# BROADBAND REFERENCE GUIDE

A Resource for Digital Stakeholders

Public Service Commission of Wisconsin

Broadband Reference Guide produced by:
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WHY A GUIDE

It's being talked about in the news, in the legislature, and now it's a household word: broadband. For digital natives, broadband is expected—at home, at work, on a mobile device. For digital immigrants (defined as individuals born before the existence of digital technology who then adopted technology later in life), basic questions pertaining to broadband arise: "What is broadband?" "Do we have broadband?" "How do I get broadband?" For Internet Service Providers (ISPs), IT professionals, business owners, public institutions, and others, broadband is a way of doing business. Additionally, broadband connects digital stakeholders like you to a diverse constituent base through a physical network connection and also as an issue of important public policy.

As a nation and state it is imperative that we pave the way for broadband. The National Broadband Plan is a roadmap to America's future that recommends that the Federal Communications Commission (FCC) set the following goals for 2020:

GOAL No. 1: At least 100 million U.S. homes should have affordable access to actual download speeds of at least 100 megabits per second and actual upload speeds of at least 50 megabits per second.

GOAL No. 2: The United States should lead the world in mobile innovation, with the fastest and most extensive wireless networks of any nation.

GOAL No. 3: Every American should have affordable access to robust broadband service, and the means and skills to subscribe if they so choose.

GOAL No. 4: Every American community should have affordable access to at least 1 gigabit per second broadband service to anchor institutions such as schools, hospitals and government buildings.

GOAL No. 5: To ensure the safety of the American people, every first responder should have access to a nationwide, wireless, and interoperable broadband public safety network.

GOAL No. 6: To ensure that America leads in the clean energy economy; every American should be able to use broadband to track and manage their real-time energy consumption.

Wisconsin's [Playbook for Broadband Progress](http://www.link.wisconsin.gov/lwi/docs/WI_Playbook.pdf) (http://www.link.wisconsin.gov/lwi/docs/WI_Playbook.pdf) offers the pathways to enhance broadband coverage and use in Wisconsin. However, to address the state or national goals it is important to have a basic understanding of broadband and how it benefits Wisconsin.

The purpose of this guide is twofold: first, to help answer some of the basic questions about broadband and to provide you with the knowledge and tools to understand broadband services and technologies; second, to help you learn why broadband is necessary in the 21st century, what it means for business and public institutions, and how it benefits our communities and its citizens

from Pre-K to gray. By understanding the basics of broadband, the different bandwidth needs, how consumers purchase services, and how to advocate for these technological changes, you can make educated decisions that impact your constituent base and help Wisconsin with its challenge to "bridge the digital divide" and bring broadband access to our rural communities.

TOP REASONS WHY BROADBAND IS SO IMPORTANT

The communication landscape is changing and technology is playing a crucial role in the change. Recent studies show that 85% of Americans 18 and older use the Internet at least occasionally. For many, these new technologies are overwhelming and often scary; however, this fear can be overcome with knowledge and exposure. What many don't understand or embrace is how broadband impacts people and communities and how it can essentially improve the lives of individuals, families and businesses. There are many reasons why understanding broadband and being "connected" is important, but the most critical reasons for broadband access include the benefits it can bring to:

- Economic and Business Development
- Education
- Healthcare
- Public Safety
- Government Services
- Access to Information and Entertainment

Economic Development

Successful communities and those that will thrive in this century are those with the essential infrastructure needed for manufacturers, retailers, farms, and service industries to efficiently operate. This infrastructure includes the "Internet super-highway" with adequate bandwidth to run a business today and tomorrow. For instance, it can allow a once catalog-based mail-order business to become an e-commerce powerhouse like Drs. Foster & Smith, the Rhinelander-based business that is now a leader in online sales (http://bit.ly/Ecommerce_broadband).

