A Fiber Network for the Village of Yellow Springs

presented by the Springs-Net Group

to

Yellow Springs Village Council

February 16, 2016

"Exploring Municipal Broadband Fiber Network for Our Village"

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Table of Contents

Introduction

A citizen volunteer group, Springs-Net, has been meeting regularly over the past year to research both the need and feasibility of a fiber-optic network in the village. This white paper will cover the results of our research, and will address the benefits of building a municipal fiber-optic network in the village of Yellow Springs, Ohio, at this point in time. We believe this endeavor is critical to modernization efforts, long-term economic growth and sustainability, and ensuring affordable high-speed Internet access for all residents. Such a network would become a vital asset to the Village in a variety of ways for decades to come. This white paper also includes an thoughtfully vetted estimate of the logistics and costs associated with building the network.

The Springs-Net Team

Tim Barhorst, Network Engineer	Thor Sage, MVECA Executive Director
Scott Fife, Director of Information Technology, Centerville City Schools (Retired)	Jordan Gray, Software Engineer, CIO
Nick Gaskins, local business owner (Bing Design)	Ellis Jacobs, Attorney
Dan Carrigan, Science and Technology Librarian	Denny Powell, Assistant Fire Chief, MTFR
Matt Cole, CPA	Melissa VanZant, Assistant Village Manager

The Need

The existing model of Internet service in our Village is old and outdated. It is mostly operating on coaxial cable and very old copper telephone lines. Due to this older technology and over-subscription by carriers, data speeds are limited and in many cases **do not** meet the current FCC definition of "Broadband" (2*5Mbps downstream and 3Mbps upstream*). The incumbent carriers, AT&T and Time Warner Cable, have no incentive to innovate and build out a fiber-to-the-home network because of their corporate revenue models.

At the August 24, 2015, Yellow Springs Village Council meeting, John Yung presented a report entitled "Ideas and Strategies for Economic Sustainability." His second recommendation was to *"remove barriers to development/redevelopment."* One of these barriers is the lack of ultra high speed Internet service. Reliable, affordable and extremely fast Internet access is a critical need for the vast majority of businesses and citizens, and is essential in fulfilling this goal.

Village communications infrastructure, much of which predates the Internet, has not been viewed in the same light as water and electricity. Long considered optional lifestyle choices, telephone, cable television, and most recently Internet connectivity, were left to the whims of the marketplace. Driven by supply and demand, most communications vendors have not been motivated to compete for the business of our relatively small and static market. As a consequence, village consumers of communications services have suffered from high prices, a lack of choices, and poor service, especially since the breakup of the telephone monopoly. Most importantly, corporate revenue models provide AT&T and Time Warner Cable little or no incentive to upgrade the existing infrastructure (primarily copper telephone lines and coaxial cable) to the 21st century standard – fiber-optic cable. Meanwhile, the explosion of Internet driven demand for data capacity has grown exponentially over the last twenty five years, to the point where fast, affordable, and reliable connectivity is now essential to the long term viability of any progressive community.

Surveys in the Village have also illustrated that many residents and business owners are in favor of building a new fiber infrastructure. According to the U.S. Census Bureau in 2014, 73% of all U.S. households have a broadband connection to the internet. Metropolitan and urban areas are even higher at 73-84%. The FCC also recently reclassified high-speed Internet service as a telecommunications service, instead of an information service, under Title II of the Telecommunications Act. This effectively reclassifies broadband as a utility, one that we would argue is a necessity for most citizens of Yellow Springs.

See **Appendix A** (Strengths, Weaknesses, Opportunities, Threats (SWOT) results from the Fiber Forum) and **Appendix B** (results from our recent online survey of villagers).

A New Model

The broadband economy and a new era of economic development has arrived. In 2010, the FCC released its National Broadband Plan which states, "Broadband is becoming a prerequisite to economic opportunity for individuals, small businesses and communities. Those without broadband and the skills to use broadband-enabled technologies are becoming more isolated from the modern American economy."

Some of the best places in the United States to get fast and affordable Internet access are communities where local governments directly provide the service. In many of these locations, the local government offers the Triple Play of telephone, Internet access, and cable television. Offering the three services has been important in ensuring this type of project generates all needed revenues to reach a short-term return on investment. This is because some of these communities have often chosen ***NOT to use taxpayer dollars to finance the network.*** Many of these communities have benefited greatly by building their networks via an already existing municipal electrical utility, something we already have in Yellow Springs.

A prime example of a small community that has already built a municipal fiber network is Sandy, Oregon, pop. 9,945. Their network was paid for with a $7.5 million revenue bond, which will be repaid by system revenues. Despite not being subsidized by taxpayer dollars, prices are still low: $40 per month for synchronous, 100Mbps service or $60 per month for 1Gbps (***Synchronous*** vs ***Asynchronous*** – synchronous connections have the same speed rate for uploading and downloading data, asynchronous does not.). There are no contracts or data caps. Officials from Sandy have been valuable reference resources for the Springs-Net team.

In November, 2014, Yellow Springs joined Next Century Cities (NCC), a nationwide 501(c)(3) public charity, dedicated to the promotion of municipal networks. **The Village Council voted to adopt all the following stated principles of NCC:**

- **High-Speed Internet Is Necessary Infrastructure**: fast, reliable, and affordable Internet – at globally competitive speeds – is no longer optional. Residents, schools, libraries, and businesses require next-generation connectivity to succeed.

- **The Internet Is Nonpartisan**: because the Internet is an essential resource for residents and businesses in all communities, the provision of fast, reliable, and affordable Internet transcends partisanship. This collaboration welcomes leaders of all affiliations and beliefs who believe fast, reliable, and affordable high-speed Internet access is essential to secure America's Internet future.

- **Communities Must Enjoy Self-Determination**: broadband solutions must align with community needs – there is no perfect model that is universally appropriate. Towns and cities should have the right to consider all options – whether public, nonprofit, corporate, or some other hybrid – free from interference.

- **High-Speed Internet Is a Community-Wide Endeavor**: building effective next-generation networks requires cooperation across communities. It is critical to involve and include multiple stakeholders and perspectives to succeed, including businesses, community organizations, residents, anchor institutions, and others. Everyone in a community should be able to access the Internet on reasonable terms.

