Marathon County

Broadband Gap Analysis

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1   Acknowledgements

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We gratefully acknowledge the assistance of the Wausau Regional Chamber of Commerce in inviting and encouraging its member businesses to participate in the online survey.

Within Marathon County government, our special thanks to Ed Hammer, Gary Hetzer, Gerry Klein, Loretta Schultz and Diane Wessel.

We also wish to thank the broadband providers who provided information about their services and coverage areas. These included AirRunner, Cellcom, Country Wireless, Network Professionals and Solarus.

2   Rationale for the Study

Marathon County has a long reputation of being one of the more successful and progressive counties in the state. The County provides the foundation "infrastructure" for prosperous businesses and invests heavily in quality and efficient services and effective partnerships utilizing citizen and business participation. The County recognizes an adequate infrastructure is necessary for economic development and growth. Infrastructure is not only roads and bridges – infrastructure includes the necessary backbone required to attract and maintain a healthy business climate.

In an article published online by MidwestBusiness.com on July 15, 2009, statements by technologist and writer James Carlini[1] support the County's position:

> "Broadband connectivity (multi-gigabit speeds) is now one of
> the top three criteria for corporate site selection committees.
> Ten years ago, it was not even on the list of requirements."

For these reasons Marathon County decided to conduct a county-wide broadband gap analysis to identify county-wide issues related to economical broadband access and telecommunications.

Drivers for conducting the study at this time include the fact that the County is undertaking a major upgrade to its public safety radio system which may offer opportunities to extend broadband services, and to a potential source of funding via the American Recovery and Reinvestment Act ("ARRA"), sometimes referred to generically as stimulus funds). The ARRA authorized substantial funds to increase

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[1] http://www.midwestbusiness.com/news/viewnews.asp?newsletterID=19694 James Carlini is an adjunct professor at Northwestern University and is president of Carlini & Associates.

access to broadband services in unserved and underserved locations, particularly in rural areas.

For the purposes of this Report, we have used the definition of "broadband" set forth recently by the National Telecommunications and Information Administration ("NTIA"), that is, at least 768 Kbps downstream and 200 Kbps upstream. We believe that these lower bounds of capabilities are significantly understated based on the widely anticipated 20 to 50 Mbps or possibly up to 100 Mbps or more by some accounts, broadband speeds being discussed for such things as distance learning, remote medical opportunities and Internet TV applications. Therefore, while we are using the NTIA standard, we recommend that the County consider options that currently exceed this NTIA standard or can be upgraded efficiently to meet expected near term speed requirements.

3 Executive Summary

The data gathered by the study team indicate that broadband offerings in Marathon County are diverse in capacity and cost, and relatively spotty in coverage, leaving many residents in the County without service. A map developed during this process show several "dead zones" (Appendix I). In addition to these areas that lack coverage it is important to understand that a number of homes and businesses within the shown wireless coverage areas cannot obtain wireless service because they are blocked by trees or located in a low-lying area which wireless signals cannot reach. We have anecdotal evidence to suggest that as many as 50% of the homes within the indicated coverage areas cannot receive an adequate wireless connection. And in some areas where DSL is generally available, the quality of the copper cabling to some homes is too poor for DSL to work.

Overall, while there are a number of providers, not one of them can (or tries to) claim it can provide service throughout the entire county.

Current wireless Internet service providers have been and seem to be continuing on a path of expanding coverage areas and increasing bandwidth (speed), but understandably aren't willing to make guarantees regarding future services.

A majority of the businesses located in and around Wausau are generally satisfied with available services as is shown in the results of interviews and the business survey. However, smaller businesses and home-based businesses in more rural areas of the County often have either just one or no broadband Internet service options. The business survey report is attached to this report as Appendix A.

Results of a residential survey[2] showed that more than 42 percent of respondents do not have broadband connections – some by choice. If extrapolated to the entire County's population, that would mean that 14,000 households would not have broadband service. The residential survey report is attached to this report as Appendix B.

From a regulatory standpoint we are living in a historic time as it relates to rural broadband. The Federal Communications Commission (the "FCC") recently issued a report that recognized that "[r]ural communities have long been unserved or underserved by broadband technology" and that "broadband service in rural America is generally inadequate."[3] The FCC also recognized that deploying "broadband throughout rural America will fundamentally benefit the nation's economy."[4] Thus, the FCC's national broadband goal is to achieve "ubiquitous and

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[2] The survey was mailed to 1,200 households with 507 valid responses. Thus the return rate for the surveys was over forty-two percent (42.5%). The confidence interval for that number of responses is +/- 3 percent

[3] See *Bringing Broadband to Rural America: Report on a Rural Broadband Strategy (the "Report on Rural Broadband Strategy")*, Federal Communications Commission, ¶¶ 15 and 27 (dated May 22, 2009).

[4] See *Id.* at ¶ 16.

affordable broadband for all, regardless of location, socioeconomic status, ethnic background, or any other factor."[5]

Recognizing that there are areas of rural America whose broadband needs are unserved or underserved, Congress through the American Recovery and Reinvestment Act of 2009 (the "Recovery Act"), appropriated $7.2 Billion for broadband grants, loans, and loan guarantees to be administered by the United States Department of Agriculture's Rural Utilities Service (the "RUS") and the Department of Commerce's NTIA.[6] Much of these funds are expected to help with the investments needed to bring broadband to underserved and unserved rural areas of the country.

Connecting rural America with adequate broadband is being compared to Rural Electrification Act of 1935 and the Federal-Aid Highway Act of 1956, which respectively first helped to bring electric and telephone service to all rural areas of the county and later connected rural areas to urban area through interstate highways, both of which transformed rural economic and social life. Subject to the terms of the Recovery Act and administrative rules of NTIA and RUS, the County, along with selected partners (if any), will have the opportunity to apply for funding under the Recovery Act for broadband infrastructure projects, public computer centers, and sustainable broadband adoption projects.

While there does not seem to be an overwhelming groundswell of demand in Marathon County for broadband services, there are instances in which the lack of broadband capacity leaves rural small businesses and residents at a distinct disadvantage when compared to their counterparts in more densely populated areas. For instance, the FCC has found that access to fixed and mobile broadband services has the potential of benefiting the agriculture business, enhancing educational opportunities, improving health care, enhancing the County's public safety and homeland security needs, assisting individuals with disabilities and offering "potentially enormous environmental benefits."[7]

3.1 Recommendations for Action

Through consultation with County Planning and Zoning and the City-County Information Technology Commission we suggest Marathon County undertake a series of short term (tactical) options followed by a longer term plan to pursue other, more strategic options.

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[5] See *Id.* at ¶ 7.

[6] See American Recovery and Reinvestment Act of 2009, Pub. L. No. 111-5 (2009) (the "Recovery Act). The Recovery Act was signed into law on February 17, 2009.

[7] See *The Report on Rural Broadband Strategy*, ¶¶ 16-21.

3.1.1   Short Term Activities

1. Educate citizens about options that already exist (please refer to section 7.1)

2. Support the expansion of wireless coverage in Marathon County (refer to sections 7.2 and 7.3) by facilitating use of existing towers by wireless providers and advocating that wireless providers expand coverage in known problem areas.

3. Work with providers to apply for grants and loans to improve middle mile bandwidth (refer to section 7.3.2.) Matching funds should be covered by the providers.

4. Consider subsidizing infrastructure enhancements through grant funding (please refer to sections 7.3 and 7.4.)

3.1.2   Strategic Plan

In order to use the Internet to its greatest potential (such as operating online businesses, telecommuting, and participating in video-based education) Marathon County should plan for a long term future that provides reliable Internet speeds in excess of 1Mbps – perhaps 5-20 Mbps – in all homes and businesses. Because current offerings don't reach everyone and most are quite limited in bandwidth, the County could undertake the following longer-term activities to improve the situation.

1. Encourage wireline telephone providers to apply for grants and loans that would allow them to expand coverage.

2. Seek out partnerships to build out a fiber backbone within the county that would allow either a) fiber to the home (FTTH) or b) fiber as a middle mile technology. A fiber backbone like this potentially would be able to be shared between multiple providers and technologies.

3. Research and consider pilot studies of other wired technologies, such as Broadband over Power Lines (BPL). Today, the most likely implementation of BPL would blend fiber in the middle mile with BPL for last mile connectivity.

4. Support efforts toward a community area network now being planned.

3.1.3   Priorities

Recognizing that there are diverse needs and many potential solutions, it is recommended decisions about these tactical and strategic options consider the following priorities:

1. Options that support improved connectivity to local units of government.
2. Options that support economic development.
3. Options that support educational activities.
4. Options that support service to residential users of internet service.

4 Process

The logical progression of this study began with researching the current broadband offerings and learning about needs of residents and businesses, followed by analyzing the gaps between those. The study then moved into the second phase: outlining feasible ways to fill those gaps and estimating costs to do so. Following is a summary of the activities undertaken for the first two phases of this project.

4.1.1 Phase 1 – Inventory, Needs Identification and Gap Analysis

This phase required a significant effort to gather data about the current status of broadband services, including

1. Six opportunities (open forum style meetings) for agri-businesses to provide information about their uses of and needs for broadband;

2. Three meetings for municipal officials from throughout the County, with participation by 26 individuals representing 18 municipalities;

3. Two public input meetings with total participation of approximately 25 individuals (some were employees of broadband providers);

4. An invitation to 975 area businesses to participate in an online survey, with 92 completed responses;

5. Brief interviews with five businesses located in business parks and a physical review of observable facilities in business parks;

6. Additional phone call interviews with three of the County's largest businesses;

7. A survey mailed to 1,200 residents, with 507 completed responses; and

8. Scores of communications with Internet Service Providers to request and obtain information about offerings, prices and coverage areas

After gathering all this information the study team compiled and analyzed the data. Part of that work included developing maps showing identified coverage gaps, and of coverage areas of broadband service providers willing to share that information.

4.1.2 Phase 2 - Cost Estimating and Potential Utilization of County's Public Safety Wireless Backbone

Based on the gaps identified, the study team analyzed how the County's new public safety wireless backbone system could be utilized as part of a broadband solution.

We also considered other feasible solutions or activities that could fill identified gaps.

Next, the study team developed conceptual (schematic) designs for the potential activities/systems, and estimated costs for such designs and activities.

4.1.3   Phase 3 - Ownership/Operations Models and Potential Partnerships

If after the first two phases there is a good case to take action, Marathon County may choose to give the go-ahead for the study team to evaluate various models to enhance broadband infrastructure to meet current and future needs. The Phase 3 deliverables would include information regarding potential take rate, ownership/ operations options, and potential partnerships.

If the County elects <u>not</u> to move forward after Phase 2, Phase 3 would not be undertaken.

5   Findings

5.1   Demographics

Marathon County consists of 41 townships, 15 villages and 6 cities. There are approximately 11,000 businesses operating in the County. There is no firm data to indicate how many of these may be home-based businesses.