Broadband creates new opportunities for start-up companies, entrepreneurs, and established businesses. It also opens the door for a business to move into a community if the communications infrastructure in the city, village or town has robust connection speeds that meet the needs of that business. Unfortunately, lack of that access can also lead a business to leave a community, as experienced in Lac du Flambeau and noted in Figure 1.
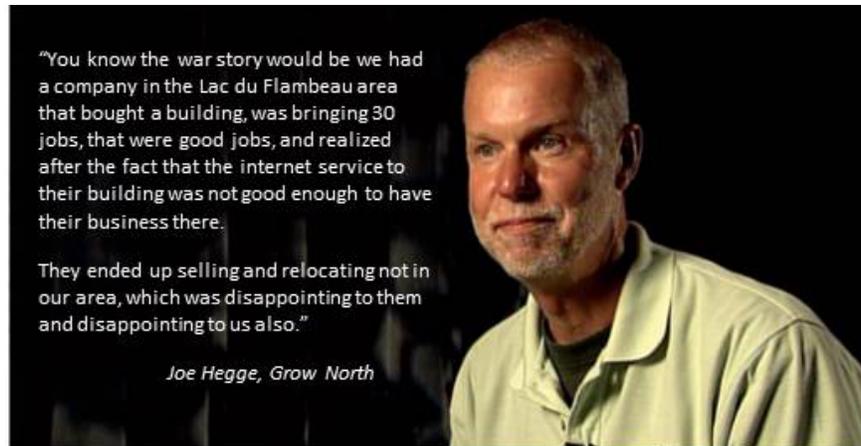
Figure 1. Grow North Economic Development

Telecommunications and adequate broadband connections can allow employees to perform business tasks anywhere, including a home office environment. The ability to share critical information anywhere can save employers money and reduce carbon emissions in the environment. Take for example UnitedHealth Group, even though its headquarters are in Minnesota, this company has 11 campuses in Wisconsin with approximately 7,400 jobs throughout our state. Over 2,000 of those jobs are telecommuting positions that enable employees to work out of a home office if they have access to broadband.

Agriculture, in its many forms, is still a vital part of the Wisconsin economy; it contributes 354,000 jobs to our state. One aspect of that agricultural presence is cheese making; Wisconsin ranks first in the nation in cheese production. The ability for this particular industry to connect to the global economy is crucial for Wisconsin cheese makers and others to sell products in the global market. As with any business endeavor, it is crucial that these agriculture businesses to have broadband on the farm for business-related purposes.

Economic development is crucial to Wisconsin and therefore the state's LinkWISCONSIN effort is developing an Economic Impact Model that will help our state answer the question "will broadband really make a difference in Wisconsin." This model will be a tool for providers to address investment in broadband and for communities to understand the impact broadband will have on economic development and quality of life. This model is a "work in progress" so check the LinkWISCONSIN (http://linkwisconsin.org/) website for the latest information.

Education

Many students Pre-K through gray are using technology in the classroom, for online courses, or research. Increasingly, schools are deploying tablet computers or laptops to "level the playing field" and ensure all students have the same access to information in our global society. The classroom as we knew it is changing; flipped classrooms (a blended learning environment where students watch content or research at home and come to class for group discussion) opens avenues for more teacher/student interaction and are becoming more prevalent, as are other

digital learning initiatives that the online community provides. The changing education landscape serves multiple learning styles and provides parents with improved interaction through school/parent portals that encourage them to keep abreast of their child's academic achievement.

The State Educational Technology Directors Association (www.setda.org) set a national goal for K-12 education to have 1Gb per 1,000 students; however, students also need the affordable access and connectivity outside of the school day. "Homework" today requires access to online information at home and thus the ability for students and families to have affordable broadband that meets the FCC requirements is essential for children to keep pace with their peers in and outside of the school day.

Despite new technology and learning tools, effective learning continues to be about content, curricula, and the most effective methods used to teach children or adults. Online classes and learning opportunities are being offered more frequently and provide access to advanced information geared toward working adults. More schools allow students to "bring their own device" to leverage learning opportunities and help schools better compete for quality education in this 21st century. Devices such as smart phones, tablet computers, e-readers, laptops, iPads/iPods or in-classroom smart boards, allow for access to information and communication forms (texting, email, social media) that the millennial and Gen-Z (aka digital natives) use on a regular basis.