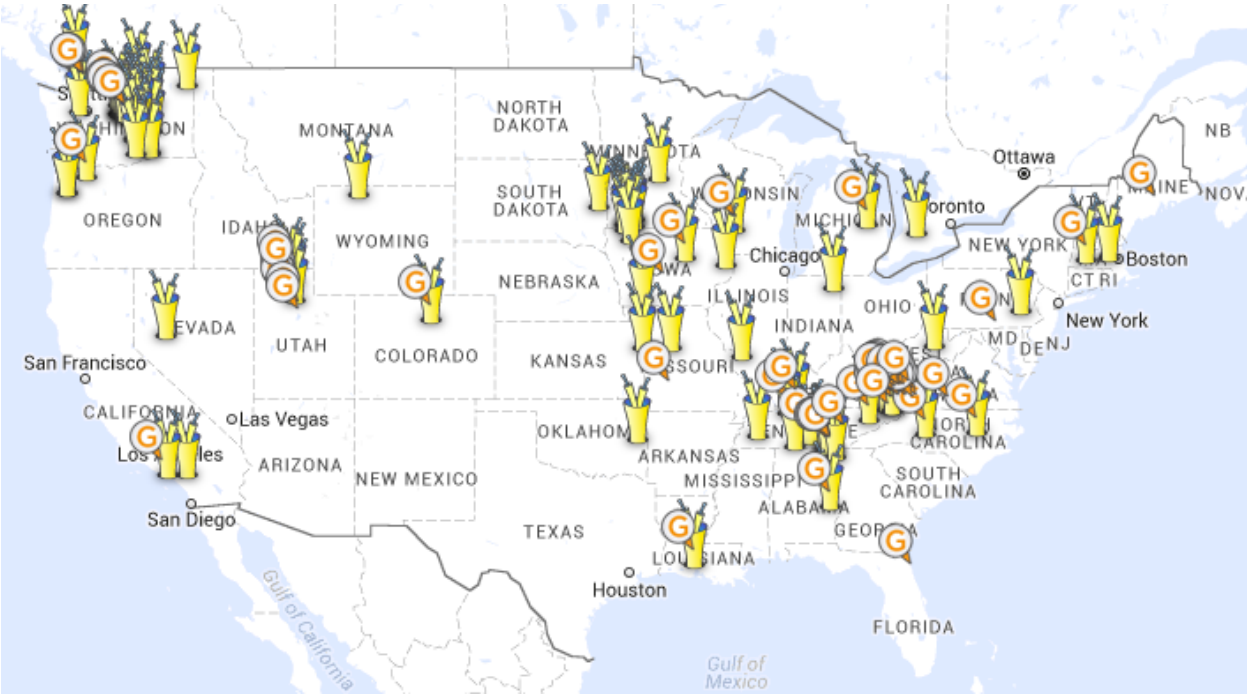
- **Meaningful Competition Drives Progress**: a vibrant, diverse marketplace, with transparency in offerings, pricings, and policies will spur innovation, increase investment, and lower prices. Communities, residents, and businesses should have a meaningful choice in providers.

- **Collaboration Benefits All**: innovative approaches to broadband deployment present diverse challenges and opportunities to communities and regions. Working together, cities can learn from the experiences of others, lower costs, and make the best use of next-generation networks.

450 United States have public owned fiber networks as of October 2015

Of those:

- 83 communities with a publicly owned FTTH network reaching most or all of the community (indicated by yellow fiber icon below)
- Over 50 communities in 19 states with a publicly owned network offering at least 1 Gigabit services (indicated by 'G' icon below)



source: www.muninetworks.org/communitymap

The Yellow Springs Fiber Solution

We propose that the Village design, construct and manage a Gigabit Passive Optical network (GPON) that will connect to every household and business location in our village.

Yellow Springs is uniquely positioned for success due to several important reasons:

- It is already a provider of water and electric utilities and owns the right of ways including most of the utility poles in the village.
- There is an existing billing system in place.
- MVECA, a public, not-for-profit, regional council of governments has an existing, multi-carrier data center in Yellow Springs. MVECA is an ideal partner for public infrastructure development and currently assists schools and governments across the Miami Valley in addressing the demands of technological modernization.
- The village has a small and manageable footprint that will allow an easy transition to fiber.

The speed and durability of fiber also work in favor of the Village. The infrastructure is estimated to easily last more than 30 years (most likely much longer) and provides almost infinite capacity to carry data well into this century.

Based on preliminary budgetary projections, survey data, and case studies of comparable markets that have successfully implemented a similar solution, a municipal fiber network appears to be financially feasible and sustainable for Yellow Springs.

Scenarios for the various types of users:

- Business – Affordable and very high speed direct ethernet will outperform commercial offerings.
- In-home Business – A better quality service at a better price will help ensure success.
- Residential – Increases home value and provides better access for many domestic applications.
- Low-income Residential – Federal "Lifeline" subsidy available will help guarantee access.

Network Description

Due to its advantages over electrical transmission, optical fibers have largely replaced copper wire communications in core networks in the developed world. Optical fibers are now widely used in communications, which permits transmission over longer distances and at much higher speeds that are greater than any other forms of transmission. The proposed network will primarily be passive (PON = passive optical network), i.e. there will be no active electronics in the field or in the street. This allows for simpler installation and support. See **Appendix C** for more technical information.

Now that all Internet, voice and video data can be 100% digital, the opportunity exists for the village to provide all three of these services, known as Triple Play. We think the Triple Play option should be studied before the build out of the network is completed.

Benefits

Regional Economic Development Efforts – Interconnected Communities
Yellow Springs, through its association with the Dublin Institute, has recently been invited to participate in the Intelligent Community Forum, an international organization that fosters community economic acceleration utilizing high-speed networking.

About Intelligent Communities
Intelligent Communities are those which have – whether through crisis or foresight – come to understand the enormous challenges of the Broadband Economy, and have taken conscious steps to create an economy capable of prospering in it. They are not necessarily big cities or famous technology hubs. They are located in developing nations as well as industrialized ones, suburbs as well as cities, the hinterland as well as the coast.

The good news is that, while the Broadband Economy presents an epic challenge to communities, it also hands them a powerful new competitive tool. Beginning in the 1990s, carriers deployed the local networks that most of us think of as broadband – DSL, cable, satellite and wireless – within neighborhoods, towns and cities. At the same time, the costs of computer software and hardware, especially data storage, plummeted in obedience to Gordon Moore's famous law that the storage capacity of microchips doubles every 18 months. Through local broadband, individuals, small businesses, institutions and local governments have gained access to worldwide information resources and a broad range of tools to connect both globally and locally.

Another opportunity is with the ***U.S. Ignite program***. It assists in the development of next-generation applications by assisting developers, communities, individuals, and partners in bringing gigabit applications to life. Over the next five years, the ecosystem created by U.S. Ignite will deliver:

- 60 next-generation applications
- 200 community test beds where applications can be researched, developed, tested, refined, and deployed
- A new forum for collaboration between an array of diverse partners

U.S. Ignite will transform how we receive healthcare, educate our children, keep our communities safe, become more energy efficient, train our employees, and manufacture goods.

An important reason why our community will invest in a municipal broadband network is because it will hope to reap economic benefits from the network. This will provide new revenue streams for our village that will stay within our village while promoting local control and self-determination.

Many people and organizations have explored the positive relationship between municipal Internet networks and economic development, as exemplified in a 2015 White House report[1]. Municipal networks create jobs by ensuring businesses and telecommuters have fast, affordable, and reliable Internet access; the old *DSL* and cable networks just don't cut it. This network will improve the productivity of existing businesses and attract new businesses to our community, allowing individuals to work from home more effectively, while also supporting advanced healthcare and security systems. It will strengthen local housing markets, (studies have shown a 5-7% increase in property values once fiber is connected) and will represent a long-term social investment in the form of better-connected citizens and students. It will allow the village to hone high tech workforce

skills and attract "targeted knowledge-based industries" thereby improving the quality of life for everyone.