The 2000 federal census lists a total population of 125,834 in Marathon County, with a total land area of 1,544.96 square miles. This calculates to a county-wide population density of 81.4 people per square mile. [*Appendix C - 2000 Census summary for Marathon County*]

At the time of the Census 38,436 people resided within the City of Wausau proper, which has a land area of 16.49 square miles. Wausau and some surrounding areas are designated by the Census Bureau as an "urban area" due to population density. [*Appendix D - Census urban area map]* The overall Wausau metro area has a population of approximately 72,000.

Much of the rest of County is rural in nature, with an average population density of fewer than 60 people per square mile. In fact, 25 of the municipalities have fewer than 30 residents per square mile.

A Census Bureau map of the County may be found in Appendix E. Each of the numbers indicates the quantity of people residing within the border of that area (these small areas are known as census blocks). This map is best viewed on-screen so one may zoom in on areas of interest. If you wish to print this map, it is designed to be printed at 36" x 60".

5.2   Terrain/Topography

Marathon County has diverse terrain, varying from moderately rolling areas with little surface water in the west to very hilly spots in the mid-eastern area, and with a fair amount of water and wetlands in the middle and southern/southeastern part of the county. Some areas in the northern part of the county are mostly forest.

Hills and ridges in various part of the county create "holes" and "shadows" that are difficult to cover with wireless services. Similarly, marshy wetland areas are a barrier to both wireless (very few areas suitable for towers) and wired services. There are also deep river valleys in the southwest and northeast areas of the County that make it extremely difficult to provide wireless coverage.

In some cases, though, hills are helpful to wireless service provision because (where permitted by regulations) locating a tower on a high point enables the signals to travel farther, allowing the provider to serve a larger territory. But if towers must be located on the side rather than the top of a hill this leads to "dead" areas on the opposite side.

5.3   Electric Utilities

Because some electric utilities take an active role in providing or supporting broadband services, the study team checked with the electric utility companies serving Marathon County to find out whether any had plans to do so, and to learn about their policies regarding potential use/lease of their facilities (poles, easements, fiber cables) for purposes of providing broadband services. We also asked whether these utilities had any plans that might entail constructing new facilities in the county, because that might provide an opportunity to add broadband facilities at the same time.

There are eight companies providing electrical service within Marathon County, not all of whom responded to our requests. In terms of territory served, the largest electric utility in the county is Wisconsin Public Service Corporation. Others serving smaller footprints include Alliant Energy, Central Wisconsin Electric Cooperative, Clark Electric Cooperative, Marshfield Utilities, Stratford Water & Electric, Taylor Electric Cooperative, and Xcel Energy. A map showing the service territories of each of these can be found at the Wisconsin Public Service Commission website: http://psc.wi.gov/utilityinfo/maps/electricmaps.htm

Both Central Wisconsin and Clark Electric partner with other companies to offer satellite-based broadband service. Other than that, none of the companies who responded to our inquiries indicated any near term plans for broadband services. For example, Taylor Electric Cooperative indicated its board has considered options, but is not interested at this time. A representative of Marshfield Utilities noted that it has nothing on the table currently, but as a publicly owned company is interested in pursuing options and helping out as feasible.

Similarly, none of the utilities with whom we corresponded indicated any plans for major construction or expansion projects within Marathon County.

Electric utilities have policies that permit the lease of space on their poles and in their easements. Pole lease rates run between $18 and $25 per pole per year. But that assumes there is available space on the pole in which to place telecommunications cable or antennas. Due to the risk of high voltage shocks, such systems may be placed only on a designated telecommunications portion of each pole, beneath the power wires. Only qualified installers are allowed to install cabling and/or antennas on or along electric utility facilities. Engineering work must be done to check whether space is available on each pole; if a pole needs to be replaced in order to accommodate telecommunications facilities, the cost can range from $1,500 to $4,000 per pole.

In all cases any broadband provider that may wish to utilize electric facilities needs to check with each electric utility individually regarding its specific policies and requirements. For example, Wisconsin Public Service Corporation allows telecommunications cabling to be placed underground in shared trenches with electric lines, but installers must be able to identify every cable in the trench and take extra care in the cases where natural gas lines may be within one foot of those cables.

5.4   Current Internet Services in Marathon County

For definitions of the various types of Internet services, please refer to the Glossary. However, additional information about fixed wireless technology is found later in this section since that technology is less well known compared with cable modem or DSL technologies.

Each of the broadband/Internet delivery methods has its own set of advantages and disadvantages, but with rare exceptions a general drawback is that users in a given area share a limited amount of capacity (bandwidth/speed). The more users in that locale who are connected at the same time, the slower the relative performance. Although systems may have originally been installed with plenty of capacity, as more subscribers are added providers often allow usage to grow beyond what systems were designed to handle; keeping costs down (and profits up). This is referred to as oversubscription or contention. Even DSL systems, which are often advertised as non-shared or dedicated connections, can have contention in the links between main equipment sites and the remote neighborhood equipment. How a provider is connected to the larger Internet and at what bandwidth also makes a difference in the user's experience.

For residents whose only choice (other than dial-up) is satellite-based Internet service, reliability and use for purposes requiring real-time two-way communications is a concern. Satellite services generally have reasonable downstream speed, but very low upstream capacity and significant latency due to the distance from the earth to the satellite. Examples of very problematic

applications for satellite Internet are web-based video conferencing, VPN use for secured telecommuting, and Voice over IP (VoIP). Thus, for employees of medium and larger corporations, working from home is difficult if using satellite-based Internet service. Weather can also be a factor in the use of satellite. Please see section 5.4.9 for more information about satellite-based Internet services.

5.4.1 Available Broadband Services

Excluding satellite-based and cellular/mobile Internet services (cellular mobile service is discussed later in this report) we collected information about nine (9) Internet service providers (ISPs) offering services within Marathon County. However, none of these ISPs provide service in **all** areas of this county.

Businesses and residents in the City of Wausau and the metro Wausau area have the largest number of Internet offerings from which to choose. In general, both cable modem and DSL services are available in this area, and much of it is also covered by one of the wireless Internet Service Providers (WISPs).

T-1 and DS-3 services are generally available throughout the County from many sources including wireline telephone companies, but are considerably more expensive than most of the other options discussed in this report. Both T-1 and DS-3 circuits are symmetric, which is an advantage to those who require higher upstream/upload capacity. These circuits are also dedicated, meaning that the customer leasing one of these circuits does not compete for bandwidth with any other customers.

For a listing of the providers, including contact information and types and costs of services offered, please see Appendix F.

5.4.2 Affordability

The table in Appendix F also includes advertised pricing as of July, 2009.

One way to compare prices among differing technologies and providers is to divide the monthly cost by the downstream bandwidth. Another is to compare packages with similar bandwidth from different providers. Keep in mind, however, that only a limited number of options may be available at a specific location.

Of respondents to the **businesses** survey who listed the costs they pay for Internet/broadband, approximately 45% indicated that amount is "somewhat high" or "too high". Reported monthly fees varied greatly, from a low of $28 per month to a high of $10,000 per month. The average expenditure for the sixty-eight (68) respondents that gave a dollar amount is $382 per month.

On the **residential** side, of the 368 households that provided the dollar amount of monthly costs, 59% categorized those costs as "somewhat high" or "too high.

The average cost per household was $38.05 at the time of the survey (July 2009).

5.4.3 Speed/Bandwidth

Survey responses and public meetings indicate there are some very real limitations in the amount of bandwidth available throughout the County. Businesses and residents in the Wausau vicinity generally have one or two higher speed options. But most other parts of the county struggle to obtain services at satisfactory speeds.

In addition, subscribers often are not aware of all the uses they could make of higher bandwidth connections, although those who telecommute or would like to do so understand that a high speed connection is a must.

It is also important to understand that advertised speeds are "best case" and subscribers may not be able to expect such speed on a regular basis. Your distance from the provider's equipment, the number of simultaneous users in your area, and other factors all can reduce the overall speed at your business or home. In other words: "Your speed may vary."

5.4.3.1 Businesses

Of the businesses that responded to the survey (Appendix A) and were dissatisfied with their current Internet service, approximately 26% listed speed as a reason for that dissatisfaction (Question #14).

A significant number of survey respondents (51) noted there are activities that they would like to perform on the Internet that they are currently unable to do or were frustrated doing using their current Internet service (Question #18). Most of those activities require significant amounts of bandwidth, especially the two most selected answers: "transmit large files and/or videos to customers" (14 responses) and "video conferencing" (11 responses).

5.4.3.2 Residents

Of the residential survey (Appendix B) respondents who said they were dissatisfied with their Internet service, 64% said it was because of speed (Question #8).

Regarding telecommuting, of those who chose "Optional" as a response to Question #13, one hundred percent (100%) indicated that Internet speed kept them from telecommuting (Question #14).

Telecommuting offers distinct advantages including reducing greenhouse gas emissions from cars, increasing productivity (less time spent driving), and curbing the use of fossil fuels. When those who are eligible to telecommute

cannot do so because of slow or unreliable Internet service, all these potential benefits are lost.

When residential survey respondents were asked how much more they would be willing to pay if they could obtain a significantly higher connection speed (Question #20), 47% answered $10-$30 more per month.

Residents who attended the public input meetings also indicated slow speeds were hampering their Internet uses.

Taken as a whole these responses would seem to indicate there is a real opportunity for providers that are able to offer higher bandwidth residential options.

5.4.4   Coverage Areas

The study team developed three maps related to broadband coverage:

♦ The first (Appendix G – Known and Assumed Wired Broadband Coverage) shows areas reported as having access to either cable modem or DSL service. Several providers did not share their coverage mapping with Marathon County. Coverage areas were determined based on a combination of information reported by survey respondents, meeting attendees, and providers who elected to cooperate in the study. This is not intended to be detailed, but rather to give County residents some concept of whether wired broadband may be available in your area; to be sure you will need to check with Charter cable (see following section for how to do this) or your local telephone company. This map also documents some known carrier-owned fiber optic paths.

♦ The second map (Appendix H – Claimed Wireless Broadband Coverage) indicates coverage areas of Internet/broadband service providers as noted by those providers, and to the degree possible, confirmed by survey results and public meetings. Elert & Associates believes this map is fairly accurate, with the caveat that even though it may indicate coverage in a given area, there is no guarantee of broadband service to any individual home or business because a variety of factors (e.g., being located in valleys or surrounded by trees) can affect service availability.

♦ The third map (Appendix I – Known and Assumed Gaps in Broadband Coverage) aggregates input of residents, businesses, municipal officials and providers. The participants were asked to indicate where and what type of Internet service they currently have, and/or where they knew from experience there was little or no broadband service available. This map is not a definitive or complete compilation, but does give a general idea of areas that lack broadband service.

5.4.5   Internet via Cable Modem

Charter Communications and Charter Business Networks offer cable modem-based services to residents, and multiple types of connectivity, including fiber optic connections in some areas, to businesses. These services tend to be available only where there is a relatively high population density and/or along major roads and highways.

