i.e. heated and air-conditioned) room with Internet access through wired and/or wireless systems. The colocation facility will be a place where fiber, wireless, and copper-based network facilities meet. It will be equipped to house high-end network equipment, servers, and other electronic gear. A variety of middle layer network components and services can be located within the colo including, for example, directory services, replicated content servers, routing services, and other elements needed to deliver new multimedia services to the home and small office from multiple, competing providers. Characteristics of a colocation facility include:

- A reliable source of AC electric power is required, with backup UPS (Uninterruptible Power Supply) service available by an onsite generator.
- Controlled access to the facility (e.g. by electronic keycard) 24 hours/day, seven days a week.
- Racks for locating network equipment and servers, and optionally locked cages for equipment racks.

Functions of colocation facilities include:

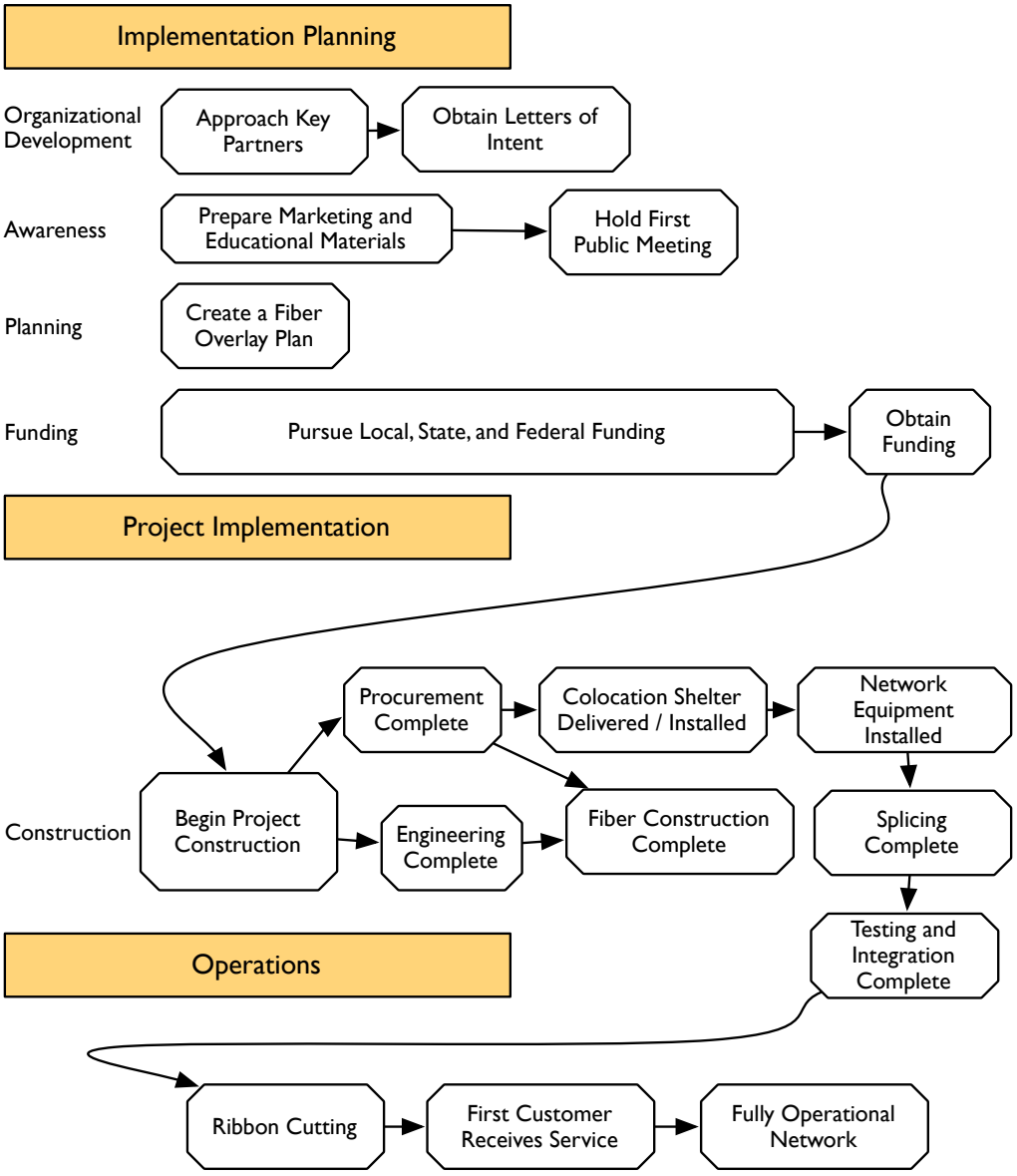
- Hub for new broadband infrastructure development for the community.
- Location for a regional and community network exchange point for local service providers. Also called a peering point or inter-exchange point, this kind of facility can reduce costs and increase performance in a win-win-win scenario (because it helps keep local traffic local and reduces service provider costs, thereby reducing the price of services). In Powhatan, a modest colo facility would provide the meet point for MBC fiber and county-owned fiber.
- Insertion point for multimedia services from multiple competing providers to reach subscribers over single broadband medium (fiber, wireless, other).
- Community, campus, or building point of presence for new middle layer components required to implement next generation Internet (directory services, caching, routing).
- Focal point for technical resources and management of community infrastructure.
- Aggregation point for low cost access to gigabit scale network services.

Backhaul

Every community network requires one or more paths (routes) out of the community to carry voice, video, and data traffic (in both directions). Backhaul network connections can be purchased from a local incumbent telephone company. In some communities, there may be other backhaul providers available. Backhaul connections are usually terminated at the community-owned colocation facility. A network in Powhatan County would allow service providers to obtain backhaul through the MBC network.

Managing a Pilot Project

Development of a pilot project includes two phases of work: Implementation Planning, and Project Implementation (actual construction), as illustrated below.



Leadership Activities

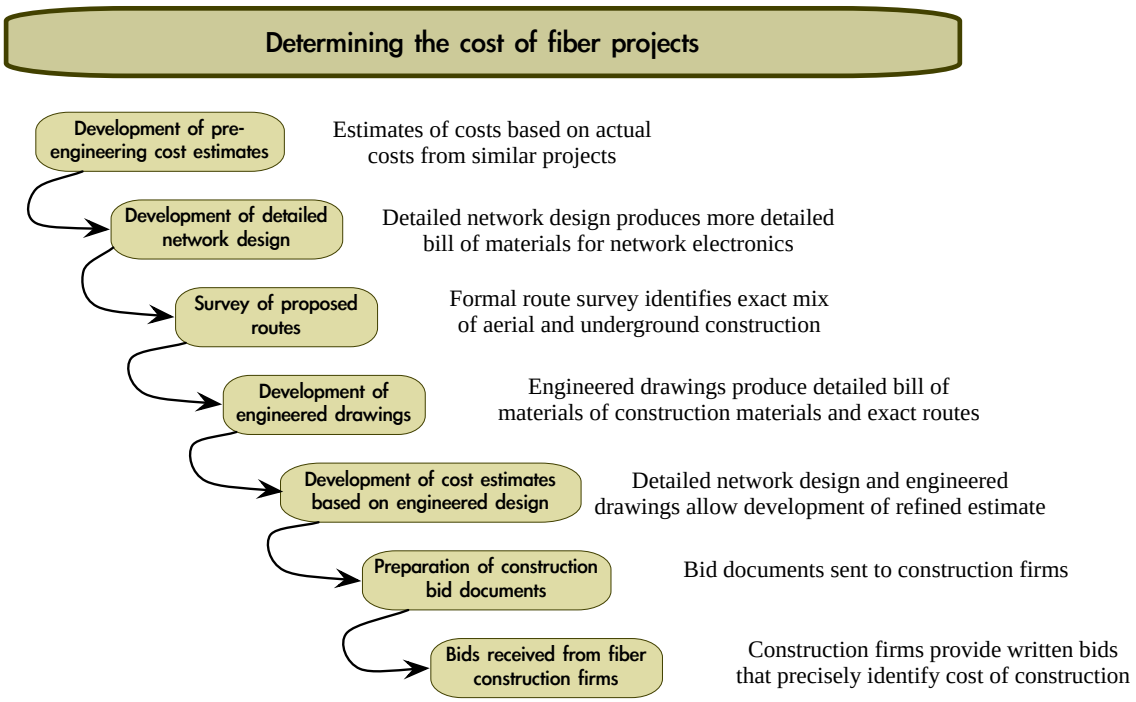
These activities are needed to form the ownership and governance entity (e.g. joint resolutions, assignment of departmental responsibilities, accounting processes, etc.). For Powhatan, this effort would be most likely managed out of an existing county department like Public Works.

Service Provider Development

This area focuses on attracting and working with service providers in the scope of the planned project, needed meetings, business agreements, and service level agreements, negotiation strategies, and ongoing public/private partnership maintenance and support. Some legal support is needed to develop a handful of standard contracts (e.g. dark fiber lease agreement, colocation lease agreement).

Network Construction Costs

Pre-engineering cost estimates provide an early look at the cost of build out; these estimates do not include formal pole surveys or the significant expense of route engineering. Even after pole surveys are completed, route surveys are performed, and engineered route blueprints are developed, the true cost of construction is not known until the construction bid documents are prepared and bids are received. The diagram below illustrates the process of establishing the exact cost of a fiber or wireless project.



Cost savings for additional build outs would be substantial, mostly in network equipment and facilities, but also in outside plant materials (e.g. fiber cable), and construction labor.

When preparing cost estimates for inclusion with state or Federal grant applications, it is good practice to use conservative cost estimates (i.e. higher cost estimates) to ensure that the grant funds are adequate to complete the project, as there is usually no opportunity to request additional funds if actual construction or materials costs turn out to be higher than the estimates. For a grant, it is always more desirable to have the actual cost of the project be under the estimated cost rather than over the estimated cost.

The percentage of aerial construction and the cost of make ready are major factors in the any cost estimate, and when comparing two different cost estimates, it is important to know the underlying assumptions upon which an estimate is based.

- For example, it is easy to develop a very low cost construction estimate by assuming 100% aerial construction and no make-ready costs.
- Some construction cost estimates include only the cost of construction labor and materials (e.g. fiber cable, attachment hardware, and splice enclosures). But a different cost estimate may include other necessary and essential costs, like project management, engineering, and network equipment. In other words, two cost estimates with the same aerial/ underground and make-ready assumptions could still vary widely if one includes all necessary costs needed to produce a functional, working network and the other estimate includes only the cost of getting the fiber on the utility poles.
- Finally, some cost estimates may include the cost of drops (the access fiber) from the pole or the curb to an individual premises.

It is only correct to compare the costs of two estimates if you can reliably determine that the underlying assumptions and costs are the same for both estimates.

In other words, the percentage of aerial construction, the amount of make-ready, inclusion of engineering and equipment costs, and the inclusion of drops all must be the same. Two estimates of construction costs for the same area may appear to be widely divergent, but one estimate may include only direct labor and material costs, all aerial construction, no drops, no network equipment or design and engineering costs, and no make-ready fees.

Note that an estimate like this would be very low but would not be a functional network and no residences or businesses would actually be connected to the fiber. The other estimate may include all the necessary costs needed to actually connect customers, including reasonable make-ready costs, some underground construction, network electronics, drop fiber cables to premises, and other costs like network design and engineering.

Estimates for construction materials and network equipment vary largely based on the amount of materials or equipment purchased. Small purchases of network electronics generally receive little or no price discount, but for larger purchases, discounts can be substantial (e.g. a range of 10% to 40% off list). Construction materials purchased in large lots also receive more discounts. Our pre-engineering estimates are conservative, with prices for materials and equipment generally using list prices. Labor costs are based on prices from other construction projects and knowledge of local conditions. Cost of labor can vary widely based on the time of year, the overall size of the job, the local economy, and the national economy.

In Powhatan, there will be at least one small equipment shelter. The pilot network has been planned to achieve the best balance between the number of buildings passed and the total cost of the network. After the initial pilot network is constructed, Powhatan County will be able to realize additional cost savings if adding additional segments to the network.

The build out assumptions for each of the scenarios will change once a formal pole survey is completed and formal engineering is complete. The age of poles, the height of poles, and the number of other communications cables on poles affects whether or not a particular pole can handle the weight of an additional cable. "Make Ready" refers to the cost of preparing the pole to receive an additional fiber cable.

Make ready fees vary widely, and make ready work can range from moving one or more existing cables up to and including pole replacement. While it is generally true that aerial construction is usually less expensive and faster than underground construction, make ready costs can be so high that underground construction becomes competitive, especially if some poles have to be replaced. Replacing a single pole will cost several thousand dollars, and $4,000 to $6,000 per pole for complete replacement is typical. With about 24 poles per mile, replacing just a few poles can quickly make underground burial of fiber cable less expensive.

Operations and Management

This area of responsibility includes tasks, roles, and responsibilities related to operating the built infrastructure, strategies for network operations and network repairs and maintenance, and long term operations planning. With recommended investments limited to passive infrastructure with a long life time (e.g. duct, fiber cable, wireless towers), the county Public Works department should be capable of handling most routine tasks, with the possible exception of fiber splicing.

Fiber splicing is easily learned, and new highly automated splicing equipment makes the job much simpler than in the past. However, Powhatan's proximity to the Richmond area would make it possible to outsource emergency fiber splicing repairs to a qualified private sector firm.

Marketing and Public Awareness

A modest public awareness campaign will be needed to ensure that businesses, institutional customers, and residents (if residential service is included) are aware of new service and price options. It will be necessary to coordinate some awareness marketing with the service providers to promote partnerships and increase take rates for providers.