In the case of municipal systems, which are not-for-profit enterprises, one measure of "success" is defined as the level of their "take rate" – *that is, the percentage of potential subscribers who are offered the service that actually do subscribe*. **Nationwide, the take rates for retail municipal systems after one to four years of operation averages 54 percent.** This is much higher than larger incumbent service provider take rates, and is also well above the typical FTTH business plan usually requiring a 30-40 percent take rate to "break even" with payback periods. We are providing financial projections for take rates of 40% - 50% - 60%. See **Appendix D.**

Village Modernization

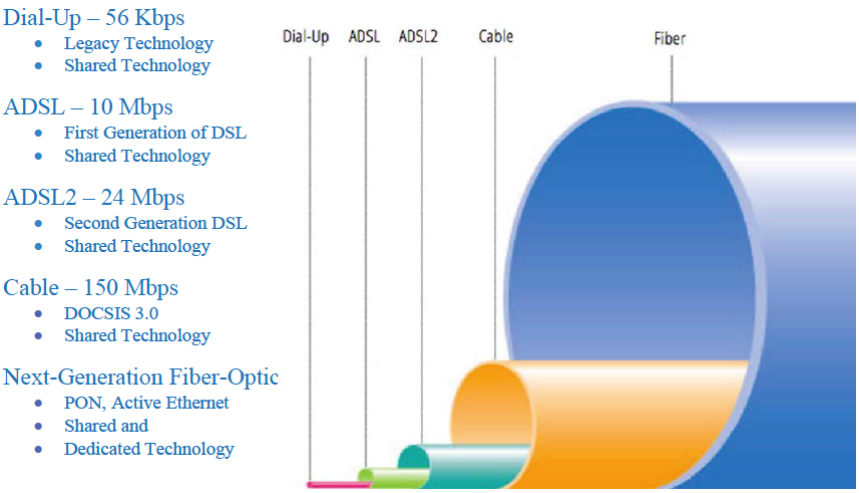
Another benefit will be to Channel 5, the community access channel. Because everyone who subscribes to the fiber will be connected, the video stream could reach a much higher percentage of citizens. This will also allow for modernization and upgrade of the station to a high definition video signal. Also, because the station will be available on the "Internet" it can be viewed by anyone outside of the village.

Springs-Net is confident that many other similar opportunities will arise once we have built our fiber infrastructure.

Lifeline for Low Income Villagers

We are committed to making sure that all villagers are able to afford this service. We will offer a "Lifeline" package for those with low incomes or who receive government benefits. The specific design of the Springs-Net program will be informed by the current Federal Communications Commission proceeding which will determine whether the funds currently available for low income phone access can be used for internet service as well.

Visual comparison of various Internet connection technologies:



Proposed Execution

Phase 1 – Basic Internet

The fiber infrastructure would be initially built out to connect every residence and business within the village perimeter – unless there are property owners that explicitly decline to have a service connection. Our cost estimates reflect this. While under construction, we recommend that there be no installation fee. After that initial period, one should be applied.

We propose two tiers of pricing:

- 100 Megabits/s at $40.00 per month
- 1 Gigabit/s at $80.00 per month

An additional tier will be custom pricing for data-intensive use by some businesses. This will be a type of connection called **"direct Ethernet"**. This is a dedicated connection for serious business use. We anticipate additional revenues from business class connections.

(These prices could change if, as expected, the costs of building out the infrastructure decreases.)

Phase 2 – Video & Phone

The fiber infrastructure will create options for video streaming and multicast video as well as telephone service (known in the industry as a Triple Play). We believe it will be feasible to offer these "bundled" services and arrange for a third party to manage them. Service providers like "Yondoo" and "CSI Digital" offer major entertainment networks as well as local stations and could manage the video service entirely. We estimate that this could provide an additional $3-$5K monthly.

Conclusion and Next Steps

In order to ensure that our village successfully continues to develop a prosperous and diversified economy, we recommend the construction of this network. In addition to enhancing economic and business incentives, it will also have great potential to solve social issues and bring about a new renaissance of opportunity for everyone. We are the right people to do this – and this is the right time!

Much time and effort have been put into technical and financial research and community awareness (forum and survey). However, we acknowledge that there are question marks that need to be addressed. These include:

- Financial numbers assume 70/30 division of aerial vs. burial of current electric service
- Financial numbers assume cost to customers does not change over 20 years
- Decisions to be made by Village, about operational costs i.e. hired or contracted
- Affordability with telecommunications act

Recommendations for Council:

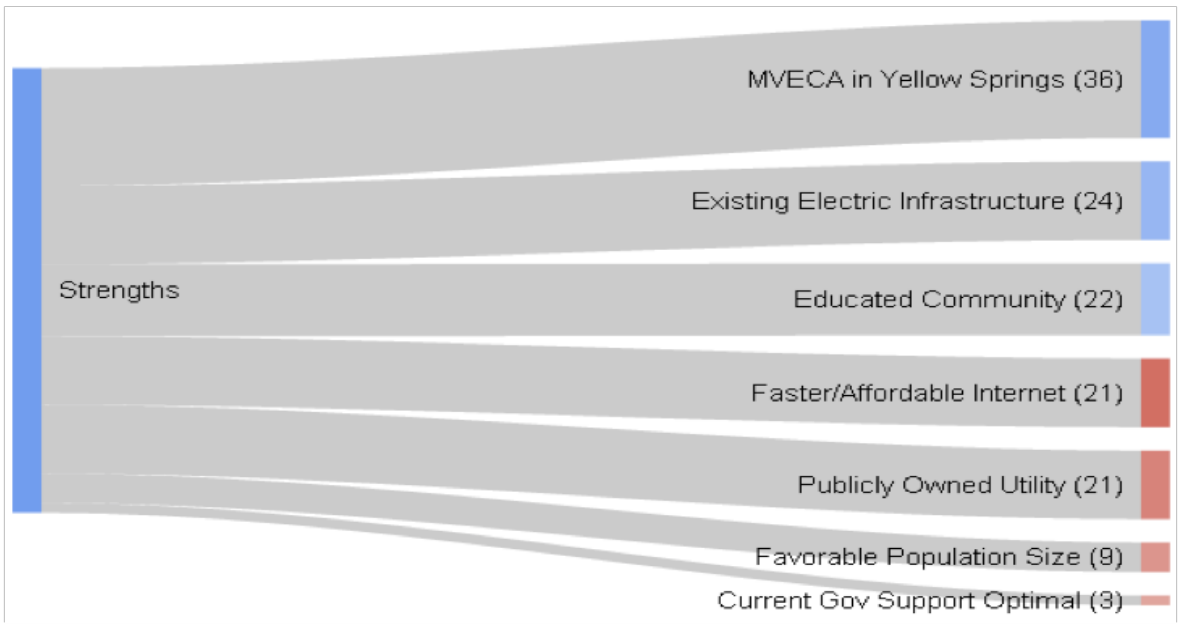
- Set up a work session to review details of Springs-Net proposal
- Approve an expenditure for a marketing study to solidify our preliminary estimates for take rates
- Approve an expenditure for an engineering study and development of an RFP to solidify our preliminary estimates for construction of the network