Healthcare

Telemedicine is increasingly important in promoting healthcare, and broadband enables the delivery of long distance or remotely connected healthcare opportunities to rural areas that might not otherwise have access to specialists and services that are available in more urban areas. Improved access to patient portals and the move toward electronic medical records streamline services and enable patients to make appointments through online resources, to check lab results, or access educational information prior to undergoing a medical procedure. Federal mandates put increased pressure on all healthcare facilities to move medical records online. For this mandate to be effective and save costs and to allow the necessary access to these records, there will be a need for a more robust and ubiquitous broadband infrastructure and an increased consumer adoption of the broadband technologies.

For medical professionals, e-health initiatives provide time and cost-savings that directly benefit the patient; for example, a radiologist can read an X-ray from his or her home, saving time, travel, and staffing costs. These technologies are changing the way Medical work is done, to the benefit of patient care and cost.

For emergency medical personnel, police, hospitals, and fire response, fast access to information can save lives. Broadband communications can provide first responders with access to visual databases to quickly locate and assess the scene of a disaster or incident (such as locating chemical storage facilities in the area). With remote access to critical patient medical records,

patient data can be transmitted to the hospital alerting staff of an incoming patient. For example, an ambulance is deployed to a patient suffering heart failure. An EMT connects a 12-lead EKG device to the patient and, with robust broadband access (Wi-Fi, Wi-Max, or cellular signals), data from the EKG is transmitted back to the hospital while the patient is in transport. When the patient arrives at the hospital, medical professionals have already read the data and therefore the patient can potentially go directly to surgery for a life-saving procedure.

Public Safety

Broadband provides the ability to move more data at faster speeds. That capability can be useful to effective provision of public safety services. Broadband technologies in public safety can also be used to regulate stop lights, monitor and update road construction and delays, and alert the public of potential dangerous situations by enabling severe weather alerts, missing children alerts, or escaped criminal alerts. Broadband also provides the ability to use real-time tactical data and video to improve firefighter and EMS personnel safety and save lives. Access to broadband services could mean the difference between life and death for a firefighter or any first responder. It also allows responders access to real-time intelligence relating to what they are about to experience instead of requiring them to react to conditions once they are on-scene.

As retired Eau Claire Fire Chief Edward Kassing notes, "for firefighting, it could mean the difference between going into a fire blind versus knowing the layout of the building before arriving on the scene by accessing pre-plans and other pertinent building and site information. Broadband can provide the ability to transmit a video from a mobile camera so the incident commander is able to remotely view where the firefighter is located, assess his/her situation, and when needed, send in back-up personnel to rescue or assist the firefighter. It could also mean the ability to transmit real-time biometric data monitoring of bodily functions such as heart rate, breathing, and skin temperature of firefighters during an incident."

