



# Broadband Recommendations

Prepared for Washington County, Maryland

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# Executive Summary

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Following the announcement of the OneMaryland fiber backbone being built through Washington County, a task force was convened to develop a strategy for determining how to leverage this significant new infrastructure investment. This report provides a series of strategies and activities to help get more and better broadband in the region. Increased affordability and availability of broadband delivered services has the potential to increase job creation in the county and the city, help retain existing businesses, and improve the region's ability to attract new businesses and entrepreneurs.

While most city and county residents and businesses have access to copper-based “little broadband” services with bandwidth in the range of 1-20 megabits/second, many other cities and towns in the country (more than 130, according to Broadband Communities magazine) have already made the leap to fiber-based “big broadband” with a minimum bandwidth of 100 megabits/second and many of those communities are now “Gigabit Cities” with a standard residential and business connection of 1,000 megabits (one Gigabit).

Local leaders might reasonably ask, "Why does anyone need a Gig of bandwidth?" The value of a Gig fiber connection is about the future, not the present. It is about preparing citizens, businesses, and the community to be able to compete for jobs and businesses over the next five to thirty years, with future-proof infrastructure that will support FUTURE needs.

***If the region wants to stand still economically, then it can stay with its current copper-based telecom infrastructure, effectively freezing economic development where it is today. But if the community wants to grow economically, retain businesses, create jobs, attract entrepreneurs, and bring new businesses, the Gigabit connection becomes a critical part of a forward-thinking economic development strategy.***

There is a growing trend of more people working from home, in two distinct groups. Throughout the United States, there are established business professionals who want to run a business from their home, but they require business class broadband services in residential neighborhoods. 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.

The trend of increasing energy costs is already making long commutes to work more expensive for Washington County 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.

Washington County and the City of Hagerstown have an excellent quality of life, a relatively low cost of living, fine small towns, and superb recreational activities. The area is also located

within reasonable distances of the major urban areas of Washington, D.C. and Baltimore, Maryland. Widespread availability of business class broadband has the potential for accelerating economic development while maintaining the great quality of life and without the risks of over-urbanization.

Over the next thirty years, the businesses, residents, and institutions of Washington County will spend, very conservatively, more than \$3.6 billion 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 Washington County and the City of Hagerstown would probably exceed \$5 billion (over 30 years).

Washington County 30 Year Telecom Expenditure Analysis			
	Households still on dial-up	Households with "little" broadband cable modem/DSL/wireless	Households with no Internet
Total households	56,386		
Total businesses	10,044		
Household Percentage	5%	73%	22%
Number of households	2,819	41,162	12,405
Average monthly telecom expenditures	Local phone: \$25 Long distance: \$25 Cable/satellite TV: \$65 Dial up Internet: \$20	Local phone: \$25 Long distance: \$25 Cable/satellite TV: \$75 Broadband Internet: \$45	Local phone: \$25 Long distance: \$25 Cable/satellite TV: \$65
Annual cost/household	\$1,620	\$2,040	\$1,380
30 year expenditure	\$137,017,980	\$2,519,100,936	\$513,563,688
Total residential expenditures	\$3,169,682,604		
Total expenditures <sup>1</sup>	\$3,645,134,995		

<sup>1</sup> Business, schools, institutions, and government costs estimated conservatively at 15% of residential expenditures. Source: Mediamark Research, Inc.

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 and tablet computer being sold by Amazon, is getting rave reviews, and Amazon has released a version its Kindle book reader software for the iPhone, the iPad, and other tablet devices. The surging popularity of this new book reader 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 recent sale of the Washington Post to Amazon (the maker of the Kindle) suggests a potential transformation in the news business.

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 Washington County might as well be living in 1400--before books, before newspapers, before any information distribution systems existed.

A recent study (Render, March, 2013) indicated that for those under the age of 35, 70% are accessing video programming through over-the-top (OTT) video services such as Netflix, Hulu, Amazon and iTunes. *About half of this group have never purchased programming from a cable TV or satellite provider.*

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 the region to collaborate on the development and deployment of a modern, world class digital transport system that will meet the needs of the region's world class 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. The Washington County region has significant assets and advantages. These include:

- ▶ Excellent quality of life – Abundant possibilities for rural living and a historic Main Street in Hagerstown and other towns in the county (unlike many suburban communities) can be an economic development attractor, especially for self-employed businesspeople and entrepreneurs.
- ▶ Excellent recreational activities – The area has superb outdoor recreational activities, including extensive hunting opportunities, hiking, and other outdoor opportunities.
- ▶ Rich history – The region has a rich set of traditions and history dating back to the early 1700s that adds historical interest to the county and enhances the quality of life.
- ▶ The county has an unusually large amount of private fiber passing through it--more than most other similar areas. This is currently an under-used economic development tool. Some investment is needed to make access to this fiber more widely available to the business community.
- ▶ The OneMaryland backbone passing through the county is also a strategic advantage that will require additional investment to get affordable access to the business community.
- ▶ Downtown Hagerstown has tremendous potential to attract younger people, start up businesses, and entrepreneurs if affordable Gigabit fiber services are more widely available in the core downtown area, including some of the residential areas of downtown (for live/work opportunities).

Commuting costs in the region due to energy increases will encourage more work from home and business from home activities. Traffic and commuting patterns will change, and these shifts in commuting patterns may suggest different budgeting strategies for community infrastructure improvements and investments. As fuel prices continue to rise, a slow but steady increase in the number of home-based jobs and businesses is being driven by the corresponding increase in the cost of commuting. But home-based workers and businesses will require more than the current residential broadband services; business class broadband will become increasingly important as the area's small towns, neighborhoods, and rural roads transition to daytime business districts.

Residents and businesses are increasingly content creators, not just content consumers. This shift in locus of content development also means that both residential neighborhoods and existing commercial areas of the region require much higher performance networks with symmetric bandwidth to accommodate content creation.

Demographic changes must be considered; if the city and the county want to attract and retain young people, consider the following data from a Fiber To The Home Council report (March, 2013):

- ▶ Among young people under 35, 54% of males are “very interested” in advanced broadband services, and 44% of females are “very interested” in advanced broadband services. In this age group, over 65% are “very interested” in working from home.
- ▶ In the over 54 age group, one third of men and women are interested in advanced broadband services, and over half want to use HD video calls.
- ▶ 11% of fiber to the home users have a home-based business.
- ▶ Fiber service is ranked as the number one factor influencing a home purchase if the buyer already has fiber at their current residence. Fiber is ranked as the number two home buying factor if they do not have fiber service now.
- ▶ Fiber connected homes are perceived as being worth \$5,000 to \$6,400 more than an equivalent home without fiber.
- ▶ Because of the increase in home-based businesses due to fiber availability, fiber can create as much as \$1.1 million in new business revenue to the community for every 1,000 homes passed by fiber.

World class broadband infrastructure will be necessary to maintain the County’s attractiveness as a great place to live.

When local governments undertake a study of broadband infrastructure, a key question should be:

*“What is the benefit if government invests in broadband infrastructure?”*

And the inverse question should also be asked:

*“What happens if we don’t make strategic broadband investments?”*

OUTCOMES OF STRATEGIC LOCAL GOVERNMENT INVESTMENT	OUTCOMES OF LEAVING IT ENTIRELY TO THE PRIVATE SECTOR
Increased competitiveness with other cities and regions that have made broadband investments and have driven down the cost of Internet and voice services for businesses and residents.	Communities with shared broadband infrastructure are seeing increased economic development activity and increased business attraction success.
Better prepared to attract businesses and jobs to the area.	The region is at an economic disadvantage without a strategy to ensure that affordable high speed broadband is in place as a business attraction and business retention tool.
Cities and counties that have made investments have seen the cost of telecom services sharply reduced, keeping more money in the community and freeing up business funds for expansion and jobs creation.	Residents and businesses will continue to pay more for voice, TV, Internet, and other broadband services.

OUTCOMES OF STRATEGIC LOCAL GOVERNMENT INVESTMENT	OUTCOMES OF LEAVING IT ENTIRELY TO THE PRIVATE SECTOR
A long term strategy of “fiber everywhere” gives rural areas of the county better educational opportunities and improved access to jobs. Fiber service in rural parts of the county will also attract entrepreneurs and business people who want to work from home.	Rural areas of the county will continue to see population outflow, loss of younger workers and families, and diminished educational opportunities.
Aggregation of the marketplace for telecom services via shared community infrastructure attracts more providers and helps keep prices for broadband services lower.	Private sector providers will continue to “Balkanize” the region, with higher prices and more limited bandwidth options because of limited competition.

## NEXT STEPS

Next steps include:

- ▶ Read and review the three reports (Needs Assessment, Cost Estimates and Mapping Report, 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 developing an RFI to solicit private sector partners for a public/private partnership.

If leaders and stakeholders believe that telecom and broadband investments are needed to support the long term goals of the County, the current broadband task force should be directed to move the effort forward. Key recommendations include:

- ▶ The two local governments must play a key leadership role to bring Gigabit fiber services to the area.
- ▶ The city and the county should not compete with the private sector. All broadband services should be sold directly to customers by existing and new private sector service providers.
- ▶ It is essential to bring “anchor tenants” into the planning work to help aggregate demand, including health care providers, K12 schools, higher education, and major employers.
- ▶ Development of a modest collocation facility in Hagerstown to provide a common, affordable meet point for all public and private fiber, including the OneMaryland backbone. This is a critical starting point for the effort.

- ▶ A regional broadband authority or a public/private partnership can be used to create the permanent oversight and leadership needed for the effort. Most jobs associated with the effort can remain in the private sector.
- ▶ Modest pilot projects like fiber in downtown Hagerstown and key economic development zones represent a low risk first step to enable improved economic development opportunities.
- ▶ Work with existing services providers – Washington County has both local, regional, and national broadband service providers. It is likely many businesses would see their Internet and/or telephone costs decline by getting a fiber connection to a service provider using shared community broadband infrastructure (as much as 40% to 70% decline in prices have been seen in other communities).
- ▶ Make modest investments in basic telecom infrastructure – The city could accelerate economic development, especially in downtown Hagerstown, 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.).
- ▶ When water, sewer, and road improvement projects are undertaken by the City and the County, telecom duct and/or fiber cable should be considered as part of the project.
- ▶ Include public safety, rescue, and first responder communications needs in the planning effort. Nationwide, public safety voice/radio communications are being upgraded to support improved access to Internet data services and to digital voice radio systems. Public safety radio and data needs should be incorporated into the long term broadband planning effort to reduce costs for local government and to improve public safety communications.

A vision for the project might be worded as follows:

***By 2017, any resident or business in Washington County and the City of Hagerstown that wants it will have access to affordable, high performance Gigabit broadband services that will support any and all jobs, business, professional, medical, educational, and personal activities.***

# National and International Trends

## DEFINED: THE WEB, INTERNET, & BROADBAND

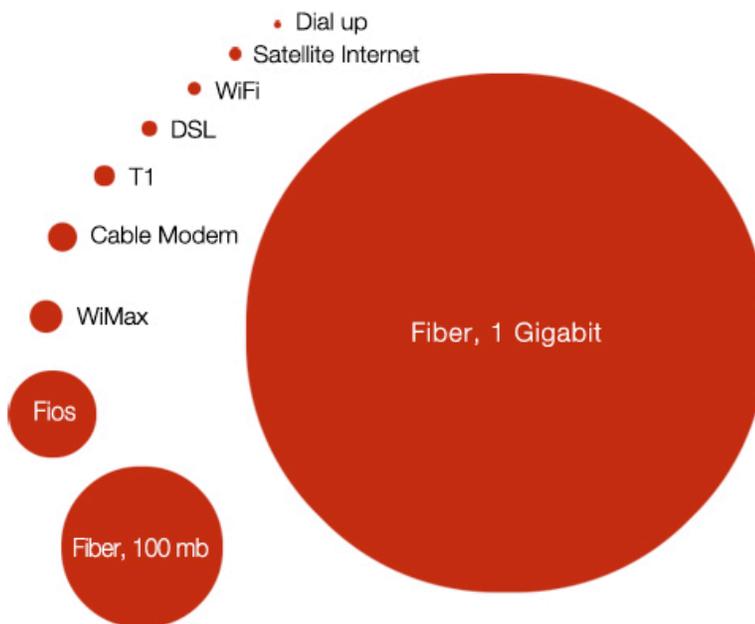
What’s the difference between the web, the Internet, and broadband? These terms are often used interchangeably, but they are not all the same. Accordingly, the Internet is defined as a system of interconnected computer networks that is available globally and publicly. These computer networks are comprised of countless government entities, for-profit organizations, non-profit organizations, academic institutions, and private organizations that are all tied together by a network of wired and wireless technologies. The Internet serves a multitude of purposes. The Internet provides access to log on to Facebook, stream television shows on your computer screen, and send emails.

The Web or otherwise known as the World Wide Web is a system of interconnected hypertext documents communicated and interpreted through the Internet through a browser. The basic foundation of the Web and the Internet is Hypertext Transfer Protocol (http), which is a technical language that allows people to view text and images between computers.

According to broadband.gov, broadband service is often associated with high-speed Internet access that is always on and faster than traditional dial-up access. Broadband service is able to provide higher-speeds of data transmission than dial-up service because broadband has a greater capacity to carry content. There are two characteristics that often describe broadband: speed and “always on.”

A good analogy can be made between the volume of data an Internet connection is able to manage and the carrying capacity of a water pipe. The diagram above illustrates the relative capacity of each of the so-called broadband technologies. Fixed wireless, satellite and cable are thought to have very little additional future capacity through advances in engineering. Cable is believed capable of achieving somewhat greater bandwidth capacity in the future.

Bandwidth/Connectivity Comparisons  
Dial-up Modem to Gigabit Ethernet

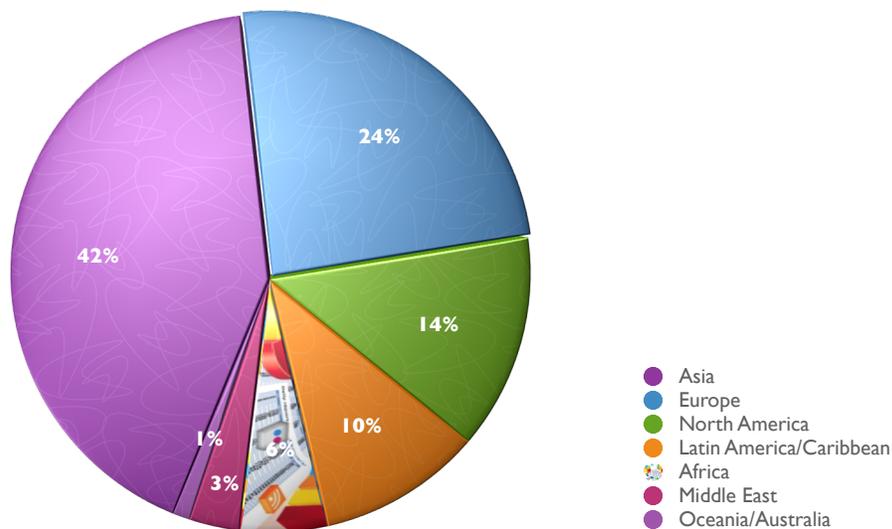


Optical fibers themselves transmit at the speed of light so the speed limitation on a fiber network is a function of the electronics that power the lasers. Today, there are real-world networks offering Gigabit-per-second Internet connections.

## WHO ISN'T ONLINE?

The Internet has become increasingly widespread in our society and for good reason. In order to support a high demand for Internet, the infrastructure must be in place. High capacity networks are seen as strategic infrastructure that serves as the catalyst for sustainable economic growth. According to Pingdom, an Internet monitoring service, there were over 1.97 billion Internet users worldwide. Of the 1.97 billion Internet users, 825.1 million of them come from Asia, 475.1 million come from Europe and 266.2 million come from North America. 2010 experienced a 14% increase in Internet users since the previous year. In addition, there were 107 trillion emails sent, a 39.1% increase in Apache websites, 88.8 million .COM domain names existing, 25 billion tweets sent, and 2 billion videos watched on YouTube per day in 2010.