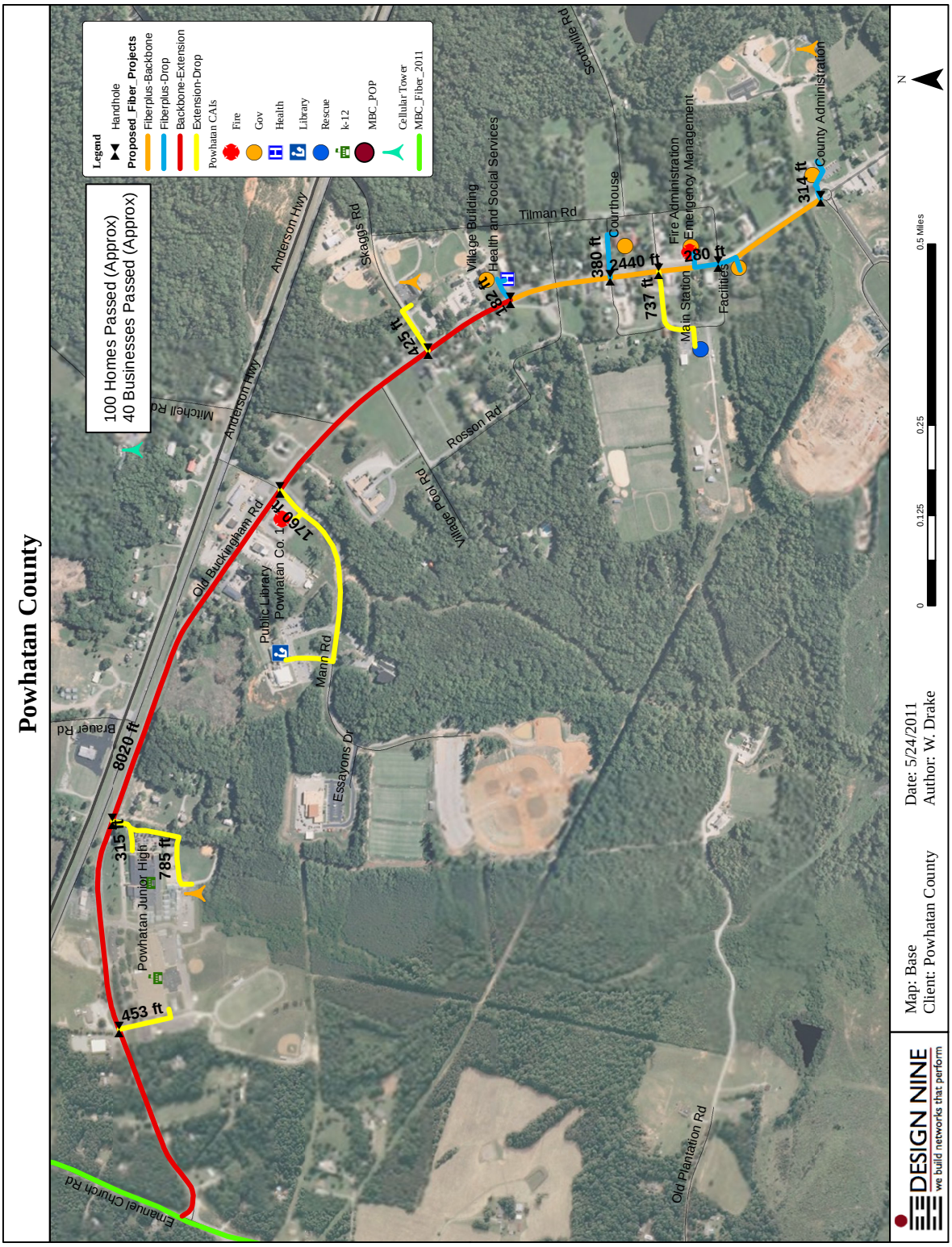
Powhatan Fiber Build Out Study

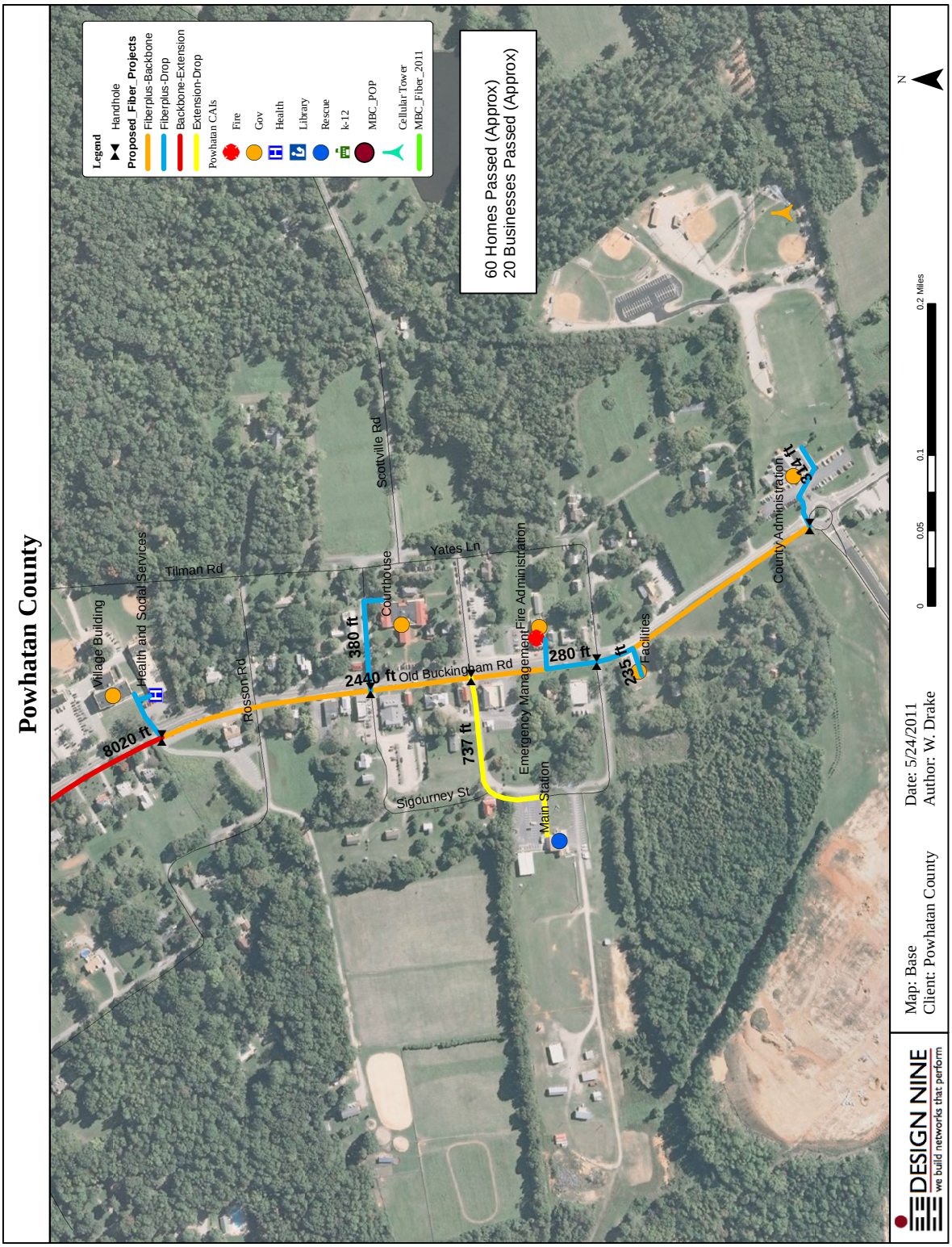
The maps on the following pages show routes for a pilot network in Powhatan. The pre-engineering cost estimates are based on the route and connections shown on the map on the next page. Adding extensions to the initial route will allow Powhatan to add more businesses and residences after the initial revenue stream is created.

For additional capacity and future expansion underground construction will include an additional duct or ducts for laterals and future fiber. The pilot project for Powhatan is designed for future growth. Handholes are placed on average every 600 feet to allow for drops, laterals, and future expansion. The design has accounted for 20 drops including drops to:

- Powhatan Junior High
- Fire Department - Company 1
- Powhatan Health and Social Services
- The Emergency Management Building
- County Administration
- Public Library
- Main Station
- Powhatan Courthouse
- Village Building (Network Hub)
- Up to twenty business connections are included in the cost estimate, and many more businesses and residents could be connected with this design for the cost of the fiber drop from the street to the side of the premises (plus customer electronics).

The pilot design extends out to Emanuel Church Road where MBC has indicated that their network is available. At this location, MBC would add a splice point, thereby giving the County and any businesses connected access to 25+ providers on the MBC network. Service providers would pay the County for access to the County-owned fiber.


Powhatan County
Legend
Handhole
Proposed_Fiber_Projects
Fiberplus-Backbone
Fiberplus-Drop
Backbone-Extension
Extension-Drop
Powhatan CAIs
Fire
Gov
Health
Library
Rescue
k-12
MBC_POP
Cellular Tower
MBC_Fiber_2011
100 Homes Passed (Approx)
40 Businesses Passed (Approx)
8020 ft
315 ft
785 ft
453 ft
1760 ft
425 ft
282 ft
380 ft
2440 ft
737 ft
280 ft
314 ft
Anderson Hwy
Old Buckingham Rd
Powhatan Junior High
Public Library
Powhatan Co. 1
Main Rd
Village Pool Rd
Rosson Rd
Skaggs Rd
Village Building
Health and Social Services
Tilman Rd
Courthouse
Fire Administration
Emergency Management
Main Station
Facilities
County Administration
Scottville Rd
Old Plantation Rd
Emanuel Church Rd
Brauer Rd
Essayons Dr
Mitchell Rd
DESIGN NINE
we build networks that perform
Map: Base
Client: Powhatan County
Date: 5/24/2011
Author: W. Drake
0
0.125
0.25
0.5 Miles
N


Powhatan County
Legend
Handhole
Proposed_Fiber_Projects
Fiberplus-Backbone
Fiberplus-Drop
Backbone-Extension
Extension-Drop
Powhatan CAIs
Fire
Gov
Health
Library
Rescue
k-12
MBC_POP
Cellular Tower
MBC_Fiber_2011
60 Homes Passed (Approx)
20 Businesses Passed (Approx)
Village Building
Health and Social Services
Tilman Rd
Rosson Rd
8020 ft
2440 ft
Old Buckingham Rd
380 ft
Courthouse
Yates Ln
Scottville Rd
737 ft
Sigourney St
Main Station
Emergency Management
Fire Administration
280 ft
235 ft
Facilities
County Administration
534 ft
DESIGN NINE
we build networks that perform
Map: Base
Client: Powhatan County
Date: 5/24/2011
Author: W. Drake
0
0.05
0.1
0.2 Miles
N

Overview of Cost Categories

The "Total Cost" estimates in this portion of the report include estimates of the costs in the categories described below. All of these activities and efforts are generally required to produce a working network. As noted in the previous section, some firms may provide cost estimates that only include two categories: Outside Plant Construction Materials and Outside Plant Construction Labor. Also as previously noted, even two estimates of just direct construction costs (materials and labor) may vary widely if one estimate includes drops and one estimate does not.

Administrative and Legal

Specialized legal counsel will be required to review contracts with service providers, contractors, and other participants in the project. Legal costs can vary with a particular location and tend to go down over time. The most legal work is needed early in the first construction phase to develop business contracts with service providers, to review construction and vendor contracts, and to broker lease agreements for use of public or private property (where network equipment like cabinets or shelters have to be located).

Leases, permits, and rights of way

Some costs will be incurred based on the permitting requirements of the project. If Powhatan is able to place the colocation facility, and tower sites on county properties at no charge, the cost of leases will be lower. If cabinets or shelters have to be placed on private property, the cost of the land or long term leases will increase. The cost of permits needed for crossing wetlands, streams, other sensitive areas, and VDOT permits are also included in this category. Formal leases and negotiated lease payments are more desirable than providing some form of free access to services. Since Powhatan County is not a service provider, it has no services to give away for free.

Project Management

Project management for a telecom build requires thorough and detailed planning, experience in procuring construction materials for a telecom project, and the ability to oversee and convey project information to contractors through the duration of the project, including construction inspection work (ensuring construction contractors have done their job properly).

Network Design and Engineering

This work include a full design of the outside plant network, cabinet and shelter specifications, and extensive detail (blueprints) that specifies how all fiber cable, and network equipment is to be installed. These documents have to be completed prior to bidding out any construction work, and are usually included as part of a construction bid package. The detail includes fiber optic cable route determination and size determination, active and passive network equipment selection and placement planning, splicing layouts and documentation, network configuration planning, and all engineering necessary to complete construction.

Buildings, Improvements, and Prefabricated Shelters

This category includes any buildings and shelters constructed as well as improvements to the buildings such as redundant HVAC systems, power improvements, fire suppression systems, security and surveillance systems, etc.

Outside Plant Construction Materials

Network construction includes the outside plant materials needed to build the network. Items like conduit, pedestals, cabinets, hand holes, enclosures, and towers are all included in network construction.

Outside Plant Construction Labor

Labor is typically included with network construction for the bidding process but is separated here to help identify money that could be saved by leveraging local labor resources. Labor includes the placement of pedestals and hand holes, the underground or aerial placement of conduit, the construction of foundations (pads) for various structures throughout the network, and more. Several material costs such as concrete and gravel are included in labor depending on the type of job to be performed.

Network Equipment, Software, and Related Costs

Network equipment includes any network electronics that will be used in the network such as routers, switches, and CPE. Network equipment also includes some items that do not use any AC power but fall into a similar category such as patch panels, and patch cables. The equipment cost will vary widely depending on the type of architecture chosen.

Network Integration and Testing

Some configuring and testing will take place after the network is built and before it is ready for use. In a dark network this involves labeling and documenting the routes of individual fiber strands, and testing of any other features of the network such as generators, air conditioners, and locks. In an active network the testing and integration includes integration requirements for a dark fiber network plus the configuring and installation of switches, routers, and other network equipment. Work in this category requires a skilled professional who is familiar with the network architecture and the business model (e.g. open access).

Miscellaneous

This category provides a small budget for miscellaneous expenses that will arise during the course of construction (e.g., bid advertisement costs, inventory tags, etc.).

Contingencies

The Contingency category is included and calculated as a percentage of the total estimated cost (e.g., 5% of total cost) to provide flexibility in managing the overall budget. Equipment costs can and do change between the time an estimate is made and construction commences. Labor costs can vary depending upon the time of year the

work starts, the state of the local economy, and the state of the national economy. Material costs and lead times can vary based on demand on certain industries, energy costs, and location.

Evaluating Cost Estimates

Each of the scenarios below has a summary table with Cost Metrics, and the table below lists those metrics along with an explanation of what each metric represents.