With a broadband network, squad cars equipped with different broadband technologies (see Figure 2) can maintain a high-speed data connection en route to an incident and responders can utilize the technologies to access and log data as they would in an office environment. For example, if the network is a private network shared between anchor institutions using multiple broadband technologies, a police car near an area hospital would automatically connect to the hospital's wireless network and the network traffic would be routed directly to the city's network. The application traffic bypasses any problems associated with the public Internet and the connection is secure and no encryption software is needed. The need for less encryption processing on the end user device (police officer laptop) results in better application performance in the car. In a majority of cases this shared private network allows the police officer to use applications not use otherwise available.
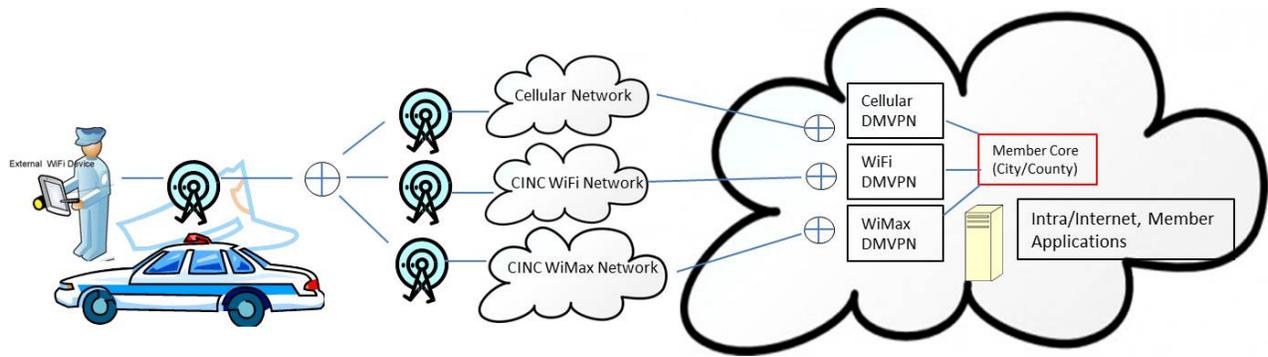
Figure 2. Squad Car Equipped with Broadband Technologies

Government Services

More and more of our government services are provided online. Renewing permits or paying license fees, streamlining interaction with government offices, or being available online for users to obtain information about programs, policies and procedures are only a few examples. People who need Access Wisconsin to obtain health, nutrition, and childcare benefits can go online to apply. Students working on a GED will have to transition to online coursework by 2014. Displaced workers need to have an online account with the Wisconsin Job Center to use the features and services to create application materials, use government forms and/or word-processing programs, and upload application documents to their job center account. The Department of Veterans Affairs has launched an e-benefits site to help veterans improve their access and understanding of the benefits available to them. At the Menomonee Nation in Keshena, open computer labs for veterans provide both computer instruction and enable the veterans to access their online benefits.

Many city and county governments use social media like Facebook and Twitter to inform their constituent base of local happenings, emergency road conditions, promotional events, and updates to local services. These methods of communication are effective ways to get valuable information out to constituents who are connected and expect this form of communication in the 21st century.

Giving access to these services increases efficiency and provides a cost effective way of doing business; however, this change means that citizens need access to the Internet. They also need the knowledge and skills to use the tools that these sites provide.

Access to Information and Entertainment

An ongoing and growing need for all consumers with broadband is the access to information. Almost every billboard, newspaper advertisement, mail correspondence, and TV ad includes a web address or link. The World Wide Web is our access to information including email correspondence, online resources, shopping, social media sites and book downloads to name a few uses. Having this access to information in all locations is a necessity to avoid "**brain drain**"

in our rural communities. With access to broadband, those who left their home communities may consider returning since broadband can provide them access to the amenities they are used to in larger cities, or allow them to work from home or start a business.

In addition, Internet-ready TVs and DVD players, home theater systems, and the influx of Netflix, Hulu, Pandora, Spotify, and Network TV that stream audio or video-on-demand, underscore the needs for broadband connectivity for entertainment today and tomorrow. For many, these "vices" are not necessities, but the home of the future will demand broadband connections for purposes of school and work applications as well as for entertainment.

WHAT IS BROADBAND?

As noted earlier, high-speed broadband connections are crucial for government services, healthcare, education, library systems, private businesses, and residents. But, what really is broadband?

Broadband refers to high-speed data transmission in which a single cable or radio frequency can transfer or carry large amounts of data at one time. Think of broadband as a "freeway" where many streams of data can travel quickly down multiple lanes. The multiple lanes can deliver Internet access, television/broadcast signals or telephone communications. Compare this highway to a single-lane road where only limited data (like a two-way phone conversation) can travel back and forth.