Charter is the sole cable TV provider in the county. Although the state recently changed franchising requirements in order to encourage new providers, so far no new cable TV providers have offered service in Marathon County.

Charter Communications elected not to respond to our request for coverage information, therefore this study could not incorporate specific data about where Charter service is available. In general, Charter cable modem services are offered within the boundaries of a city or village. Based on the information found on Charter's web site and what we were told by residents and municipal officials, Charter cable modem service is available in at least <u>some part</u> of the following cities, villages and towns: Abbotsford, Athens, Birnamwood, Dorchester, Edgar, Hatley, Marathon City, Marshfield, Mosinee, Rothschild, Schofield, Stratford, Wausau and Weston.

Residents may check whether Charter cable modem service is available to them by calling 888-438-2427 or by going to https://www.charter.com/order/localize.aspx?targetpage=../order/alloffers.aspx and filling in either the phone number or address where service is desired.

As one can infer from the name, Charter Business Networks (CBN) focuses on commercial customers and offers some features not needed by most residences, but which are appealing to corporations. An example is keeping a business's Internet traffic separate from the public Internet. In some cases, Charter Business Networks will provide a direct fiber optic connection (rather than coaxial cabling) in order to provide a larger amount of bandwidth or to reach a more distant location. Potential customers must contact CBN directly at http://www.charter-business.com/Products-Services.aspx or 888.692.8635 to find out whether this is an option at their business location. In areas where this is available the cost to install fiber usually must be paid by the customer.

At the time of this report, Charter (and subsidiaries) is in Chapter 11 bankruptcy, but expects to continue to offer services without interruption.

While franchises for residential cable video (television) service are reviewed and approved by the Wisconsin Department of Financial Institutions (http://www.wdfi.org/corporations/VideoFranchise.htm), that entity does not have authority to regulate Internet services.

5.4.6   Digital Subscriber Line (DSL)

DSL services are delivered via telephone cables, but having a wired telephone line does not guarantee the availability of DSL service. There are distance and other physical issues that can limit access to DSL within any given area.

Telephone services provided by landline telephone companies are regulated, and in the past, distinct territories were assigned to those companies, which has affected where DSL services may be available. See Appendix I for a map showing these territories within Marathon County. This map is based on a state-wide map developed by the Wisconsin Public Service Commission (WPSC) and brought to the county level by Marathon County. Note that customers have no choice as to which company provides <u>landline</u> telephone service in their area.

Landline telephone service providers may allow other entities to re-sell DSL services via the wires owned by that telephone company, thus giving customers a choice of Internet service providers. But this is only the case if DSL can be provided to that customer in the first place considering the physical limitations noted above.

Verizon (www.verizon.com) provides DSL services to its customers subject to on availability, and also allows resellers to purchase DSL services for resale. **Solarus** and **Network Professionals** both resell Verizon DSL in some portions of Marathon County.

As of May 13, 2009, Verizon entered into an agreement with Frontier Communications to sell all Verizon's Wisconsin landline business to Frontier (press release from Verizon: http://newscenter.verizon.com/press-releases/verizon/2009/verizon-to-divest-wireline.html). The two companies plan to complete this transaction within 12 months from the date of the announcement. This means that Frontier Communications would become the primary DSL provider in the current Verizon territory within Marathon County.

For a number of reasons, including aging copper cabling and distance limitations, there are many Verizon landline customers in Marathon County who cannot obtain DSL service. The study team was unable to reach a Verizon representative who could/would provide data about areas in which DSL is and is not available in the county. To find out whether Verizon-based DSL is available at your location, go to http://www.dsl-providers-broadband.com/wisconsin-verizon-dsl.html and type in your phone number or address and zip code. Or you can check with **Solarus** (http://www.solarus.net/telephone_servarea_veriz.php) or **Network Professionals** (http://www.netpros-inc.net/content.cfm?PageID=7) regarding availability of DSL in Verizon's Marathon County territory.

Three other DSL providers in the county have smaller coverage areas (or "footprints") based on their telephone service areas.

TDS Telecom (www.tdstelecom.com) covers a small portion of the northwest area of the county (portions of the Towns of Bern, Holton and Johnson, including the Village of Dorchester), and also recently acquired Mosinee Telephone Company. The former Mosinee Telephone was an early provider of DSL services, and had extended DSL coverage to nearly 100% of the area in which it offered telephone line service. A TDS representative indicated 90-100% DSL availability in the former Mosinee Telephone area, and information gathered during this study supports that claim. TDS further indicated that the northwest area has approximately 50% DSL coverage.

Wisconsin Internet DSL (www.wi-net.com) is available to customers of the **Amherst Telephone Company** in small portions of the Towns of Bevent and Franzen. Telephone exchanges served include 592, 677 and 894. DSL is not necessarily available to all landline customers in these exchanges, however.

WittenbergNet (www.wittenbergnet.net) is a division of **Wittenberg Telephone Company** and provides DSL service within telephone exchanges 253 and 454 (southeast corner of Marathon County, including the Village of Elderon, and portions of the Towns of Bevent, Elderon and Franzen). If you already have telephone service through Wittenberg Telephone, it is very likely you can obtain DSL service as well. In fact, a representative of WittenbergNet indicated this company guarantees that some level of DSL service is available to all its landline telephone customers.

The Wisconsin Public Service Commission (http://psc.wi.gov/) regulates landline telephone services, but not Internet services (DSL) delivered via those lines.

5.4.7   Fixed Wireless Service

In this case, the word "fixed" service means service to stationary locations such as homes and businesses, not to mobile users. With this method, a centrally located base station is installed and links are established to end points via radio waves.

Fixed wireless broadband access typically operates in one of three bands of frequencies. The most widely used bands are unlicensed 900 MHz, 2.4 GHz, and 5.8 GHz. Neither 2.4 GHz nor 5.8 GHz penetrate well through trees but 900 MHz can do so to a limited extent. The primary drawback of 900 MHz compared to the other two frequency ranges is lower bandwidth. Some providers also offer wireless service using licensed frequencies, which reduces the possibility of interference.

Generally, a tower or other tall structure is selected on which to mount needed base station (central transmitter/receiver) equipment. Antennas at the base station can look much like the antennas on a cell phone tower. Equipment in a shelter or "hut" below the tower may include rack-mounted systems such as a UPS, router(s), control computer and/or radios.

At the subscriber (customer) end of each link, an antenna, radio and possibly a router connects to the user's computer or computer network. The antenna may consist of a flat panel, a vertical rod or a directional antenna which points to the base station. A cable interconnects the antenna to the customer's computer.

The customer's site may require a tower or mast of some type as well. This allows subscriber locations to "see" the base station and establish a line of sight. In the farming areas of Marathon County, silos are sometimes used to gain sufficient height above trees and other obstacles, providing a clear sight line to the nearest base station.

The following diagram is a conceptual example of a wireless service.
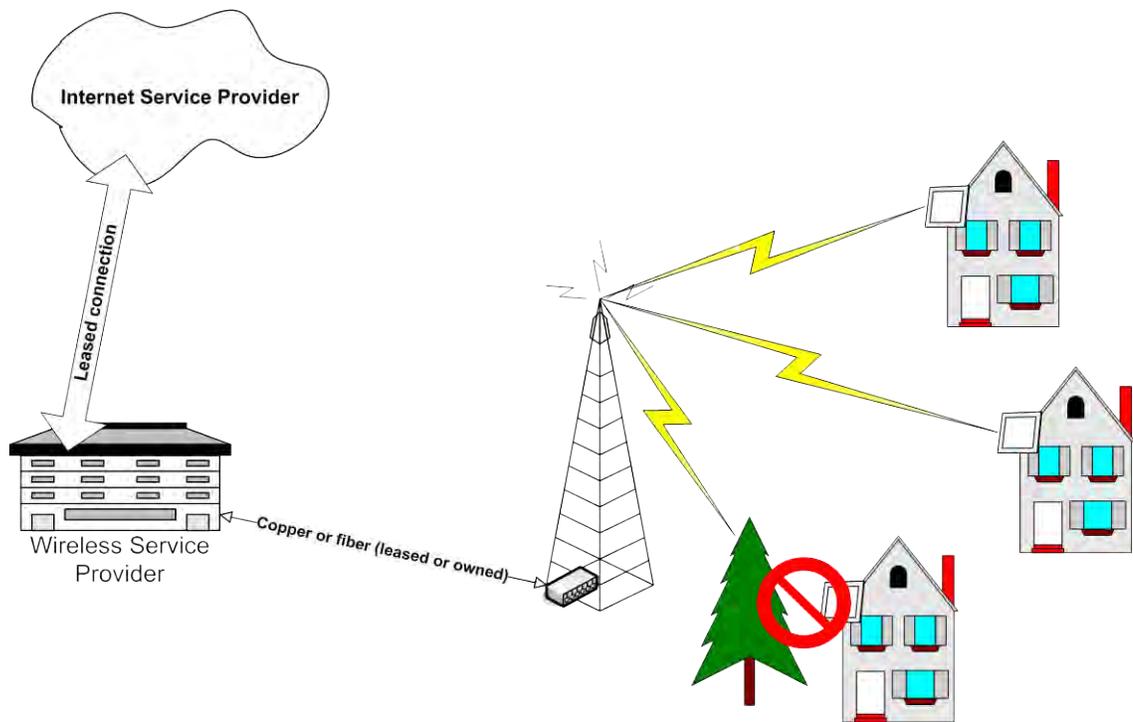
5.4.7.1   Speed/bandwidth

The current generation of fixed wireless services offered as a shared service (sectorized) typically can provide bandwidths of from 256 Kbps to 3 Mbps. The speed of individual connections will vary based on a number of factors including terrain/obstacles, the number of other subscribers in the same vicinity, and distance. In fact, the connection speed/s available to any particular location is often directly related to the distance from the nearest distribution point in the provider's network.

Most, but not all offered fixed wireless services are symmetrical downstream and upstream. However, different providers may implement any combination they believe will work best (per local terrain constraints) and attract the greatest number of users. (For Marathon County options as of July 2009, refer to Appendix F).

5.4.7.2   Use of Wi-Fi

Many people use Wi-Fi regularly within buildings like homes, libraries and stores, but using Wi-Fi as a wide area coverage technology is challenging. Some of the ISPs offering fixed wireless services in Marathon County already use Wi-Fi in parts of their networks. Other, new providers could as well, but have to deal with the same technical problems, which include potential interference, low ability to penetrate trees and/or walls, and more rapid signal deterioration compared to cellular technologies. Additional challenges include: a typical Wi-Fi access point covers a radius of only about 500 feet around it and must have electrical power.

5.4.7.3   Available Fixed Wireless Services in Marathon County

Companies offering wireless options are often not national in scope, but rather local, small businesses. These businesses are known as Wireless Internet Service Providers, or WISPs.