Cost Metrics	Description
Total Cost	Total cost of the scenario, including ALL project management, engineering, make ready, and equipment costs.
Total Miles	Total road miles of fiber. This does NOT include drops from the road to premises.
Homes Passed	The number of premises passed by the fiber.
Drops	The number of premises connected in the scenario.
Cost Per Mile	This is an all inclusive cost per mile that accounts for all costs and expenditures needed to deliver a working network, including project management, engineering, drops, network equipment, and make ready fees.
Cost Per Home Passed	This is an inclusive cost per home passed that includes all costs and expenditures needed to deliver a working network, including project management, engineering, drops, network equipment, cabinets, generators, and make ready fees.
OSP Only Cost	This is the cost of just constructing the fiber cable outside plant (OSP), and includes the cost of the drops. Cabinets, shelters, and generators are NOT included.
OSP Only Cost Per Mile	Cost per mile for fiber construction only, including drops.
OSP Only Cost Per Home Passed	Cost per home passed for fiber construction only, including drops.
OSP Only (No Drops) Cost	Cost of fiber construction only, excluding drops. Cabinets, shelters, and generators are NOT included.
OSP Only (No Drops) Cost Per Mile	Total cost per mile for fiber construction only, excluding drops. Note that this figure usually yields the lowest cost per mile, and is most often the figure provided by fiber construction firms.
OSP Only (No Drops) Cost Per Home Passed	Total cost per home passed for fiber construction only, excluding drops.

Construction Method and Assumptions

In Powhatan fiber should be installed underground in the VDOT right of way. Many consider underground construction to be more expensive, but for small projects in rural areas this can often be reasonably competitive with aerial construction. Soil conditions and roadside conditions in Powhatan will further decrease the cost of buried construction. Depending on pole condition and make ready costs aerially, and the condition of the roadside, pavement, and existence of buried utilities, underground construction is often the best and less expensive way to go. Underground construction

also alleviates the time consuming task of pole permitting and the ongoing costs of using poles that Powhatan would not own. Though underground fiber is more susceptible to damage by other construction projects, it is protected from damage by falling branches and ice storms.

A key feature of an all-buried approach for Powhatan would be lower operating expenses once the fiber is in place. Aerial construction may be less expensive, but annual pole attachment fees, over the long term, often makes buried construction a better choice from a financial perspective.

It is also important to note that an agreement to attach a cable to the poles has to be negotiated as well. For some pole owners, this process can take a very long time. This list below shows the key assumptions used to develop these estimates.

- Average Distance Between Poles: 225 feet
- Make Ready Heavy Percent: 45%
- Make Ready Light Percent: 55%
- Average Aerial Drop Footage: 750 feet
- Average Underground Drop Footage: 750 feet
- Average Distance Between Hand Holes: 550 feet (applies only to aerial, in the buried estimate the layout was used to determine the number of hand holes)
- Average Distance Between Slack Loops: 1500 feet
- Percentage of Hand holes with a closure (splice can): 75%
- Distance between aerial splice closures: 1500 feet
- “Buried Fiber” Marker Posts every 300 feet
- Amount of drops made to premises: 100% (Powhatan may decide to wait until a customer takes a service to provide a drop)

Note that all costs are estimates based on current market prices for materials and construction costs are based on typical prices paid in past projects. Actual construction and materials costs may vary.

The table below shows distances of construction broken down for different types of installations. On main routes two conduits with 2” diameters will be installed with one conduit containing a 144 count fiber and the second being empty for future expansion. Laterals, the side routes, will consist of a single 2” conduit and a 24 count fiber. The single conduit will have space if more cable is needed at a later date. When estimating the installation costs the construction types are broken down according to the percentages shown in the table below. Though this is a buried design the 3% aerial figure estimates for the use of poles in certain circumstances. Cable buried along a roadside will often be transferred to aerial when crossing a creek, gas line, or other obstacles.

Linear Construction Inputs			
Total Distance (labor)	16,091	Construction Method	
2x2" distance	10,460	Aerial Construction	3%
1x2" distance	5,631	Trenching	60%
144 count fiber	10,460	Boring	25%
24 count fiber	5,631	Direct Bury	12%

Since the Powhatan network is a passive network the estimate tables below do not account for the electronics that would be required for service.

Construction Assumptions	
Average Distance Between Poles	225
Make Ready Standard Percent	0%
Make Ready Heavy Percent	75%
Make Ready Light Percent	25%
Average Aerial Drop Footage	750
Average Underground Drop Footage	750
Average Distance Between Hand Holes	600
Average Distance Between Slack Loops	1500
Percentage of Hand holes with a closure	50%
Distance between aerial closures	1500
Pedestals every x feet	0
"Buried Fiber" Marker Posts every x feet	300

	Units	Unit Cost	Total	Planning Budget Category
Leases and Land				-
Shelter Site Purchases / Leases	1	$2,500.00	$2,500.00	*Leases, permits, and rights of way*
2" HDPE Conduit (Orange w/ tape)	5,631	$0.99	$5,580.00	*Outside Plant Construction Materials*
2x 2" HDPE Conduit (Orange w/ tape)	10,460	$2.05	$21,450.00	*Outside Plant Construction Materials*
144 Count FOC	10,460	$1.40	$14,650.00	*Outside Plant Construction Materials*
24 Count FOC	5,631	$0.40	$2,260.00	*Outside Plant Construction Materials*
Slack Fiber	1,120	$1.40	$1,570.00	*Outside Plant Construction Materials*
Sno Shoes (pair)	1	$55.00	$60.00	*Outside Plant Construction Materials*
Direct Bury (36" deep)	1,931	$4.50	$8,690.00	*Outside Plant Construction Labor*
Trenching (36" deep)	9,655	$5.50	$53,110.00	*Outside Plant Construction Labor*

Conventional Boring (1-2" conduit)	4,023	$11.00	$44,260.00	*Outside Plant Construction Labor*
Aerial Construction - Existing Poles Make Ready Heavy	3	$1,200.00	$3,600.00	*Outside Plant Construction Materials*
Aerial Construction - Cable Placement (per foot)	482	$3.00	$1,450.00	*Outside Plant Construction Labor*
Trace Wire	15,609	$0.12	$1,880.00	*Outside Plant Construction Materials*
Pull Rope	15,609	$0.04	$630.00	*Outside Plant Construction Materials*
"Buried Fiber" Marker Posts	53	$18.00	$960.00	*Outside Plant Construction Materials*
Bulk Splicing (per splice)	2048	$25.00	$51,200.00	*Outside Plant Construction Labor*
Small Handhole (street rated)	27	$550.00	$14,850.00	*Outside Plant Construction Materials*
Small Handhole Placement	27	$150.00	$4,050.00	*Outside Plant Construction Labor*
3M Small Fiber Optic Splicecase, or equivalent closure	14	$305.00	$4,270.00	*Outside Plant Construction Materials*
Aerial Splice Closures	1	$285.00	$290.00	*Outside Plant Construction Materials*
Telecom Vault (36" x 36" Handhole)	1	$950.00	$950.00	*Outside Plant Construction Materials*
Vault Placement	1	$350.00	$350.00	*Outside Plant Construction Labor*
Kohler Standby Generator (LP)	1	$4,000.00	$4,000.00	*Outside Plant Construction Materials*
Generator Tank or Gas Line Connection (materials & install)	1	$1,500.00	$1,500.00	*Outside Plant Construction Materials*
19" Equipment Racks	2	$500.00	$1,000.00	*Buildings, Improvements, and Pre-fab Shelters*
Network Equipment				-
144 Port Rack Mount Patch Panel with Whip	1	$4,750.00	$4,750.00	*Network Equipment, Software, and Related Costs*
IP Addressable Power Strip	1	$250.00	$250.00	*Network Equipment, Software, and Related Costs*
UPSs (Hut/Cabinet Model)	1	$3,000.00	$3,000.00	*Network Equipment, Software, and Related Costs*
Drop Costs				-
Drop Duct (underground drops only)	14,250	$0.30	$4,280.00	*Outside Plant Construction Materials*
Trace Wire (underground drops only)	14,250	$0.04	$570.00	*Outside Plant Construction Materials*
Drop Fiber (6 Strand Single Mode)	750	$0.15	$120.00	*Outside Plant Construction Materials*

NEMA Box	20	$25.00	$500.00	*Outside Plant Construction Materials*
Customer Premises Splice Tray w/ Pigtails	20	$75.00	$1,500.00	*Outside Plant Construction Materials*
Fiber Jumpers	20	$16.00	$320.00	*Network Equipment, Software, and Related Costs*
Miscellaneous Drop Hardware	20	$40.00	$800.00	*Outside Plant Construction Materials*
Drop Planning	20	$125.00	$2,500.00	*Network Design and Engineering*
Drop Splicing (Field Splicing)	40	$35.00	$1,400.00	*Outside Plant Construction Labor*
Drop Labor (per drop, underground drops only)	19	$450.00	$8,550.00	*Outside Plant Construction Labor*
Drop Labor (per drop, aerial drops only)	1	$250.00	$250.00	*Outside Plant Construction Labor*
Other Upfront Costs				-
Inventory Stickers (per 100)	2	$40.00	$80.00	*Network Equipment, Software, and Related Costs*
Miscellaneous (Marketing, Bid Advertisements, Printing Costs, etc.)	1	$3,000.00	$3,000.00	*Miscellaneous*
Professional Services, Design, and Engineering				-
Permitting Fees	1	$2,500.00	$2,500.00	*Leases, permits, and rights of way*
Network Design	1		$6,987.00	*Network Design and Engineering*
Engineering and Permit Prep	1		$20,400.00	*Network Design and Engineering*
Project Milestone and Timeline Management	1		$13,974.00	*Project Management*
Project Status Reporting	1		$6,987.00	*Project Management*
Procurement and Contractor Management	1		$13,974.00	*Project Management*
Construction Site Inspection	1		$5,250.00	*Network Design and Engineering*
Legal Fees and Counsel	1	$4,500.00	$4,500.00	*Administrative and Legal*
Contingencies	1		$17,857.00	*Contingencies*

The costs for each category and the total cost of the project is shown in the table below.

Budget Category	Cost
Administrative and Legal	$4,500
Leases, permits, and rights of way	$5,000
Project Management	$34,238
Network Design and Engineering	$34,998
Buildings, Improvements, and Pre-fab Shelters	$1,000
Outside Plant Construction Materials	$86,270
Outside Plant Construction Labor	$173,310
Network Equipment, Software, and Related Costs	$8,400
Network Integration and Testing	$0
Miscellaneous	$3,000
Contingencies	$17,536
Total Project Cost	$368,252

Total	$368,252
Per Home Passed	$18,412.6
Per Home Connected	$18,412.6
Per Mile	$120,835.905785
Miles	3.05
Homes/Mile	6.6
OSP total cost	$213,920
OSP Per Mile	$70,194.37
OSP Per Home Passed	$10,696
OSP Per Drop	$10,696
OSP total cost (no drops)	$234,810
OSP (no drops) Per Mile	$77,049.08
OSP (no drops) Per Home Passed	$11,740.5
OSP (no drops) Per Drop	$11,740.5
Average Drop Cost	$294.5

The table below shows the projected costs if Powhatan were to only connect the County office buildings and facilities (indicated by orange and blue on the map). Doing this small section of network would limit the savings realized by Powhatan as there are some scales of economy involved in outside plant construction.

It is also important to note that this County-only approach will NOT generate any revenue.

Budget Category	Cost
Administrative and Legal	$4,500
Leases, permits, and rights of way	$5,000
Project Management	$24,859
Network Design and Engineering	$16,511
Buildings, Improvements, and Pre-fab Shelters	$1,000

Outside Plant Construction Materials	$32,690
Outside Plant Construction Labor	$89,200
Network Equipment, Software, and Related C	$8,400
Network Integration and Testing	$0
Miscellaneous	$3,000
Contingencies	$9,258
Total Project Cost	$194,418

Projects are currently seeing a lead time of over 20 weeks on fiber orders and with more ARRA stimulus projects entering the construction phase, it will be important to order fiber cable early in the implementation phase so that the materials are available once a construction contract has been awarded.

The costs per mile and cost per home passed in this estimate are considered to be high due to the startup costs of constructing a network and the project size. As the network grows and covers more territory these costs should drop. Powhatan should only proceed after extensive financial projections have determined the business model, goals, and amount of risk that Powhatan would be involved in.

Organization and Network Operations

This section will provide a comprehensive presentation of the possible organizational/ ownership structures for proposed broadband infrastructure networks – including but not limited to (as allowed by Virginia Law) owner/operator, public/private partnerships, lease-hold agreements. All options presented will include potential staffing requirements, legal requirements, maintenance, and budgeting estimates. We will identify the interest level of all service providers in the community using a "Request for Interest", develop a comprehensive business plan for leasing and maintaining the network, and develop a master plan for build out of high-speed broadband access.

During the course of this analysis, the governance entity types listed below were examined for their suitability as a governance entity for the Powhatan County pilot network.

Governance Entity	Definition
Government Ownership	A local government creates a town or county department for the purpose of offering broadband or uses an existing department to manage the infrastructure (e.g. Public Works).
Regional Authority	An independent entity jointly owned by one or more local governments for purpose of offering a shared service. Typically used when multiple local governments decide to collaborate on multi-jurisdictional infrastructure.
Nonprofit	Nonprofits are typically not an appropriate entity for ownership of revenue-generating telecommunications infrastructure, as there is a risk that the nonprofit status could be revoked by the IRS.

Government Ownership

Many communities in the United States have municipal entities that offer services to the general public. The most common services are water and sewer, and are administered operationally either as a department of the government or as an authority. Typical water and sewer authorities are quasi-public entities that operate independently of direct local government oversight but operate as a nonprofit. However, most towns in the WiredWest area do not offer water or sewer services.

Also common are municipal electric service operations. Several hundred communities in the U.S. have municipal electric power, and some have moved into the telecommunications arena, largely because it is convenient to do so--the organization already has utility pole access, experienced staff, and equipment like bucket trucks. However, the direct municipal approach is not likely to work for the effort because the local governments have already indicated that they are not interested in owning and administering the system directly.