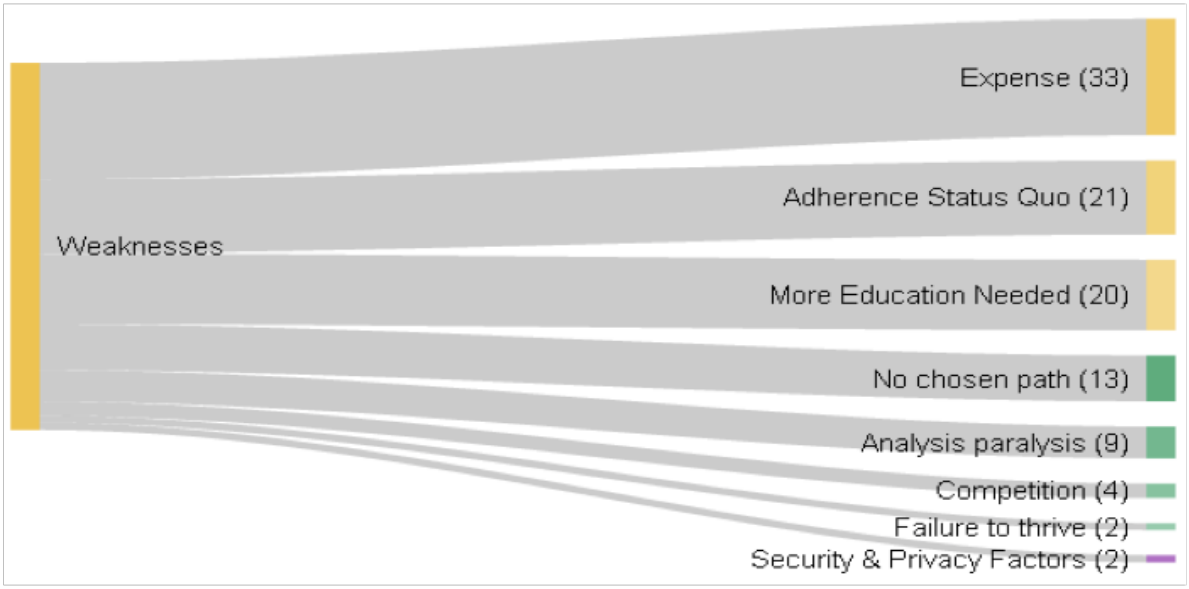
Appendix A – Springs-Net Fiber Forum

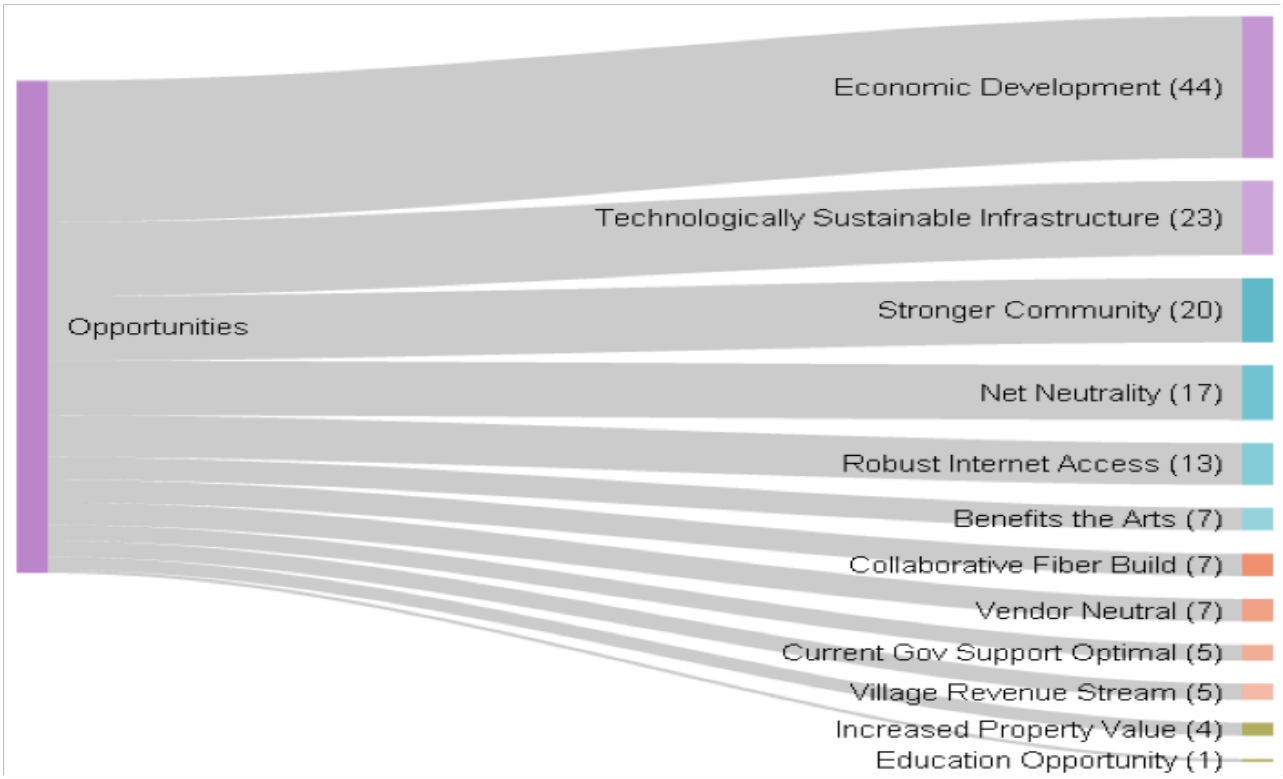
Organized by Springs-Net Committee at Miami Valley Educational Computer Association (MVECA) on April 25, 2015.

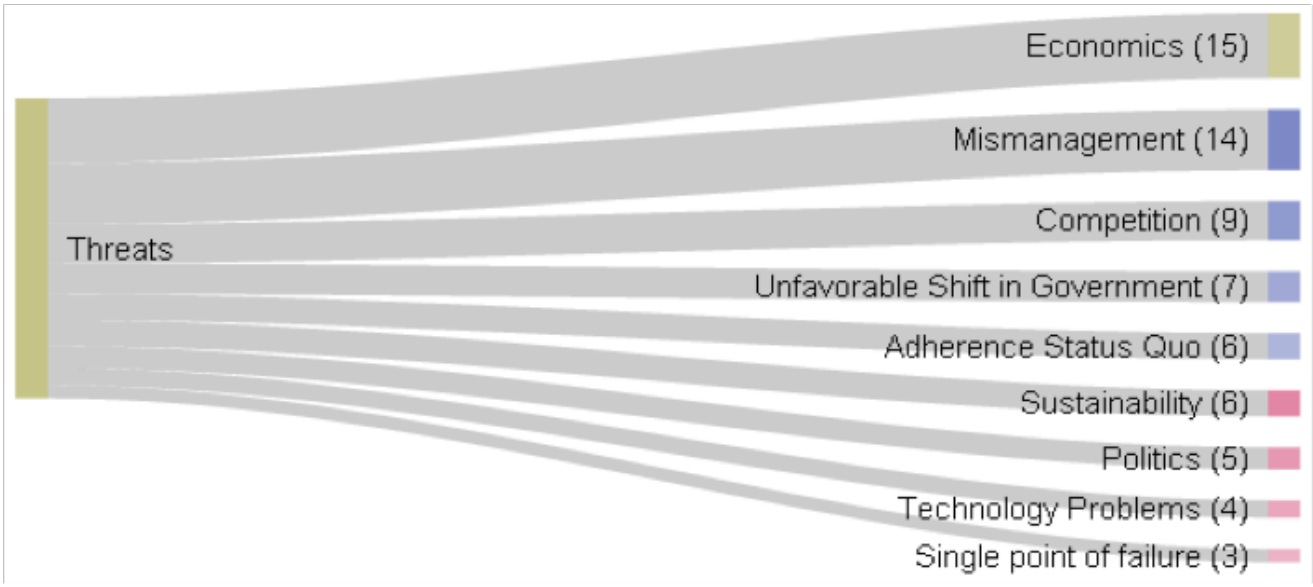
Yellow Springs News - BLOG - From the Fiber Forum by Amy Magus
http://ysnews.com/news/2015/04/blog-from-the-fiber-forum