Broadband connects people to the Internet. It is a high-speed transmission link from a home, business or school to the World-Wide Web and other digital resources. It replaces a traditional "dial-up" or narrow band telephone connection since it is always on and allows you to use multiple services at the same time. For example, you don't need to disconnect from the Internet to make a telephone call.

Broadband is available for different technologies (laptops, mobile phones, tablets) and from many different Internet Service Providers (ISPs). With compatible equipment, broadband connections allow a user to support many different devices at once. You can access the Internet (i.e., surf the world-wide-web, listen to music, check your email, visit social media sites, etc.), watch TV, and use your telephone. Often these services (Internet, phone, and TV) are packaged together or **bundled** so one provider (one bill) offers all these options to meet your household or small business needs. Broadband service providers can be telephone or cable companies, a wireless network provider (cell phone companies) or satellite service.

Broadband infrastructure consists of the backbone, the middle mile, and the last mile (refer to Figure 3). The backbone consists of very large capacity trunks (usually fiber optics) that connect to multiple fiber-optic lines capable of transmitting large amounts of data. It provides a path for the exchange of information that local or regional networks can connect with for long distance data transmission. These data routes and backbone connections are owned by private providers, commercial, government, academic and other network centers.
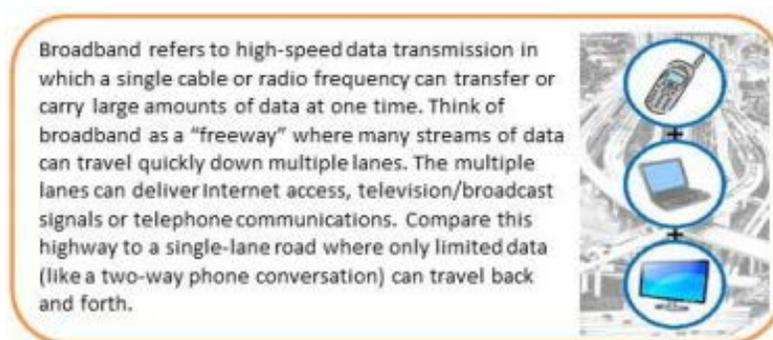
The middle mile links the backbone to the ISP or telecommunications providers' core network or telecommunications exchange. In some communities, the middle mile may connect anchor institutions that enable them to share applications, infrastructure, and other resources.

The last mile brings the connection to residents' homes and small businesses within the telephone exchange or cable company serving the area. Though all pieces of the broadband infrastructure are important, much focus of the debate and concern on broadband is on the availability (or lack thereof) the last mile connectivity.

Often the difference between residential broadband connections and broadband networks that connect to the middle and last mile is the infrastructure, the connection speeds, and the size of the data files that are transferred. Communities find creative ways to get broadband access to their anchor institutions and residents; additional resources about different models of building subscribership at a community level are documented and available at:
http://broadband.uwex.edu/resources/
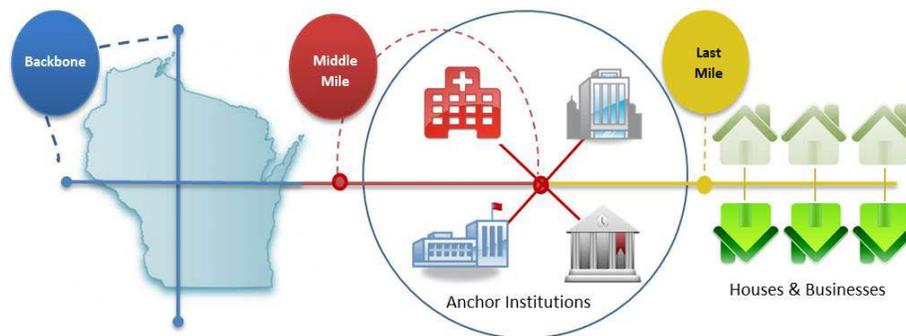
Figure 3. Statewide Network Example
Reference: National Telecommunications and Administration, U.S. Department of Commerce

Understanding the benefits of and potential for broadband and gaining an appreciation of why broadband is vital for communities to thrive in this 21st century is a starting point to move Wisconsin forward. However, to have effective and productive dialog on broadband policy, it is also important to understand the different broadband technologies and what broadband speeds (or bandwidth) are needed for consumers, education, government and business.