There are five known companies that provide fixed wireless service in various portions of Marathon County: **AirRunner Networks** (www.airrun.net), **Cellcom** (www.cellcom.com), **Country Wireless** (no web site; phone: 715-389-8584), **Network Professionals/Air-Net** (www.netpros-inc.net) and **Solarus** (www.solarus.net). Each has a different service coverage area, some of which overlap. Refer to Appendix H which shows the coverage areas stated by three of the five providers.

While Cellcom representatives discussed the coverage in Marathon County with the study team, the maps they provided are considered trade secret information, therefore Cellcom's coverage area is not included on the aggregate map. However, we can note that coverage is available across much of the county, but like all wireless services, depends upon how close the customer is to the nearest tower. Elert & Associates estimates Cellcom's broadband service covers ***approximately*** 35% of Marathon County.

Solarus indicated it is in the midst of updating its coverage map and estimated their company can provide service to ***approximately*** 15% of the County from two current tower locations (Brokaw and Stratford) using licensed 700 MHz frequencies.

Country Wireless (mostly in southeast area of the county) indicated it has plans to implement substantial bandwidth increases later this year.

Even though homes or businesses may be within the listed or mapped coverage area of one of these companies, there is no guarantee that it can obtain service. Wireless signals generally require a clear line of sight between the provider's nearest tower and your location. That means if your house is in a valley or is surrounded by trees it may not be possible to obtain service, or it may require addition of some sort of tower on your property to, in effect, "reach up" to intercept the wireless signal.

All wireless signals deteriorate (degrade or attenuate) with distance; the further the distance, the lower the speed/bandwidth. So if your site is near the "edge" of a provider's service coverage area, the signal strength may be insufficient to provide reliable service. Thus most WISPs cannot guarantee you can receive service, much less a particular speed until they have come to your location to measure the amount of signal that reaches that location. This type of visit is known as a site survey. Once that survey has been completed, the provider will let you know whether service is available and what speed or speeds you can get. Refer to Appendix F for a table listing the different services that may be available.

The current fixed wireless service offerings are not a panacea for everyone. Some residents who already have this service reported they found it too slow and/or not reliable enough for their purposes. If several neighbors are connected to the same service, heavy use by one or more of them can cause all to suffer reduced speeds.

5.4.8 Mobile/Cellular Wireless

Most cellular providers now offer some version of wireless "data" service in addition to traditional voice service, but coverage areas and bandwidths vary greatly from one locale to the next.

Customers typically either obtain services directly via mobile devices such as netbooks, smartphones or PDAs which have built in radio modems, or may purchase a separate modem. Today's cellular modems (sometimes referred to as "air cards") are usually USB devices or cards that fit into PC Card slots in computers.

5.4.8.1 Speed/bandwidth

Where users can obtain 3G service (AT&T calls its service EDGE; Sprint & Verizon provide versions of EVDO), downstream bandwidth is typically from 800 Kbps to 1.5 Mbps, and upstream from 200 Kbps to 800 Kbps.

Due to the difficulty of maintaining consistent signal strength when in motion, passengers in moving vehicles using cellular networks for data/Internet access will experience lower performance (speed) than when they are stationary.

5.4.8.2   Coverage areas

> Within Marathon County most of the nationally known carriers' data service coverage areas are limited to the immediate Wausau vicinity and the I-39/51 and Highway 29 corridors.
>
> Cellcom, a regional carrier headquartered in Green Bay, covers a larger cellular "footprint" within Marathon County. Besides its fixed broadband offering noted in the previous section, this company also offers mobile broadband. Pricing is noted in the table comparing local ISP/broadband services.

5.4.9   Satellite-based Internet Service

> Marathon County residents and businesses can obtain Internet service through either **Hughes Net** (http://go.gethughesnet.com) or **WildBlue** (www.wildblue.com).
>
> Satellite Internet service can be obtained anywhere satellite television works – the key is having a clear path from the home or business to the satellite (south-southwestern sky). Thus the satellite dish must be placed in an unobstructed location. WildBlue's web site has a graphic showing how satellite Internet service works: http://www.wildblue.com/aboutWildblue/how_it_works_demo.jsp.
>
> Satellite-based Internet service offers higher speed than dial-up services and has very widespread coverage. Assuming a clear path (which is not a given), any location in Marathon County can access satellite services.
>
> Costs for satellite service tend to be somewhat higher than other broadband services on a per-kilobit or per-megabit basis. Initial equipment costs can be steep, but may be discounted as an incentive to sign up. Customers may also be able to lease equipment for a monthly fee rather than pay for it up front.
>
> The primary drawbacks to this type of Internet service are the relatively slow upstream speed, the delay (latency) in two-way communications and the potential of downtime due to bad weather (especially heavy rain). In general, it is not possible to support VPN (most large businesses use a technology known as VPN to secure traffic back and forth to their home-based workers) and Voice over IP services (many businesses have converted their telephone systems to VoIP to deliver telephone calls over Internet connections) over a satellite connection without special hardware. These disadvantages make satellite service a less attractive choice for many consumers compared to other broadband services.

5.5 *Business Broadband Findings*

The study team investigated the business community in two distinct ways: interviews/meetings and an online survey. The interviews/meetings cannot be viewed as a statistically random sampling since specific businesses were asked to participate in the interviews/meetings, but it does indicate an overall view of these unique subsets of businesses.

5.5.1   Interviews/Meetings

Representatives of several of the businesses we talked with were not sure what type of broadband service they had or the speed or costs for the services. But in most of those cases they also had no complaints. From this we surmise that those businesses are mostly satisfied with their current service.

Following is a sampling of businesses we contacted who were able to provide more details about their current Internet services:

1. A large business of international scope located in the Stratford business park indicated that until recently its only broadband option was a T-1 circuit (1.5 Mbps both down and upstream). This had created a significant limitation on features such as web-based video, training and other uses. However, Charter Business Networks very recently (early July) brought new service to the Stratford business park. The business believes this new service offering to be due partly to requests by their previous IT director. The company now subscribes to a dedicated 10 Mbps service and is quite happy with the improved speed. The change is so recent they have not yet formed an opinion about reliability or customer service. The current IT director at this company noted that for residential service in this area he's aware of Country Wireless and Cellcom as options.

2. An established small business (33 years in business; 7 personnel) in a Spencer business park indicated it has Verizon DSL service and is satisfied with it. This company uses it mostly to receive orders via email, although roughly half their orders still come in by fax.

3. Another business in Spencer (different business park) uses Verizon DSL as well. This company subscribes to the "third highest" speed level available. They have found the service very reliable. They use an Internet service combined with two business lines, and thus weren't sure what the cost of Internet only would be. This business uses the Internet for online banking and to order products.

4. A business with 22 employees in the Marathon City business park also uses Verizon DSL. They chose the highest level of service available, estimated their cost at ~$60 per month, and are generally satisfied with the service.

5. One of the ten largest businesses in the County, located in Wausau, indicated it uses Charter Business Networks for its primary Internet service. This company uses four separate connections with Charter – 2 at 20 Mbps, 1 at 30 Mbps and 1 at 40 Mbps. In addition, it has T-1 service from AT&T as a backup. The IT Director indicated he would like to have more high speed service choices (other than Charter). He noted that many of the company's employees are only able to get satellite or dial-up Internet service at home and are very frustrated when trying to access company information when working from home.

6. Another of the largest employers in the County (a health insurance company) indicated they have no issues with Internet capacity and are satisfied with the current service.

5.5.2   Agri-business

The study process allocated six open forum meetings specifically for agri-businesses in the county. More than 60 businesses and cooperatives were invited to attend these meetings. Unfortunately there was very little participation. One small farm owner and one representative of a co-op attended. The farm owner who participated is also a director on the board of a different cooperative.

The farm owner indicated their family-owned business subscribes to a wireless service from a local WISP at a cost of ~$36 per month for ~384 Kbps service. He considers this to be somewhat slow, but adequate. There is an option for faster service at higher cost. His spouse needs to use the Internet for online courses required for her job. She finds the speed very slow for this purpose. They had previously tried satellite Internet service, but found the wireless connection to be faster. The wireless provider uses the silo on a nearby farm to relay ("bounce") signals to other local subscribers.

For the farm owner, Verizon is the local phone company (landline), but does not offer DSL at his location. Charter cable also is not available. He noted that fiber runs about 200 feet from one of his properties, but he can't get access to it. He would switch providers if there were a new option, assuming the costs and benefits made sense.

When discussing lack and affordability of Internet services in general, the farm owner noted that the public library in Edgar offers free Internet for up to 90 minutes per person per day.

The representative of the cooperative is the person responsible for technology services there and indicated the co-op uses Verizon DSL for Internet service and is satisfied with it. He mentioned that their office is "right next to" the local Verizon office. Uses of Internet include map downloads, notifications to farmers, online manuals (parts) lookups and online purchases. He noted that many of their member farmers only have dial-up Internet service. In his opinion

the cost of other options is the main reason most farmers still have dial-up service.

5.5.3   Business Survey Results (Appendix A)

In summary, the results indicated that almost eighty (80) percent had access to broadband as defined by the NTIA[8] and 70% of the respondents are satisfied with their current service.

Having said that, this survey generally elicited responses from the urban triangle from Wausau to Mosinee to Weston as approximately ninety (90) percent of the respondents were in this urban triangle. Therefore, access to broadband Internet services outside this urban area should not be assumed to be represented by this survey.

Also the survey found that approximately thirty (30) percent of the businesses were unable to do everything they wished, were dissatisfied with current services, or felt they could expand if a better internet connection was available Please refer to Appendix A for the complete Business Survey Report.

5.5.3.1   Regional Chamber of Commerce

Prior to the online survey, the consultants met with a representative of the Wausau Regional Chamber of Commerce. The Chamber representative noted that just this past winter (2009) the Chamber undertook an assessment of Internet services for its members. The results indicated there is quite good wireless Internet access throughout the County for businesses. Based on communications with members, there did not seem to be any significant gaps in coverage. The review found that cost is more of an issue to Chamber members than access/availability.

5.5.3.2   University of Wisconsin Extension Office

Mr. Mike Wildeck of the local UW Extension Office spoke with us regarding Internet access and use. One example of issues that local farmers may face is that the state requires farms to use a specific software application for nutrient management and reporting. Mr. Wildeck made presentations about a new version of this software to ~70 participants at various sites around the County last fall. The new software was made available for farmers to download via the web. It took some of the participants 45 minutes to download this rather small application, and a new version is released at least once per year.

Another use for Internet service is purchase of commodities, but one needs to have reliable access to do this. Some have tried satellite Internet, but found it

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[8] The NTIA standard for "broadband" is at least 768 kbps downstream and 200 kbps upstream.

would often fail during stormy weather. Mr. Wildeck also noted that more and more web sites have large graphics files and/or video which make the use of dial-up almost impossible. From his observations, many areas of the County still lack higher speed Internet options.