Feedback gathered from the 1 hour breakout sessions held at the end of the Fiber Forum which was held on April 25, 2015. Data collected was further classified into the following aggregate view to normalize the results for easier reading.






Opportunities
Economic Development (44)
Technologically Sustainable Infrastructure (23)
Stronger Community (20)
Net Neutrality (17)
Robust Internet Access (13)
Benefits the Arts (7)
Collaborative Fiber Build (7)
Vendor Neutral (7)
Current Gov Support Optimal (5)
Village Revenue Stream (5)
Increased Property Value (4)
Education Opportunity (1)


Threats
Economics (15)
Mismanagement (14)
Competition (9)
Unfavorable Shift in Government (7)
Adherence Status Quo (6)
Sustainability (6)
Politics (5)
Technology Problems (4)
Single point of failure (3)

Videos of Springs-Net Fiber Forum Presentations

Introductions to Yellow Springs Fiber Forum
"Building a municipal fiber network in Yellow Springs"
Mr. Tim Barhorst - Resident, Network Engineer & Springs-Net Committee, Yellow Springs, OH
https://youtu.be/JjE1XvvIUjY?rel=0&start=483&end=2583&autoplay=1

"Why Local Government Broadband is the Solution & Strategies" + Audience Q/A
Mr. Greg Dunn, Esq - Partner, Ice Miller, LLP, Columbus, OH
http://www.icemiller.com/people/gregory-j-dunn/
https://youtu.be/JjE1XvvIUjY?rel=0&start=484&end=2583&autoplay=1

"The Rise of Municipal Networks" + Audience Q/A
Mr. Chris Mitchell - Institute for Local Self-Reliance (ILSR), Washington, DC
https://ilsr.org/about-the-institute-for-local-self-reliance/staff-and-board/christopher-mitchell/
https://youtu.be/JjE1XvvIUjY?rel=0&start=2583&end=4198&autoplay=1

"The Story of Dublink" + Audience Q/A
Mr. Dana McDaniel, City Manager of Dublin, Ohio
http://dublinohiousa.gov/newsroom/dana-mcdaniel-named-dublin-city-manager/
https://youtu.be/JjE1XvvIUjY?rel=0&start=4199&end=6073&autoplay=1

"Technical Explanation of Fiber for Everyone" + Audience Q/A
Alex Figuero, Senior Sales Engineer Corning Inc., Columbus, OH
https://www.linkedin.com/in/alex-figuero-a237265b
http://youtu.be/vwqfaTpqfhA?rel=0&start=0000&end=1584&autoplay=1

"Importance of Local Government Action" + Audience Q/A
Deb Socia, Executive Director, Next Century Cities, Washington, DC
http://nextcenturycities.org/about-ncc/
http://youtu.be/vwqfaTpqfhA?rel=0&start=1585&end=2658&autoplay=1

"Fiber to the Home" + Audience Q/A
Kevin Schoen, CEO of ACD.net, Lansing, MI
https://www.linkedin.com/in/kevinschoen
http://youtu.be/vwqfaTpqfhA?rel=0&start=2659&end=4056&autoplay=1

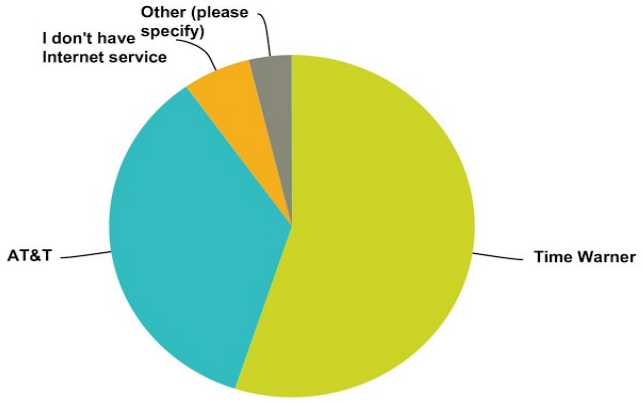
"Fiber to the Home" + Audience Q/A
Jeremy Pietzold, Council President of Sandy, OR
http://www.ci.sandy.or.us/Jeremy-Pietzold/
http://youtu.be/vwqfaTpqfhA?rel=0&start=4057&end=5670&autoplay=1

"Yellow Springs is Ready" + Audience Q/A
Thor Sage, Executive Director, MVECA & Springs-Net Committee, Yellow Springs, OH
https://www.linkedin.com/in/thor-sage-04181112
http://youtu.be/vwqfaTpqfhA?rel=0&start=5671&end=6830&autoplay=1

Appendix B – Results from Q4 2015 Survey of Villagers

Q1 Who is your current Internet service provider?

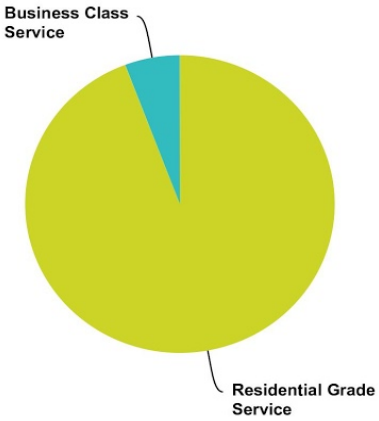
Answered: 367 Skipped: 0



Answer Choices	Responses	
Time Warner	55.04%	202
AT&T	35.15%	129
I don't have Internet service	5.99%	22
Other (please specify)	3.81%	14
Total		367

Q2 What level of Internet service do you use?

Answered: 313 Skipped: 54



Answer Choices	Responses	
Residential Grade Service	94.25%	295
Business Class Service	5.75%	18
Total		313

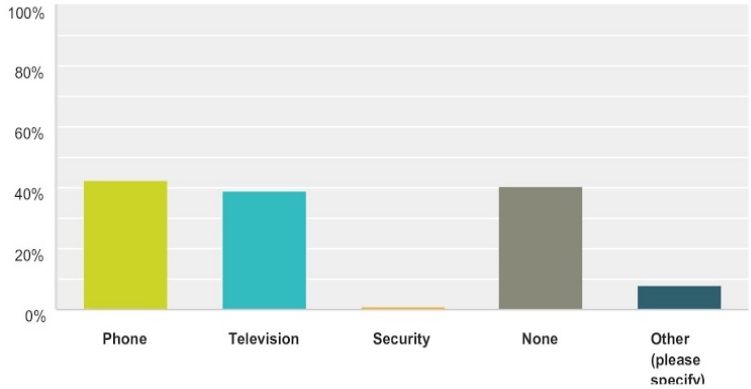
Q3 How would you rate your current Internet service?