Internet Users Divided by Region, June 2010



Source:

## WHAT HAPPENS IN JUST ONE DAY ON THE INTERNET?

- ▶ Enough information is consumed to fill 168 million DVDs.
- ▶ 294 billion emails are sent.
- ▶ 2 million blog posts are written.
- ▶ 172 million people visit Facebook.
- ▶ 40 million people visit Twitter.
- ▶ 22 million visit LinkedIn.

- ▶ 250 million photos are uploaded.
- ▶ 22 million hours of TV and movies are watched on Netflix.

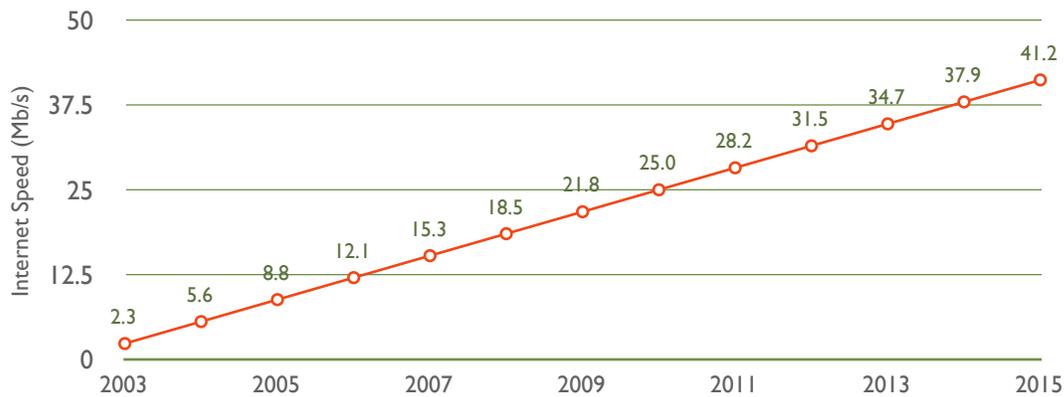
## EXISTING CONDITIONS

Although the U.S. once led the way in the World Wide Web, the U.S. has now fallen to the 15th place among developed nations for broadband connectivity according to a report conducted by the Information Technology and Innovation Foundation in 2008.

In addition, limited choices often force U.S. consumers to purchase slower bandwidth speeds at a higher cost as compared to other nations. However, increasing bandwidth speed at an affordable price point will be necessary to compete in a global economy. The speed of the bandwidth can have a significant impact at the local, state, federal, and international level in regards to the standard of living and economic development.

The networks embedded from the Internet serves the purpose of maintaining and creating jobs, facilitating telemedicine, improving education, ensuring public safety, and providing public services. Just within the past decade, the key purposes of the Internet were intended for basic use to hop onto the web. However, the Internet is now used for both play and for work.

Trend of Internet Speed from 2003 to 2015



With greater use of the web, comes faster broadband speeds. Broadband speeds have increased from 300 Kb/s in 2003 to 25 Mb/s in 2010 according to a report conducted by Cisco. Despite the fact that global IP traffic has increased eightfold over the past 5 years, and will increase fourfold over the next five years, most U.S. Internet connections are not sufficient enough to support interactive home-based medical monitoring, multi-media distance learning, or to send and receive data to run a home-based business as denoted by the Cisco Visual Networking Index.

In other words, the U.S. is average on the playing field of first generation broadband measures. The U.S. is an even weaker performer on providing reasonable prices for high and next-generation speeds. This surmounts to a large concern if consumers of broadband want to compete globally for business development and enjoy the same connectivity capabilities as others worldwide.



- ▶ Global IP traffic has increased eightfold over the past 5 years, and will increase four fold over the next 5 years.
- ▶ In 2015, there will be 6 million Internet households worldwide generating over a terabyte per month in Internet traffic.
- ▶ Traffic from wireless devices will exceed traffic from wired devices by 2015.
- ▶ Internet video is now 40% of consumer Internet traffic, and will reach 62% by the end of 2015.
- ▶ From a study of 13 countries, the Internet has contributed on average 3.4 percent to GDP. Additionally, the Internet contributes to more GDP than agriculture, energy, and other better-established industries from the 13 countries studied.

## NEXT GENERATION CONNECTIVITY

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“Next generation” is the term used to describe future planning for the next step in network connectivity and infrastructure. This may suggest an emphasis on deploying fiber-to-the-home (FTTH). But why? By pulling fiber deeper into the neighborhood and providing greater access to connectivity, this allows the infrastructure to be in place to accommodate future communication needs, capacities, and innovations. The U.S. is currently the only country where fiber is being deployed in largely suburban areas with single family homes. However, many countries are on the lookout to improve broadband speed and subscribership.

Next generation broadband reaps in a number of substantial benefits in functionalities. This service is powerful and may serve an interest to various customer groups. There are four main functionalities of “Next-Generation Broadband”:

- ▶ Dramatically faster file transfer speeds for both uploads and downloads
- ▶ The ability to transmit streaming video, transforming the Internet into a far more visual medium
- ▶ Means to engage in true-real time collaboration
- ▶ The ability to use many applications simultaneously

Clearly, consumers have a strong interest in a visual medium from when and wherever they are. YouTube is the second most popular search engine after Google, which demonstrates the need to support the infrastructure to transmit streaming video.

In addition to video streaming, true-real time collaboration also provides an effective way for people to interact from wherever they are. People can engage in a two-way, real-time collaboration, so that fruitful, visual conversations can be held between friends, family, business associates from the state, country, or internationally.

Because of fiber networks, employees have the capabilities of working from their home. Findings suggest that if all Americans had fiber to the home, this would lead to a 5 percent reduction in gasoline use, a 4 percent reduction in carbon dioxide emissions, \$5 billion in lower road expenditures, and 1.5 billion commute hours recaptured.

## SIGNIFICANCE OF BIG BANDWIDTH FOR THE FUTURE

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*According to the 2009 report from the World Bank on information and communications technologies, for every ten additional broadband subscribers out of 100 inhabitants are correlated in high income countries with GDP growth increases of 1.21%.*

### PROSPERITY

As suggested from the statistic above, the Internet generates growth. In more than a handful of countries, GDP growth doubled to over 21% due to the Internet. Although some jobs have been eliminated due to the emergence of the Internet, nearly 1.2 million jobs have been created over the past 15 years from the Internet. The McKinsey's global SME survey suggests that 2.6 jobs were created for every one destroyed.

### HEALTH CARE DELIVERY

According to "The 2008 State New Economy Index" healthcare can be significantly improved in the future through greater use of information technology and connectivity to the web. Healthcare costs can potentially be cut by \$80 billion annually. The cost of health care continues to rise annually. For instance, health care as a share of U.S. GDP has almost doubled from 8.8 percent to 15.3 percent in 2005. One aspect of health care that is gaining steam is electronic prescribing. Electronic prescribing cuts medical transaction costs by eliminating the need for confirmation phone calls and faxes and reduces the chance of health risks due to prescription delays. This is a particularly useful asset for communities in rural areas who do not have convenient access to medical assistance.

### GOVERNMENT AND CIVIC LIFE

The term E-Government refers to networked information technologies online to serve constituents. The Internet cuts costs for many state governments from reducing the paper trail to expediting services through the Web like renewing drivers' licenses and paying taxes. Furthermore, E-government will become a setting for online based discussions between constituents and bureaucrats. This allows for greater transparency in hopes of garnering a better perception of how government functions. More local and state governments and the federal government are attempting to involve constituents through webinars, blogs, wikis, and videos.

## EDUCATION

Students benefit greatly through the use of computers and Internet. Nearly every public school in America has access to the Internet. In 2007, there were 180,00 more instructional computers in the schools than in 2006. Students who attend schools without access to computers and the Internet may be ill prepared for the work place. The prevailing use of information technologies in not only the United States, but also globally is a clear indicator that future prosperity is in the hands of students who are able to understand and use the pertinent tools.

# The Big Broadband Challenge

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## WHAT IS BROADBAND?

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There is much confusion about the “true” definition of broadband. From the perspective of economic development, there can be no upper limit on the definition of broadband. Saying that broadband (as an example) is 5 megabits/second of bandwidth or 10 megabits/second is to immediately tell businesses in the region that there will be structural limits on their ability to do business in the future—it is dictating the size of a truck that determine the amount of goods and services delivered. Here is the only appropriate definition of broadband:

***Broadband is whatever amount of bandwidth is needed to support a business’ ability to compete in the global economy.***

Broadband is a community and economic development issue, not a technology issue. The essential question is not, “What system should we buy?” or “Is wireless better or cheaper than fiber?” Instead, the question is:

***“What do our businesses and residents need to be able to compete globally over the next thirty years?”***

In short, Washington County and the City of Hagerstown today has “little broadband” in the form of DSL and cable modem service, along with limited access to “big broadband” in the form of fiber that passes a small percentage of businesses and institutions.

If Washington County and the City of Hagerstown is to make investments in broadband and telecommunications infrastructure, it is absolutely critical that those investments are able to scale gracefully to meet business and economic development needs for decades. This drives the solution towards an integrated fiber and wireless system, rather than a wireless only service orientation. Wireless is able to provide basic Internet access needs, but is not able to support advanced video and multimedia services. Some off the shelf business videoconferencing systems in use today require a minimum of 50 megabits of bandwidth—far beyond the capabilities of any wireless system. Two key concepts that should drive community investments in telecom are:

***“Broadband” is not the Internet***

***Bandwidth is not a fixed number***

Broadband and “the Internet” are often used interchangeably, but this has led to much confusion. Broadband refers to a delivery system, while “the Internet” is just one of many services that can be carried on a broadband network. The challenge for communities is to ensure that businesses and homes have a broadband network with sufficient bandwidth to deliver all the services that will be needed and expected within the next three to four years, including but not limited to “the Internet.”

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)		1.2 megabits
Standard definition TV		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 Washington County homes and businesses will need in the coming years (see the table on the next page).

	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

## USE TRENDS AND SERVICE NEEDS ANALYSIS

Mark Peterson, a Professor of Community and Economic Development at the University of Arkansas who studies the impact of broadband access and affordability on rural communities, wrote recently, “Broadband connectivity is not the infrastructure of the future, it is the infrastructure of the present.” Washington County faces a challenge in economic development infrastructure with primarily “little broadband” (i.e. DSL, wireless, and cable services) when many communities, regions, and countries have already made the decision to focus resources on the development of “big broadband,” which is typically fiber with a minimum capacity of 100 megabits or Gigabit to the premises.

- ▶ A third of IBM employees work from home at least part time, and the company has reported annual savings of \$110 million.
- ▶ Australia’s government is converting the entire telecommunications infrastructure for the country to an open access system by buying a major portion of Telstra assets. Telstra, which is currently the country’s primary incumbent telecom provider, will become a service provider on the new open network.
- ▶ Fiber to the premises attracts home buyers, who are willing to pay \$2000 to \$4600 more for a house with fiber service.
- ▶ Fiber to the home users say they are able to work from home more often, averaging 7.3 workdays per month, reducing their carbon footprint and decreasing wear and tear (and maintenance) on roads.

- ▶ More than 13% of homes in the U.S. had been passed by fiber by mid 2009.
- ▶ Nationally, less than 10% of homes have no access to any kind of broadband service, but in the region, more than 16% of homes still have no broadband access, or 50% higher than the national average.

In its March, 2009 report, the ITIF (Information Technology & Innovation Foundation) listed some of the next generation services and applications enabled by high performance, affordable broadband. The table on the next page lists these and other services that all represent broadband-enabled applications and services that must be available in Washington County and the City of Hagerstown if the County and City is to remain economically viable.

<b>Residential and Business</b>	Videoconferencing
	IP TV (Internet Protocol TV)
	HD streaming video
	Ultra hi-def (BluRay) video streaming
	Video on demand (e.g. Netflix)
	Place-shifted video
	Cloud computing services
	Online and cloud-based gaming
	Smart homes, buildings, and appliances, including smart electric meters, AMR (automated meter reading), and AMI (advanced metering infrastructure)
	Remote computer aided design (CAD)
	Work from home jobs
	Business from home
	3D graphic rendering and CGI server farms
	Remote network management and managed services
Virtual collaboration spaces (e.g. enhanced GoToMeeting, Webex style services)	
<b>Public Safety</b>	Intelligent transportation applications (smart road systems)
	Public safety and first responder networks
	Emergency dispatch and coordination
	Webcast agency meetings (e.g. virtual meetings)
	Online training for first responders, fire, and rescue
<b>Society</b>	Broadcast of local sports events
	Videoconferencing of community and town hall meetings for wider participation
	Wider availability of nonprofit and community organization services
<b>Health Care</b>	Teleconsultations
	Telepathology
	Telesurgery
	Remote patient monitoring

	Remote diagnosis
	Remote medical imaging
	Grid computing for medical research
<b>Education and Research</b>	Distance education
	Virtual classrooms
	Remote instrumentation
	Multi-campus collaboration
	Digital content repositories and distribution (digital libraries)
	Data visualization
	Virtual laboratories
	Grid computing for academic research

When analyzing future service needs, it is important to take into account ALL services that may be delivered over a broadband connection. As we noted in the previous section, “broadband” is not a service--it is a delivery medium. If we think about broadband by using a roads analogy, broadband is the road, not the trucks that use the road. Internet access is a service delivered by a broadband road system, and that Internet service is just one of many services that are in demand. Today, congestion on broadband networks is not due just to increased use of email and Web surfing, but many other services.

- ▶ FCC Commissioner Deborah Tate spoke in April, 2008 at the Broadband Properties conference in Dallas, Texas. Commissioner Tate noted that:
  - ▶ Demand for bandwidth has been doubling every two years for the last ten years.
  - ▶ By 2015 (just two years from now), the FCC thinks bandwidth requirements will be fifty times (50x) what they are today (current average bandwidth to homes and businesses is 1-2 megabits). In Japan, where they have had 100 megabit connections to homes and businesses available for several years, they are already observing congestion--meaning 100 megabit pipes are already filling up.
  - ▶ Americans are watching more than 10 billion videos per month over the Internet. The table and chart below illustrate the growth in average bandwidth to the home over the past fourteen years.

The FCC’s prediction of a 50x increase in bandwidth needs in just five years (i.e. 2018!) indicates that DSL and cable modem services will be adequate, especially for businesses, but also for home uses of telecom services.

- ▶ This means that current DSL, wireless, and cable modem services are completely inadequate for future needs. Current DSL offerings are in the range of 384 kilobits to 1.5 megabits for most residential users, 768 kilobits to 3 megabits for business DSL users, and there are severe distance limitations on DSL. Higher bandwidth (2-5 megabits) is possible, but as the DSL bandwidth goes up, the distance it can be delivered goes down.

- ▶ Current wireless offerings are in the range of 1/2 megabit to 1 megabit, and future WiMax services will only be able to deliver 2-4 megabits. Some wireless providers are rolling out 10-15 megabit services, but wireless does not scale up well with respect to cost. As bandwidth increases, the cost of the equipment also increases, and even a 15 megabit service is well short of the FCC projections of the need for 50 megabits of bandwidth in the near term. Wireless performance and capacity is heavily dependent upon backhaul (the local connection to the provider's core network); if this connection is also wireless, the bandwidth available at the access point is shared among all users, even if the rated capacity of an individual connection is 15 megabits. In other words, if the backhaul capacity is 100 megabits, and twenty local users are sharing that capacity, actual bandwidth available to any single user may be much lower than 15 megabits. If all the users are trying to watch video at the same time (not uncommon in early evening), performance can suffer drastically.
- ▶ Current average bandwidth for cable modem services is typically 1 to 2 megabits. It is important to note that cable providers make heavy use of the phrase "up to" in their advertising, and it is not unusual to see ads promoting cable modem speeds of "up to 6 megabits." However, that amount of bandwidth is shared among many users (often 200 or more) in a neighborhood, which results in much lower average speeds, and during peak use times in residential areas, the actual bandwidth available to a single household may be less than one megabit.