5.6 Residential Broadband Findings

Five hundred and seven (507) validated completed surveys were returned to Marathon County of twelve hundred (1,200) mailed out. The return rate for the surveys was over forty-two percent (42.5%). The confidence interval for 507 responses is at the 97 percent confidence level or +/- 3 percent.

5.6.1   Residential Survey Results (Appendix B)

Overall, it appears that the respondents to the survey that had Internet access would overwhelmingly consider switching providers based on price and speed considerations. We are assuming this to be significantly true for those respondents (twenty-six (26) percent) that are using dial-up providers and are not currently receiving "broadband" service as defined by the NTIA. Further, it appears that those respondents that do not have Internet access (twenty-six (26) percent) are older and earn less than those with Internet access.

5.6.2   Public Libraries

As an adjunct to Internet service at their homes, several participants of various meetings mentioned there is free high speed Internet access available at local public libraries. We checked this with a representative of the library system, Mr. Garrett Erickson.

Mr. Erickson indicated that libraries do indeed provide Internet access, but that **most branches are "maxing out" their Internet capacity nearly every day**. The exceptions to this are the main library in Wausau and the Rothschild library which has a fiber connection to the main library. Each of the other 7 branch libraries (Athens, Edgar, Hatley, Marathon, Mosinee, Spencer, and Stratford) has just a single T-1 connection (1.5 Mbps both down and upstream) due to budget constraints.

Most libraries also provide some computers for those who do not have their own, but the number of computers is partly constrained by space in which to place them.

If a resident has a laptop, he or she can bring that to a library and use the Wi-Fi wireless the libraries make available at their locations. However, whether wired or wireless, all simultaneous users at one branch library still share 1.5 Mbps of total capacity.

As noted elsewhere in this report, in order to accommodate as many patrons as possible some of the libraries limit the time any one user can spend each day using the provided computers.

5.6.3   Higher Education

Northcentral Technical College also wants to be able to provide a two way, synchronous audio video conference to students at business and industry and to their homes. Chet Strebe, the CIO of NTC, reports that the college has the technology, but doesn't have the bandwidth to students and to business and industry.

5.6.4   School Districts

Representatives of CESA #10 (serving Athens & Spencer School Districts), the Mosinee School District and the Stratford School District responded to questions emailed by the study team. Those questions requested information about connectivity among school buildings, publicly accessible computer labs and broadband subscribership at students' homes.

These districts each have fiber optic links between their buildings. This is slowly becoming the norm for public K-12 districts. Most of that fiber is leased from either Verizon or Charter. Most districts pay an ongoing fee for the connectivity and the higher the capacity (bandwidth), the higher that cost.

Both Stratford and CESA #10 have surveyed students about connectivity at their homes. The Stratford survey was conducted in 2007 and found 41% of students' households subscribed to broadband service. The CESA survey was conducted in the 2008-2009 school year and also indicated approximately 40% of students have broadband at home. More than 50% of Mosinee district students have such access.

With regard to the availability of computers, the CESA survey showed that 90% of households with students in its districts had computers. The Stratford district will accommodate those who need access to computers via the school library during school days and in the business education rooms in the evenings (upon request of a community member or parent).

5.6.5   Public Input Meetings

Meetings open to the public were held from 7:00 PM – 9:00 PM on July 7 and July 8, 2009. Notice of these meetings was published in the local media per standard County procedure.

To preserve their anonymity attendees were not asked to sign in. Approximately 25 people attended the two meetings. Some participants were employees or owners of local Internet service providers and attended both meetings. Those

individuals did introduce themselves as representatives of providers, and were counted only once.

At both meetings, participants were asked to mark on a map either their own residence location with type of Internet service or areas they are aware of that lack broadband Internet service.

A common concern among attendees of both meetings (and the municipality meetings as well) was that "everyone <u>assumes</u> we have high speed Internet" and that residents who do not have that option are at a distinct disadvantage, especially if there are school age children in the household or they operate a home-based business.

5.6.5.1   July 7th meeting

At this meeting the study team asked whether residents have a choice of high speed Internet services, and most answered in the affirmative.

Three wireless Internet service providers had personnel in attendance. Due to these providers' systems there is relatively good coverage west of Wausau, but there are still significant numbers of residences that may be within a wireless provider's coverage footprint but cannot receive signals due to being blocked by trees and/or terrain.

One resident who currently subscribes to a wireless service indicated it is better than dial-up or satellite, but still insufficient for their needs. They want a dedicated amount of connectivity, not shared. One person in their household uses the Internet quite heavily and has been called several times by the wireless provider requesting that they reduce activity because it is affecting other subscribers in the area.

5.6.5.2   July 8th meeting

Several residents who have Verizon telephone service stated they cannot get DSL service. Further, copper cables are so bad in some areas that even dial-up service is degraded (maximum speed of 26 Kbps in one case and 44 Kbps in another) compared to the typical maximum speed of 56 Kbps. Residents who live near a line between Verizon and Mosinee Telephone (now TDS) territories noted that as a Verizon phone customer they cannot get DSL, but just across the road, Mosinee (TDS) DSL is available. They feel they should be able be served by their choice of provider (not limited due to a line drawn many years ago).

Residents from the Town of Texas and the southern portion of the Town of Marathon noted they have very few choices of Internet service. One resident of the Town of Texas who wanted to run a business from home ultimately gave up because of the lack of high speed Internet access.

One couple commented that they feel the lack of Internet options affects their home's value.

Another resident noted they brought their children to their workplace so those students could access homework.

One business in Birnamwood has employees who would like to telecommute but who cannot because they only have dial-up.

Two residents who currently subscribe to satellite based service indicated the performance is slow and/or unreliable, but it is the only choice other than dial-up.

One resident who does volunteer work noted that her service to the community is limited/reduced by the loss of productivity due to slow Internet service.

5.6.6   Municipality Meetings

Municipal officials of all the cities, towns and villages in the county were invited via mailed invitations and email messages to attend any one of three meetings to gather information about municipal needs as well as those of residents within those municipalities. The meetings were held in the afternoons of July 7 and July 8 and the evening of July 15, 2009.

At all three meetings, participants were asked to mark on a map areas they are aware of that lack broadband Internet service.

5.6.6.1   July 7th Municipality meeting at Cassel Town Hall

14 total representatives of the towns or villages of Cleveland, Emmet, Wien, Frankfort, Cassel, Halsey, Edgar and Berlin participated in this meeting.

♦ Some of these individuals do not have Internet service as they are not comfortable using computers. Many of those indicated, however, that others expect them to have it, especially for tasks such as reporting to state agencies.

♦ One attendee said they have been trying to get Solarus to install a tower for more than two years so they can receive wireless Internet service.

♦ The Town of Halsey has many trees which results in poor wireless and cellular coverage. The phone lines in that area were also said to be in poor condition.

♦ One attendee said they get discounted Internet access because their silo is used to serve two other households (wireless).

♦ One participant stated that paying for three different services each month, a landline phone, cell phone and Internet, is too costly.

♦ Town of Halsey representative noted that schools now expect Internet access at students' homes.

5.6.6.2   July 8th Municipality meeting at 212 River Road, Wausau

A total of 10 representatives of the Cities of Mosinee and Wausau, the Village of Kronenwetter, and the Towns of Berlin, Easton, Hewitt, Texas, Franzen and Rib Mountain participated in this meeting.

♦ An emergency medical technician present stated their team needs Internet access all of the time, and it must be reliable.

♦ Representatives of Easton, Hewitt, and Texas indicated there is little or no access to high-speed services in those areas.

♦ A representative of the Town of Texas noted that telecommuting isn't possible there due to lack of high speed services.

♦ The Town of Texas was told they would need to install towers to get wireless Internet service, but feel that is too costly and shouldn't be necessary.

♦ Representatives of Franzen and Rib Mountain noted that broadband is available but too costly. They feel this is partly due to a lack of competition in those areas.

♦ The City of Mosinee is well covered – Charter cable modem service and Mosinee Telephone (TDS) DSL are both available.

♦ The Village of Kronenwetter feels fortunate to have Mosinee DSL for most purposes, but the upstream capacity is not sufficient for police video they need to transmit.

5.6.6.3   July 15th Municipality meeting at 212 River Road, Wausau

Two individuals representing the Towns of Hull and McMillan participated.

♦ McMillan Town Hall and Fire Station have wireless Internet service.

♦ Some McMillan residents use the Marshfield public library for public Internet access.

♦ McMillan has 2-3 high-speed Internet service options – due to being close to Marshfield.

♦ The representative from Hull noted that she knows of only one business there that has DSL.

♦ The Hull Town Hall does not have Internet service.

♦ Hull residents often use the public library in Colby for Internet access.

5.6.7   Other Gathered Information

One resident became aware of the study via the media and contacted the County to provide input. He has lived in the Town of Stettin for 20 years. He noted that houses on a street just to the west have access to Verizon DSL service, but DSL is not available to the six homes on his street (Little Rib Circle). Because this area is in a low spot and surrounded by trees, they have also not been able to obtain high speed wireless service. One of his neighbors subscribes to satellite Internet service, but the resident who contacted us felt this service was too expensive.

County personnel provided summaries of requests and comments from the most recent Comprehensive Plans adopted by municipalities and incorporated into the County's overall Comprehensive Plan. Much of this input was collected in prior years and some circumstances may have changed in the interim. Within that context, six municipalities (Birnamwood, Holton, Johnson, Plover, Ringle and Texas) referenced "conditions or issues" related to telecommunications, and five of those developed one or more goals related to this topic.

5.7   Fiber Facilities (known or discovered)

It can be difficult to learn where fiber optic cabling is located. Most fiber owners consider this trade secret information. Where fiber runs underground, it can often be identified by slim upright poles placed along the path of the fiber – usually along highway rights-of-way. Those poles are usually labeled with the name of the fiber's owner. The study team found or was told about the following fiber facilities, and in two cases approximated the locations of those fiber pathways on a map in Appendix G.

1. Verizon (the wireline telephone company, not the cellular company) owns multiple underground fiber cables that run (more or less) along Highway 29, Highway 13, and another which runs to east to west. A retired Verizon engineer indicated that the Highway 13 fiber is quite old and might have less capacity than other fiber.

2. Qwest owns underground fiber running from the east edge of the county along Highway 29, then following County Road N westward out of the Weston area and through to the County's west border. We were told that two conduits were placed in this path, only one of which contains fiber. This would potentially allow another entity to purchase or lease the empty duct for its own purposes, if Qwest were amenable to that.

3. Norlight/KDL has fiber connecting Wausau to Green Bay, Stevens Point and Merrill. This is a part of Norlight Telecommunications' inter-city fiber system. A schematic map may be viewed at: http://www.norlighttelecom.com/network.asp

4. Underground fiber was found in the Abbotsford business park. It is labeled as belonging to GTE, however since that entity merged with Verizon we assume it now belongs to Verizon. We were unable to verify this, however.