Answered: 313 Skipped: 54

	Excellent	Good	Marginal	Poor	Total	Weighted Average
Speed	**10.86%** 34	**64.22%** 201	**21.73%** 68	**3.19%** 10	313	2.83
Reliability	**14.06%** 44	**64.86%** 203	**17.89%** 56	**3.19%** 10	313	2.90
Customer Service	**9.58%** 30	**41.53%** 130	**35.78%** 112	**13.10%** 41	313	2.48
Value	**3.83%** 12	**26.52%** 83	**47.28%** 148	**22.36%** 70	313	2.12

Q4 What other services come bundled with your Internet?

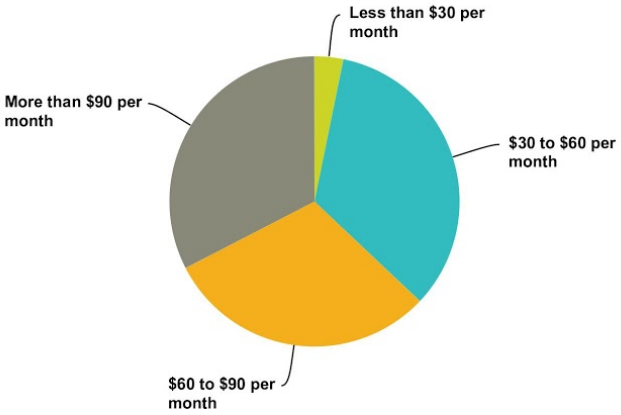
Answered: 312 Skipped: 55



Answer Choices	Responses	
Phone	**42.31%**	132
Television	**38.78%**	121
Security	**0.96%**	3
None	**40.38%**	126
Other (please specify)	**8.01%**	25
Total Respondents: 312		

Q5 How much does your Internet or bundled-services package cost?

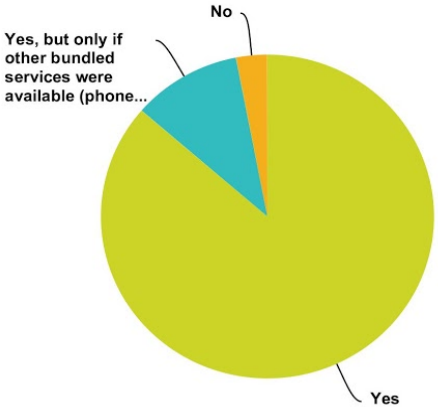
Answered: 313 Skipped: 54



Answer Choices	Responses	
Less than $30 per month	3.19%	10
$30 to $60 per month	33.87%	106
$60 to $90 per month	30.35%	95
More than $90 per month	32.59%	102
Total		313

Q6 Would you subscribe to a faster and more affordable Village-owned Internet utility service?

Answered: 330 Skipped: 37



Answer Choices	Responses	
Yes	86.36%	285
Yes, but only if other bundled services were available (phone, television)	10.61%	35
No	3.03%	10
Total		330

Appendix C – Technical Data

Fiber to the Premises (FTTP) and **Fiber to the Home (FTTH)** are forms of fiber-optic communication delivery, in which an optical fiber is run in an optical distribution network from the data center all the way to the premises occupied by the subscriber.

A **Gigabit Passive Optical Network (GPON)** is a unique and efficient implementation of a fiber network which basically uses NO active components to deliver information; all connections are passive (i.e. require no additional power). The drivers behind the modern passive optical network include high reliability, low cost, and passive functionality. The devices at each end are called the **Optical Line Terminal (OLT)** and the **Optical Network Terminal (ONT).**

OLT: Optical Line Terminal

A device which serves as the service provider endpoint of a passive optical network. This device is installed at the data center.

It provides two main functions:

1. To perform conversion between the electrical signals used by the service provider's equipment and the fiber optic signals used by the passive optical network.

2. To coordinate the multiplexing between the conversion devices on the other end of that network (called either optical network terminals or optical network units).

ONT: Optical Network Terminal

The ONT converts fiber-optic light signals to copper/electric signals. This is the device that is installed at the location where service is provided.

Each ONT is capable of delivering:

- POTS (plain old telephone service) lines
- Internet data
- Video/TV

Illustration of Fiber To The Home in Leverette, MA

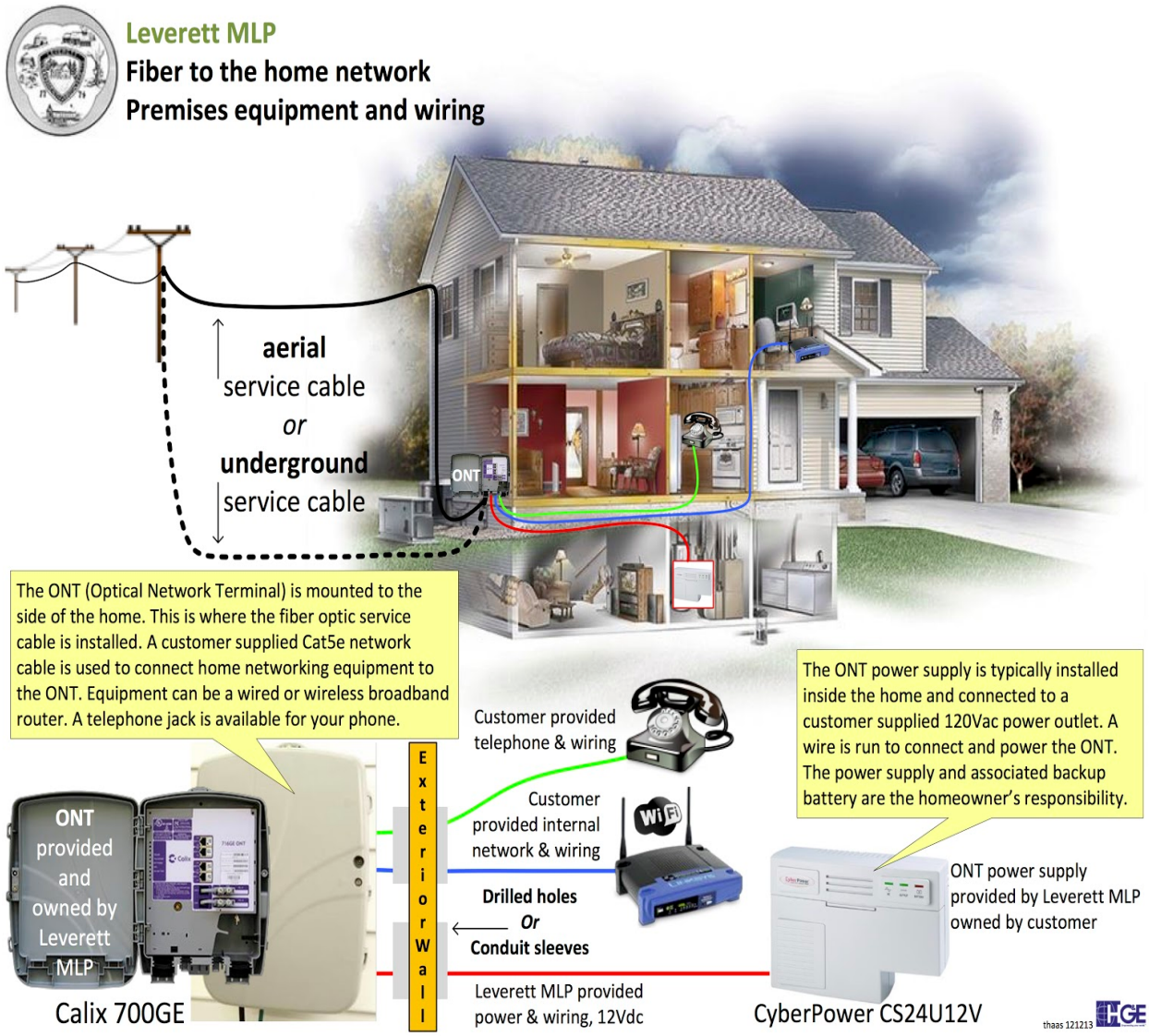
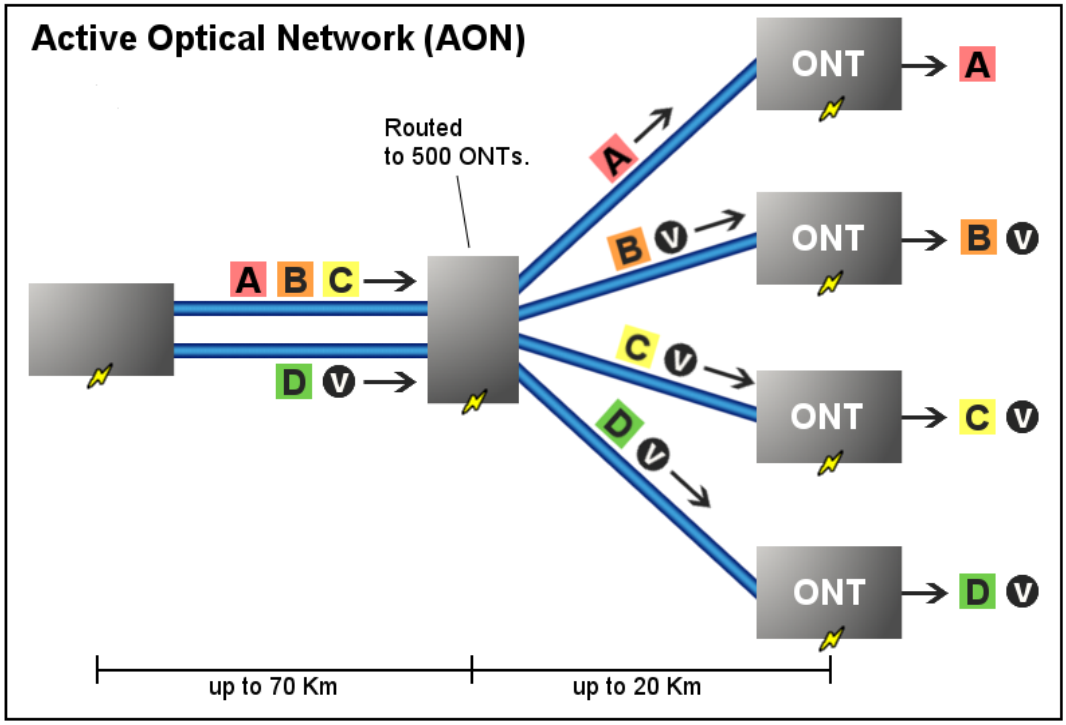
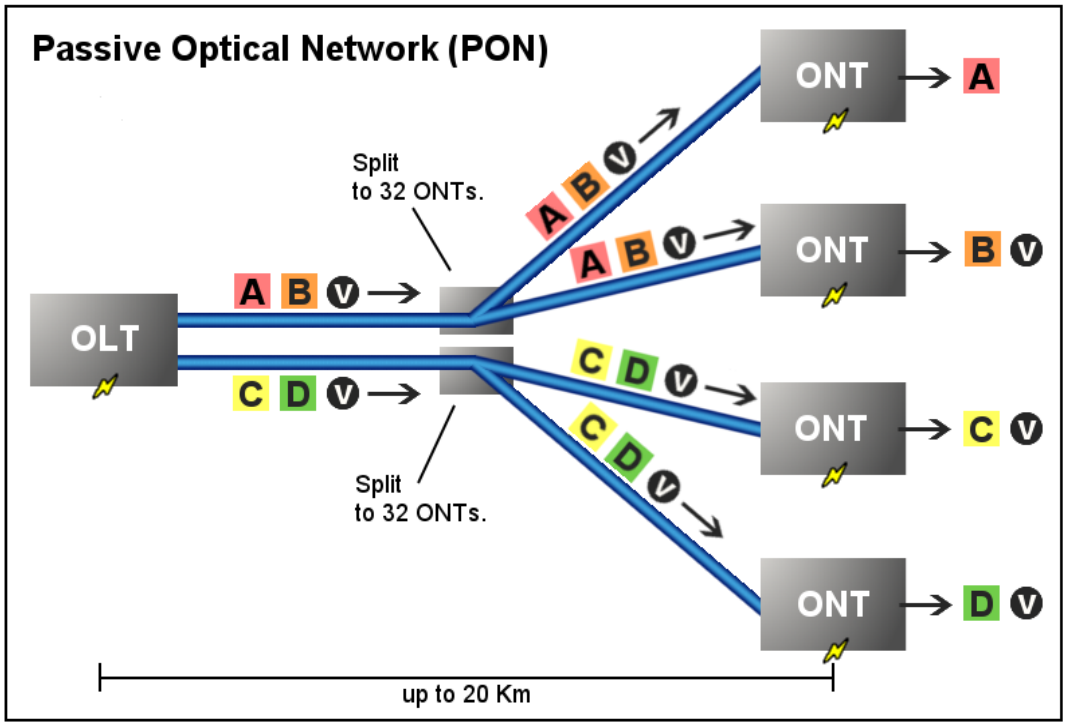


Diagram of Active Optical Network vs. Passive

(Yellow Springs will primarily be a "Passive" network with exceptions for certain dedicated business customers.)





Key: A - Data or voice for a single customer. V - Video for multiple customers.