The challenge for Washington County is to ensure that the businesses, residents, and institutions in the community have a telecommunications infrastructure in place that will be able to handle the 50x bandwidth increase projected by the FCC (which is based on many years of real world data).

A recent talk by a DirecTV official provided additional insight into residential bandwidth needs. The DirecTV speaker noted that one of their biggest complaints is that the company does not have enough HD format programming. He went on to note that a single channel of "standard" HD content uses 10 megabits of bandwidth when delivered via IP-TV, and a live event like a race or sporting event (e.g. football) requires 15 megabits of bandwidth. The firm is already delivering video programming to end users using Internet-based IP-TV formats, and noted that many buildings and homes do not have the internal cabling to support the IP-TV bandwidth needs. He also indicated that their early IP-TV users cannot tell the difference between IP-TV delivery of video and traditional cable/satellite delivery.

In 1993, the year that the Internet began to be used commercially, the average connection speed was 14,400 bits per second. At the end of 2011, the average bandwidth to the home is fifty times that for DSL service (768 kilobits per second), and over 100 times that for the typical cable modem connection (about 3-5 megabits per second). DSL speeds have flattened out because DSL capacity has flattened out, not because demand has diminished.

# First Mile Connectivity Options

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## TELEPHONE/DSL

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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 Washington County and Hagerstown, DSL at low to moderate speeds is available in many locations in the county and city. Verizon appears to be making improvements in the availability of DSL services in the area.

## CABLE SYSTEMS

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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.

In Washington County and Hagerstown, Antietam Cable and Comcast offer cable services, and Antietam Cable has made significant upgrades to their system in recent years, and offers 50 meg and 100 meg services, although the company reports that the take rate on those higher service tiers has been low. Customers buy higher bandwidth speeds when applications and services that they want require those speeds. Broadband adoption of higher bandwidth offerings occurs based on the availability of applications, not on the availability of the pipe size.

## SATELLITE

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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 of 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 additionally.

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 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. Hughes uses independent small businesses as installers and resellers. Wild Blue has partnered with many rural electric coops, with the coops acting as sales agents and installers. 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 Washington County and Hagerstown, and satellite still remains relatively expensive compared to wired or terrestrial wireless service.

## BPL

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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 coops 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 coop that has been "experimenting" with BPL for more than two years, the coop 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

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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 of connections continues to increase 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 significantly 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 only once, while wireless systems will have to be replaced entirely several times. Properly priced 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. As a result, the additional feeder fiber becomes costly as it is considered a “forklift upgrade.”

Every business in Washington County, and specifically Hagerstown, 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, as well as a viable tax base.

## THE WIRELESS BROADBAND DEBATE

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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, the wireless systems are relatively expensive when taking into account the demands of the entire life cycle. Wireless systems are inherently less secure than cable based systems, and we never recommend that a business use 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 Washington County and Hagerstown, wireless will be important over the next three to five years as a primary delivery system for broadband services in many parts of the area. 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

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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 magical 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 receive 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 Washington County and Hagerstown. 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 an essential public infrastructure that is critical to community and economic development. Furthermore, a 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

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Community investments in fixed point wireless 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 use a service other than 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, fiber and duct backhaul connections) can be re-used over time to support mobile wireless services and ensure long term public safety voice and data services. If Washington County makes investments, it should be in close coordination with public safety and rescue services to affirm that public safety voice communications will 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

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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 Washington County and Hagerstown, mobile wireless access to the Internet will probably be provided entirely by the private sector cellular providers. Any community wireless invest-

ments 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.

# Case Studies of Other Communities

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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. There are twenty broadband authorities that have been formed in Virginia, and approximately half of those authorities have built a network or have network construction underway.

## ROCKBRIDGE AREA NETWORK AUTHORITY

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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 began in 2012 and the project will be complete by the summer of 2013. The data center in Lexington is the most sophisticated facility of its kind in southwest Virginia. The 120 miles of fiber being built passes more than 11,000 homes and businesses and is

“last mile ready,” meaning businesses and residents can get fiber connections quickly and easily once initial construction is complete.

Attribute	Description
Governance	The network and data center is owned and operated by the Rockbridge Area Network Authority (RANA).
Funding	Approximately \$500,000 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 spring of 2013, and most operations and maintenance is expected to be outsourced.
Technology	The network is an active Ethernet system with a standard Gigabit symmetric fiber connection. 10Gig connections are also available.

## DANVILLE

The City of Danville, Virginia is operating an open access, open services network ([www.ndanville.net](http://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. In 2011, the City began using the funds generated by the network to begin a fiber to the home expansion in several neighborhoods, with a total of about 1500 homes connected.

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.

The availability of fiber in the River District, adjacent to Main Street, has been a significant factor in attracting businesses back to the core downtown area, with several national and international businesses locating several hundred employees in renovated tobacco warehouse and historic office spaces.

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.

Attribute	Description
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.

## 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, which is the commercial and business hub for the region. 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 was completed in 2012. This work installed fiber to all lots in all three regional business parks, new fiber in Hillsville and downtown Independence, a fiber to the home project in Grant Virginia, 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.
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. 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. The Wired Road is currently installing a Gigabit connection as the standard fiber circuit to homes and business.

## ACCOMACK/NORTHAMPTON BROADBAND AUTHORITY

Accomack and Northampton counties, on the Eastern Shore of Virginia, have formed a broadband authority (ESVBA) and 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 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 Eastern 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.

## FARMERS TELECOM COOP

Farmers Telecom Coop serves 17,000 subscribers in rural Georgia ([www.farmerstel.com](http://www.farmerstel.com)), and the customer-owned enterprise has begun executing on its plan to take fiber to every premise. The telephone company chose an active Ethernet network design because an active network can scale up more easily to meet future demand than an equivalent PON system, and because network troubleshooting and diagnostics was deemed easier to perform. Customers receive a 100 megabit fiber connection capable of delivering a wide variety of services, including the traditional triple play of voice, video, and Internet, but also video and movies on demand, HD business videoconferencing, telemedicine and telehealth services, and a wide variety of other business and residential services and applications.

Attribute	Description
Governance	The coop has an eight member board of trustees, and coop members elect board members.
Funding	The coop is financing the network upgrade with internal funds and loans.
Business Model	The coop is offering traditional triple play service bundles. There is no competitive service offerings.
Management	The coop handles both network operations and outside plant maintenance with existing staff.

Attribute	Description
Technology	The network offers a standard 100 megabit symmetric fiber connection that supports voice, TV, and Internet access, and Gigabit connections are also available.

## 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 2012, all four redundant fiber loops had been completed. 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.

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 also uses the network to connect hospital medical records and data services with several local health clinics and medical offices. FiberNET was operating in the black operationally in year one, and continues to do so as it enters its fourth year of operation.

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).

# Network Business Model Options

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## PRIVATE SECTOR ONLY

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The “leave it to the private sector” model has obvious shortcomings, which is why so many communities are now beginning to consider telecom as essential public infrastructure. Private sector firms have a primary responsibility to preserve and enhance shareholder value. They do not make operational and service area deployment decisions based on community and economic development needs. For many communities, this has meant that broadband services have lagged well behind the rest of the world and places those communities at a competitive disadvantage when trying to attract or retain businesses.

The private sector model requires overbuilding, which means that each service provider must build its own network end to end to serve customers. This leads to completely duplicated networks, which increases costs and makes it more difficult for these firms to make a business case for enhanced services in many areas. This business model is a fundamental weakness, because these private networks are not only expensive, but typically underutilized. Residential networks are only used heavily in late afternoon and evenings, and are virtually unused overnight and during the work day. Business networks that are only used heavily during work hours typically have very low utilization for the other two-thirds of the day. School and education networks are used only 8 to 12 hours per day, and are empty the rest of the time.

Community broadband projects can overcome this fundamental weakness and substantially reduce the operating cost of networks by using a shared model, rather than a private model.

## MUNICIPAL RETAIL

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Also known as Muni (Municipal) Triple Play. Local government builds the network and sells services in direct competition with the private sector, offering only traditional “triple play” voice, video, and broadband. Muni triple play systems are usually closed systems that offer little choice to customers. Muni triple play systems compete directly with the private sector, and tend to have very low take rates. Opponents of community broadband often cite the low take rates of muni triple play projects to “prove” that community broadband is a poor investment. But the low take rates only show that muni triple play business models are not financially viable over the long term.

The two key issues with this model are:

- ▶ It requires local government officials and leaders to sign long term contracts (typically 5 to nine years) with the providers whose services will be resold over the network. This means that those local leaders must have a high degree of confidence that they can accurately predict, seven to nine years out, what level and quality of services the businesses and residents of the community will require. While contracts can be renegotiated as needs change, prices are likely to rise during that renegotiation.

- ▶ This model situates the local government in direct competition with incumbent providers. This not only tends to keep take rates low, which threatens financial viability, but adoption of this model also encourages lawsuits from the incumbents (Bristol, Virginia, Lafayette, Louisiana, Geneva, Illinois, and Monticello, Minnesota are examples of communities that were sued after selecting the muni retail model).

## MUNICIPAL WHOLESALE

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Local government builds the network and provides access to service providers, who must use Layer 2 Virtual Private Networks (VPNs). Services must be provisioned individually for each subscriber. Muni wholesale systems may have some competition for some service categories, but the technical complexity of these systems may limit the ability of smaller providers to take full advantage of the system. Technically, most “open access” systems are managed at what is called Layer 2; the limitations of Layer 2 open access tend to keep the cost of providing services somewhat higher, compared to an open services network that provides fully automated, end to end provisioning of services.

Issues to consider with the wholesale approach include:

- ▶ Each service provider must manage their own service provisioning, which raises the cost of market entry and increases the cost of all services (because the service provisioning and support software must be duplicated by every provider). This can limit the number of providers to a few bigger ones that already have such systems or can afford to build or purchase them.
- ▶ The Layer 2 provisioning by each provider increases the technical complexity of debugging network issues and resolving customer service problems.

A lesson learned from communities that have implemented community broadband networks is that with both the wholesale and open services model, it is essential to ensure that sufficient service providers are prepared to sell services on the network.

## OPEN ACCESS INFRASTRUCTURE

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In this model, the community limits investments primarily to passive infrastructure, which can include real estate, duct, dark fiber, handholes, splice cabinets, colocation facilities, and wireless towers. Each service provider that wishes to use the shared infrastructure must provision their own network electronics. Some of the issues that must be considered with this model:

- ▶ The requirement to provide electronics raises the cost of market entry for service providers. It can also limit competition, as the first service provider who spends the money to install electronics in a business area or residential area may “capture” a large portion of the available market, making it more difficult for the next service provider to justify the expense of trying to compete. However, the availability of the fiber can still give some customers options, especially business customers in retail areas and business parks, where there is more incentive for providers to compete aggressively.

- ▶ The fiber design for the network must be done carefully to avoid both running out of fiber and to ensure that there is enough fiber to support competition. Fiber capacity must be overbuilt in the last mile (first mile) portion of the network to ensure there is enough fiber cable to support multiple providers. Fiber cable cost has decreased substantially, so this is not as much of an issue as it once was.
- ▶ Splice cabinets and locations for equipment cabinets and colocation facilities must also be considered carefully with respect to both location and aesthetics--making it easier for providers to install equipment. If the authority provisions cabinets, it makes it much easier for service providers to compete, because finding locations for equipment cabinets is a major time and cost factor when entering a new market area.
- ▶ Costs can be quite modest if the focus is primarily on improving wireless access, as costs are limited to procuring sites for wireless towers, the towers, equipment shelters, provision of electric power, and a minimum of other equipment and facilities.
- ▶ For fiber, the initial investment is lower, but the cost of duct and fiber, as a rule of thumb, is likely to be 60% to 70% of the cost of a full open access network.

## MULTI-SERVICE NETWORK

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Customer aggregation is a key advantage to a shared, community-owned telecommunications infrastructure. By building fiber to homes and businesses, the community maximizes the market potential for private providers who want to sell services. For Washington County, the early focus should be tied to economic development goals. Infrastructure investments should be supporting areas where business and jobs growth is most likely to occur, as this will also help ensure financial sustainability for the network. As the revenue increases from leasing network services, the revenue that exceeds operating costs and debt can be used to expand into other areas of the county, including residential suburbs and smaller towns like Hancock, Clear Spring, and Williamstown. Residential fiber build outs can occur over time as the network expands. The community investment allows these businesses to reach more customers than any single company could reach on its own. Some of the outcomes are:

- ▶ More customers -- When a community builds the transport layer of a digital road system (the roadway), each provider has a much lower cost of infrastructure needed to enter a market. In smaller towns and regions, this is a critical difference. Community investments allow more companies to profitably offer services in smaller markets than a firm could do on its own.
- ▶ Lower costs -- When a firm can reach more customers via a community broadband system, lower costs of service usually results. Typical reductions in cost in open access systems are usually on the order of 15%, and are frequently much more than that. It is not unusual to see the cost of telephone service decline by 40% or more.

Services aggregation occurs when communities build open networks, meaning that any qualified service provider can offer services using the community digital roadway. In this business model, there are usually several service providers competing for customers in each category of services (e.g. voice telephone service, TV, Internet access).

- ▶ More choice-- A natural outcome of more services is more choice for purchasers of services. Instead of a single monopoly provider of telephone or television, customers can pick and choose among a variety of service plans at various price points.
- ▶ More competition -- When more services are available, there is more competition for customers. Subsequently, service providers must sell services for the lowest possible price, and also creates incentives to provide excellent service to customers. Compare this to a monopoly environment where there is no competition and hence little pressure for a company to provide good service--customers have no other service options.
- ▶ More services -- When there is a wider choice of services on the community system, there is more opportunity to use more services. This is, in part, what makes open service provider networks financially sound investments for communities: Open systems create a bigger market for telecom services, and thereby creates more revenue flowing through a community revenue sharing plan.

Features	Private Sector Only	Municipal Retail	Muni Wholesale	Multi-Service Network
<b>Basic Concept</b>	Three separate services (voice, video, data) with little or no sharing of network.	Only three services (voice, video, data) with little or no sharing of network.	Network services limited by requiring VPNs (Virtual Private Networks) for each service provider.	Very high efficiency achieved by end to end automated service provisioning. All providers share network capacity.
<b>Government Involvement</b>	No government involvement. Private sector decides where and when to offer services. Some areas get little or no service.	Government competes directly with the private sector. Government decides what services are offered.	Government provides high performance digital road system with limited revenue potential. Buyers have limited choice of services.	Government does not compete with private sector. Government provides high performance digital road system that benefits all public and private users. Buyers have rich set of choices.
<b>Governance</b>	Owned by a private company. Community must accept whatever services are offered.	Owned and operated by local government. Limited triple play services sold directly by local government.	Owned and operated by local government. More difficult for buyers to mix and match services.	May be owned by local government or by a community enterprise like a broadband authority or coop. Wide variety of services sold by private sector companies.
<b>Competition</b>	Little or none in most areas. Cartel-like pricing keeps prices high.	Government bureaucrats pick providers of each service. No incentive to lower prices.	More limited. Cost of administering services using VPNs limits market competition.	Level playing field creates robust competition. Service providers drive down costs and provide great service to get customers.
<b>Service Options</b>	Limited. Providers can offer triple play at most.	Limited. Government resells triple play services.	Limited. Higher cost of providing services and support effectively limits service options.	Unlimited. Low cost of market entry and high level of service automation attracts service providers and encourages innovation.