5. The Athens School District, Spencer School District and Mosinee School District each lease fiber connections between school buildings within their respective districts. Thus we can deduce that leased fiber could be obtained in the near vicinity of each of those school buildings.

6. It is a certainty that both Verizon and Charter own fiber within Wausau and the near vicinity, but we were not able to identify specific paths.

7. One cellular/wireless provider indicated it has installed fiber to connect some of its primary communications facilities.

5.8   Regulatory Climate

5.8.1   Federal Rules and Regulations

While Marathon County has no intention of offering broadband services to businesses or residents, Federal law and regulations do not prohibit local governmental provision of telecommunications, cable or information services. Section 253(a) for the Telecommunications Act of 1996 provides, "No state or local statute or regulation, or other state or local requirement may prohibit or have the effect of prohibiting the ability of any entity to provide any interstate or intrastate telecommunications service".

All telecommunications providers must comply with all FCC rules and regulations on the actual provision of any communications services delivered solely or in concert with other entities. The choice of delivery technology will determine the federal rules and regulations applicable to the service.

1. Fixed Wireless

Federal rules and regulations for fixed wireless service are minimal. As described in Section 5.6.7, fixed wireless service transmits broadband service from stationary points to user antennas. If the County utilizes fixed wireless broadband service, the County must comply with federal rules and regulations for broadcasting radio signals and antennas. Fixed wireless providers typically utilize unlicensed frequencies thereby eliminating or minimizing any federal regulatory requirements on the transmission aspect of the technology. Reputable manufacturers of fixed wireless broadband equipment will likely provide equipment that meets all FCC technical requirements and will likely provide direction to purchasers if the equipment broadcasts in license-required frequencies.

The County and/or a partner fixed wireless provider must comply with federal rules and regulations involving the licensing and maintenance of towers especially should the County erect towers in excess of 200 feet. Towers and antennas are subject to local regulation as noted in Section 5.5.4.

2. 3G/4G Wireless

The FCC extensively regulates services operating in the spectrum allocated for cellular frequency services as a common carrier under Title II of the Telecommunications Act of 1996. All cellular service providers must acquire an electromagnetic spectrum license through an auction process. There are currently no auctions scheduled for cellular licenses. The County may acquire a license from an existing area provider if such provider is willing to lease, partition, disaggregate, or sell its license. The FCC requires all potential license holders to use its Universal Licensing System.

3. Wireline – Fiber to the Home (FTTH)

The federal government lightly regulates the wireline provision of broadband services to the public Internet as information services. However, the federal government generally defers to local government authorities to manage their rights-of-way in the construction of such networks.

The FCC adopted a policy statement on August 5, 2005 in FCC 05-151 promoting open network principles, also known as network neutrality, on all broadband networks where the networks provide access to the public Internet.

4. WiFi/WiMax

See fixed wireless in part 1 above.

5.8.2   Recovery Act Grant Opportunities

On February 17, 2009, President Obama signed ARRA into law as an economic stimulus package. The Act included $7.2 billion in broadband initiatives through an expansion of the Rural Utilities Service (RUS) Broadband Initiatives Program (BIP) and a new Broadband Technology Opportunity Program (BTOP) through the NTIA. Marathon County may be eligible to receive loans or grants under the BIP or BTOP programs.

To be eligible for a BIP loan or grant, the County must submit a project in which seventy-five percent (75%) of the project is in a rural area that lacks

sufficient access to high-speed broadband service. BIP loan and grant combinations may serve underserved rural areas. The Act allocated $2.5 billion for BIP programs including $1.2 billion for last mile projects that will extend infrastructure to the end user. The Recovery Act allocated $800 million in loans and/or grants for middle mile projects.

BTOP includes $4.7 billion in unserved and underserved areas allocated into broadband infrastructure funding, public computer center funding and sustainable broadband adoption projects.

The NTIA and the RUS issued a Notice of Funds Availability (NOFA) on July 2, 2009 that established the evaluation criteria for applications. The initial round of BTOP and BIP closed on August 20, 2009. NTIA and RUS contemplate two (2) additional application acceptance periods expected for funding awards no later than September 30, 2010. A Marathon County project may qualify for the second or third round of BTOP and BIP awards.

5.8.3   State Rules and Regulations

While Marathon County has no intention of offering broadband services to businesses or residents, the County would not be prohibited from entering into public-private partnerships for the construction of broadband facilities within the County.

While the County has not indicated that it would seek to offer communications directly to the public, the State of Wisconsin does not prohibit Marathon County from creating a communications utility to provide broadband services either solely or in partnership with other public or private entities. The State granted counties home rule in Wisconsin Statute § 59.03 such that a county has the authority to enact organizational or administrative actions to the extent not limited by express language. It must comply with the applicable provisions of Wisconsin Statutes Chapter 66 and Wisconsin Statutes Section 196.204. The County should be aware that if the County provides video or voice service in addition to or through a broadband technology platform, the County will be subject to additional state regulatory requirements of the Wisconsin Public Service Commission. *See* Wisc. Stat. Ch. 196.

The County must also comply with all Wisconsin "Diggers Hotline" state law requirements contained in Wisconsin Statute § 182.0175 if the County owns transmission facilities.

5.8.4   Local Ordinances

In June 2009, our study team requested all of the telecommunications regulatory ordinances from the County and all of the cities, towns, and villages within the County. Based on our review of the local ordinances, we believe there are no significant local regulatory hurdles to the construction of broadband facilities.

The following is a summary of all of the ordinances that were received or were located through research:

1. **City of Abbotsford**

    See City of Abbotsford Zoning Code, Article J (Signal Receiving Antennas; Wind Energy Systems; Wireless Telecommunications Systems [NOTE: City provided section 13-1-180 (Signal receiving antennas – Satellite Dishes) – they did not provide the section on Wireless Telecommunications Systems]

2. **Village of Brokaw**

    The Village of Brokaw has enacted a title in its zoning code for Telecommunications Facilities. The ordinance identifies telecommunications facilities that are exempt from the ordinance provisions, areas where telecommunications facilities may be allowed or prohibited, permit and design requirements, performance standards, and the removal of abandoned telecommunications facilities. *See* Village of Brokaw Zoning Ordinance, Section 4.04.

3. **Town of Bevent**

    The Town of Bevent has a section in its zoning code relating to the height and setback requirements for cellular phone antennas. *See* Town of Bevent Zoning Ordinance, Section 4(1)(A).

4. **Village of Edgar**

    The Village of Edgar has a zoning ordinance, and an Article entitled "Satellite Earth Stations; Television or Radio Antenna Towers; Wind Energy Systems," however, there do not appear to be any provisions actually relating to television or radio antenna towers, which is where we would typically see regulations related to telecommunications providers. *See* Village of Edgar Zoning Ordinance, Section 13-1-130 to 13-1-140.

5. **Village of Kronenwetter**

    The Village did not provide any ordinances to our team. Our separate research has revealed that the Village has enacted at least two ordinances of interest. *See* Village of Kronenwetter Code, Chapter 58 (Streets, Sidewalks and Other Public Places); Village of Kronenwetter Code, Chapter 30 (Franchises).

6. **City of Marshfield**

    The City of Marshfield does address antennas and towers in its zoning code. *See* City of Marshfield Zoning Ordinance, Section 18-153. The ordinance generally requires a permit and has minimal standards relating to installation and prohibitions.

7. Town of Mosinee

The Town of Mosinee has addressed telecommunications towers with a minimum height of 40 feet in its zoning ordinance. *See* Town of Mosinee Zoning Ordinance, Section 4.4-5.

8. City of Mosinee

The City of Mosinee has very basic provisions relating to set-back, height, and safety of radio and television antenna towers. *See* City of Mosinee Zoning Code, Subdivision V, Section 42-872.

9. Town of Plover

The Town of Plover has a very detailed zoning ordinance provisions relating to Telecommunications Facilities. *See* Town of Plover Zoning Code, Section 3.15. The ordinance requires permits and has detailed application provisions. It also specifies where telecommunications facilities may be allowed or prohibited, and design, set-back, performance and safety requirements. Plover's ordinance is one of the more comprehensive in the County.

10. Town of Rib Mountain

The Town of Rib Mountain also addresses Communications Towers in its zoning code. *See* Town of Rib Mountain Code, Section 17.056(7)(c). The ordinance contains some basic provisions relating to permitting, lot requirements, set-backs, signage, and design.

Our separate research also revealed that the Town has also enacted an excavation ordinance. *See* Town of Rib Mountain, Rep. & Recr. #97-02.

In addition, Chapter 23 of the Town's code addresses cable television franchises. Section 23.13 covers conditions on street occupancy.

11. Village of Rothschild

The Village of Rothschild did not provide any local ordinances to our team. *See* Village of Rothschild, Ordinance No. 7.02 (8/14/2006).

12. Village of Spencer

The Village of Spencer provided a 3-line ordinance provision relating to Broadband Cable Communications Service, which simply incorporates two federal standards relating to technical standards and broadcast signals. *See* Village of Spencer Code, Section 9-3-9.

13. Town of Stettin

The Town of Stettin has a comprehensive ordinance relating to towers and antennas, similar to that of the Town of Plover. See Town of Stettin Zoning Code, Section 7.1-7.9.

14. Village of Stratford

The Village of Stratford has very basic provisions for radio and television antenna towers in its zoning code. *See* Village of Stratford Zoning Code, Section 10-1-131. It addresses set-back, height and safety requirements.

15. Village of Unity

The Village of Unity provided its Ordinance No. II7, which is the Village's cable franchise. Section 10 of the cable franchise has general public-way provisions.

16. City of Wausau

See Wausau Municipal Code, Chapter 18.32 (Radio and Television Antennas and Towers); *See* Wausau Municipal Code, Title 12 (Streets and Sidewalks); *See* Wausau Municipal Code, Chapter 5.78 (Cable TV Franchise).

17. Village of Weston

The Village of Weston has a very comprehensive zoning ordinance addressing telecommunications facilities, similar to the Town of Plover. *See* Village of Weston Code, Section 94.124.1.

18. Town of Weston

The Town of Weston's zoning ordinance is identical (or nearly identical) to the Village of Weston. *See* Town of Weston Code, Section 94.124.1.

6 Potential Broadband Technologies

In keeping with the County's desire to consider longer term economic development, the study team also examined some broadband technologies that are not currently available in Marathon County but may be in the future. Specifically this section discusses 4th Generation cellular (4G), Broadband over Power Line (BPL) and Fiber to the Premise.

6.1 *4G (WiMAX and LTE)*

Several carriers are just beginning the process of upgrading their cell systems to a newer version known as 4G (4th generation). As the carriers install these network upgrades users will see significant improvements in performance.

The fight between the competing next generation cellular technologies LTE (Long Term Evolution) and WiMax (Worldwide Interoperability for Microwave Access) is well underway. WiMax has been quicker to market and already has operational networks in a few cities in the US, but more carriers worldwide have announced they will use LTE. Since Intel is the primary backer of WiMax, laptops have already started to come out with that technology built in alongside WiFi. On the other hand, inexpensive LTE USB plug-in modems will soon become readily available.