Government operated networks using the muni retail model attract legislation forbidding localities from offering telecommunications services. Several states, including Pennsylvania, Nebraska, South Carolina, and Virginia, have enacted legislation making municipal telecom services illegal within the state shortly after a municipality or public service company started a data service. The Virginia bill was overturned by the Federal Circuit court in a remarkably brief decision that seems crystal clear:

I find that the broad and unambiguous language of § 253(a) [the Federal Telecom Deregulation Act] makes it clear that Congress did intend for cities to be "entities" within the meaning of the Telecommunications Act. Therefore, § 15.2-1500(B) [the Virginia legislation in question] is in direct conflict with federal law, and is void under the Supremacy Clause. Section 253(a) is a concise mandate that no state "may prohibit or have the effect of prohibiting the ability of any entity to provide any interstate or intrastate telecommunications service." 47 U.S.C.A. § 253(a) .....Simply put, it strains logic to interpret the term "any entity" in § 253(a) to mean "any entity except for municipalities and other political subdivisions of states." While it is true that such an interpretation is possible, the Supreme Court has cautioned that "[a] statute can be unambiguous without addressing every interpretive theory offered by a party." .....The federal statute, therefore, not only mandates that no state statute "may prohibit" telecommunications competition, but also that no state statute "may have the effect of prohibiting" telecommunications competition. 47 U.S.C.A. § 253(a).

While most communities that have been challenged by lawsuits have eventually won in court, the legal battles usually add years and significant expense to such efforts. Lafayette, Louisiana, as one example, spent substantial sums of money and nearly two years in court to defend the right to build a community-owned network. The city eventually prevailed and now has an outstanding network offering some of the lowest telecom service prices in the U.S., but the effort was delayed for years by the lawsuit from the incumbents.

Regional Authority

Regional authorities are widely used for regional projects that require long term oversight and involve participation from more than one local government entity. These regional agreements are widely used by local governments for the ownership and control of essential infrastructure that is better managed regionally. Typical regional projects include solid waste authorities and water and sewer authorities.

The concept of several local governments collaborating on a shared facility or utility has different names and different legal restrictions and privileges, depending on the state in which they are located. The term used for these agreements varies widely, and these terms include Joint Municipal Agreements, joint powers agreements. intergovernmental agreements, or inter-municipal agreements. Some community projects in Virginia use this approach because the Commonwealth of Virginia created enabling legislation

specifically for broadband authorities. A Virginia broadband authority automatically receives revenue bonding privileges by law, which is a significant advantage.

Despite the differences in terminology, the basic principle underlying this approach is to create an independent management and governance entity that operates on a non-profit/ cost-plus basis and which is firmly vested in the community. Some of the advantages of this approach include:

- Professional managers recruited and hired because they have the appropriate skills and experience to manage a dedicated enterprise.
- Elected officials do not have direct, day to day involvement in management issues.
- The regional entity usually has either general obligation and/or revenue bonding authority, which provides a stable, long term financing solution. Revenue bond financing is particularly attractive as it does not affect the credit rating of the local governments involved and has little or no impact on local property tax rates.
- The enterprise is firmly vested in the community or region, as opposed to a private venture (e.g. a LLC or co-op), and via the board of directors, the local governments can guide the long term goals and objectives of the organization.

Non-profit

There are various kinds of nonprofit businesses. The most common is the 501(c)(3), which is limited to strictly charitable efforts. A 501(c)(3), according to IRS rules, must have a well-defined charitable purpose targeted toward a specific need and/or a specific target population. In other words, a 501(c)(3) cannot, according to IRS rules, operate as a nonprofit business that provides services to the general public.

Many of the first community networking projects in the early and mid-nineties were formed as 501(c)(3) organizations; it was common for these entities to offer dial-up Internet access to the general public at a time when Internet service providers were still relatively uncommon. But by 2000, most of these organizations had closed their doors and/or discontinued their Internet access services because of IRS challenges.

Today (2011), we see new 501(c)(3) organizations repeating this approach by offering broadband services either directly or indirectly (using an open access business model). It is our view that eventually all these organizations will receive letters from the IRS challenging their status.

However, one or more nonprofit businesses may be useful as part of the overall effort. A 501c3 may be desirable as a mechanism to accept charitable donations, and more importantly, to apply for certain kinds of grants. Once the funds have been received by the 501c3, and the donors have received the tax credit, the nonprofit can, in turn, give or loan those funds to another organization (e.g. an authority or co-op chartered specifically to provide services).

Ownership Recommendations

Ownership	Discussion	Advantages	Considerations
County Ownership	For investments limited to passive infrastructure and limited scope, this approach is ideal. ***Powhatan should strongly consider this approach.***	This gives the county the flexibility to make decisions quickly and to get more service options available in the county more rapidly.	If the scope of the project expands with additional infrastructure investments, the county would still have the option of forming a broadband authority in the future.
Authority	Typically only used when two or more local governments collaborate on shared investments.	Authorized by Virginia statute. Relatively easy to form, with a board of five directors, operating as an independent political subdivision. No different in practice than a solid waste authority or a water authority.	An authority tends to insulate the effort from political considerations and changes in political leadership. Not a major concern if investments are modest and revenue potential is limited.

Business Model

The most cost-effective approach for Powhatan County, given the modest size of the market, is to build a broadband open access network with:

- Construction of a limited duct and dark fiber network in the Powhatan Courthouse area that would connect local government buildings, schools, public safety facilities, local businesses, and some residential homes. This would help lower telecom costs for the county and for businesses connected to the network.
- A modest colocation facility (small concrete shelter where the fiber and duct are terminated and where service providers would locate their own network equipment.
- The initial fiber effort should be built to meet the planned MBC fiber on Old Buckingham Road. This maximizes the economic benefit to both the County and to local businesses that connect to the network. By extending the fiber to meet MBC, the County would be able to bid out County telephone and Internet services to 25+ providers, and could expect savings of as much as 50% over current costs, and it is also very likely the overall Internet bandwidth available to County departments would double or triple.

All services on both the fiber and wireless infrastructure would be offered by private sector service providers, and the county would NOT sell services to businesses or residents. Powhatan's access to the Mid-Atlantic Broadband Cooperative will be key to getting service providers to join the network.

Approach

The leasing model that the county will use is straightforward. Service providers lease fiber from the county and rack space in equipment shelters, and then market and sell services directly to their own customers. Service providers bill their own customers directly, and the providers also have responsibility for first line customer technical support and routine troubleshooting related to service issues (the county is responsible for problems on the physical network, like a fiber cut).

Service providers pay a flat monthly fee per subscriber to the fiber network. The service provider using the network has virtually no capital expense related to maintaining the physical network. Current service provider business models have to account for both capital expenditures (Capex) and operating expenditures (Opex).

Because the fiber connections can efficiently deliver many services, not just the traditional "triple play" of voice, TV, and Internet, it will be attractive for service providers to offer bundles of services because their cost of transport is fixed. High value services like telehealth and video on demand, even if purchased by a relatively small number of subscribers, can create additional revenue opportunities for providers.

The fiber leasing model will encourage competition because leasing fiber will be available to any qualified firm. Customers will be able to switch from one provider to another easily.

Finally, the fiber leasing approach encourages innovation. Because the cost of starting a new service is extremely low compared to traditional service provider models, providers can experiment easily with new services.

The network will be owned, managed, and maintained by Powhatan County. Maintenance of the infrastructure (e.g. fiber repairs, generator maintenance) would be outsourced to qualified private sector firms to minimize the impact on Powhatan County's staff.

Description of the Business Model

The county would use a dark fiber infrastructure lease business model, making its telecom infrastructure investments available to service providers on a first come, first serve basis. All existing telecom providers, including incumbents, will be invited to use the system to sell services both to existing customers and also to reach new customers with new services that were not possible to deliver using older, copper-based technology. Service providers would pay a small fee per customer to the county for

access to residents and businesses. This income would be used to fund completion of the build out and to pay debt incurred to build the network. This open access approach will lower the cost of market entry for service providers, provide more choice of services for businesses and eventually residents of Powhatan County, and keep the demands on county staff and employees manageable.

Powhatan's business model is based on sharing costs across the largest possible marketplace of buyers of telecom services.

- The dark fiber leasing model keeps the cost of management and Powhatan County's responsibilities limited to maintenance of the physical infrastructure. Service providers will be responsible for all network electronics needed to serve their own customers.
- Demand aggregation creates a larger marketplace of customers, which makes the network attractive to service providers. Service providers attracted to either the fiber or wireless opportunities in Powhatan will be more likely to make use of the other network elements as well.
- The "digital roads" model shares the expense of building and operating the network across many public and private users.
- The flat fee for dark fiber model allows service providers access to customers at a known fixed cost, and encourages bundling of services, which customers prefer.

There are no significant funding or technology challenges related to the project. Communities routinely invest in, build, and manage water and sewer projects that are many times more expensive than community broadband systems. The bulk of county's investment in broadband infrastructure will be in passive infrastructure that will have a conservative life span of thirty years or more. This is ample time for the region to recoup not only its investment but also to receive regular income from the project.

Powhatan has a significant advantage compared to many other Virginia localities because of the MBC backbone passing through the county. This brings a wide range of service providers to Powhatan who would be interested in using county-owned fiber to sell services to customers connected via the county network. Other open access projects in Virginia that are in operation, including nDanville and The Wired Road, have not had any difficulty attracting providers.

When considering the costs of developing a network for Powhatan County, it is important to keep in the mind that it is not just the cost of the initial build out that should be included in making a decision about whether to move forward. In fact, a thorough financial analysis should include a careful evaluation of the these factors.

- **Community telecom expenditures** – As shown in the previous table, community telecom expenditures, extended over a period of twenty or thirty years, is an important part of the decision-making process. These

expenditures provide an indication of the economic impact (positive and negative) of the cost of telecom services on businesses, government, schools, institutions, and residents.

- **Cost of build out** – Capital expenditures, or Capex, tends to dominate discussions of community broadband projects. While accurately forecasting capex is necessary, it is not sufficient to make a decision about whether to move forward.
- **Cost of operation** – Some community projects have encountered financial difficulties because they failed to accurately forecast the cost of operating their network once it was built. Management, financial administration, equipment maintenance, and maintenance and repairs of outside plant (duct, fiber, wireless towers) all must be considered as part of an accurate financial analysis.
- **Revenue** – Revenue is collected from service providers that use the network to deliver services and additional fees may be collected from the homes and businesses connected to the network (e.g. tap fees, monthly connection fees, pass by fees).
- **Cost of capital** – Most communities will use some form of borrowing to finance the build out of their network, and interest paid on loans and revenue bonds can be a significant expense.
- **Income** – Income represents funds left after capex and opex costs have been paid and the interest has been paid on loans. If projected revenue exceeds expenses over an acceptable period of time (e.g. 7 to 10 years), then the network is affordable, regardless of the amount of the initial cost.

Premises Passed and Take Rate

The assumption is that thirty (30) premises would be connected during construction, including ten county buildings and facilities. For the purposes of this analysis, we assume that no other businesses or residences would ever be connected. We assume this to demonstrate that the initial investment generates sufficient revenue to cover operating expenses. In reality, more subscribers would be added year by year, increasing revenue over what is projected in this study.

Powhatan Study	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Premises passed (%)	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
New premises passed	30	0	0	0	0	0	0	0	0	0
Total premises passed	30	30	30	30	30	30	30	30	30	30
Percentage of premises connected	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Total premises connected	30	30	30	30	30	30	30	30	30	30
New premises connected	30	0	0	0	0	0	0	0	0	0
Take rate	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Premises that take service	30	30	30	30	30	30	30	30	30	30
New premises that take service	30	0	0	0	0	0	0	0	0	0

Capital Expenditures

Approximately three miles of fiber and drops are constructed. This is a dark fiber business model, so no electronics are required. The design would allow for at least one hundred additional connections to homes and businesses at very minimal expense.

Construction costs	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
OSP cost	$345,752	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total drop cost (homes connected * drop cost)	$22,500	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Electronics cost (homes connected * electronics)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Capex per year	$368,252	$0	$0	$0	$0	$0	$0	$0	$0	$0
Cumulative capex	$368,252	$368,252	$368,252	$368,252	$368,252	$368,252	$368,252	$368,252	$368,252	$368,252

Financing

If the county provides the cash for this effort, based on future savings from the elimination of leased lines and reduced costs for Internet and phone service, no borrowing or additional equity would be required. A $100 one time connection fee would be charged to each connected premises.

Debt or Capital Cost	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Equity from connection fees	$3,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
Other New Equity (e.g. grants)	$368,252	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Equity	$371,252	$371,252	$371,252	$371,252	$371,252	$371,252	$371,252	$371,252	$371,252	$371,252
New Debt	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

Debt or Capital Cost	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
% Debt over Other New Equity (Grants)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Total Debt	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual interest cost	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual principal payments	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

Revenue, Operating Expenses, and Cash Flow

The primary operating expense would be a small retainer for emergency fiber splicing. Because no electronics are part of this design, other operating expenses are nominal. Revenue is generated from leasing fiber pairs to providers that offer services to connected premises. Projected revenue is larger than projected expenses, resulting in a modest amount of cash on hand for future maintenance and repairs.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Income per Subscriber										
Average monthly subscriber fees	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750
Other monthly income	$200	$200	$200	$200	$200	$200	$200	$200	$200	$200
Total monthly income	$950	$950	$950	$950	$950	$950	$950	$950	$950	$950
Annual Revenue	$5,700	$11,400	$11,400	$11,400	$11,400	$11,400	$11,400	$11,400	$11,400	$11,400
Monthly Operating Expenses										
SG&A + OPEX (per customer flat fee)	225	450	450	450	450	450	450	450	450	450
Marketing expense	0	0	0	0	0	0	0	0	0	0
Total monthly expenses	**$225**	**$450**	**$450**	**$450**	**$450**	**$450**	**$450**	**$450**	**$450**	**$450**
Total Annual OPEX	$2,700	$5,400	$5,400	$5,400	$5,400	$5,400	$5,400	$5,400	$5,400	$5,400
Annual EBITDA	$3,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000
Cash Flow	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000
Cash on Hand	$6,000	$12,000	$18,000	$24,000	$30,000	$36,000	$42,000	$48,000	$54,000	$60,000

Funding Strategies

The bulk of the community's investment in broadband infrastructure will be in passive infrastructure that will have a conservative life span of thirty years or more. This is ample time for the county to recoup not only its investment but also to receive regular income from the project.