<b>Revenue</b>	Limited by low returns on the individual services.	Limited by low returns on the triple play services.	More limited because revenue is based on raw bandwidth rather than the value of the services.	Unlimited. Revenue directly linked to demand. Revenue increases with demand.
<b>Service Area Expansion</b>	Limited to high density population areas. Rural areas at a structural disadvantage.	Limited by triple play approach, which keeps funds for expansion low.	Lower revenues may slow expansion.	Unlimited. Expansion completely supported by revenue sharing or use fees. Open services network can provide become financially sustainable relatively quickly.
<b>Risks</b>	Some areas do not get adequate service or affordable pricing.	Government officials must predict business technology needs years in advance.	High cost of provisioning services keeps smaller, innovative ISPs out of the market--limits competition.	More complex network management required, but reduces costs sharply for service providers, which encourages competition.

# Broadband Network Architecture

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The diagram on the next page provides an overview of a modern broadband network, with both fiber and wireless components. For the county and the city, the existing WCPN fiber can be combined with new fiber extensions to create a very high performance network capable of delivering affordable Gigabit and 10Gig connections anywhere in the city and the county. Additionally, Gigabit wavelengths can be utilized to maximize the DOT fiber strands to add even more capacity to the backbone portion of the network.

## CORE NETWORK

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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, so the “ring” feature may be a long term design goal.

## DISTRIBUTION NETWORK

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Distribution networks are connected to the core network, and provide primary network paths through a county, city, 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).

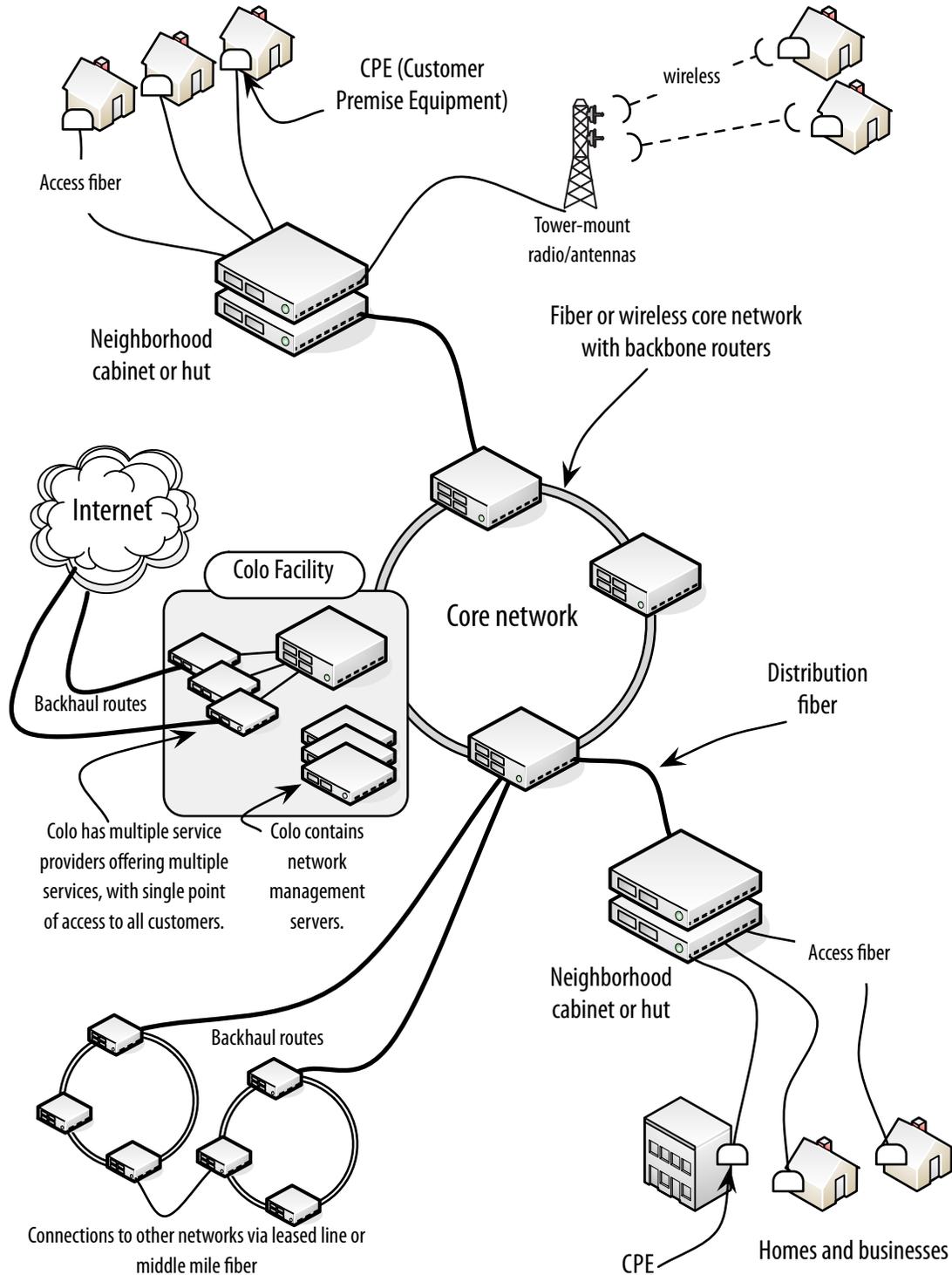
The distribution network connects the core network (the network backbone) with the individual connections within a neighborhood or business district that connect to home and businesses. This portion of the network can be fiber-based or wireless, but fiber will be required over the long term to support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

## 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 Premises 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.

To make the best use of the OneMaryland backbone passing through the county, small cabinets or shelters should be placed strategically in Hagerstown

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 Washington County, a modest colo facility would provide the meet point for private fiber and County-owned duct/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-

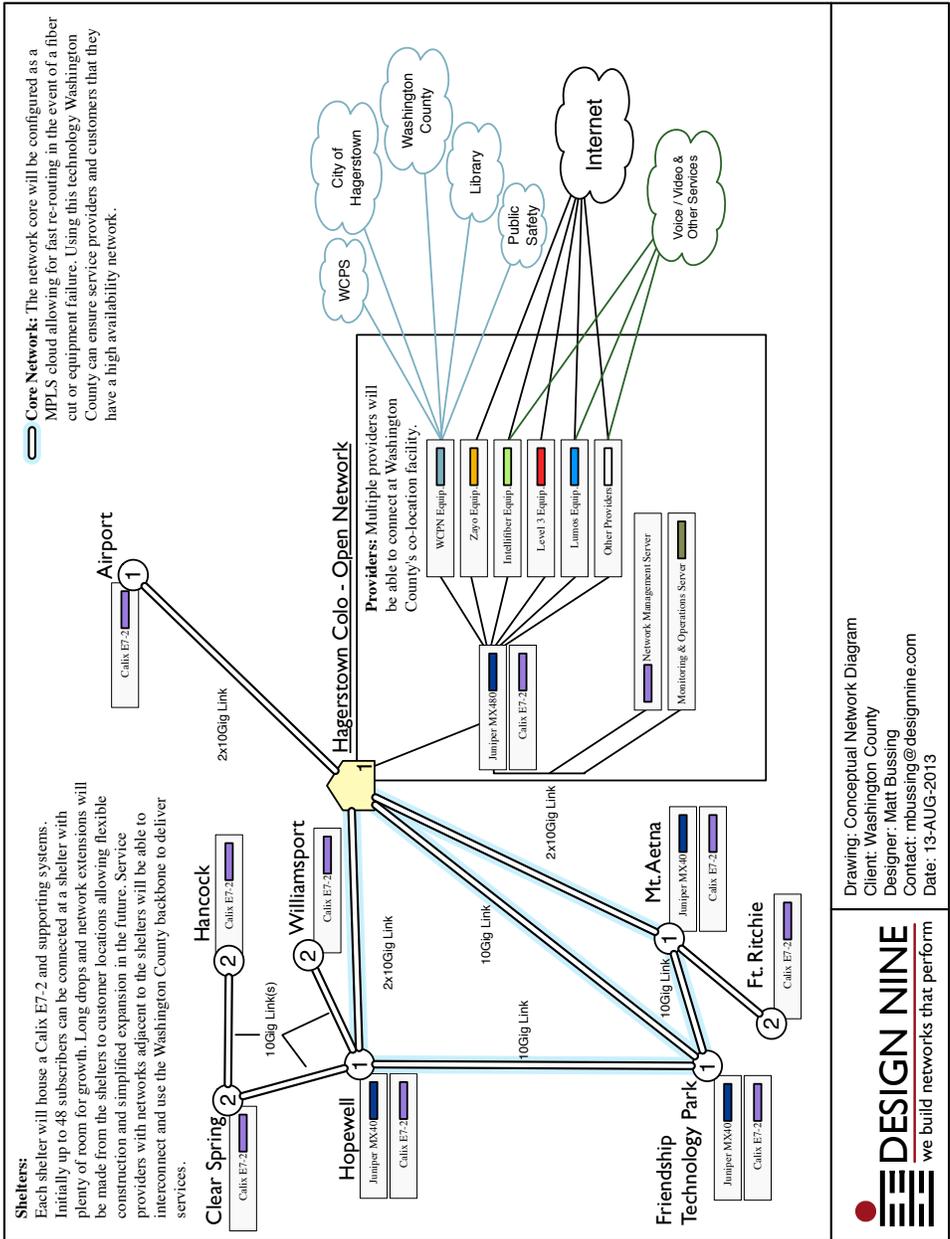
owned colocation facility. Any additional infrastructure constructed in Washington County and the Hagerstown would need to meet service provider networks at a mutually convenient colocation facility or meet point.

## TECHNICAL DESIGN

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The technical design for the proposed network is illustrated on the diagram below, with the key element a new colocation facility in Hagerstown that would become a meet point and peering point for all public and private network owners and users in the county and the city. As noted elsewhere in this report, the region has a tremendous strategic advantage because of the amount of fiber networks passing through the area.

The fiber extensions to the proposed economic development areas in the city and county would make those areas extremely attractive with respect to business attraction if the new network provides competitive access to national and regional providers like Level(3), Zayo, Intellifiber, and Lumos. The OneMaryland network brings many more providers into the area, but there is currently no aggregation of markets or networks. The colocation facility provides both: the facility can bring dozens of services providers into a single building, and if all the fiber extensions bring business, retail, and commercial customers into the same facility, the combination of the colo and the new fiber network become a powerful business development tool.



Drawing: Conceptual Network Diagram  
 Client: Washington County  
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# Current Service Provider Offerings

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Washington County businesses have a wider choice of service providers than many surrounding communities, but the private fiber deployed in Washington County exists primarily in Hagerstown and the surrounding areas.

Much long haul fiber passes through the county and Hagerstown, but affordable access to those fiber networks is limited to businesses and institutions that are adjacent to the immediate fiber routes. Businesses that are not directly passed by this fiber are limited to purchasing services from Comcast or Verizon.

## COMCAST

### *BUSINESS SERVICES*

▶ Basic phone	\$44.95/mo.
▶ 16 Mbps/3 Mbps	\$69.95/mo.
▶ 27 Mbps/7 Mbps	\$109.95/mo.
▶ 50 Mbps/10 Mbps	\$199.95/mo.
▶ 100 Mbps/10 Mbps	\$369.95/mo.

### *RESIDENTIAL INTERNET*

▶ 20 Mbps/ 4 Mbps	\$49.99/mo.
▶ 50 Mbps/ 10 Mbps	\$74.95/mo.
▶ 105 Mbps/ 20 Mbps	\$114.95/mo.

### *TELEPHONE*

▶ Local with More	\$34.95/mo.
▶ Unlimited	\$44.95/mo.

### *TV*

▶ Digital Economy	\$29.95/mo.
▶ Digital Preferred	\$69.99/mo.
▶ Digital Premier	\$89.99/mo.

## VERIZON

### *BUSINESS SERVICES*

▶ Basic Nationwide phone	\$49.50/mo.
▶ 1 Mbps/384 Kbps	\$29.99/mo.
▶ 3 Mbps/768 Kbps	\$37.99/mo.
▶ 5 Mbps/768 Kbps	\$54.99/mo.
▶ 7 Mbps/768 Kbps	\$74.99/mo.
▶ 10 Mbps/ 1 Mbps	\$84.99/mo.

### RESIDENTIAL SERVICES

- ▶ Basic phone \$49.99/mo.
- ▶ 1 Mbps/384 Kbps \$19.99/mo.
- ▶ 3 Mbps/768 Kbps \$29.99/mo.

### RESIDENTIAL BUNDLE SERVICES

- ▶ Basic Phone & Internet \$44.99/mo.
- ▶ Basic Phone, Internet, & TV \$74.99/mo.

## LUMOS

### RESIDENTIAL SERVICES

- ▶ Value Pack \$49.95/mo.
- ▶ Triple Play \$134.94/mo.
- ▶ Double Play \$79.94/mo.
- ▶ Broadband Security \$50/mo.
- ▶ Unlimited Voice \$44.99/mo.

## ANTIETAM CABLE

### BUSINESS SERVICES

- ▶ Basic phone \$54.95/mo.
- ▶ 8 Mbps/1 Mbps \$69.95/mo.
- ▶ 15 Mbps/2 Mbps \$109.95/mo.
- ▶ 30 Mbps/5 Mbps \$149.50/mo.
- ▶ 50 Mbps/10 Mbps \$189.95/mo.

### RESIDENTIAL INTERNET

- ▶ 8 Mbps/1 Mbps \$52.95/mo.
- ▶ 15 Mbps/2 Mbps \$66.95/mo.
- ▶ 30 Mbps/5 Mbps \$84.95/mo.

### TELEPHONE

- ▶ Unlimited \$44.95/mo.

### TV

- ▶ Variety Plus Package \$14.99/mo.
- ▶ Sports Plus Package \$7.99/mo.
- ▶ Movies Plus Package \$4.99/mo.

## ZAYO

Zayo is a national carrier with some limited fiber availability in Washington County, mostly in Hagerstown. Some of the services available from the company are listed below.

- ▶ Ethernet services are offered at speeds of 10 Mbps–10 Gbps
- ▶ IP Transit is offered from 10 Mbps-10 Gbps
- ▶ Dedicated Internet Access is offered as an end-to-end service with speeds from 10 Mbps-10 Gbps
- ▶ Virtual Private Network (VPN) services are delivered in two standard forms, IP-VPN and E-VPN, on Zayo’s global owned optical network, enabling end-to-end VPN service between multiple locations

### LEVEL3

Level3 is a national carrier with some limited fiber availability in Washington County, mostly in the Hagerstown. Some of the services available from the company are listed below.

- ▶ Internet Services
- ▶ Content Delivery Network (CDN)
- ▶ Converged Business Network
- ▶ Private Line Services
- ▶ Wavelength Services
- ▶ Virtual Private Network

### INTELLIFIBER

Intellifiber is a national carrier with some limited fiber availability in Washington County, mostly in the Hagerstown. Some of the services available from the company are listed below.

- ▶ Ethernet services are offered at speeds of 3 Mbps– over 1000 Mbps
- ▶ SONET dedicated diversified connectivity
- ▶ Wavelengths are available as high-bandwidth point-to-point optical connection anywhere along the network
- ▶ Custom private network configurations are also available, along with colocation services.

# Broadband Adoption and Education Strategies

## BROADBAND ADOPTION COUNTY COMPARISON

### INTERNET USAGE

The issue of “broadband adoption” has re-surfaced in recent years, although it is not a new idea. Many early community networking efforts invested heavily in broadband adoption programs in the early and mid-nineties. More recently, it has become a talking point of incumbents who have tried to argue that there is nothing wrong with their primarily “little broadband” service offerings, but rather the real problem is with customers who simply don’t know how to use high bandwidth services.