Verizon has announced it will roll out LTE in 20 to 30 US cities/market areas in 2010 and complete its nationwide upgrade program by early 2014. Clearwire (partly owned by Sprint) already offers WiMax in Atlanta, Baltimore, Las Vegas, and Portland, OR. Clearwire plans to launch WiMax service later in 2009 in Charlotte, Chicago, Dallas/Ft. Worth, Honolulu, Philadelphia, and Seattle; meanwhile Boston, Houston, San Francisco, and Washington D.C. are in line for a 2010 startup.

Since cellular upgrade efforts tend to start in larger metro areas and "trickle down" to less densely populated areas later, customers in Marathon County may have to wait a some time to reap any benefits since the previous generation (3G) of services only quite recently came online in most of this area. However, even after these technologies are implemented, the "footprints" won't necessarily cover more territory than is now the case.

Once rolled out, both LTE and WiMax will provide significantly greater bandwidth than is now available. The claims for 4G range from 7 Mbps to more than 20 Mbps downstream. However, such claims should be taken with a grain of salt until there are enough users on the systems to indicate the true capacity when heavily used.

Interestingly, WiMAX is also being implemented by smaller, regional and local wireless providers, using different licensed frequencies than the big companies.

One such company (Open Range) holds licenses for use in the Wausau area, but did not respond to requests about the potential timeline to provide services.

6.2 *Broadband over Power Line (BPL)*

The intent of this technology is to deliver broadband Internet access over electrical power lines. As of the date of this report, BPL has faced significant technical challenges in getting services online.

The primary difficulty is interference. High and medium voltage electrical systems generate unintentional signals in some of the transmission ranges used by wireless networks, thus causing interference. Special efforts and equipment are needed to prevent this from disrupting network traffic.

The excitement around BPL is that it uses existing electrical power lines to distribute broadband. This means a much smaller initial investment than bringing in new cabling, and could trump wireless when the use of that technology is blocked by physical barriers.

One current BPL offering is from International Broadband Electric Communications, a Huntsville, Alabama company. IBM Global Services working together with IBEC began deploying Internet service last year [2008] with one rural electric cooperative in Alabama, and in February 2009 announced an expansion to include five more electric cooperatives in Alabama, Indiana, Michigan and Virginia. Pricing for residential BPL offerings in Alabama are $30/month for 256 Kbps, $50 for 1 Mbps and $90 for 3 Mbps. Pricing for businesses is quite a bit steeper at $70 for 256 Kbps, $130 for 1 Mbps and $230 for 3 Mbps.

Washington Island (off Door County) has implemented Wisconsin's first BPL service. It is intended as a pilot and was installed through a deal between the Washington Island Electric Co-op and IBM, which has invested in BPL technology. For an article about this see http://wistechnology.com/articles/5991/

In August 2009, an IEEE working group completed main development of a BPL standard and released the first draft of technical specs. Reaching this stage of the standards process usually indicates a technology is nearly ready for deployment, but does not guarantee that it can be provided cost effectively.

As of August 2009, it is too soon to tell whether BPL will be a feasible solution for most areas, but it is worth watching.

6.3 *Fiber to the Home/Fiber to the Premise*

This method of providing service involves installing fiber optic cabling directly into each building (business or house). This technology is often referred to as FTTH or FTTP. In some parts of the eastern US, Verizon Communications has

installed this type of service to residential and business customers. Verizon has dubbed its service FiOS. AT&T has also installed some FTTH in portions of Texas. In almost all cases, the providers installed these systems in densely populated, high income areas. In less populated areas it can be difficult for for-profit companies to justify the cost to install new FTTH systems.

In a variation on this, some providers install fiber most of the way and then use copper cabling to reach the last few hundred feet to individual buildings. This type of installation may be known as Fiber to the Neighborhood/Fiber to the Node (FTTN). In the cable TV industry, that other technology is usually coaxial cabling; in the telephone industry, the outgoing cable would be the existing phone wires. FTTN can be a phased step toward fiber to the home/fiber to the premise.

A fiber to the home network is a major investment with an eye to major long term benefits. Among those benefits:

♦ Using fiber rather than copper cabling vastly increases the amount of data that can be transmitted. Fiber to the premise systems typically offer speeds from 10 Mbps to 100 Mbps per subscriber, and bandwidth amounts can be guaranteed – unlike wireless. The City of Lafayette, LA is providing 10, 20 and 50 Mbps symmetrical service options to its residents.

♦ Fiber has virtually unlimited bandwidth potential; 100 Gigabits capacity over 25 miles has been demonstrated, and even greater speeds are expected through ongoing research and development.

♦ Fiber is immune to interference.

♦ Fiber has a long useful lifetime (30+ years) and unlike wireless technologies, can be considered a long-term asset, rather than something which depreciates in value.

Many communications experts believe fiber is the only truly viable option for the long run, and that it is simply a matter of time until everyone requires the service capacity only fiber can deliver.

7   Viable County Options

While Marathon County provides many services that support economic development, the County's leadership believes that broadband service to residents and businesses should be available from commercial providers in a free market environment, rather than offered by government. Thus the following options involve activities which do not include end user services.

7.1   Provide Information to the Public about Existing Options

During the public meetings it was clear that many residents don't know about current broadband options available to them. Thus, the County may be able to help its businesses and residences by

1. Publishing selected portions of this report, including placing maps and tables on the County's web site.

2. Developing a concise "brochure" for residents about broadband and distributing it within County mailings required for other purposes.

7.2   Make Use of Existing County/Municipal Towers

Marathon County owns or has access to a number of towers and water towers for public safety purposes. Not all of the towers on this map are open for use by commercial entities, but most may be, depending on the wind load capacity and location.

Recognizing that wireless providers already cover much of the County, it may be in the County's best interest to maximize those providers' coverage and bandwidth by offering space on available towers to wireless providers at affordable prices to encourage expansion of their coverage areas. This may require changing some County policies.

Like other tower owners, the County could choose to allow commercial wireless providers to attach equipment to County towers and distribute services from those sites. Typically, separate agreements are negotiated for each type of facility at each tower location.

Physically, there are many possibilities for how and where equipment might be located on a tower. Due to cabling limitations for Power over Ethernet, most wireless providers must locate their antennas at less than 300 feet above the ground. Depending on the areas desired to be covered with new services, providers may want only one or multiple 60-degree coverage angles and therefore may wish to lease only a portion of any particular vertical space on a tower. Space is usually allocated at 10 foot intervals, but due to wind load parts of towers may not be usable for antenna placement. Thus each installation is unique.

For any negotiated lease, those wishing to lease tower space would be responsible to conduct wind-load studies and to obtain and develop space on which to locate ground-based equipment and systems.

Recommended activities include:

1. Identify County and City towers in unserved and underserved areas of the County.

2. Invite Cities, Villages and Towns located in the County to partner in this effort.

3. Conduct an engineering review of each tower to determine whether each tower has capacity to allow additional providers.

4. Identify and meet with potential providers.

5. Conduct a financial and legal review.

6. Identify legal process and terms to partner with competitive carriers.

7. Distribute information about known towers to local providers who might otherwise not know this option exists (only towers taller than 200 feet must be registered with the FCC so the availability of towers less than that height would not be generally known). This will help ensure fair access for commercial entities.

8. Encourage municipalities that own water towers to offer similar terms to providers.

9. See item 7.3.1 regarding connecting public facilities via the public safety wireless system.

7.3 Support Expansion of Broadband Wireless Coverage by Commercial Providers

7.3.1 Service to end users

Meet with current and prospective wireless providers to review the coverage map showing known poor or non-existent coverage areas (Appendix I), and encourage those providers to specifically target those areas for expanded coverage.

7.3.2 Middle mile infrastructure

Consider working with providers to apply for grants and loans to improve middle mile bandwidth. If applicable and helpful, offer to provide secondary bandwidth from the new microwave backbone (East and West) to providers. The County should designate that the providers would cover the costs of the implementation.

7.3.3   Apply for grant funds to subsidize pole installations

Although current wireless providers cover a large portion of the county, many homes are located in heavily wooded areas or at low elevations and thus cannot receive wireless signals. In many cases, the addition of a pole of 60-90 feet would elevate an antenna above the treetops and low hills. Each pole would cost approximately $2,500 - $3,000 to install. This is cost prohibitive for most residents. An option to resolve this would be to submit a broadband grant request in which citizens paid a portion of the costs and the County applied for and received grant funding for the rest remainder. The County could work with the public to learn what level of subsidization would make this affordable for citizens. Note: the County should fully understand potential liability issues before proceeding.

7.4   Enhance Public Access

1. Provide high-speed internet connectivity to city and village governments to facilitate public services. This would allow these municipalities to greatly speed up elections reporting and enhance employee productivity.

    One possibility is to use County towers for point-to-point wireless links. The advantages to doing so are that the backbone already exists and is highly reliable. Another option would be to construct fiber connections between the cities and villages and downtown Wausau. This would be a more expensive option, but could provide more bandwidth.

    To help fund this potential project, the County could apply for ARRA stimulus funds through the NTIA Broadband Technology Opportunities Program (BTOP) Infrastructure program to connect the community centers as part of a "middle mile" project. This program focuses on providing high capacity connections to key institutions that provide services to the public. Funds are available through competitive grants. At least one more round of funding is expected, with the likely time for applications to start in mid-December 2009.

2. Actively support non-profit, school and municipal entities that plan to enhance access to broadband and/or provide computers for disadvantaged residents. Examples of supportive actions the County could undertake might include:

    a. Provide meeting rooms for training classes

    b. Establish a volunteer service program in which participants assist with training classes and/or in setting up computers

    c. Support a community-led initiative to train and educate members of the community how to use broadband/the Internet

     d. Encourage local businesses to donate computers and volunteer their services to support sustainable broadband adoption.

The foregoing activities may be eligible for grant funding through the NTIA BTOP Sustainable Broadband Adoption program.

7.5 Identify Potential Collaborative Grant Projects

Consider collaborating with other public-service entities, including neighboring counties, Northcentral Technical College, healthcare organizations (e.g., the Marshfield Clinic) and K-12 school districts.

Each of these entities has valid reasons to promote more available and affordable broadband services in the region, and each has resources or assets to bring to the table. For example, Northcentral Technical College owns licensed frequencies that could be used to provide fixed wireless broadband. Healthcare organizations have qualified staff who could conduct remote "house calls" for home bound patients; but this requires reliable, high capacity broadband connectivity to the home. K-12 districts want to ensure students have quality Internet access at home as more and more course material is now available only online. Those districts have land and buildings that could be used to host network equipment sites.