Start up funds for further planning and implementation may be available from a variety of sources, but the Virginia Department of Housing and Community Development (DHCD) should be engaged early to discuss their funding assistance. Fiber to health care providers (county and state agencies and private health care facilities) in Powhatan Courthouse may qualify for DHCD support.

Any company that chooses to use the network infrastructure for commerce would pay a share of revenue that reflects a fair value for access to that infrastructure.

All existing telecom providers, including incumbents, would be invited to use the system to sell services both to existing customers and also to reach new customers with new services that were not possible to deliver using older, copper-based technology. Incumbents indicate that they cannot offer higher performance services in some business areas and neighborhoods in Powhatan because of the high cost of infrastructure upgrades. This is true, because the current telecom business model of each company building, maintaining, and managing its own infrastructure (called overbuilding) is expensive--much more expensive than building a single common digital road system that is shared by many companies.

Somewhat paradoxically, the cost of such a community digital road system is lower when there is a day one commitment to build to any residence or business that requests service. This maximizes the potential marketplace of buyers and attracts more sellers to offer services because of the larger potential market. This is so because:

- Service providers are reluctant to make a commitment to offer services on a network without knowing the total size of the market. A larger market, even if it takes several years to develop, is more attractive.
- Funding agencies and investors that may provide loans and grants to a community network project want to know how the funds will be repaid and/or that grants will contribute to a financially sustainable project. Knowing that the size of the customer base is the maximum possible for a service area helps reduce the perceived risk for providing loans and grants.

The financing of community-owned telecommunications infrastructure faces several challenges with respect to funding.

- Not all local governments are willing to commit to making loan guarantees from other funding sources like property taxes, because the idea of community-owned

telecom infrastructure has a limited track record and therefore a higher perceived risk.

- Similarly, citizens are not always willing to commit to the possibility of higher taxes that may be needed to support a telecom infrastructure initiative, for many of the same reasons that local governments are still reluctant to make such commitments: perceived risk and a lack of history for such projects.
- Finally, banks and investors are also more skeptical of community telecom projects because of the relative newness of the phenomenon. By comparison, there are decades of data on the financial performance of water and sewer systems, so the perceived risk is lower.

There are a wide variety of financing options available, and we believe Powhatan County will end up using at least four or five different sources of funding, depending on project needs, where in the project timeline the funds are needed, and local opportunities that may arise. There are two general categories of funding strategies:

User/customer funding approaches – Sources of revenue and equity that come from directly or indirectly charging users (e.g. businesses, residents, and institutions) fees that represent one time equity contributions and/or recurring fees.

General funding strategies – There are a variety of sources that may be used to provide loans, grants, guarantees, tax credits, and other types of equity and loans. It is important to note that the bulk of the county's investment in broadband infrastructure will be in passive infrastructure that will have a conservative life span of thirty years or more (i.e. fiber cable). Powhatan County infrastructure investments create hard assets that have tangible value and can then be leveraged for additional borrowing. The demand for services and the associated fees paid for those services will provide the revenue that will pay back loans over time. There is ample time for the project to recoup not only the initial capital investment, but also to receive regular income from the project.

User/Customer Funding

One option for funding is to charge a pass by fee (when the fiber cable passes a premises) and/or a tap fee (a one time connection fee when a customer actually gets service). Use fees can be levied against the customer receiving the service or against the service provider offering the service. The difference is that billing providers is a simpler task with many fewer invoices.

Funding Source	Description	Notes
Connection Fee	Business and residential customers pay the network owner a one time connection fee (either in a lump sum or monthly payment over several years).	Not all customers may be willing to pay a full connection fee. The amount of the connection fee may have to vary depending upon how recurring charges are collected (i.e. monthly use fee or revenue share).

Funding Source	Description	Notes
Use Fee	Business and residential customers pay the network owner a flat monthly use fee instead of an indirectly paid revenue share. Alternatively, the use fee can be charged to the service provider.	The use fee provides the network owner with a predictable revenue stream that will improve bonding potential.
Purchase Commitments	Customers make a binding or non-binding commitment to buy one or more services (or spend a certain minimum amount for services) from providers on the network.	Very useful for determining where to build first. Binding commitments can help strengthen bond offerings.

Connection Fees

Tap fees, pass by fees, and connection fees are already commonly used by local governments for utilities like water and sewer. The revenue share model can be strengthened from additional sources of revenue, including one time pass by fees, connection fees and sweat equity contributions.

- Pass By Fees – Pass by fees could be assessed once the fiber passes by the property, just as some communities assess a pass by fee when municipal water or sewer is placed in the road or street–and the fee is assessed whether or not the premise is connected, on the basis that the value of the property has been increased when municipal water or sewer service passes by. At least one study has indicated that properties with fiber connections have a higher value by $5,000 to $7,000 that similar properties without fiber access.
- One Time Connection Fees – A one time connection fee can be assessed to property owners (e.g. residents and businesses) when the fiber drop from the street to the premise is installed. This is similar to the kinds of connection fees that are typically charged when a property is connected to a municipal water or sewer system. The fee is used to offset the cost of the fiber drop and the Customer Premise Equipment (CPE) needed to provide the operational access to the network. The connection fee can be modest (e.g. $100) or it can be a larger percentage of the actual cost of the connection. Fiber CPE may range from $250 to $350 and a fiber drop may cost from $200 for a premise very close to the distribution fiber passing along the property to $1,000 or more if the premise is hundreds of feet from the road. One variant would be to charge a minimum connection fee for up to some distance from the road (e.g. $100 for up to 75' and $2 for each additional foot).
- Sweat Equity Contributions – The cost of the drop fiber (from the road to the residence) can be substantial if the house is some distance from the road, and a significant portion of the higher cost of fiber in rural areas can be attributed to these longer distances. Powhatan County can offer a program to residents that allows them to install their own duct between the premise and a demarcation

point on the road right of way. This has been successfully done in other rural areas and can be a valuable source of construction funding.

Danville, Virginia, which began operating its community open access network in late 2007, recently made the decision to use monthly connections fees ($8.80/month per premise) to help offset the cost of network equipment needed to accelerate their build out to more homes and businesses. This approach also enabled them to lower the fees charged to service providers using the network, which should attract more providers and enable nDanville to offer a wider range of services to customers.

There is already some data that indicates that residential property values increase by as much as $5,000 to $7,000 if fiber broadband services are available, so pass by fees can be justified on the basis of increased property values accruing to the property owner. Given the novelty of this approach, pass by fees may need more time to become an accepted finance approach, but tap fees (for installing the fiber cable from the street or pedestal to the side of the home or business) may be easier to use, especially for businesses that may need improved broadband access. Tap fees have the potential of reducing the take rate in the early phases of deployment, but as the value of the network becomes established, it is likely that there will be much less resistance to paying a connection fee.

The Utopia project in Utah (an open access, open services community-owned network) reports that in one community, they were successful getting 1,600 residents to pay $3,000 each to get connected to the network. In other words, users financed $4,800,000 of network build. Brigham City, Utah is building a $5.5 million network with a $700,000 investment by charging residents for connections. They are financing the payments–residents pay $25/month for up to 20 years ($6,000). So if residents choose the long term payment plan, they pay a portion of the interest incurred on the funds borrowed by the project. Brigham City apparently has enough interest that they are telling residents if you don't sign up to pay for a connection, you go to the bottom of the list and will be hooked up last.

The Wired Road project is also having some success using pass by and tap fees to finance network connections. Some businesses are paying as much as $3,000 to get a fiber connection to their place of business because the pay back is less than ten months–in other words, their Internet costs drop by more than $300/month when using a Wired Road service provider.

Use Fee Model

The use fee is a monthly (recurring) fee charged directly to connected users by the network owner as an alternative to the revenue share, which is an indirect charge (the revenue share is paid to providers by customers, and the provider, in turn, pays the network owner). The primary advantage of the monthly use fee is that it provides the network owner with a predictable stream of revenue that does not depend on the less predictable ability of service providers to attract and retain customers. The connected

user pays the use fee as long as any service from any provider is being used. Use fee customers will pay lower rates to providers for the actual service because the provider does not have to mark up the service costs to cover the revenue share portion.

Use fees may have to be adjusted based on what services are available on the network. For example, a use fee of $25 works well for customers buying a triple play package of TV, Internet, and phone from a provider. But a use fee of $25 for a customer buying only a package of Internet artificially inflates the cost of that service.

Purchase Commitments

While purchase commitments (intent to buy services from providers on the network) are not a direct source of funds, communities that are able to achieve high levels of purchase commitments can use them to strengthen the attractiveness of a revenue bond offering, which could help reduce the interest rate charged for bonds. These purchase commitments can be binding or non-binding. Binding commitments would contractually obligate the property owner to buy some minimum amount of services (e.g. $25, $40) from one or more providers on the network. Non-binding commitments would simply provide an indicator that the property owner intends to buy some amount of services from providers on the network. The former–binding commitments–are much more valuable from a funding perspective, since lenders can more easily predict what kind of revenue is going to be generated from customers.

Purchase commitments can also be used for another, though related, purpose, which is to identify where to build first. For example, in a multi-town network, the project leadership might indicate that the first towns to get infrastructure will be those that can obtain a minimum of 25% purchase commitments. By using this market-driven approach, the project leadership has a good indication that the capital expense it is undertaking in the community will generate enough revenue to cover operating costs and debt payments. If a community can only get a 5% or 10% purchase commitment from residents and businesses, that town would be placed lower on the build out list.

General Funding Strategies

Funding Source	Description	Notes
Revenue Bonds	Long term debt instruments guaranteed with revenue from the network.	Requires some equity/funding from other sources.
General Obligation Bonds	Long term debt guaranteed by local taxes.	Generally more difficult to get approval from elected officials and voters.

Funding Source	Description	Notes
Revenue Bond Guarantees	Third party guarantees on revenue bonds, so that if revenue fails to meet financial targets, bond guarantor makes debt payments.	Guarantors could be local or state governments. Does not require a direct cash outlay. Guarantor must have a good credit rating.
RUS Loans	Excellent source of low cost, long term loans for telecom initiatives.	RUS loans have a complicated application process that can require substantial expense to prepare. RUS favors rural co-ops, but does not have a strong track record of supporting start up ventures.
New Markets Tax Credits	Tax credits are sold to investors, and funds are used for the network.	Project must meet eligibility requirements and typically takes a year to plan and to receive approval.
State Funds	State agencies may be a source of planning and capital funds.	Capital funds are usually relatively small, but direct financial grants from the legislature are possible.
Federal Funds	Grants and loans of various kinds are often available from Federal agencies.	Federal grant programs and funding levels tend to change with changes in administration. Can often take 1-2 years for approval.
Business Contributions	Local business are sometimes willing to make donations to the effort.	Donations are typically made with the expectation of fiber services becoming available to the business within a reasonable time frame.
Grants and Donations	Citizens and local foundations will sometimes provide grants.	Local foundations may require tying funds to a specific purpose.

Revenue Bonds

Many community projects are already being financed with revenue bonds, including Monticello, Minnesota, Powell, Wyoming, and the Utopia project (14 towns and cities in Utah) have used revenue bonds to finance their broadband efforts. Revenue bonds are repaid based on the expectation of receiving revenue from the network, and do not obligate the local government or taxpayers if financial targets are not met. In that respect, they are very different from general obligation bonds. Many kinds of regional projects (water, sewer, solid waste, etc.) are routinely financed with revenue bonds. We believe most community projects will finance a significant portion of the effort with revenue bonds. Obtaining funding using revenue bonds requires an excellent municipal credit rating and an investment quality financial plan for the operation and management of the network.

Revenue bonds must be used carefully, and a well-designed financial model is required to show investors that sufficient cash flow exists to pay back the loans. Some issues to consider are:

- Revenue bonds are paid back solely from system revenue.
- A very solid business plan is needed.
- Management, marketing, and operations of the network must be professional and with careful attention to meeting operational and financial targets.
- Powhatan County will need some local fund-raising to support the credit rating/ credit enhancement needed for the initial borrowing. This local fund-raising should be targeted to support some initial construction and operations to show that Powhatan County can plan, construct, and manage a state of the art network, and that Powhatan County can attract both customers and service providers.
- Market conditions at the time the initial bonding is attempted can affect the cost of the bonds and the success in selling those bonds.

General Obligation Bonds

General obligation bonds are routinely used by local governments to finance municipal projects of all kinds. G.O. bonds are guaranteed by the good faith and credit of the local government, and are not tied to revenue generated by the project being funded (i.e. revenue bonds). G.O. bonds obligate the issuing government and the taxpayers directly, and in some cases could lead to increased local taxes to cover the interest and principal payments.

Even though G.O. bonds are quite common for more traditional community infrastructure, local leaders and taxpayers have typically been resistant to using them to finance community telecom projects. G.O. bonds often require a voter referendum, which raises the bar even higher, but some community telecom projects, notably the City of Lafayette, Louisiana, prevailed in a voter referendum to build a city fiber network despite heavy advertising against the referendum by incumbent providers.

Revenue Bond Guarantees

Revenue bond guarantees are not a direct source of funds but can be extremely valuable as part of a revenue bond offering. A bond guarantee could come from local governments that are involved in the network development, a state financing authority that helps underwrite municipal bond offerings, or as a special authorization from the state legislature. Some community network project bond offerings have been guaranteed by tax revenues from the local communities (e.g. the Utopia project in Utah). Powhatan County should investigate the potential for a state level guarantee for a bond offering. The guarantee could be for just a first round of financing, and additional guarantees could be contingent upon the network meeting certain financial targets.

RUS Loans

The USDA Rural Utilities Service agency has been making low cost loans for telecommunications for decades. Those funds have traditionally been supplied

primarily to rural telephone companies and co-ops, but the agency has recently begun looking at assisting community broadband projects. Powhatan County could meet with the local USDA rep to discuss the project and learn more about the RUS loan program and the application process. The RUS application process can be expensive and time-consuming, and it may take six months to a year and some fundraising to develop a competitive application.