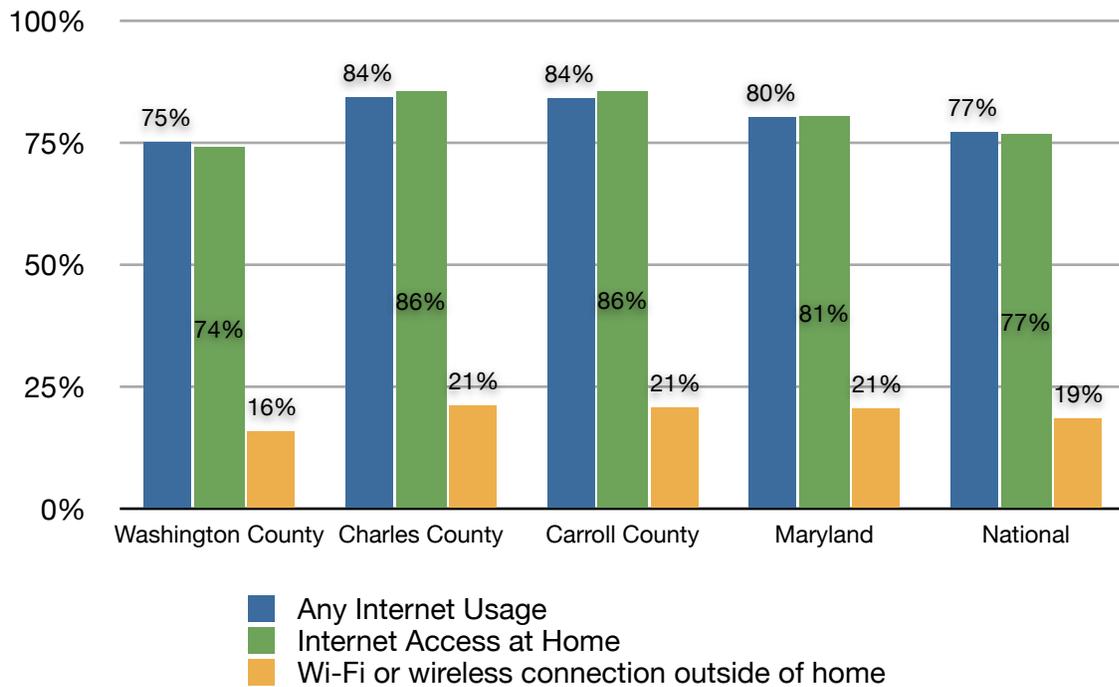
Based on data from the national survey research firm MRI (Mediamark Research and Intelligence) Washington County’s use of the Internet by residents is extremely close to the national average. MRI's data comes from random surveys of consumers and aggregated in their yearly "Survey of the American Consumer." While county residents lag behind some other Maryland counties like Charles and Carroll, we don’t see a significant issue with broadband adoption in Washington County; residents are using the Internet at about the same level as the rest of the country.

BROADBAND ADOPTION (PERCENTILE COMPARED TO NATIONAL AVERAGE)	WASHINGTON COUNTY	CHARLES COUNTY	CARROLL COUNTY	MARYLAND	NATIONAL
Internet, Any Usage: Any Internet/Online usage	97th Percentile	109th Percentile	108th Percentile	103rd Percentile	100th Percentile

The table below shows the percentage data for the three counties, Maryland, and the U.S.

Internet Usage	Washington County	Charles County	Carroll County	Maryland	National
Any Internet Usage	75.2%	84.3%	84.1%	80.3%	77.3%
Internet Access at Home	74.1%	85.5%	85.6%	80.5%	76.9%
Wi-Fi or wireless connection outside of home	15.9%	21.1%	20.7%	20.5%	18.5%

## Internet Usage



## INTERNET CONNECTION TYPE

When looking at the type of broadband Internet connection, Washington County is again close to the national average, while lagging behind Charles County, Carroll County, and the state. Washington County also relies more on dial-up modem than the other counties, the state, and nationally.

Internet Connection Type	Washington County	Charles County	Carroll County	Maryland	National
Any Broadband or High Speed Connection	65.7%	79.4%	78.2%	74.7%	70.0%
Cable Modem	28.3%	35.1%	34.7%	34.0%	31.3%
DSL Connection	23.3%	25.7%	26.1%	23.1%	22.7%
Dial-up Modem	5.1%	3.4%	4.3%	3.1%	3.8%
Not sure/Don't know	2.5%	2.2%	2.3%	2.4%	2.6%
Wireless Connection from a computer or laptop (e.g. Wi-Fi, wireless router, etc.)	18.1%	22.6%	22.6%	21.6%	20.2%

## INTERNET SERVICE PROVIDER

Some of the main Internet service providers regionally, statewide, and nationally include AT&T, Comcast/Xfinity, and Verizon Online. Generally, Washington County has a similar

proportion of individuals who use each of these service providers when compared regionally, statewide, and nationally.

Internet Service Provider	Washington County	Charles County	Carroll County	Maryland	National
AT&T	9.9%	15.0%	12.5%	13.7%	12.1%
America On-line (AOL)	2.0%	1.9%	2.3%	2.0%	2.0%
Comcast/Xfinity	11.8%	18.5%	16.9%	17.9%	14.7%
Verizon Online	8.2%	9.7%	9.4%	10.3%	9.1%
Any service (Including Antietam Cable TV)	73.9%	85.2%	85.4%	80.2%	76.6%
Other	21.8%	16.3%	19.8%	13.9%	16.3%

## INTERNET USE AND APPLICATIONS

The majority of the population in Washington County, Charles County, and Carroll County usually spends between 1 to 2 hours per day on the Internet. *Washington County has slightly more individuals (about 8% to 15%) who spend between 5 to 10 hours per day on the Internet than Charles County and Carroll County.* Unsurprisingly, individuals across the board tend to use the Internet on a computer and not a cellphone or smart phone.

Internet Use Frequency on a Typical Day	Washington County	Charles County	Carroll County	Maryland	National
Internet - Times looked at/used: less than 1/2 hour	24.3%	23.0%	24.6%	21.9%	22.8%
Internet - Times looked at/used: 1 hr. - less than 2 hrs.	31.6%	33.6%	34.2%	33.3%	32.6%
Internet - Times looked at/used: 2 hrs. - less than 5 hrs.	30.4%	30.4%	29.7%	31.0%	31.1%
Internet - Times looked at/used: 5 hrs. - less than 10 hrs.	11.0%	10.2%	9.4%	10.7%	10.7%
Internet - Times looked at/used: 10 or more hours	2.6%	2.8%	2.1%	3.0%	2.9%

Devices used to look at or use	Washington County	Charles County	Carroll County	Maryland	National
Any computer	75.2%	72.7%	74.5%	72.2%	73.1%
Cellphone or Smart-phone	24.8%	27.3%	25.5%	27.8%	26.9%

The final table in this section displays the various activities done on the Internet. Some of the activities that all three counties tend to do on the Internet include downloading media like music, videos, and books, making a purchase for personal use, obtaining the latest news or current events, and using email. Washington County does not use the Internet as much as Charles County and Carroll County for paying bills online, obtaining childcare or parenting information, and obtaining financial information. These three activities pursued through the Internet can greatly enhance the lives of Washington County's residents for convenience and time savings, so that residents do not need to travel to and from acquiring information.

Activities Done on the Internet	Washington County	Charles County	Carroll County	Maryland	National
Downloaded media	7.7%	7.6%	7.2%	7.9%	8.0%
Listened to Radio on the Internet	3.1%	3.1%	3.0%	3.1%	3.1%
Looked for Employment	3.5%	3.2%	2.9%	3.3%	3.3%
Made a phone call	1.5%	1.7%	1.6%	1.8%	1.7%
Made a purchase for business use	2.1%	2.2%	2.3%	2.2%	2.1%
Made a purchase for personal use	7.6%	7.7%	8.1%	7.5%	7.5%
Made personal or business travel plans	3.1%	3.8%	3.9%	3.9%	3.7%
Obtained childcare or parenting information	0.9%	1.0%	0.9%	0.9%	0.9%
Obtained financial information	5.7%	6.1%	6.2%	5.9%	5.7%
Obtained information about real estate	2.2%	2.4%	2.4%	2.4%	2.3%
Obtained medical information	3.9%	4.0%	4.1%	4.0%	4.0%
Obtained the latest news/current events	9.1%	9.2%	9.5%	9.1%	9.0%
Paid bills on-line	6.6%	8.5%	8.4%	8.2%	8.1%
Participated in on-line dating	0.3%	0.3%	0.2%	0.3%	0.3%
Played games online	5.7%	4.8%	4.7%	4.9%	5.1%
Tracked investments/Traded stocks, bonds, or mutual funds	2.2%	2.5%	2.8%	2.6%	2.4%
Used e-mail	15.1%	14.2%	14.6%	14.0%	14.3%
Used instant messenger (IM)	8.3%	7.6%	7.4%	7.6%	7.9%
Visited online blogs	2.3%	2.4%	2.4%	2.5%	2.5%
Watched a TV program on-line	2.1%	2.1%	2.1%	2.2%	2.2%
Watched a movie online	1.3%	1.3%	1.2%	1.4%	1.4%
Watched online video	4.4%	4.3%	4.2%	4.5%	4.6%

## EDUCATION STRATEGIES

Washington County has an excellent school system with a graduation rate higher than the national average (33% compared to 29.4%), but the county is somewhat below the state and

national average when it comes to workers with a college degree. Only 7.6% of the population in Washington County have attained a bachelor's degree, while the state percentage is 12% and the national level is 9.1% according to the U.S. Census 2011 American Community Survey. As low wage 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. Washington 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 home 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 Washington 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 Washington County's education and training goals.

### HAGERSTOWN COMMUNITY COLLEGE

Like many community colleges in the region, Hagerstown Community College offers online registration for courses and there are numerous opportunities to take classes completely online without setting foot in a physical classroom. In addition, the courses are fairly affordable and can be completed within a short timeframe. Some of these classes target high school students or individuals preparing for college that help refine skills for introductory coursework in college like math, science, and test preparation.

For individuals who are seeking to attain a high school diploma, there are opportunities to enroll in courses to fulfill General Education Development (GED) requirements. Other classes offered prepare individuals to enter the workforce, which include accounting fundamentals, computer applications, and business writing. There are also concentrations that individuals can pursue to enter certain sectors of the workforce like healthcare and fitness, IT and software development, media and design, hospitality and service, skilled trades and industrial, and sustainable energy.

Coursework is also available for individuals to fulfill goals of learning for pleasure like creative writing, poetry, scrap booking, and gardening. Some of the most popular coursework is related to enhancing one's skills for workforce and technical development includes:

#### ***Workforce Development Coursework***

- ▶ Introduction to Microsoft Excel
- ▶ Accounting Fundamentals
- ▶ Project Management Fundamentals
- ▶ Introduction to QuickBooks
- ▶ Introduction to Microsoft Access
- ▶ Effective Business Writing
- ▶ Fundamentals of Supervision and Management

#### ***Technical Coursework***

- ▶ AutoCAD 2011
- ▶ Microsoft Web Developer

- ▶ Web Applications Developer
- ▶ Webmaster
- ▶ iPhone/iPad (iOS) Application Developer
- ▶ Graphic Design with Photoshop CS5 Training

## WASHINGTON COUNTY LIBRARY

The local library is usually a prominent educational center for 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 offers Wireless Internet hotspots at all library locations.

Currently, a number of online computer classes are offered to the residents of Washington County through the neighboring Allegany County Library System. A majority of these online computer classes are aimed for adults to learn basic computer topics like the parts of a computer, creating word documents, and using the Internet on their own time. However, these classes require the capability to stream videos, which may pose as an issue for some residents in Washington County. While there are a few classes offered directly by Washington County, the vast majority are offered by Allegany County. Moreover, it may be wise for Washington County to develop and offer more adult education classes of their own to residents. Residents are able to gain skills that will make them competitive in an evolving, technological work place that often demands basic computer knowledge. Some of the course opportunities include:

### **Basic Technology Literacy**

- ▶ Introduction to the Computer
- ▶ Introduction to the Internet
- ▶ Introduction to Microsoft Word
- ▶ Introduction to Microsoft PowerPoint
- ▶ Creating Resumes with Word 2007

### **Speciality Classes**

- ▶ Google Drive (Docs)
- ▶ Intro to Photosharing
- ▶ What's Up with Twitter?

# Ownership and Governance

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There are several different ownership and governance options available, and there are three (Municipal Department, Public/Private Partnership, and regional Authority) that we recommend for consideration. Note that these three options are not necessarily mutually exclusive, and the strategy chosen by the County, the City, the County K12 schools, and the County library system could include elements of all three options.

For example, Washington County and Hagerstown might choose to install duct (Municipal Department) and lease it to the private sector (Public/Private Partnership). The County and City might also begin to work with a new regional entity (e.g. a regional broadband Authority) to provide better connectivity throughout the area.

The four local government entities participating in this study (the County, the City, the K12 schools, and the library system) currently own fiber assets, share the use of those assets to meet individual organization IT needs, and have done so successfully for several years. Part of the reason for this study was to identify ways to leverage the existing assets with the new OneMaryland fiber backbone passing through the County, and making it possible to lease new OneMaryland fiber and excess capacity on the existing assets to the private sector to expand the availability of high capacity, affordable fiber in the region. Formalizing the ownership and governance of the assets would be important to long term financial viability and to meet the desired economic and community development benefits that could accrue from more and better fiber availability.

The viable options include:

- ▶ Municipal Department -- While the County and City could build a network and offer services in direct competition with the private sector, we do not regard this as desirable. However, if County and City investments were limited to duct and dark fiber, the County and City could likely manage the infrastructure without significant new costs. Leasing duct/fiber would create a new revenue stream for the County and City.
- ▶ Public/Private Partnership -- In this approach, the local government partners work with a private sector venture that takes on some of the financial risk. The County and City work constructively to ensure access to ROW, easements, and timely permitting. This approach could be fast-tracked by issuing an RFI (Request For Information) similar to the one issued by the Roanoke Broadband Task Force. Responses to the RFI could be evaluated and a partnership pursued based on those responses.
- ▶ Regional Authority -- The County and City, along with the County K12 schools and the County library system, could seek to develop a project based on collaboration with a newly formed broadband authority in the region.
- ▶ Coop -- A broadband coop could be formed, but such an enterprise would require an initial board of directors with substantial experience in the telecom business, a proven track record of business management of a large enterprise, and broad marketing and

sales experience. A coop has certain advantages not available to public initiatives like an authority, but may not be a good fit for the area.

- ▶ Private Non-profit Entity -- Some community networks are owned by a non-profit, but non-profit ownership has to be done carefully to avoid tax problems with the IRS. It may be useful to create a non-profit as a complementary organization; non-profits can be useful for accepting donations and for applying for certain kinds of grants.
- ▶ Private For Profit Entity -- While potentially similar to the Public/Private Partnership option, this alternative was evaluated in the context of the past twenty years, in which no existing or new provider has offered to deploy fiber widely in Washington County. The sentiment of the committee was that if a company could do this without some kind of partnership with the Washington County, it would have happened already.

## DEFINITIONS OF ENTITY TYPES

During the course of this analysis, the governance entity types listed below were examined for their suitability as a governance entity for Washington County and Hagerstown and the expected participation of the surrounding areas. The Comparison Grid at the end of this section provides an overview of the advantages and disadvantages of each type of entity, and the narrative discussion on the following pages provides more detail about each option that has been considered.

Governance Entity	Definition
Municipal Department	A local government creates a city or county department for the purpose of offering broadband.
Public/Private Partnership	A collaborative effort between the local governments and one or more private sector firms.
Regional Authority	An independent entity jointly owned by several local governments for purpose of offering a shared service.
Private Coop	A private sector coop owned by the customers receiving services.
Non-profit	A 501(c)3 private corporation formed for a specific charitable purpose.
For profit	A stock corporation owned by the shareholders.
Ad Hoc	An informal committee formed for a specific purpose.
Economic Development Corporation (EDC)	A public or private corporation formed to promote economic development in a geographic region.