7.6 Consider Partnering with Local Incumbent Phone Companies

As part of our research in the availability of broadband Internet service in the County, it became apparent that in addition to the major players like Verizon and Charter, the County's residents and businesses are served by a variety of small incumbent local exchange carriers, such as Wittenberg Telephone, Amhearst Telephone and Solarus. These companies, while small, have advertised availability of DSL services in their service territories. While it appears that many of these small ILECs have reasonably good coverage of DSL services, we believe that these companies are constrained by the availability of capital to expand and/or upgrade their systems especially in this tight capital market.

Thus there may be several unique opportunities for the County to partner with these small ILECs with regards to grant opportunities under the BTOP program. We recommend that the County explore these potential opportunities with the small ILECs as part of Phase 3. If these opportunities do exist to partner with these small ILECs, the County may have the opportunity to significantly upgrade the service offerings of these small ILECs by deploying County or shared capital assets for these small ILEC's use in these rural areas. Potentially these small ILECs might be able to offer higher broadband speeds and new services like IPTV to rural communities

Glossary

3G or Third Generation Wireless: The current state of cellular wireless data communications. The first generation was analog and the second was digital (CDMA, TDMA and GSM).

4G or Fourth Generation Wireless: refers the next step up for mobile wireless. Fourth generations systems will provide higher-speed data connections - both fixed and mobile.

Asymmetric: A connection with more capacity in one direction than the other. Most DSL and cable modem links are asymmetric, with higher capacity (speed) in the downstream path.

Attenuation: the deterioration of a signal over distance. Also may be referred to as "loss"

Backbone: Refers to the highest speed and widest bandwidth point of a communications circuit or path. In most cases data sources such as shared servers are connected to the backbone, with lower bandwidth circuits extending to user stations.

Backhaul: the intermediate links between the backbone of the network and the sub-networks or provider networks. See also "middle mile."

Bandwidth: The amount of data (capacity) that can be carried by a circuit between two points of a network. Bandwidth is typically measured in kilobits per second or Megabits per second (shortened to Kbps and Mbps). The top speed of modems is 56 Kbps. One strand of fiber optics can carry 20,000,000,000 bits per second (20 Gbps) or more.

Base Station: The central radio transmitter/receiver that maintains communications with end user sites within a given range. Although many base station site antennas are placed on specially constructed towers, where existing structures provide a site that is higher than its surroundings, antennas can be placed on those structures. For example, antennas have been placed on water towers, grain silos, and building rooftops.

BPL: Broadband over Power Line. A technology that allows broadband services to be delivered via electric lines. BPL is discussed in Section 6.2 of this report.

Broadband: A generic term for high-speed data transmissions. The current federal definition of broadband is a minimum of 768 Kbps downstream and 200 Kbps upstream.

Cable Modem: A device used to provide data services over a cable TV network. Users in a given locality (determined by the provider) share the available bandwidth, so when many local users are connected simultaneously they experience slower network performance.

Cell: The basic geographic unit of a wireless system. Also the basis for the generic industry term 'cellular.' A geographic area is divided into 'cells,' each of which is equipped with a low-powered radio transmitter/receiver. The cells can vary in size depending upon terrain, capacity demands, etc. See also Base Station, Cell Site.

Cell Site: The place where communications equipment is located for each cell. A cell site includes antennas, a support structure for those antennas, and communications equipment to connect the site to the rest of the wireless or wired network. The equipment is normally housed in a small shelter or "hut" at the base of the site. See also Base Station, Cell.

Central Office: A term used by carriers when referring to switching points. May also be called a local exchange or telephone exchange.

CLEC: Competitive Local Exchange Carrier. A new entrant in a telecommunications market previously limited to one carrier. Contrast with ILEC.

Co-location: The siting of two or more separate companies' (or departments') equipment in or on the same structure/tower or building.

Contention: When multiple customers share a finite amount of broadband capacity and simultaneous use, they "contend" or compete with one another for that limited resource. Contention may be due to increased use or to inherent system design constraints. Synonymous with **oversubscription**.

CPE: Customer Premises Equipment. CPE is a term that refers to any equipment that is located at the customer's site.

Downstream/download: data transfer from the web/Internet "down" to the customer. Typically measured in thousands of bits per second (Kbps) or millions of bits per second (Mbps). See also Upstream/upload.

DS-3 (Digital Signal, Level 3): A 44.736 Mbps carrier facility, (also referred to as a T3, and generally thought of as 45 Mbps), which is the equivalent of 28-T1 connections

DSL: Digital Subscriber Line. A service providing data connectivity (to the Internet or private networks) over ordinary copper telephone lines. DSL circuits are switched, not shared as cable modems, but bandwidth can vary greatly, based on both distance and the quality of the circuit. There is a typically a distance limitation of approximately 12,000 to 18,000 feet from the nearest main facility (telephone company central office or equivalent).

DSLAM: DSL Access Multiplexer. Used to aggregate many DSL connections onto a single higher-bandwidth connection/link. DSLAM equipment is typically placed in above-ground equipment cabinets within or at the edge of neighborhoods.

FCC (Federal Communications Commission): The government agency responsible for regulating telecommunications in the United States.

Fixed wireless: Refers to wireless systems that are permanently installed and designed to cover a specific area or site.

ILEC: Incumbent Local Exchange Carrier. The former monopoly local telephone carrier. Contrast with CLEC**.**

ISP: Internet Service Provider

Kbps: Kilobits per second. Thousands of bits per second.

"Last-mile" (sometimes referred to as "first mile"): This term is used to describe the final connection to a building as opposed to the high capacity circuits extending across a city or county. This connection is often the bottleneck that prevents high-speed network connectivity, due to lack of high capacity cabling options. Contrast with "middle mile."

Latency: The time it takes for a signal to travel between two points on a network. Also referred to as "delay". When there is significant latency a normal voice conversation may be very difficult as the parties must wait for responses and may "talk over" each other.

Leased Line Services: These are typically communications circuits provide by a telephone company or cable company and leased for a monthly fee to a customer such as a city or school district. Typical leased lines include T-1 and T-3.

Line of Sight (LOS): Transmission limited to straight lines and in which the transmitting/receiving locations can be viewed/seen from one another. Most wireless wide area network transports require a line of sight from the sending location to the receiver.

Mbps: Megabits Per Second - Million bits per second. Telephone modems operate at Kbps (thousands of bits per second) speeds, whereas local area networks operate at Mbps.

Microwave: The portion of the electromagnetic spectrum, beginning with 1 GHz, which is used for many different wireless communications. Microwave links are often used in links where there is a line of site and a distance of less than 30 miles.

Middle mile: may also be referred to as backhaul. The links between ISPs and local or regional broadband service providers are considered "middle mile" connections. Contrast with "last mile".

Monopole: A slender, self-supporting tower on which wireless antennas can be placed.

Oversubscription: see **contentio**n.

PROW (Public Right-of-Way or Public Rights-of-Way): The land/areas owned by a public entity such as a city or county that are used for installation of telecommunications and other services. For example, most counties own and control the PROW along county roads.

Right-of-Way (for outside plant cable): Refers to a designated space alongside a street or other access (such as a railroad line). An entity wishing to install cable among buildings must obtain the rights to a pathway for that cable. Right-of-way access must be granted by the owner of the path to be used, which may include public landowners (city, county, etc.), private landowners (railroad companies), or the owners of poles such as cable, telephone, or power companies. Cities typically require written permits for the use of their rights-of-way – usually for a fee. See also PROW.

Router: a device that "translates" among different types of network connections and speeds, and can also perform basic security functions. Routers are most frequently used at the point of incoming services such as ISP or carrier WAN connections.

Site Survey: Internet service provider personnel visit your home or business location to determine whether service is/can be made available there.

Symmetric: Used to describe communications technologies in which the upstream and downstream data rates are identical – e.g., High Bit-rate Digital Subscriber Line.

T-1 (DS1): In the United States the T1 standard has a speed of 1.544 Mbps. T-1 circuits usually are provided by telephone companies using copper cabling, but fiber and wireless systems can be set up to provide T-1 connectivity as well.

Take Rate: The percentage of households or business that are offered service who choose to subscribe to that service. For example, if DSL service were available to 100 households and 33 elected to "take" that DSL service, the take rate would be 33%.

Underserved and Unserved: the FCC recently defined these terms that describe areas that lack broadband access. For complete definitions refer to the July 9, 2009 federal register Notice of Funds Availability: http://frwebgate3.access.gpo.gov/cgi-bin/PDFgate.cgi?WAISdocID=97311421117+1+2+0&WAISaction=retrieve

Upstream/upload: data transfer from the customer back to the web/Internet or provider. Typically measured in thousands of bits per second (Kbps) or millions of bits per second (Mbps). See also Downstream/download.

VoIP: Voice over Internet Protocol. A technology that puts voice (telephone) conversations over an IP "data" network. Can be used to aggregate (or "trunk") multiple calls between buildings, or for individual calls from an IP-enabled telephone or from a computer equipped with a microphone and speaker. Skype is one example of VoIP.

VPN: Virtual Private Network. A network set up for specific sites and users and open only to authorized users. A VPN uses encryption to prevent communications from being deciphered by non-authorized personnel.

WAN (Wide Area Network): A wide area network is used to extend connectivity beyond a building or campus, usually through telephone carrier facilities, but may also be privately installed and owned. See also LAN and MAN.

Wind load: the designed capacity of a tower to withstand wind forces. Each structure (mast, antenna, etc.) added to a tower adds to the overall wind load of that tower.

WISP: wireless Internet service provider. A company that distributes Internet service via wireless networking. In order to provide service to a given location or territory a WISP may develop its own tower sites and/or may lease space on towers or structures owned by others.

Appendix A – Business Survey Report

Appendix B – Residential Survey Report

Appendix C – Census Summary for Marathon County

Appendix D - Census Urban Area Map

Appendix E – Census Bureau Map of Marathon County

Appendix F – Internet Service Providers in Marathon County

The table starting on the next page lists information about Internet Service Providers in Marathon County. This information was gathered through a variety of sources including the residential broadband survey, checking directly with providers (though some chose not to respond to inquiries) and researching information available in the public domain (e.g., providers' web sites).

Pricing changes frequently, so consumers should be sure to check with potential providers when considering any service.

Appendix G - Known and Assumed Wired Broadband Coverage

Appendix H – Claimed Wireless Broadband Coverage Map

Note: the areas shown on this map are as claimed by the noted providers.

Elert & Associates believes these areas are fairly accurate, with the caveat that even though this map may indicate coverage in a given area, there is no guarantee of broadband service to any individual home or business because a variety of factors (e.g., being located in valleys or surrounded by trees) can affect service availability.

Also the speed of connections will vary based on distance and terrain/obstacles. In fact, the connection speed/s available to any particular location may be directly related to the distance from the nearest distribution point in the provider's network.

Appendix I – Known and Assumed Gaps in Broadband Coverage

Appendix J – Terrain Challenges – Forest and Slopes

Appendix K – Telephone Company Service Areas

Appendix L – Forested Areas of Marathon County