New Markets Tax Credit

New markets tax credits are a form of private sector financing supported by tax credits supplied by the Federal government. The New Markets Tax Credit (NMTC) Program permits taxpayers to receive a credit against Federal income taxes for making qualified equity investments in designated Community Development Entities (CDEs). The CDEs apply to the Federal government for an allotment of tax credits, which can then be used by private investors who supply funds for qualifying community projects. Substantially all of the qualified equity investment must in turn be used by the CDE to provide investments in low-income communities. The credit provided to the investor totals 39 percent of the cost of the investment and is claimed over a seven-year credit allowance period. In each of the first three years, the investor receives a credit equal to five percent of the total amount paid for the stock or capital interest at the time of purchase. For the final four years, the value of the credit is six percent annually. Investors may not redeem their investments in CDEs prior to the conclusion of the seven-year period.

Throughout the life of the NMTC Program, the Fund is authorized to allocate to CDEs the authority to issue to their investors up to the aggregate amount of $19.5 billion in equity as to which NMTCs can be claimed.

State Funds

Many local broadband projects are receiving help from state sources of funding, particularly for early stage planning, but some funds are often available for pilot projects and specific expansion projects that meet certain kinds of public safety or economic development criteria. As a couple of examples, the Virginia Department of Housing and Community Development (DHCD) has been providing early phase planning funds to communities that commit to following a specific planning process supplied by DHCD. The South Carolina Department of Commerce has also been providing some support for similar local efforts in that state. The Commonwealth of Virginia may be able to provide bond guarantees, which would be extremely valuable for the initial bond offering. This would not require the state to make a cash outlay at the time of the bond offering.

State agencies may also be able to assist with applying for Federal funds. Community Development Block Grants (CDBG) are now being provided for some kinds of local broadband efforts. CDBG grants have to meet eligibility requirements (e.g. Low and

Moderate Income areas, distressed downtown areas, etc.). Some community broadband projects have also successfully received direct grants from the state legislature.

Federal Funds

Several different Federal agencies provide some support for community or regional broadband efforts. Powhatan County may be able to qualify for some of them by collaborating with the right mix of partners. The FCC recently distributed $400 million for community and regional telehealth and telemedicine projects across the U.S.

Of particular interest for early funding is the USDA Community Connect grant program, which makes grants of up to $1 million for rural broadband infrastructure.

Earmarks can be a valuable source of funding, albeit a highly unpredictable one. The Eastern Shore of Virginia Broadband Authority was able to obtain several million dollars in earmarks funds to help build its 80 mile fiber backbone, but it took more than two years to get the funds approved and allocated. Earmark funds can be approved but not allocated, which has sometimes caused problems–approval by Congress for the earmark does not automatically ensure that the Federal agency serving as the administrator of the funds receives a budget allocation. In some cases, earmark funds that have been allocated can be re-allocated by the receiving agency for a related purpose. Strong Congressional support is needed for earmarks.

Federal funds usually require long lead times to obtain (12 to 18 months is typical) and are best used for specific opportunities where the funding guidelines match well with a specific local need or opportunity.

Business Contributions

Some businesses recognize the value of having community fiber at their premises because they may be able to obtain previously unaffordable services and/or lower the cost of existing services. If the savings are substantial, some businesses may be very willing to pay pass by and connection fees to obtain access to the community fiber, and we have spoken to businesses in other communities that have expressed willingness to make no strings attached contributions to the local effort. However, such contributions are usually linked to specific plans to pass the businesses with fiber within a reasonable time frame.

Grants and Donations

Grants and donations can provide funds for planning and for targeted construction projects (e.g. fiber to a local hospital, a community institution, etc.). Community foundations will often contribute funds to local technology projects. Sometimes the expenditures have to be tied to specific foundation goals (e.g. improved K12 education), but often local foundations will accept grant applications for a wide variety of local projects. Some community efforts have also received private donations, although these are usually modest, and have also usually been provided to support a specific need or project.

Survey Results

Overview

In early 2011 Powhatan County conducted a survey to better understand the current level of service and the needs of residents and businesses in Powhatan County and the surrounding area. The survey was available online and in a paper distribution throughout the county. Completed surveys could be mailed or dropped off. A significant portion of the surveys were returned in this manner. The participation of the management team and entities of Powhatan County contributed a great deal in making the survey a success.

358 residents responded to the residential survey. Responses came from all parts of the county. Overall the results of the survey highlight the high interest in broadband service in the area, and the challenge that some residents face when it comes to getting service.

Some of the key data points that resulted in the survey include:

80% of residents need better Internet/data service.

65% of residents are somewhat or very willing to pay more for better Internet access.

95% of residents felt the Internet is very important to their household.

26% of residents are already working part or full time from their home, and an additional 46% need evening and weekend access to their place of work.

49% of residents have VPN access to their place of work, meaning a significant number of workers already need business class broadband access from home.

96% of residents answered that they did have an Internet connection.

82% of residents purchase Internet access through Verizon or Comcast.

Residential Survey Results

A total of 358 responses were received as of April 30th, 2011. Not all responders answered every question.

Check the items that you agree with below

80% of the respondents indicate that they want more choices for Internet at home.

Need Better Telephone	Need Better Internet/data	Need Better TV	Satisfied with all
131	288	166	55
37%	80%	46%	15%

Total # of people in the household

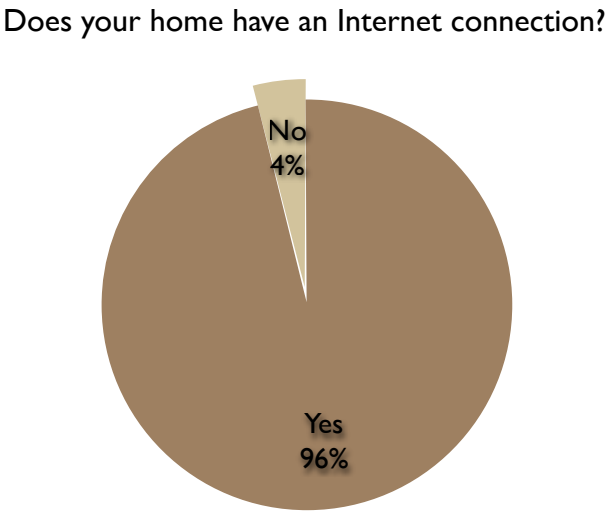
1	2	3	4	5	6	7+
16	112	76	108	36	7	2
4%	31%	21%	30%	10%	2%	1%

Total # of computer users

1	2	3	4	5	6	7+
33	119	97	85	21	1	1
9%	33%	27%	24%	6%	0%	0%

Does your home have an Internet Connection?

Yes	No
341	14
96%	4%



What type of connection does your home have?

The responses below show that a majority of the area is served by DSL (primarily Verizon).

Dial-up	DSL Line	Fiber	Cable Modem	Wireless	Satellite	Don't Know	Other
21	131	4	83	71	22	3	11
6%	38%	1%	24%	21%	6%	1%	3%

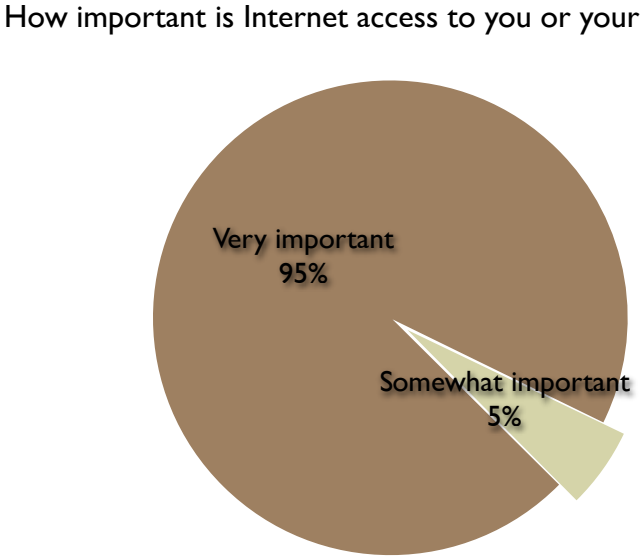
How much do you pay for Internet access each month?

No Internet	$10 to $20	$21 to $40	$41 to $60	$61 to $80	More than $80 per month	Use free local hotspots
8	25	102	134	60	23	1
2%	7%	29%	38%	17%	7%	0%

How important is Internet access to you or your household?

95% of residents feel that the Internet is Very Important.

Very Important	Somewhat Important	Not Important	No Opinion
338	19	0	0
95%	5%	0%	0%



How satisfied are you with your current landline telephone service?

Not at all Satisfied	Somewhat Satisfied	Satisfied	Very Satisfied
58	148	121	22
17%	42%	35%	6%

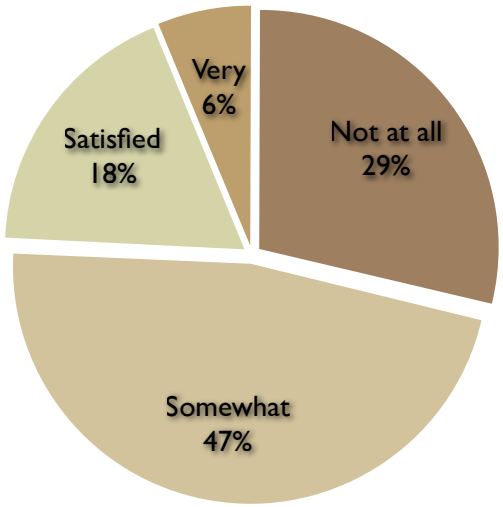
How satisfied are you with your TV service (cable or satellite)?

Not at all Satisfied	Somewhat Satisfied	Satisfied	Very Satisfied
57	152	105	35
16%	44%	30%	10%

How satisfied are you with your current Internet service?

Not at all Satisfied	Somewhat Satisfied	Satisfied	Very Satisfied
102	167	64	22
29%	47%	18%	6%

How satisfied are you with the speed of your Internet service?



If you are still on dial up, (no broadband connection), why are you?

About one third of the respondents that are still on dial up have no better choices in Internet service.

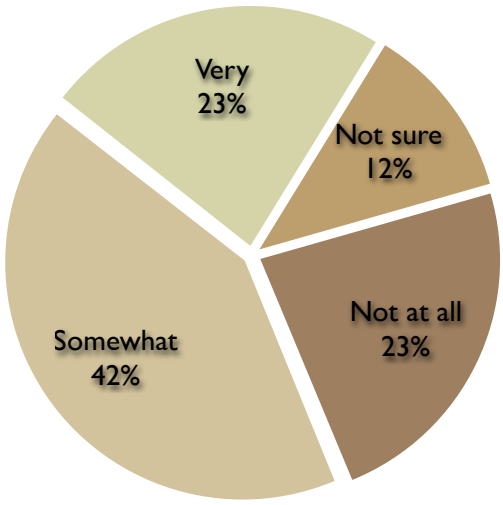
No broadband options in my area	Too expensive	Not interested	Lack of help/support
58	3	5	0
82%	4%	7%	0%

Would you be willing to pay more for faster, higher quality Internet access?

_% of respondents show willingness to pay more for better broadband.

Not at all willing	Somewhat willing	Very willing	Not sure
77	139	77	39
23%	42%	23%	12%

Would you be willing to pay more for faster, higher quality Internet access?



What equipment do you currently connect to the Internet?

Device	Response	Percentage
Personal computer (desktop, laptop, netbook, or tablet)	350	100%
Gaming console	137	39%

Device	Response	Percentage
Hand held gaming console	36	10%
E-reader	67	19%
Cell phone	147	42%
PDA	31	9%
Ipod	131	37%
Other	26	7%

351 people responded to this question. 'Other' devices included the Nook, cameras, televisions, and blue ray players.

Check all items you use the Internet for now

Application	Response	Percentage
Email	355	99%
Access news and current events	319	89%
Homework / schoolwork	218	61%
Work from home	238	67%
Watch movies and online video	159	45%
Download or listen to music online	248	69%
VoIP - Place calls online (e.g., Vonage, Skype, etc.)	76	21%
Online backup	58	16%
Telemedicine, telehealth	28	8%
Online gaming	106	30%
Social networking -- Facebook, Myspace, Linkedin, etc.	279	78%
Personal research	315	88%
Download books/audiobooks	140	39%
Shopping	316	89%
Online banking	301	84%
Other	9	3%

357 people responded to this question.

Does anyone in your household use the Internet to complete school assignments or job training course work?

53% of respondents are using the Internet weekly for school or job training. This suggests that broadband access is important to workforce development and training.

Yes, several times a week	Yes, at least once a week	Yes, at least once a month	No
141	47	48	119
40%	13%	14%	34%

How difficult is it to find help and training for things you would like to do on the computer or on the Internet?

Very Difficult	Somewhat Difficult	Not Difficult
32	92	222
9%	27%	64%

For your household, how much do you spend each month for local and long distance telephone, TV, and Internet?

$50 or less	$50 to $75	$75 to $100	$100 to $150	$150 to $200	More than $200 per month
22	29	33	104	107	56
6%	8%	9%	30%	30%	16%

Who is your Internet Service provider?

More than half of the respondents are using Verizon. 'Other' service providers included Wild Blue, Juno, Century Link, Sprint Air Card, AOL, and People PC.

Verizon	Comcast	Hughes Net	AOL	Other	None (many because they could not find a provider for their address)
189	98	14	10	27	7
54%	28%	4%	3%	8%	2%

Who is your cable or satellite TV provider?

There are two satellite television providers (Dish and DirecTV) in Powhatan who each serve about half of the residents with TV. Other providers included Comcast and Verizon.

Dish	DirecTV	Comcast	Other	None
39	171	107	4	20
11%	50%	31%	1%	6%

Who is your local dial-tone provider?

Verizon	Other	Don't have a landline
286	8	34
84%	2%	10%

85% of respondents are subscribed to Verizon local phone services. Other included Vonage, AT&T, and Magic Jack.

Who is your long-distance telephone service provider?

Verizon	AT&T	Cell Phone Provider	Other	None
234	17	21	31	33
69%	5%	6%	9%	10%

Cell phone signal was mentioned twenty one times as "Cell Phone" or a similar response.

What other telecommunication needs do you have that were not covered in this survey?

Live in Dead Zone area no cellular phone service available.

Better cell phone coverage. We do not get good signals and drop calls often in Powhatan.