## GOVERNMENT OWNERSHIP

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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.

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.

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. For example, 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.

## PUBLIC/PRIVATE PARTNERSHIP

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Public/private partnerships can take a wide variety of forms, and the term is general enough to be used when discussing some of the other options proposed in this section. For example, a regional authority might outsource network operations and network maintenance to private sector firms, qualifying those arrangements as a “public/private partnership.”

For the local government entities in Washington County, we could propose a very specific public/private partnership, in which the existing and any new fiber assets continue to be owned by the local government entities, but management and operation of those assets is turned over entirely to a private business, which would lease capacity, collect revenue, pay all expenses, and share a portion of revenue with the government entities. The private sector partner could be selected via an open bidding process to identify both the most qualified firm to run the network and the best revenue sharing offer.

A good example of this approach has been the very successful conversion of the Seagirt Marine Terminal to a public/private partnership. Seagirt is operated by Ports America Chesapeake under a 50-year public-private partnership signed in 2010 with the MPA (Maryland Port Administration). Under the agreement, Ports America has constructed a new 50-foot container berth that accompanies four state-of-the-art super Post Panamax cargo cranes. Ports America will also invest in other necessary infrastructure at Seagirt, saving the State of Maryland hundreds of millions of dollars it would have had to invest in capital improvements. The MPA receives an annual payment and ongoing revenues from Ports America during the life of the agreement.

Advantages of this approach would include:

- ▶ The four local government entities would not have to form a new entity (e.g. an authority), thereby avoiding the legislative challenge of that approach, as well as the ongoing effort of appointing board members and managing the enterprise over the long term.
- ▶ The current ad hoc sharing of fiber assets could be easily codified in a new agreement among the government partners and/or that agreement could be part of the business agreement negotiated with the private sector partner.
- ▶ This approach could be achieved relatively quickly compared to forming an authority.

## REGIONAL AUTHORITY

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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.

In Maryland, creation of a regional authority usually requires an act of the legislature, which could take a substantial amount of time and would require not only careful planning but sig-

nificant support from local state legislators. Some examples of regional authorities include the Northeast Maryland Waste Disposal Authority, the Washington Metropolitan Area Transit Authority (an interstate authority), and the Maryland Stadium Authority.

Despite 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 can be 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 coop), and via the board of directors, the local governments can guide the long term goals and objectives of the organization.

## PRIVATE COOP

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Cooperative business enterprises as formal entities date from the mid-1800s. The first cooperative was set up in England to serve customers unhappy with local merchants. In the United States, the Grange movement began setting up cooperatives in rural areas to sell needed items to members and to help sell produce and other agricultural products that were produced by members. Today, credit unions are the most common form of coop business in the United States, with more than 65 million people obtaining services from over 12,000 credit unions.

Telephone and electric coops continue to be very common in rural parts of the U.S., and in fact, the majority of telephone companies in the United States are coops, but most have very small numbers of customers--often less than a thousand subscribers. Telephone coops serve more than a million subscribers in thirty-one states. The True Value and Ace Hardware chains are actually buying coops that help keep independent hardware stores competitive with the large chain stores.

The U.S. Department of Agriculture (USDA) provides extensive support for existing coops, and also helps communities start coops. One of their publications lists the principles of the coop:

- ▶ User-Benefits Principle -- Some purposes of a coop are to help members get services that might otherwise not be available, to get access to markets, or for other “mutually beneficial” reasons.
- ▶ User-Owner Principle -- The users of the cooperative own it.

- ▶ User-Control Principle -- The owners of the coop (i.e. members) control the coop through voting (annual meetings, etc), and indirectly by electing a board of directors to manage the enterprise. Large users who make high volume purchases of goods or services may receive additional votes.

Because cooperatives are user-managed, control of the enterprise is vested in the community or region where the users reside. Cooperatives also return excess earnings to its members; these refunds are called patronage refunds, and are typically computed at the end of the fiscal year. The expenses and income of the coop are calculated for the year, and any excess is returned to members, based on the percentage paid in by each member (e.g. a member that paid in 1% of total earnings would get a refund of 1% of any excess earnings).

Most cooperatives do not pay dividends on capital. This helps keep outsiders from taking control of the company, which would result in the community losing control over the quality of services and direction of the enterprise.

Coops are organized in part based on the territory they serve, and there are several classifications that may be relevant for community broadband efforts. A local coop serves a relatively small area that may be a single town or county and/or a radius of ten to thirty miles. A super local coop serves two or more counties. A regional coop may have a service area of several counties up to an entire state (or multiple states). For projects that involve several local government entities that are already trading services like local public safety dispatch, a super local coop may be the most appropriate designation.

Most local and super local coops use the centralized governance structure, which means that individuals and businesses represent the bulk of members.

Cooperatives offer one or more of three kinds of services:

- ▶ Marketing coops help sell products or services produced by members.
- ▶ Purchasing coops buy products and services on behalf of members.
- ▶ Service cooperatives provide services to members, and service coops include the credit unions, the electric coops, and the telephone coops.

Equity is typically raised for coops by direct investment from members. In return for an investment, members receive a membership certificate. The member may also receive shares of stock if the cooperative issues stock (some do, and some do not). Once a member has invested, they gain the right to vote in elections. As an example, if the local governments made a large initial investment in the cooperative, they could gain substantial influence in the affairs of the organization by gaining multiple shares and increased voting rights. Property owners (residential property owners and business property owners) who paid an initial connection or pass-by fee would also gain shares in the business, so every property owner that pays the connection fee gains ownership in the enterprise--an important selling point when encouraging property owners to, quite literally, invest in the project.

Although cooperatives are typically constrained by both Federal and state laws to do a majority of business with members, in most cases, cooperatives are able to do business with non-members up to some percentage of business income that can be as high as 49 percent. Note

that this may be affected by the underlying legal incorporation of the cooperative--if incorporated as a 501(c)(12), the IRS requires that 85% of income must come from members for the purpose of meeting ordinary expenses.

In summary:

- ▶ Coops are member (subscriber) owned, meaning they are strongly vested in the community. Any effort by the coop board to dispose of assets or to sell the coop would have to be approved by a majority vote of the members.
- ▶ Members play an active long term role in governance by nominating and electing board members. So members have a straightforward way of influencing decision-making by the board.
- ▶ Coops generally operate on a cost-plus basis. Income that exceeds some preset level is returned to members periodically as a distribution of funds.
- ▶ Broadband coop bylaws must be carefully written, especially if there is an interest in several classes of membership. Each class of membership can be charged a different membership fee, and this can be a valuable source of start up funds, but membership categories are difficult to change later.
- ▶ Coops are largely immune to challenges by incumbent telecom providers due to the long history of existing coops and because of special legislation passed by Congress.
- ▶ Coops can tap USDA funds, but the application process would be time-consuming and expensive for a start up coop.

## NON-PROFIT

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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 (2010), 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 coop chartered specifically to provide services).

## FOR PROFIT BUSINESSES

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There are various types of for profit business organizations: individually owned businesses, partnerships, general business corporations, and limited liability companies. A for profit business avoids many of the legal and regulatory problems related to broadband assets that are owned directly or indirectly by local governments, but some of the other issues of a private enterprise would include:

- ▶ A private sector company will not have the same direct access to public funds are involved in the development of the system (e.g. revenue bonding, tax funds).
- ▶ A for-profit enterprise may not be as firmly vested in the community, even if the owners are largely local investors.

## AD HOC AND INFORMAL PARTNERSHIPS

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Some local governments have deployed duct and/or dark fiber and have made ad hoc arrangements to provide capacity to other institutions like K12 school systems or adjacent local governments. In some cases, they have a policy for leasing duct or fiber to the private sector (the city of Sacramento, California has leased duct for over a decade) but have not developed a comprehensive plan for management and expansion.

## EDC OWNERSHIP

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EDCs and similar organizations like IDAs (Industrial Development Authorities) often have access to state and Federal funds that can be used to get a broadband project started, and many of these organizations have the management expertise to build and operate a business enterprise over the long term.

As an example of this approach, the community-owned New Hampshire FastRoads network has been formed as an LLC, but it is a wholly owned subsidiary of the Monadnock Economic Development Corporation (MEDC). MEDC is a non-profit, so that eliminates any tax liability, and the MEDC board already has appropriate regional/community representation, which protects the interests of the forty-three towns that comprise the FastRoads region.

## GOVERNANCE QUANTITATIVE EVALUATION

Six factors can be evaluated to provide a quantitative assessment of the various governance options. These factors are:

- ▶ **Transparency** - Does the governance structure provide adequate transparency about decision making? Do stakeholders and interested parties have adequate ways to obtain documents, financial reports, and related governance materials?
- ▶ **Timeliness** - How quickly can the governance entity be legally formed? Time is of the essence, as WiredWest must be able to leverage the funded MBI middle mile backbone.
- ▶ **Community Oversight** - Does the entity have adequate community control and oversight? Do the communities have adequate representation in the governance structure to ensure that assets are managed properly?
- ▶ **Legislative Authority to Build/Operate** - Does the governance entity have clear legislative approval to build and operate a telecommunications network?
- ▶ **Financing Options** - Are there adequate financing options available to provide the appropriate level of funding over time to meet the long term vision of the region?
- ▶ **Tax Liability** - Does the governance entity incur tax obligations?

Three categories (Timeliness, Legislative Authority, and Financing) are weighted because of the importance of these issues.

	Evaluation Categories	Scoring
Unweighted Factors	Transparency Community Oversight Tax Liability	<ul style="list-style-type: none"> <li>• 0 - Poor or inadequate</li> <li>• 1 - Weak but workable</li> <li>• 2 - Excellent, meets all needs</li> </ul>
Weighted Factors	Timeliness Legislative Authority to Build/Operate Financing Options	<ul style="list-style-type: none"> <li>• 0 - Poor or inadequate</li> <li>• 2 - Limited but workable</li> <li>• 4 - Excellent, meets all needs</li> </ul>

Entity Type	Transparency	Timeliness	Community Oversight	Legislative Authority to Build/Operate	Financing Options	Tax Liability	Score
Municipal Department	2	2	2	1	2	4	13
Public/Private Partnership	2	3	3	4	2	4	18
Regional Authority	2	3	4	3	4	4	20
Private Coop	1	0	1	4	2	0	8
Non-profit	0	4	0	0	0	0	4
For Profit	0	2	0	4	2	0	8
EDC	1	4	1	0	4	2	12

# Financing Options

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It is important to note that the bulk of Washington 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). These types of 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.

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. This may not be true in the WiredWest area, where most towns do not have municipal water or sewer systems and therefore lack the financial track record of water and sewer management.

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.

There are a wide variety of financing options available, and we believe Washington 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.

## USER/CUSTOMER FUNDING

Funding Source	Description	Notes
Revenue Share	Service providers pay a share of per customer monthly revenue directly to the network owner.	Network owner has only a small number of monthly bills--one for each provider. Revenue is somewhat unpredictable, particularly in the first year or two.
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).
Use Fee	Business and residential customers pay the network owner a flat monthly use fee instead of an indirectly paid revenue share.	Service providers pay nothing for transport, and in this model, their prices are correspondingly lower. The network owner must bill each connected customer monthly. 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.
Take or Pay	Business and residential customers in a community agree to buy services from providers on the network or pay a fee.	If voter approval can be obtained, helps get high take rates and provides predictable funding to help support revenue bonding efforts.
Electric Utility Partner	The electric utility agrees to use the network for meter reading and energy conservation.	Achieves immediate 100% take rate for electric service. Fees paid to network owner are small, but predictable and include all connected customers.

## REVENUE SHARE MODEL

In the revenue share model, any company that chooses to use the community network infrastructure for commerce would pay a share of revenue that reflects a fair value for access to that infrastructure. This percentage of revenue varies with the anticipated operating costs, debt load, and type of service being delivered, but typically ranges between 10% and 35%. Numerous projects in Europe and the United States have successfully implemented this model, and attracting service providers has not been an issue since the providers benefit by having little or no capital costs to acquire new customers.

All existing telecom providers, including incumbents, are 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 western Massachusetts 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.

## 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 than 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. Washington County can offer a program to residents that allows them to install their own duct between the premise and a demarc 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 Danville 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.

## SPLIT FEE MODEL

The Split Fee model would offer customers one of two options:

Buy services using the revenue share model, whereby the network owner collects fees from the service provider supplying the service or services to the customer. In this case, residential and business customers make no payments to the network owner and the network bills only the service provider for the appropriate revenue share amounts.

Customers agree to the connection fee/use fee model. In this case, customers still buy services directly from providers, but would pay a lower rate for those services because the provider pays no revenue share to the network owner. Business and residential customers would pay a one time connection fee (either a one time payment or billed in monthly increments over a period of years) and a monthly use fee as long they are taking one or more services from the providers on the network. The network owner bills these customers directly for the monthly use fee and for the connection fee.

The split fee model gives the network owner the ability to raise capital early and directly from users of the network, in the form of the one time or “easy pay” connection fee. The network also has the benefit of the predictable monthly income from the use fee, which investors will value more highly than the less predictable revenue share fees paid by providers to the network.

Split Fee Model	
Revenue Share Customers	Connection/Use Fee Customers
Services are purchased directly from providers.	Services are purchased directly from providers.
Providers bill their own customers directly.	Providers bill their own customers directly, but at a lower rate because providers do NOT pay a revenue share to the network owner.
The network owner bills providers for the appropriate revenue share for each customer monthly.	The network owner bills customers for the appropriate connection fee and monthly use fee.
Providers pay the network owner the revenue share fee.	Providers pay no per customer fees to the network owner.

Split Fee Model	
Revenue Share Customers	Connection/Use Fee Customers
Customers of services pay nothing to the network owner.	Customers pay providers for the cost of subscribed services and pay the network owner the appropriate fees.

As an example, if Washington County and the City of Hagerstown set the one time connection fee at \$3,000, and 10% of potential subscribers in the area committed to that form of payment, that would represent as many as 5,633 subscribers contributing approximately \$16,899,000 in equity funding to the project.

The split fee model does require more accounting and bookkeeping, but the potential to raise funds locally offsets the cost of doing so. Of critical importance will be selecting network management software that can track which customers are paying via revenue share and which customers are paying connection/use fees.

### 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 county or city would be placed lower on the build out list.

### TAKE OR PAY MODEL

The “take or pay” model has been used by local governments to help finance infrastructure projects like water and sewer. In this approach, property owners agree to buy the service (e.g. water, sewer, fiber services) or pay a monthly or annual fee in lieu of service. The monthly fee in lieu of service is used to help pay for the cost of the infrastructure. Take or pay is based on the principle that the new infrastructure

provides both a common good for the community and increases property values. It is not a tax, since it is not assessed on property owners that use the services delivered by the community infrastructure.

Take or pay could be a vehicle for raising equity for construction as well as a means for supporting the issuance of revenue bonds. If a round of bond funding is to be spent in communities that have approved the take or pay approach, investors will view the bonds favorably because they know that there will be two reliable streams of revenue: revenue from those customers that buy services on the network, and all other households and businesses will be paying an established and predictable fee.

Take or pay could also be used as a mechanism for determining which towns get fiber build outs first. Towns that are able to pass a warrant that approves take or pay could be given higher priority for where bond funds are spent.

### ELECTRIC UTILITY PARTNER

Electric utilities can be valuable sources of funding for community broadband efforts. If the utility is willing to use the fiber network for Automated Meter Reading (AMR) and energy conservation efforts like Advanced Metering Infrastructure (e.g. remote turn on/turn off of major appliances like air conditioners and water heaters), the broadband project can achieve a 100% take rate in the utility service area. Even though the fee paid by the utility for each electric subscriber may only be a few dollars a month, the 100% take rate, coupled with an expected ten or twenty year term of service, provides a predictable and reliable revenue stream directly, and can indirectly strengthen a bond offering and make it more attractive to investors.