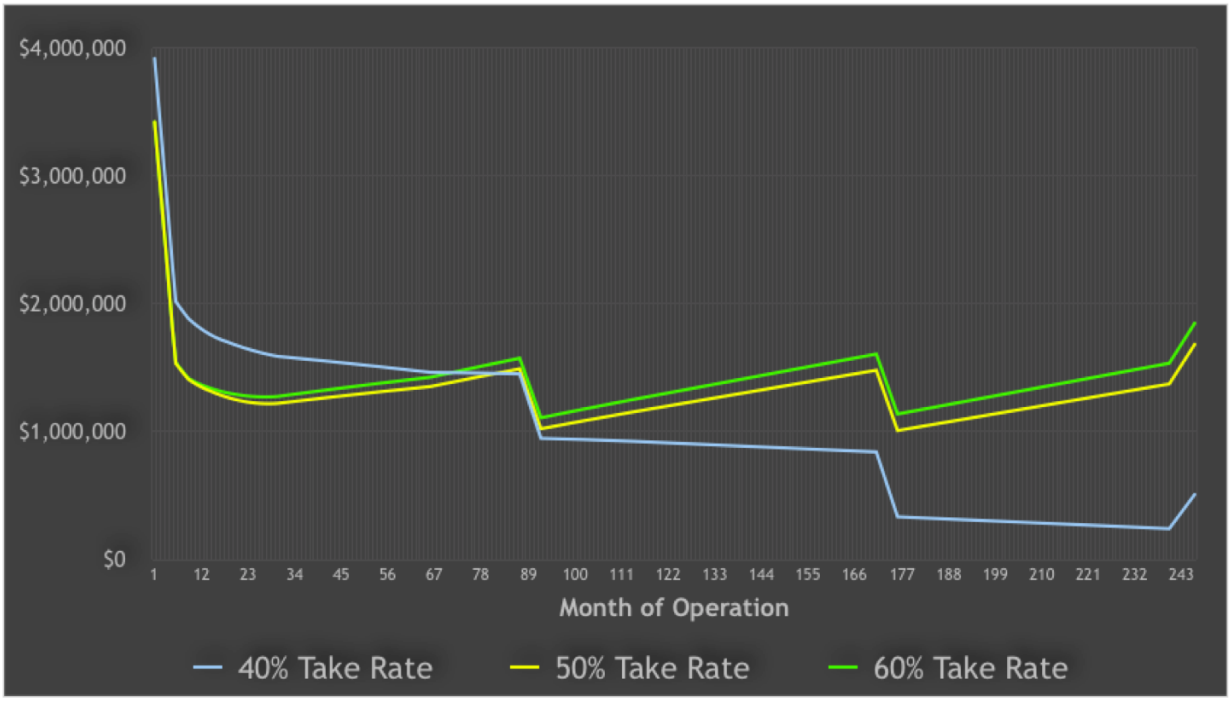
Appendix D – Funding

In the case of municipal systems, which are not-for-profit enterprises, one measure of "success" is defined as the level of their "take rate" – that is, the percentage of potential subscribers who are offered the service that actually do subscribe. **Nationwide, the take rates for retail municipal systems after one to four years of operation averages 54 percent.**

This is much higher than larger incumbent service provider take rates, and is also well above the typical *FTTH* business plan usually requiring a 30-40 percent take rate to "break even" with payback periods.

We propose that the village issue 20 year revenue bonds totaling around 3.5 - 4 million dollars. We have created an Excel spreadsheet which illustrates (3) take rates and the resulting fund balances. It is important to note that we NEVER want to have to utilize money from the village general fund.

It is very likely that these numbers will look even better once a detailed engineering study is performed as we think our estimates are overly conservative.



Appendix E – Community Comparison

Community Comparison: Leverett, MA, Yellow Springs, OH and Sandy, OR

Description	Leverett, MA 01054	Yellow Springs, OH 45387	Sandy, OR 97055
Population (2014 ACS)	1876	3549	9945
Household Income (2014 ACS)	$78,125	$61,402	$56,476
Geography (Gazzetter US Census)	22.7 sq miles	2.02 sq miles	3.14 sq miles
Population Density	83 per sq mile	1757 per sq mile	3170 per sq mile
Median Age (2014 ACS)	50.8	49.8	33.1
Total Housing units (2014 ACS)	817	1820	4168
Households w/ children (2010 Census)	27.2%	25.4%	40.6%
Households 65 y/o + over (2010 Census)	28.5%	31.6%	21.6%
Individuals below Federal poverty level (2014 ACS)	9.6%	14.6%	9.6%
Home-Based Workers est. 10.6% (SIPP)	112	196	541
Businesses (Zip Code Business Pattern, town & surrounding postal area YSO see CUPU)	36	142 (2009)*	412
Fiber service Subscriber (take rate)	2015 80%	Not Available	2015 60%
Notes:	Rural town, north of Amherst, MA, **Previously:** unserved broadband area, no general cable / DSL service.	Flat Suburb of Dayton, WPAFB and Springfield. **Currently:** 2 broadband incumbents, One limited to DSL, no general fiber service available.	Gateway to Mt Hood, semi-rural town, 45 min west of Portland, OR **Previously:** city operated phone, DSL and Wifi service.

Sources: US Census, American Community Survey (ACS)
US Census, Survey of Income and Program Participation (SIPP)
"Yellow Springs Business Retention & Expansion Survey" (2009)
Center for Urban & Public Affairs (CUPU), Wright State University
http://www.45387.org/docs/growth/BusinessRetentionExpansionSurvey.pdf

Appendix F – Glossary / Related Websites / Case Studies / Articles

http://muninetworks.org/glossary/1#lettert
Compiled by the Institute for Local Self-Reliance, this is a glossary of terms commonly used in discussions about community broadband. Other terms can be found on Wikipedia.

http://nextcenturycities.org
Across the country, innovative municipalities are already recognizing the importance of leveraging gigabit level Internet to attract new businesses and create jobs, improve health care and education, and connect residents to new opportunities. Next Century Cities is committed to celebrating these successes, demonstrating their value, and helping other cities to realize the full power of truly high-speed, affordable, and accessible broadband.

https://www.intelligentcommunity.org
Intelligent Communities are those which have – whether through crisis or foresight – come to understand the enormous challenges of the Broadband Economy, and have taken conscious steps to create an economy capable of prospering in it. They are not necessarily big cities or famous technology hubs. They are located in developing nations as well as industrialized ones, suburbs as well as cities, the hinterland as well as the coast.

"LeverettNet Launches Fiber-to-the-Home Service" – Nov 2015
http://www.bbcmag.com/2015mags/Nov_Dec/BBC_Nov15_LeverettNet.pdf

"EPB (Electric Power Board of Chattanooga, TN)" – Oct 2015
https://static.epb.com/annual-reports/2015/wp-content/uploads/2015/10/2015-financial-report.pdf

"SandyNet Goes Gig: A Model for Anytown USA" – Nov 2015
https://ilsr.org/wp-content/uploads/2015/11/sandynet-2015.pdf

"LeverettNet Municipal Broadband Network" – Oct 2015
http://broadband.masstech.org/press-releases/leverett-highlights-impact-municipal-broadband-network-launch-event

"Small Telcos, Municipal Systems Dominate New FTTH Builds" – 2012
http://www.bbpmag.com/Features/0612feature-FTTH.php

"FTTH Customer Base Continues Strong Expansion" – 2013
http://www.bbpmag.com/Features/0713feature-FTTH.php

"Municipal Fiber to the Home Deployments: Next Generation Broadband as a Municipal Utility" – 2009
http://www.ftthcouncil.org/d/do/69