There are no good high speed internet connections even available in my end of the county

Coverage and internet speeds for cell phones and portable devices. Some residents have eliminated their home phone service and rely on "air cards" or smartphones for their internet access. This survey focuses on wired means of internet service only.

I find it very upsetting that Verizon high speed internet is available to houses less than 2 miles from my house yet I can get nothing here other than satellite internet. My husband works from home and the satellite is extremely unreliable. Hughes net was sort of ok when we got it but has steadily gone downhill over the last few months. Out land line service, Verizon, is horrible. We

have had numerous problems with noisy phone lines, equipment failure. Repair service has been slow and we have turned them into the State Corporation commission several times because we have had to wait for DAYS to get repair work done. Most of the time the problem has been due to their equipment failing. We would love to be able to get higher speed reliable internet even if we had to go with Verizon Fios. It would also be nice to be able to get a better landline phone service.

Our Virgin Broadband is extremely weak and very frustrating. We had had Verizon Wireless but it got so bad, unreliable and expensive for overages that we switched to Virgin. After investigating over the years we have found out that we have no chance of ever getting DSL or Fios because we don't live in a new subdivision. We live in the Flat Rock area but on a private dirt road and cable won't come down here. We would gladly subscribe to Comcast just to get the internet but it isn't available. Our Sprint cell phone signal is weak, too. You would think in a populated area that has towers not that far away (there are a couple just about 3 miles from our house)that service would be better. We have friends who still have Verizon cell and have a horrible time and many dropped calls, etc. Providers for the county of Powhatan really need to address this serious problem. Thank you for doing this survey and I will be encouraging everyone I know to participate, too.

We would love to have comcast, but would be satisfied with dsl.

Nothing, We just need faster internet at a reasonable price.

We had to pay comcast to install cable to our house. $3600. We don't have access to digital phone services at our address. Comcast does not offer the digital service for us. Verizon FIOS is what we'd like to have, but it's not available. Please bring FIOS to our neighborhood.

There are limited options for quality service in Powhatan county, all of which I consider to be very expensive.

I am on a 1 mile stretch of a busy, developed road that has no high-speed internet options available except satellite. I do not have the option of cable TV on this side of the road. It's ridiculous to have these services all around me and not to have them available. Defies logic as Verizon is missing 2 whole neighborhoods while running FIOS and DSL on the lesser populated ends of the street.

Verizon needs to be forced to provide affordable dsl to all citizens in this county--not just those in newer, more expensive neighborhoods. Comcast is the only option I have other than satellite and we all know how reliable that is!

cell phone- need better reception or cheaper rates for a landline. currently we only use cell phones.

We need FIOS!

Urgent Need for Cable and/or Fiber options in Powhatan County.

Cable tv with broadband.

Comcast of Powhatan refuses to run cable to our address. Verizon is the only choice in telephone services and will not run dsl or television programming to our house. Because we have satellite internet, we pay a high price and are under restrictions of a fair access policy (FAP). Current cable and dsl charges are about half per month of what we currently pay. The FAP enforced by our current provider limits us to a maximum of 300mb a day in combined uploads and downloads during a 24 hour period. We have a child who is homeschooled and cannot watch instructional videos unless between the hours of 2-6 AM. Needless to say there are no music downloads, youtube videos, movies or tv shows that are downloaded. We are desperately waiting for lower prices, faster speeds, and no limit on internet based activities.

I just want to get rid of dial up!

We need broadband internet in Powhatan. I have Verizon FiOS in Chesterfield, which is much better than DSL.

The internet connection is my area is horrible. I am continually getting disconnected. I pay too much money for wireless for it not to work. We need a tower closer to 522

We pay a huge amount of money for these services but cannot stream a movie either on the TV or laptop. It is too slow. We just want higher speed. We are not picky people.

cell phone issues -cannot connect in most places in the home

We simply need better coverage and less costly options . . . PLEASE!!!

--less expensive services in all areas --more choices so that I can pick what I want, as in the cable channels I want to see, without having to pick a package that contains a lot of stuff I never use --I don't even have long distance thru my house phone any more because several years ago I discovered that there was a minimum monthly fee I had to pay if I did NOT make a SINGLE long distance call from my house. Now I can only make nonsecure long distance calls, via my cell phone, which I don't want to do if I am making calls where I would be giving out credit card or other personal financial info --reliable service, no dropping of cell calls.

We need quality service at an affordable price.

It would be wonderful to have the option of cable tv and broadband internet. We don't even have the option of DSL. My children find it difficult to complete school work and assignments due to the lack of proper internet service.

We need a faster internet connection than we have here. We use a wireless card, but the signal is so poor that it's only marginally quicker than dial-up and cost three times as much ($60.00 a month)

The cost versus the service is quite high. We need more reasonably priced options especially in the western end of the county.

I would like more options. I feel like Verizon has a monopoly on these types of services in the area and as such can charge whatever they like and we have to pay it.

Comcast charges too much. They need competition.

One company to provide all services at a fair rate and with good, fast service.

No access to Cable. No access to FIOS. This is the 21st Century and we can't get cable or FIOS. Sad.

I would like to see a competitive service provider in our area. currently Verizon is our only choice and their customer service is a real issue. If we were offered another option I would consider switching. We moved from Ohio where we had AT&T U-Verse and we loved it.

My husband called Verizon for over a year trying to get hooked up for her. We sent 3 boxes back. There is major confusion from Verizon on were we feed from. Verizon is awful with phone and internet with tower out. Most of our students don't have internet service

I teach classes for two universities and need reliable internet connection to communicate with students and to send in grades.

The problem is not service quality; the problem is the lack competition between service providers. Upon moving here, I was told that my only options for phone was Verizon, for cable TV was Comcast or Satellite, and for internet was Comcast. I am unable to understand why VOIP is not available from Comcast. Comcast indicated it was a licensure limitation put into place by the local government. Verizon was unable to offer me DSL internet. I was told by Verizon that our phone line was capable of DSL, however the number of licenses for the area was limited by the locality and there was no availability at the current time. I would be willing to pay for FIOS, however there is no availability in the area. The lack of competition is a disservice to the citizens of the county. Essentially, each company has a monopoly and is able to charge whatever they want for mediocre service.

It seems our DSL goes in and out all the time - can be several times a day and especially after rains - it may go out for a day. When the dsl goes out, we can't use our phones because they are through vonage. And the vonage quality is iffy. Sometimes I can't hear the person on the other line because the quality goes in and out all the time. VERY FRUSTRATING!!

It's incredibly expensive for those of use in the western part of the county who are working professionals and need high speed internet in order to work. Any options would be great! Other than a wireless card, using your cell as a hotspot or getting it via satellite (which is no better than dial up) we're stuck. Between my internet at home, office down the road and two date plans on our smart phones it costs us nearly $200 a month just to have internet.

Would like high-speed internet access w/ broadband. Also Verizon cell service stinks.

faster cable or fiber internet

What's up with Comcast refusing to provide service (run lines) to new homes that according to them are too far off the road? How can they refuse service when they are supposed to be the provider in the area? This has happened to 2 of my friends.

We want Verizon high speed, but they will not come into our neighborhood - due to close proximity to Comcast??? We do not want Comcast internet

I moved to Powhatan from an area where I had a choice of providers and services, DSL, cable , fios. My DSL service here is terrible, it only works half of the time. Unfortunately, I have no other options for high speed service. It would be great if other companies stepped in and offered options. Thank you.

We need fiber (FiOS) here in Powhatan!

Even though we have Broadband, it is slow and unreliable. Have to log on quite often and can't get any better speed. Can't download any movies, TV or music. Can't even download off of YouTube in a reasonable time.

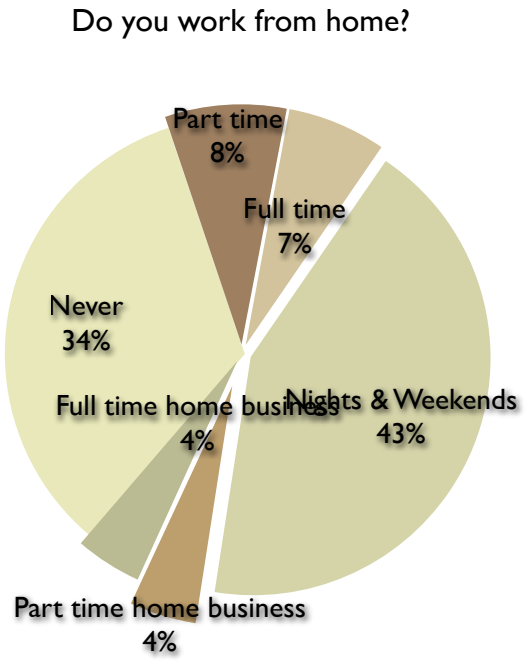
Does your employer use a VPN (Virtual Private Network) to allow remote access to the corporate network?

About 49% of respondents already work for companies using VPNs for remote access to company networks. VPN connections typically need higher bandwidth to support access to company data and services. Another way of looking at this figure is that _% of homes may already need work from home broadband services.

Yes	No	Don't know
167	69	105
49%	20%	31%

Do you work from home?

I work part time from home for another company	I work full time at home for another company	I need nights and weekends access to my place of work	I work part time from home	I work full time from home	I never work from home.
26	21	138	25	14	108
8%	6%	42%	8%	4%	33%



Business Survey Results

A total of 33 responses were received as of June 20, 2011. Not all responders answered every question. The results show there is keen interest among businesses in the County in improved access and affordability of broadband services.

32 Businesses responded to this question.

I need better...

Telephone	Internet/data	TV	None
11	20	6	8
34%	63%	19%	25%

Total # of employees

1-4	5-9	10-19	20-49	50-99	100-249	250-499	500-999	1000+
15	9	2	3	1	1	0	1	0

Total # of computer users

1-4	5-9	10-19	20-49	50-99	100-249	250-499	500-999	1000+
15	7	3	3	0	1	1	1	1

Type of organizational activities conducted at this facility

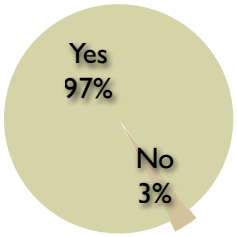
Retail	Professional	Government	Educational	Medical	Non-Profit	Other
6	9	2	4	2	1	8

Does your organization have an Internet Connection?

Nearly all businesses have an Internet connection, indicating that the Internet is an essential business service in Powhatan County.

Yes	No
31	1
97%	3%

Does your organization have an Internet connection?



What type of connection does your organization have?

Dial-up	DSL Line	Fiber	Cable Modem	T1 Line	Satellite	Don't Know	Other
1	13	0	7	2	3	4	1
3%	41%	0%	22%	6%	9%	13%	3%

32 businesses responded to this question.

Internet access cost

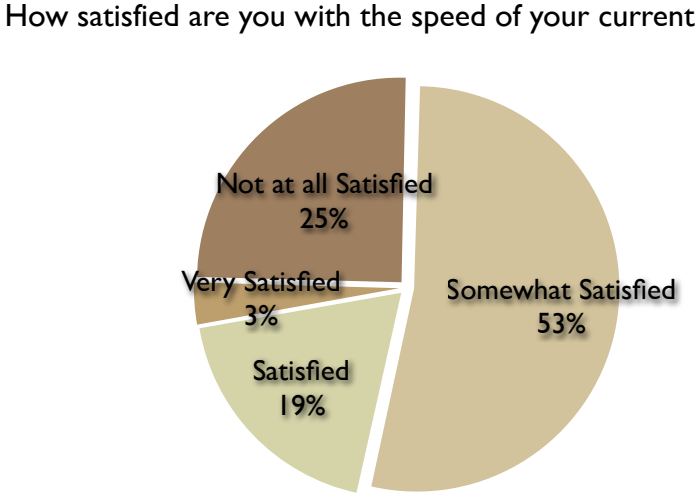
No Internet	$0 to $20	$21 to $40	$41 to $60	$61 to $100	$101 to $150	$151 to $300	$301 to $500	$501 to $1000	$1001 to $5000	Greater than $5000
0	1	4	7	6	5	2	0	0	2	2
0%	3%	14%	24%	21%	17%	7%	0%	0%	7%	7%

Internet access speed

Less than 56K	56K to 256K	256K to 512K	512K to 768K	768K to 1 Mb	1 Mb to 1.5 Mb	1.5 to 3 Mb	3 to 5 Mb	5 to 10 Mb	10 to 25 Mb	25 to 50 Mb	50 to 100 Mb	100+ Mb
1	8	0	2	2	2	2	5	0	1	0	1	1
4%	32%	0%	8%	8%	8%	8%	20%	0%	4%	0%	4%	4%

How satisfied are you with the speed of your current service?

Not at all Satisfied	Somewhat Satisfied	Satisfied	Very Satisfied
8	17	6	1
25%	53%	19%	3%



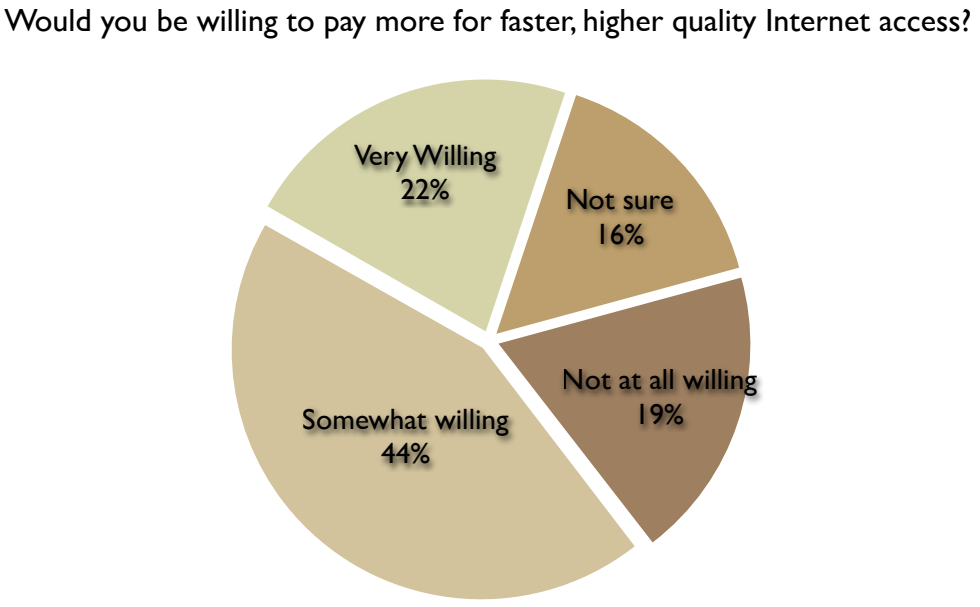
Check all applicable uses of the Internet needed for your business now

Application	Response	Percentage
Email	32	100%
Access news and current events	29	91%
Download or listen to online music	15	47%
VoIP (Vonage, Skype, etc.)	6	19%
Online Backup	18	56%
Transfer large files	19	59%

Application	Response	Percentage
Monitor / control security, alarms, health, processes, etc.	11	34%
Telemedicine / telehealth	3	9%
Communication between headquarters and remote sites	12	38%
Processing credit card / debit card transactions	13	41%
Research	24	75%
Ordering / managing inventory	23	72%
Maintaining a web presence with a blog or other site	23	72%
Allowing and processing online orders	10	31%

Would you be willing to pay more for faster, higher quality Internet access?