## 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.
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 coops, 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.
Municipal Leasing	Local governments can borrow money and pledge the asset as collateral.	Can be used for funding specific (limited) projects, like fiber to a school system or government offices.
Commercial Loans	Local banks are often willing to assist with funding.	Usually requires pledging network assets as collateral. Must be able to show a revenue stream to pay back the loan. Good for small, high priority network extensions with guaranteed customers.
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.

Funding Source	Description	Notes
Grants and Donations	Citizens and local foundations will sometimes provide grants.	Local foundations may require tying funds to a specific purpose.
Sales Tax	Assess a small increase in the local sales tax to pay for construction, or use existing sales tax revenues as a bond guarantee.	May require a voter referendum.
Special Assessment Tax	A one time special assessment on all properties in a community. Typically paid in installments over several years.	May require a voter referendum.

## REVENUE BONDS

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.
- ▶ Washington County and the City of Hagerstown 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 Washington County and Hagerstown can plan, construct, and manage a state of the art network, and that County and City 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). Washington County and the City of Hagerstown 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 coops, but the agency has recently begun looking at assisting community broadband projects. However, RUS has historically favored rural coops when making loans and grants. If Washington County and the City of Hagerstown decide to move forward, it would be useful to 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.

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. Some other Federal agencies also provide funds for telecom, and Washington County and the City of Hagerstown 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, and in the

current Federal budget environment, earmarks should be regarded as a low priority effort.

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.

## MUNICIPAL LEASING

Communities routinely use municipal leasing to fund a wide variety of needs, including water and sewer projects, buildings, equipment, and vehicles like police cars, fire trucks, and public works equipment. Municipal leases can take the form of a straight loan, but for telecom projects, one option called a “moral obligation” lease may be more appropriate. In a moral obligation lease, the network itself is used as collateral to guarantee the loan, rather than requiring the use of general funds to pay back the loan if the network does not perform as expected. Obtaining approval for a moral obligation loan requires an excellent municipal credit rating and an investment quality financial plan for the operation and management of the network.

## COMMERCIAL LOANS

Commercial loans from local banks are an option that could provide funds for small, urgent short term opportunities (e.g. building a short fiber run to reach a business that needs improved connectivity to add jobs). If a business case can be developed that shows how the improvements or extensions will increase revenue to repay the loan, this form of financing should be easy to obtain.

For early fundraising, long term notes offered to local investors is an option. In this approach, the network offers long term notes (e.g. fifteen or twenty year terms) with the interest capitalized for several years; repayment starts after the interest capitalization period. This enables the network to raise funds relatively quickly and the interest capitalization period allows the network to develop adequate cash flow before having to make loan payments.

## 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.

## SALES TAX

The Arrowhead Electric Coop in rural Minnesota is paying for a full fiber build out to all homes and businesses by working with the local county government (Cook County) to collect a special 1% sales tax. The tax is actually used for a variety of infrastructure improvements, with the broadband build out using about 48% of the funds collected. The broadband portion of the sales tax is used to underwrite the cost of the CPE (Customer Premise Equipment), which is the box installed at the residence or business. This approach lowers the overall capital cost and reduces the financial risk for the electric coop. The Utopia project in Utah has been financed in large part by using loan guarantees backed by existing local sales tax revenue. This approach does not require changes in how existing sales tax revenue is used unless the fiber project runs into financial difficulties; in that case, the localities collecting sales taxes would be obligated to use some of the sales tax collected to make loan payments.

## SPECIAL ASSESSMENT TAX

The town of Leverett, Massachusetts recently funded the entire cost of a 100% fiber build out to all homes and businesses by passing a one time special assessment tax on every property in the community. This measure was passed with a citizen vote in Leverett's annual town hall meeting. Leverett is an underserved community with very limited current broadband offerings, so there was strong support for the measure. It is not likely to be an attractive or feasible option in some other communities, but it does show that under the right conditions, a community can self-fund the entire cost of a fiber build out.

## RISK FACTORS AND REGULATORY ISSUES

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### 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.

Washington County has a residential market of 56,386 households (2010 estimate) and a business market size of approximately 6,715 establishments. Washington County represents a business opportunity for service providers who can make a business case for providing advanced services beyond Internet access, TV, and telephone: home health care, home security monitoring, computer backups, pay per view/video on demand, and other high margin services are going to become increasingly common. 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 may be operated as a 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 tower space lease rates to cover routine maintenance, minimizing financial risk and requiring limited 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.

## 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 a substantial investment in a network. 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 this area will be relatively low if investments are confined primarily to passive infrastructure in the early pilot projects.

# Why Move Forward?

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## SETTING A VISION FOR THE FUTURE

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A modern business-oriented community-owned network in Washington County would have the following characteristics.

### EXPANDED BANDWIDTH

#### WITHIN THE COUNTY

*As a long term goal, businesses in Washington County should eventually have as much bandwidth as they need to do in order to maintain and enhance services globally.* Fiber to every premise will eventually be needed to support the business class services that will be requested by commercial and retail businesses in Washington County. Unlike roads, water, and sewer systems, fiber capacity can be increased incrementally as needed without incurring additional construction costs, making it a reliable and secure investment. Steady increases in work from home opportunities and home-based businesses require fiber in residential areas, not just commercial and retail areas of the County. Wireless access in Washington County can be used in the short term to meet urgent needs for better broadband access in rural parts of the county, and in the long term, wireless will remain important for mobile access to the Internet and access to business information while away from the office.

#### REGIONAL AND NATIONAL CONNECTIONS

Washington County has excellent long haul fiber services available in the community—a major economic development advantage. Getting good connections in and out of an area is often a very difficult challenge for many communities, but Washington County and Hagerstown have a key economic development advantage in this regard. The challenge is to leverage more local connections to these fiber networks to drive down local broadband service costs, which will in turn help attract businesses and jobs.

### SYMMETRIC BANDWIDTH

Upstream and downstream data capacity of the broadband network should be equal. Most current broadband systems restrict upstream data capacity to a fraction of the downstream capacity—upstream capacity is often only 10% of downstream capacity. These limits restrict economic development, entrepreneurial activities, and work from home opportunities. Increased access to fiber services via modest investments in telecom infrastructure by Washington County can help retain existing businesses and attract new ones, especially to the downtown area of Hagerstown.

### WIDESPREAD AVAILABILITY

Widespread availability of broadband should be an important goal for the County. Over time, high performance network connections should be available at every business

and resident in the County. Broadband is increasingly being used to make relocation decisions, not only for businesses, but for residences as well.

## STRATEGIC INVESTMENTS

Given the already significant private sector investment in fiber and fiber/coax networks in Washington County and Hagerstown, any community-owned broadband infrastructure build out should be focused on underserved areas (e.g. Hancock, Clear Spring, other rural parts of the county) and in areas targeted for jobs growth and economic development (e.g. downtown Hagerstown, Mt. Aetna area).

## AFFORDABILITY

It is more efficient from both network and financial perspectives to provide some basic infrastructure on a shared basis--leasing that infrastructure to private sector providers. County and city investments in basic infrastructure allow service providers to offer services at lower cost because their capital expenses have been reduced substantially while increasing their access to a much larger, aggregated market.

## SUPPORT FOR A WIDE RANGE OF SERVICES BEYOND “TRIPLE PLAY”

Telecommunications services have undergone a massive transformation in the past fifteen years, and that change will continue for at least an additional ten years as all services formerly delivered over narrow bandwidth analog networks (i.e. the traditional “triple play” of Internet, TV and telephone) are delivered over wide band digital networks. Many new services (e.g. YouTube, iTunes Music Store, VoIP phone services) were not anticipated or predicted by most industry pundits just ten years ago. Newly emerging high bandwidth services include a wide range of telemedicine and telehealth services, new kinds of online entertainment options, and many more kinds of business and ecommerce services. Any telecom infrastructure investments undertaken must be capable of supporting a wide range of future services that are going to emerge but cannot be predicted precisely.

## COMPETITIVE MARKETPLACE

Increased awareness of alternative service providers via carefully targeted pilot project fiber investments will help lower costs for businesses and residents. This will increase the kind and type of service offerings while keeping prices lower than those in communities without a competitive marketplace for telecom and broadband services. This will make Washington County more competitive from an economic development perspective and help to retain existing businesses and jobs and also help to attract new residents and businesses to the County and City.

## LIMITED GOVERNMENT INVOLVEMENT

Investments should be limited to providing basic infrastructure; services provided to businesses and residents should be offered by private sector service providers. Incumbent providers as well as other interested firms should all be invited to use this “open access” community-provided infrastructure to sell current services and new, innovative services both to existing customers in Washington County and new

customers. This approach will keep elected and appointed officials out of the business of providing telecom services directly to the public. Communities where the local government has chosen a “municipal retail” approach, where residents and businesses buy telecom services (e.g. telephone, Internet, TV) directly from the local government have often been sued by incumbent providers on the grounds that public funds should not be used to compete directly with the private sector.

## BENEFITS OF MOVING FORWARD

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### BUSINESS ATTRACTION

Chattanooga and Kansas City have both reported that the “big broadband” Gigabit fiber available in both locations has brought new businesses. Many of these new businesses are owned by entrepreneurs that deliberately moved to one of the two cities to take advantage of the high performance networks and the associated low cost of connectivity.

A near term effort to deploy fiber widely in Washington County would give the county an edge in business attraction, but as more communities make similar investments, this opportunity will degrade over time.

### BUSINESS RETENTION

If fiber services from a wider range of providers was more widely available in Washington County, the cost of typical businesses services like Internet and telephone will likely decline. When the Wired Road project in southwest Virginia began offering competitive services from private sector providers, prices for Internet and phone declined by as much as 60%, and many businesses found they were able to dramatically increase the amount of bandwidth they were purchasing for Internet access while simultaneously paying less. Efforts to reduce the cost of telecommunications for businesses will become more important to business retention efforts as other communities, especially those nearby, roll out Gigabit service connections and competitive pricing.

### BROADBAND IS GREEN

Home-based workers and business owners reduce wear and tear on Washington County’s roads, and reduce the County’s carbon footprint for each day they work at home rather than commuting to work at business locations in the County and City.

Other green benefits include:

- ▶ Reduced use of paper for some services and applications (e.g. reading newspapers and magazine on tablets, rather than the higher carbon footprint of home delivery of paper version).
- ▶ Email reduces the amount of fuel needed to deliver paper mail.

- ▶ Online shopping is more efficient in terms of delivery costs (one UPS truck can deliver packages more efficiently than individual consumers each driving a private car to the store).
- ▶ Concentrating computing resources in the high efficiency “data cloud” can reduce the amount of electricity needed by businesses and users.
- ▶ Fiber to most homes and businesses in Washington County and Hagerstown would enable rapid use of Smart Grid technologies that have the potential to reduce home and business energy use by 15% or more.

# Next Steps

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We have identified five different options that could be pursued after the end of this study. Options Four and Five are not recommended, but we note them to provide the complete range of options available to the local governments.

## OPTION ONE: FIBER EXPANSION VIA REGIONAL AUTHORITY

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As we have noted previously, identifying the appropriate ownership and governance mechanism is the critical first step in making good use of existing and new fiber assets. In this option, the local government partners (Washington County, the City of Hagerstown, Washington County Public Schools, and the Washington County Free Library) would:

- ▶ Agree to form a regional broadband authority. In Maryland, a new authority must be created by the legislature, so local state legislators would have to become involved in the effort, develop the statutory language needed, and move the bill through the legislature.
- ▶ Once the authority has been authorized by the legislature, all existing fiber and network assets would be transferred to the authority, along with the management responsibility for the OneMaryland assets assigned to the County.
- ▶ The local government network needs could be addressed under the new authority by continuing the informal arrangement (a combination of dark fiber allocations and some shared assets and services), or by reconfiguring the network to provide a new Layer 2 network exclusively for the four partners that is completely separate from the network intended for commercial, business, and residential use. In other words, the Authority would manage two physically separate Layer 2 networks (and possibly some dark fiber might also be allocated to the four partners). Alternately, the Authority could create a single high performance Layer 2 network, with both public and private use carried over the same logical network. This would be less expensive both in capital costs and in ongoing operational costs. It would also be possible to allocate dedicated fiber exclusively for public safety use (where high levels of security might be a requirement).
- ▶ To make the Authority successful, funding would have to be obtained, primarily to create new fiber extensions into desired economic development zones and into parts of the county that are underserved by the private sector. Some funds would be needed to purchase network equipment, hire a very limited number of management staff, and to cover operational expenses until revenue supports the day to day operational costs of the network.
- ▶ The Authority would use an open access business model, in which capacity on the network would be leased to private sector providers, who would sell services like Internet, phone, and video services directly to their own customers. ***The Authority would not sell any retail services directly to businesses or residents.*** Instead the Authority would sell only to qualified companies that sign a wholesale purchase agreement with the Authority.

- ▶ The Authority would seek to minimize operational expenses by outsourcing network operations and physical maintenance to qualified private sector firms. For a start up network, this is generally less expensive than hiring dedicated staff, and has the potential to create some local jobs.
- ▶ Revenue from leasing network capacity would be used for operational expenses, debt payments, network expansion over time to all homes and businesses that request service, and any revenue over operations and expansion costs would be distributed to the government partners.

## OPTION TWO: FIBER EXPANSION VIA PUBLIC/PRIVATE PARTNERSHIP

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Option Two, as a public/private partnership, puts most of the business and management responsibilities into the private sector while maintaining local government ownership of the assets. In this approach, the fiber assets would be owned by the localities, but the entire business of provisioning, managing, and operating the network would be awarded to a qualified private sector business. Steps in this process would include:

- ▶ Formalize the existing network sharing arrangement with a Joint Municipal Agreement that would provide the basis for making an appropriate allocation of fiber assets to the private sector partner. This would include an appropriation of some of the current fiber assets currently managed as the WCPN network. It would also be possible for the partners to continue operating on the current ad hoc basis for local government needs.
- ▶ To attract a qualified private sector partner, the local government partners would probably have to commit to providing some minimum amount of funding, primarily to purchase network equipment and to create new fiber extensions into desired economic development zones and into parts of the county that are underserved by the private sector.
- ▶ A private sector partner would be selected by an RFI/RFP process, in which a simple RFI (Request For Information) would be used to collect feedback on how to structure an agreement, and a subsequent RFP would be used to solicit a partner with the required qualifications and willingness to work with the local governments.
- ▶ The agreement should be structured to require an end to end open access business model to avoid creating non-competitive fiber zones in the county (i.e. a middle mile only business model will not achieve the desired economic and community development benefits).
- ▶ The private sector company may be responsible for managing all required network equipment, provisioning and network management software, staff, and outside plant support. The agreement between the local governments and the partner would have to be designed to give both partner entities the appropriate control (e.g. it would be important not to encourage a high cost structure to minimize revenue sharing with the localities).

In Maryland, an excellent example of this approach is the Seagirt Marine Terminal.

- ▶ In January 2010, the Maryland Port Administration (MPA) and Ports America began a 50-year public-private partnership lease and concession agreement for Seagirt.
- ▶ Under the agreement, Ports America runs the operations at Seagirt and is building a 50-foot container berth and four state-of-the-art super Post Panamax cranes.
- ▶ Ports America will also invest in other infrastructure, saving the State of Maryland hundreds of millions of dollars it would have had to invest in capital improvements.
- ▶ The MPA receives an annual payment and ongoing revenues from Ports America during the life of the agreement.
- ▶ Ports America receives a base payment for 50 years and all net revenues.
- ▶ The total investment and revenue to the State of Maryland has the potential to reach up to \$1.8 billion over the life of the agreement. It will also generate nearly \$16 million per year in new taxes for Maryland.

## OPTION THREE: ASSET LEASING ONLY

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The existing WCPN fiber assets represent a significant asset that could be leased either on a per strand basis or as a whole. The former option (ad hoc leasing) would lead to a very inefficient use of a scarce asset (fiber strands) and is not recommended. The latter approach would lease a designated amount of the WCPN fiber to a single private sector enterprise under certain conditions designed to meet the city and county long term community and economic development goals.

An appropriate amount of fiber strands would be reserved for public safety, K12 school, library, and local government use, and an leasing Request For Proposal (RFP) would be issued for the balance. The goal would be to select the bidder that offered the best financial payment and most efficient use of the fiber.

The “most efficient” uses of the fiber might include offers to:

- ▶ Operate the county portions of the fiber and any other extensions of the fiber as an open access network (i.e. giving other providers equal access to circuits).
- ▶ Build additional fiber to targeted economic development areas.
- ▶ Build additional fiber to residential neighborhoods.
- ▶ Build additional fiber to smaller towns and communities in the county.

The bid value of the assets would be based on the cost of building new fiber on the same lateral routes and the backbone route. The lateral distances are relatively short, so the primary value of the leasing opportunity would be the backbone fibers running east-west through the county.

While this option provides for very light administrative overhead and oversight, we do not believe this option would provide much support for economic development, as there would be little opportunity for the county and city to influence what services are available on the network and/or where fiber connections would be available.

## OPTION FOUR: FORMALIZE STATUS QUO

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In this option, the four local government partners would formalize the existing arrangement with a document (e.g. Joint Municipal Agreement) that identifies roles, responsibilities, and a road map for future network expenditures for the four partners. This agreement might include:

- ▶ Creation of a single Layer 2 network with circuits and bandwidth allocated to the partners as needed. This would eliminate some duplication of equipment and network assets.
- ▶ Creation of a shared funding pool for future network enhancements (including both equipment and fiber extensions).
- ▶ Identification of one partner as the network manager to reduce the overhead of network management among all four partners. The designated partner might receive some funding from the other three partners, and overall, the expenditures allocated for network management should be lower.

This option should create some additional efficiencies among the four partners, but this would still not meet the requirements of this study. The new OneMaryland backbone passing through the city and the county would likely remain under-utilized, and the broader economic and community development objectives would not be supported very effectively.

However, we would note that if agreement is not reached on either Option Three or Option Four, this option would be worth pursuing, since it could improve network utilization for all four partners and has the potential for freeing up existing budget funds for other purposes.

## OPTION FIVE: MAINTAIN STATUS QUO

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The four partners currently sharing fiber and network resources in the county (Washington County, the City of Hagerstown, Washington County Public Schools, and the Washington County Free Library) could continue to operate the existing fiber and network assets under the informal arrangement that has been in place for several years. IT managers and other administrative staff meet on a regular basis to work out management and operational policies and procedures.

This approach, while viable, would not meet the objective of this study, which is to identify how to leverage the OneMaryland fiber network passing through the County. In particular, maintaining the status quo would not assist with county and city economic development efforts to attract more businesses and jobs to the region. It would also not help the more rural parts of the county gain access to faster and more affordable broadband options.

We would also note that the current informal arrangement is not the most efficient way to allocate IT funds, especially for new fiber and network assets. In this kind of arrangement, some duplication of network equipment (e.g. routers, switches, etc.) and some over-building of fiber in some areas of the county is inevitable.

This approach also does not enable the potential of using converting the current excess fiber and network capacity to a revenue-producing asset, and eliminates the even greater potential of attracting new businesses and jobs to the county and the city via low cost, high performance fiber-based network services.

## COMPARISON OF OPTION ONE AND OPTION TWO

We have provided some analysis of options Three and Four in the Ownership and Governance section of this report, but the table below provides some additional comparison of the two approaches, including some of the operational and business aspects not discussed in the Ownership/Governance section.

CHARACTERISTIC	REGIONAL AUTHORITY	PUBLIC/PRIVATE
<b>Start Up</b>	Authorization from the legislature would be required with some uncertainty about the outcome. Some incumbents might be inclined to lobby against forming a broadband authority.	A joint municipal agreement could be negotiated among the government partners on a relatively short timeline and the RFI/RFP process could be completed in six to nine months.
<b>Operations</b>	The Authority could outsource the operations of the network, but would still have the ultimate responsibility for the management of the network.	The private sector partner would have complete responsibility for operations. The local governments would have limited oversight responsibilities.
<b>Network Ownership</b>	The local governments would still own the fiber, but operational control would be vested in the Authority. Some fiber would be dedicated for government use and the balance managed by the partner.	The local governments would retain ownership of the fiber and network equipment, with some fiber dedicated for government use and the balance managed by the partner.
<b>Funding</b>	The local governments and the Authority would have joint responsibility for finding the funds necessary for both the initial capital investments and ongoing network expansion. Over time, revenue from the network could provide funds for network expansion.	A variety of cost-sharing arrangement could be negotiated, but it would be important for the local governments to retain ownership of the fiber assets (and possibly the network equipment) so that in the event of poor performance, the partner agreement could be terminated and replaced with a new partner.
<b>Network Availability</b>	Formation of the Authority will add time to the front end of the project. Six to nine months might be required to complete some initial fiber extensions, construct connections to businesses, and select an operator.	It could take nine to eighteen months to complete the RFI/RFP process, negotiate an agreement, construct any initial fiber segments needed, and to begin operations.

# Setting Goals and Getting Started

## LONG TERM GOALS

Long Term Goals	Description
<b>Encourage Public/Private Partnerships</b>	Partnerships among local government partners, service providers, schools, public safety agencies, major businesses and health care institutions will assist with business attraction and lower telecom costs for all partners.
<b>Create New Business Opportunities for Existing Service Providers</b>	Local government should provide only basic infrastructure and transport, and should not compete with existing providers by selling services to businesses and residents. This is best done by the private sector.
<b>Fiber Should Support Economic Development</b>	Investments in broadband should be targeted to promote business growth and jobs creation. A shared regional network will reduce the cost of telecom services for local governments while simultaneously supporting economic development business attraction and retention.
<b>Reduce Costs for Small and Large Businesses</b>	A shared regional network will reduce the cost services for entrepreneurs, business start ups, and existing businesses.
<b>Don't Wait</b>	Many other communities have already made investments and aggressively promoting their infrastructure as part of their economic development strategies.

### ENCOURAGE PUBLIC/PRIVATE PARTNERSHIPS

The size of the county and the diversity of public and private interests in the county will require a commitment to regional collaboration if this effort is to be successful. Important and critical partners include:

- ▶ The four local government partners.
- ▶ Large institutional users of broadband services, especially health care and medical facilities in the county.
- ▶ The K12 school system is an essential partners because they are among the largest users of broadband connections.
- ▶ Existing incumbent and competitive telecom service providers.

By taking the time to develop the partnerships needed for an integrated approach:

- ▶ Costs are spread across a larger market area, making the long term financial sustainability much more likely.
- ▶ The larger market base will attract more providers and services, leading to even lower prices and a greater diversity of service offerings.
- ▶ The larger market base will also encourage more private investment, especially in building new and diverse fiber routes in and out of the region.
- ▶ It will be possible to raise more funds more quickly and thereby build to more businesses, residents, and institutions more quickly.

### CREATE NEW BUSINESS OPPORTUNITIES FOR EXISTING SERVICE PROVIDERS

Any local government investment in telecom and broadband infrastructure should be at the physical layer and the transport layer of the network. Local government should avoid selling services to businesses and residents. Providing basic infrastructure and transport will allow them to reach new customers at much lower cost and allow them to offer improved services to their existing customers. An important goal of any local government investment should be to create new business opportunities for existing incumbent and competitive providers.

### BUILD FIBER IN SUPPORT OF ECONOMIC DEVELOPMENT GOALS

The county and city need more distribution and access fiber, which is essential for meeting future demand for broadband services. To maximize the potential of the extremely valuable OneMaryland fiber in the county, additional investments will be required to extend connections to that middle mile fiber. *In other words, without last mile fiber, the OneMaryland fiber has very little potential as a driver of economic development.*

To the maximum extent possible, this core network should avoid over-building existing privately owned fiber assets, and any construction should be preceded by an effort to obtain long term leases of fiber where it is available.

- ▶ Fiber is needed to every economic development area and corridor in the region, and open fiber is needed within every business park to reduce the cost of broadband services for businesses located in those parks.
- ▶ Over time, fiber to the home should be planned to support work from home opportunities. Fiber to the home is needed to support business from home ventures, especially small business start-ups and entrepreneurial ventures.
- ▶ More “last block” fiber is needed in downtown Hagerstown to support economic revitalization efforts and to meet business needs in core downtown area.

### REDUCE COSTS FOR SMALL AND LARGE BUSINESSES

A single, shared, high performance network will reduce the cost of telephone, Internet, data back up, videoconferencing, and other business services through reduced cost of infrastructure and increased competition. The region is competing for jobs and businesses with other com-

munities in Virginia and communities in other states that already have this kind of infrastructure in place--and most of those communities are aggressively promoting it as part of their economic development business attraction and retention strategies.

## DON'T WAIT

As we have described in more detail in the Needs Assessment report, many other regions, some very close by, are well ahead of the Washington County area in their plans to acquire 21st century broadband infrastructure.

- ▶ Kansas City, Kansas and Kansas City, Missouri have construction underway in their Google partnership, which will connect hundreds of government locations, thousands of businesses, and tens of thousands of homes.
- ▶ The Utopia project in Utah is investing more than \$60 million to expand its community-based fiber network from 9,000 homes and businesses to a planned 25,000 homes and businesses.
- ▶ More than 200 other communities in the United States have operating networks or have substantial network construction underway.

How will area businesses, schools, health care facilities, and government agencies be connected? And what will bring businesses to the area?

## SHORT TERM GOALS

A variety of short term goals should be considered as next steps in this effort.

Short Term Goals	Description
<b>Continue the Current Broadband Committee Initiative</b>	The current group of public and private stakeholders and interested parties should continue development of this initiative.
<b>Select a Governance and Ownership Model</b>	Answering the question, “What entity will own and manage the infrastructure?” is an essential first step.
<b>Commitment from Local Governments to Support the Effort</b>	Regardless of the type of governance structure selected, support of the local governments is essential to success.
<b>Consistent Message and Coordinated Public Awareness</b>	If a decision to move forward is made by local governments, stakeholders, and interested parties, a consistent message about the benefits and advantages will be critical to gain public support.
<b>Develop a Strategy for Attracting a Regional Colocation Facility</b>	A regional colocation is an important component that makes the fiber network more valuable, and the fiber network will make the data center more valuable.
<b>Explore Public/Private Partnership Options First</b>	Prior to making a decision on community investments, consider issuing an RFI that asks private sector telecom providers to submit a proposal for a public/private partnership to meet the region’s broadband goals and objectives.
<b>Develop a Common Fiber Overlay Plan and Open Ditch Policy Across the Region</b>	Duct and handholes should be included where appropriate in all new public and private construction. Opportunities for shared trenching should be vigorously pursued.
<b>Coordinate Broadband Infrastructure Improvements with Public Safety Spending</b>	Coordinate upgrades to public safety communications systems with planned fiber and wireless improvements to reduce the cost and improve the quality of public safety voice/data traffic.

### CONTINUE THE CURRENT BROADBAND COMMITTEE INITIATIVE

The current group of local government officials, private sector business people, and institutional stakeholders should continue to meet regularly, identify key decision points, recommend an overall strategy, and advise local governments on next steps.

### COMMITMENT FROM LOCAL GOVERNMENTS TO SUPPORT THE EFFORT

Local government support may consist of assistance with financing, commitments to buy services once the network is constructed, and commitments to provide expedited right of way

and construction permit processing. The commitment to buy services for local government facilities and agencies is particularly important for early financial sustainability and stability. Over time, as more private sector businesses and residents are connected, government purchases of services have less financial impact on the enterprise, but early commitments from local governments to be anchor tenant customers can ease financing (both for public and private ownership) and can help attract service providers.

K12 school commitments to buy services on the network are particularly important, as K12 schools are often the single largest public or private purchaser of broadband services in a locality. Regrettably, K12 schools often choose not to support community broadband initiatives, so early commitments of support from K12 schools have an outsized impact on the project.

During the planning stages of an early phase build out, it is also important that local government IT managers and directors not purchase or renew long term broadband and telecom service contracts with providers (and in fact, this is true for large business and institutional customers as well). Large “anchor tenant” customers for the new network can use their purchasing power to encourage local incumbent and competitive service providers to amend their contracts to allow a graceful transition to the new open network.

The community broadband projects that have succeeded have all had consistent long term support from local governments--even across local elections. Candidates for local offices should be asked about their commitment to current and future community broadband plans prior to the election to prevent erosion of political support over time.

## CONSISTENT MESSAGE AND COORDINATED PUBLIC AWARENESS

Public support for the project will be important to the long term success of the effort. All parties involved in the effort must be able to address key talking points clearly, succinctly, and consistently to avoid confusion and negative rumors. Incumbents often embark on extremely negative and mis-leading public relations campaigns that seem to suggest a wide range of poor outcomes to such an effort. Citizens often assume that taxes will be increased to support the effort. A well-managed public awareness campaign that includes helping elected and appointed officials both understand and discuss key parts of the project will be very important.

## DEVELOP A STRATEGY FOR CREATING A REGIONAL COLOCATION FACILITY

The city and county have numerous private fiber networks passing through, along with the new OneMaryland network. A first step could be to create a regional meet-me point and colocation facility in Hagerstown to facilitate better pricing for broadband services and to identify where any new fiber should terminate. Options could include:

- ▶ A large pre-fabricated colocation facility (e.g. 12' x 30') that could be quickly placed in the city (e.g. near the train station).
- ▶ Depending on how much funding is committed to the effort from local governments, a more ambitious effort might include building a larger facility that could be used as a data center and colocation facility. It would be necessary to obtain some day one commitments for space before embarking on such a project, but off site data storage for both public and private organizations is becoming a critical operational requirement.

## EXPLORE PUBLIC/PRIVATE PARTNERSHIP OPTIONS FIRST

Prior to making a decision on community investments in broadband infrastructure, consider issuing an RFI that asks private sector telecom providers to submit a proposal for a public/private partnership to meet the region's broadband goals and objectives. The RFI should ask for innovative proposals from qualified private sector companies. The RFI should outline the goals and objectives that must be met. For example:

- ▶ Affordable, high performance “big broadband” fiber connections to most homes and businesses in the region.
- ▶ Network build out in a reasonable period of time.
- ▶ What kind of support is needed from local governments to form the partnership.
- ▶ A network that will offer a wide range of both traditional “triple play” services along side a wide offering of new and innovative services from many small and large service providers.

Such an RFI could be issued in early summer 2013, and responses could be evaluated quickly so that the overall effort keeps moving forward without a long delay.

## DEVELOP A COMMON FIBER OVERLAY PLAN AND OPEN DITCH POLICY ACROSS THE REGION

A fiber overlay plan is an essential part of any next steps. The four localities should agree to develop a shared GIS layer that identifies desired fiber routes and connected facilities, and any road reconstruction or repairs, water or sewer expansion, and any other civic construction or utility work should be compared to the overlay plan to determine if the new work is on a desired fiber route. If it is, funds should be budgeted during the planning phase of the effort to include adding duct and fiber along that route.

Planning departments in the region should update new project guidelines and checklists to encourage both public and private development projects to include conduit, duct, and hand-holes where appropriate, just as private developers routinely provide shared infrastructure like roads, sidewalks, water and sewer.

Public works departments should be trained to install duct so that incremental build opportunities can be pursued at least cost.

## COORDINATE BROADBAND INFRASTRUCTURE IMPROVEMENTS WITH PUBLIC SAFETY SPENDING

Public safety can benefit substantially from cost sharing with a regional open access network. Fiber can be reserved specifically for public safety use so that those agencies have secure data transmission with no information co-mingled with commercial and residential data. Public safety radio networks can be enhanced by running fiber to all repeater towers, improving the quality of voice transmission and potentially reducing the overall number of towers and repeaters needed.

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