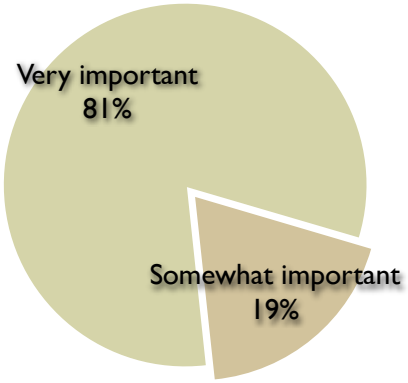
Not at all willing	Somewhat willing	Very willing	Not sure
6	14	7	5
19%	44%	22%	16%



How important do you think Internet technology will be for the success of your company over the next 5 years?

81% of respondents said that the Internet is “very important” to the success of their business over the next five years.

How important do you think Internet technology will be for the success of your company...



Not Important	Somewhat Important	Very Important
0	6	26
0%	19%	81%

How difficult is it to find personnel with the needed computer, software, and Internet skills from the local area?

Very Difficult	Somewhat Difficult	Not Difficult
3	12	16
10%	39%	52%

How difficult is it to find and provide the appropriate training for employees in computer, software and Internet applications?

Very Difficult	Somewhat Difficult	Not Difficult
0	13	18
0%	42%	58%

Broadband is not a system or a technology, but rather refers to speed and capacity (bandwidth) of a network connection. Broadband in this context refers to high-speed Internet connections that are always connected (no dial-up) to very high-speed networks, enabling super-fast downloads and uploads. Broadband networks have the potential to dramatically change, enhance, and transform the types of applications and

services currently available through todays narrowband Internet. A broadband network can provide customers with a choice of service providers and services.

Given the definition above, do you believe your organization would benefit from an affordable broadband Internet connection?

Yes	No
28	2
93%	7%

Broadband: What is affordable and at what speed?

Not sure

We currently have a 5m/768k connection costing about $70/month with our business phone bundle. We can go to a 7m/768k connection for just over $100/month. It is just not worth the price increase for such a small increase in speed. If we could get a connection with closer to matching up/down speeds then it would be worth the added cost. I would say a 10-15 in both directions would be worth the $100/month price.

The price and speed should be in keeping with the Richmond metro area.

I would like the fastest most reliable internet. Either affinity or FIOS.

Comcast of Powhatan refuses to run cable to our address. Verizon is the only choice in telephone services and will not run DSL or television programming to our house. Because we have satellite internet, we pay a high price and are under restrictions of fair access policy (FAP). Current cable and DSL charges are about half per month of what we currently pay. The FAP enforced by our current provider limits us to a maximum of 300mb a day in combined uploads and downloads during a 24 hour period. We are desperately waiting for lower prices, faster speeds, and no limit on internet based activities.

As fast as we can get!!!! 100mb $50 per month.

I don't know but the speed we have is slow.

I would love it for the county to go wireless, throughout the backroads and hard to get places. It would do wonders for business and offer opportunities for the students/children of Powhatan that very few areas could offer.

I would like a 10mbs connection for $35 a month.

My only choice for phone service is Verizon, and they only offer DSL, so my internet is Comcast cable. It is obviously more expensive to have my services with different companies.

We need dedicated T-1 lines with their associated Service Level Agreements (availability, etc.)

I think what we are paying now okay. What we need is faster speeds. I just performed download speed test on all of our computers and it was 6-7mb. However, my Verizon account at home in Bon Air is 20mb. It would be nice to have that speed here as we download and upload large picture files.

$50-$75/month for 1-10MB up and down

We deal with pictures and videos and therefore higher the speed the better.

$50/month - 12MB

I need speed comparable to Verizon High Speed that is available in eastern end of county now. I also run a real estate business and it is becoming harder to sell homes in areas of Powhatan that have only satellite high speed. This is not satisfactory for most companies that allow employees to work from their home.

I currently pay right around $40/month in my business phone package for mediocre speed DSL. If I could have faster speed for the same price like I have at my home with internet cable, it would be worth it. It seems that you automatically pay more just because it is for a business.

I don't know the speeds but DSL is not going to cut it. I don't feel it should cost more than $40 a month.

Rates are always negotiable and I'm not informed enough to give you a speed estimate. We currently pay $60 per month for our USB internet device.

Powhatan Today has ordered DSL internet connection and it works well most of the time. We have headquarters downtown and quite often it freezes up but I'm not sure the cause of it. Also the cell phone service does not work in the building at all. Not sure the cause of that either.

Who is your dial-tone provider?

Comcast	Verizon	Cavalier	Other	N/A
2	19	4	2	1
7%	68%	14%	7%	4%

Who is your long-distance telephone service provider?

Comcast	Verizon	Cavalier	Other	N/A
1	18	3	2	1
4%	72%	12%	8%	4%

Who is your Internet Service provider?

Comcast	Verizon	HughesNet	Cavalier	N/A Don't Know
7	14	3	1	2
26%	52%	11%	4%	7%

Who is your cable or satellite TV provider?

DirectTV	Comcast	Verizon	N/A
10	5	1	8
42%	21%	4%	33%

What other telecommunication needs do you have that were not covered in this survey?

Wireless

Bundled packages, possibly optical fiber like FIOs would be great!

Better cell phone service is the issue.

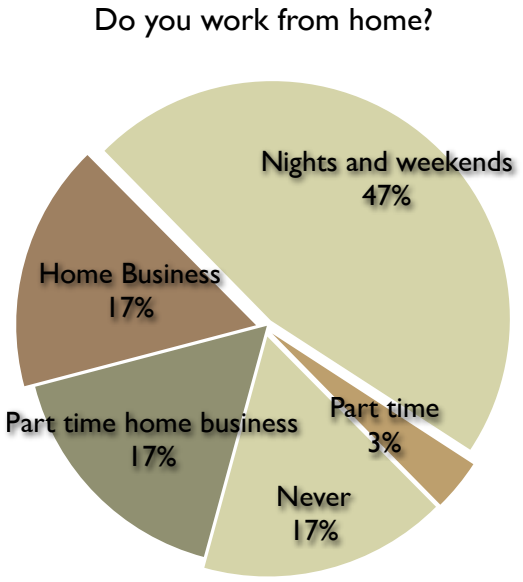
Responses such as none and n/a have been removed.

If more affordable broadband allowed your business to add new jobs, will the jobs to be filled require no more than a HS degree and no special skills required for employment? (unless training will be available from the company or business):

Yes	No
6	22
21%	79%

Do you work from home?

I have a full-time home-based business	I work full-time from home for another company	I work only part time from home for another company	I have a part time home based business	I need nights and weekends access to my place of work	I never work from home.
5	0	1	5	14	5
17%	0%	3%	17%	47%	17%



Recommended Areas of Attention

Broadly stated, Powhatan County should pursue an open access, "dark fiber" infrastructure approach to improve broadband choice and price options within the county. By using making modest, carefully targeted investments, additional competitive broadband service options would become available to Powhatan businesses and entrepreneurs. Other communities that have done this have seen sharp reductions in the cost of Internet and phone service--as much as 40% reductions for Internet, and 40% to 65% reductions in the cost of phone service is not unusual. Private sector service providers would sell all services on the network; the county would not compete with the private sector, and would in fact be creating additional private sector jobs and business opportunities.

Ownership and Management

The county should own and manage any telecom assets.

The county should pursue an open access dark fiber infrastructure approach, which would make additional competitive broadband service options available to area businesses and residents.

- Connect county facilities in the Powhatan Courthouse area with fiber.
- Extend the fiber to meet the planned MBC fiber on Old Buckingham Road to maximize competitive choice in service offerings and to achieve maximum price reductions.
- Make county-owned fiber available to residents, commercial and retail businesses in the Powhatan Courthouse area, using an open access model that would have private sector service providers offering all services. This will be especially attractive to businesses in the area, as their cost for phone and Internet services should decline sharply.

Public/Private Partnerships

Powhatan County should not compete directly with the private sector by becoming a service provider. Instead, focus on making investments that support an open access business model that lowers the cost of basic broadband infrastructure for private sector service providers.

Action Step: Provide summary recommendations of this report to area service providers and solicit their participation in the effort.

County Initiatives

There are numerous opportunities for Powhatan County to make prudent investments in telecom infrastructure without spending large amounts of money, or in some cases,

without spending any money at all directly. County policy changes can have a substantial impact on the installed telecom infrastructure in the community over time, if those policy changes are embraced and pursued diligently.

Develop a fiber overlay plan for the county that will take fiber to all critical county facilities, including public safety and first responder locations, water and sewer pump facilities, high water and water monitoring locations, parks and recreation facilities, and all key traffic management equipment.

Action Step: Identify and map all recommended areas for for possible fiber deployment.
Action Step: Develop a fiber overlay plan that identifies all major routes for fiber and all needed wireless tower and/or antenna locations.
Action Step: Plan to build a fiber backbone along the entire length of Route 60 to support existing businesses and economic development in that corridor, and to facilitate extensions to other communities and sub-divisions in the county.

Powhatan County should have an "open ditch" policy that considers installing fiber alongside water and sewer extensions and improvements.

Action Step: Meet with county department heads and planners to review the fiber overlay plans.
Action Step: Develop a policy of including telecom duct in any open ditches (for water and sewer improvements), and other public works projects when the work matches routes in the fiber overlay plan.

Fiber cable installed by the county should be designed with additional capacity for future needs and uses.

Action Step: Standardize on a minimum of 144 fiber cable for all future county deployments, and a 288 fiber count cable should be used on Route 60. Any work on Route 60 should include a minimum of two conventional 1/14" HDPE ducts (one for access, one for distribution) or make use of appropriately sized micro-duct.

Powhatan County should discuss utilization of a next generation network to support shared public safety goals.

Action Step: County planning and IT staff should meet to discuss how a next generation network could improve response and management of public safety emergencies (e.g. pandemics, weather catastrophes, etc.).

Community

Numerous opportunities exist to improve the living and work spaces in Powhatan, especially when new construction is underway. Remarkably, many builders and architects still fail to include adequate network cabling in their residential and commercial building designs. The county can play a leadership role by encouraging stepped up private sector investment in telecom infrastructure.

All new homes built in Powhatan should have appropriate "Internet ready" structured cabling in every living space.

Action Step: The county should begin meeting with local builders and developers to encourage the inclusion of structured cabling (Ethernet cables) in all new residential single family homes, rental units, and condominiums.

Action Step: A short handout should be prepared that describes the adequate level of structured cabling needed in new homes. This should be circulated to county planners, local builders, developers, and real estate agents.

Action Step: The county should consider using financial and/or tax incentives to encourage developers to construct "Internet ready" homes.

Action Step: Powhatan County officials should work with state officials to encourage the development of updated building codes that would require appropriate structured cabling in new homes. These changes would address the emerging shift to using Ethernet cabling for not only Internet access in the home, but also to deliver telephone and TV services.

Discussion

The cost of adding structured cabling to a new home is a tiny fraction of the cost of construction (typically less than $500). At least three Cat 5e/6 cables should be pulled to every living space in the home (with the exception of bathrooms) to provide for complete voice, video, and Internet access in every room. All cables should be run back to a structured cabling panel on an outside wall, near the building entrance for utilities. A recent study showed that homes with fiber to the premise sell for $5,000 to $7,000 more than homes without fiber.

All new residential developments in Powhatan should have duct from each home to a pedestal or hand hole, and duct from each pedestal or hand hole back to a neighborhood demarcation point for network electronics and/or optical splitters.

Action Step: All new homes in the county should have telecom duct installed from the home to a county-designated demarcation point in the right of way. Homeowners would be responsible for the duct to the county demarcation point. The county would own the conduit in the right way (pedestal to pedestal duct).

Action Step: County planners should begin meeting with developers to discuss this initiative and to help educate developers and builders on the enhanced value that accrues from this investment.

Discussion

All new residential developments in the county should have telecom duct installed by the builder. Duct would be routed from the side of the home where other utilities enter the home to a nearby pedestal or handhole. Duct from the handhole should run back to a neighborhood cabinet or optical splitter location for network aggregation. The cost of this work is typically only $200-300 per home.

All new commercial and retail buildings constructed in Powhatan County should have appropriate "Internet ready" structured cabling from a Building Distribution Frame (BDF) to all office and workspaces.

Action Step: County planners should begin meeting with developers, builders, and architects to encourage adding appropriate telecom facilities in all new buildings.

Discussion

All new commercial buildings in the county should include appropriately designed telecom facilities (e.g. telecom closet(s), cable trays in the ceilings, 4" risers between floors, etc.). The building spaces become more valuable, and when the appropriate infrastructure is designed in, the cost to the tenants is lower.

All new commercial and retail buildings constructed in Powhatan County should have a minimum of two 4" ducts from a pedestal or hand hole in the public right of way to the telecom closet or BDF (Building Distribution Frame) area.

Action Step: All new commercial buildings in the county should have telecom duct installed from the structure to a county-designated demarcation point in the right of way. Property owners would be responsible for the duct to the county demarcation point. The county would own the conduit in the right way (pedestal to pedestal duct).