Data, Broadband Speeds, and Bandwidth

For many, the jargon of broadband can be as confusing as the technology. Data in a digital sense is made up of bits (a bit is a 0 or 1); 8 bits of data (00101110) is a byte. For broadband data, transmission speeds and bandwidth, you will encounter references to bits and bytes (and kilobits, kilobytes, megabits, megabytes, gigabits and gigabytes and so on (refer to Table 1. Data Measurement) [1].

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[1] Often – though you will encounter inconsistencies –references to bits per second will use this terminology – kbps, mbps, gbps. References to bytes will use this: KB, MB, GB, etc.

Table 1. Data Measurement

Data Measurement				
Name	Equivalence			
Bit	1 bit	= single 1 or 0 (on or off)		
Byte	1 byte	= 8 bits		
Kilobyte (KB)	1 KB	= 1,024 bytes	or	= 8,192 bits
Megabyte (MB)	1 MB	= 1,024 kilobytes	or	= 1,048,576 bytes
Gigabyte (GB)	1 GB	= 1,024 megabytes	or	= 1,048,576 kilobytes

Broadband speed is how fast data transfers over a connection; speed is measured in bits per second. Data (files stored on your computer or information transmitted over a network) is measured in bytes (megabytes, kilobytes, and so on). The speed at which data moves over a network connection is determined by **bandwidth**; that is, the size of the "pipe" or broadband technology that the data is traveling on.

For example, data transfers from your computer in packets or bytes of information; a typical packet contains 1,000-1,500 bytes. Every web page you visit receives a series of packets and every email you send leaves your computer as a series of packets; each packet gets to its destination by the best available route. How fast the data gets to its destination depends on the file size (or how much data is being sent) and the bandwidth of the technology the data is traveling on. Figure 4 shows four different technologies, their related broadband speeds, and the approximate time it would take to download an 11 minute movie clip that is 835MB is size. Notice the larger the pipe, or more robust the broadband technology, the faster data can download to its destination.
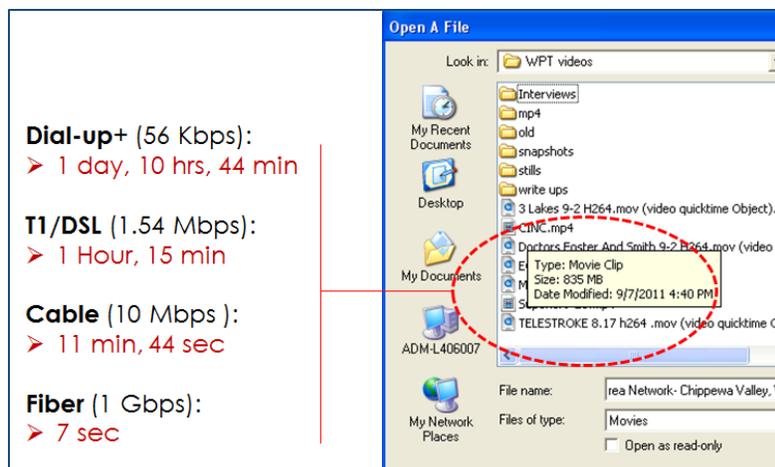
Figure 4. Speed Comparison to Download a Movie

Figure 5 shows the data speed capacity or approximate speed ranges for different broadband technologies; the illustration shows the capacity at both a mature state of deployment and conceptual or developmental stage. Wireless technologies are marketed by generation such as in 2G (EDGE), 3G, and 4G as illustrated; however, each generation uses different and more advanced technologies for the wireless service such as Long Term Evolution (LTE) and Wi-Max. Not all broadband technologies are available in every location, and therefore the broadband technology available to you depends on where you live.
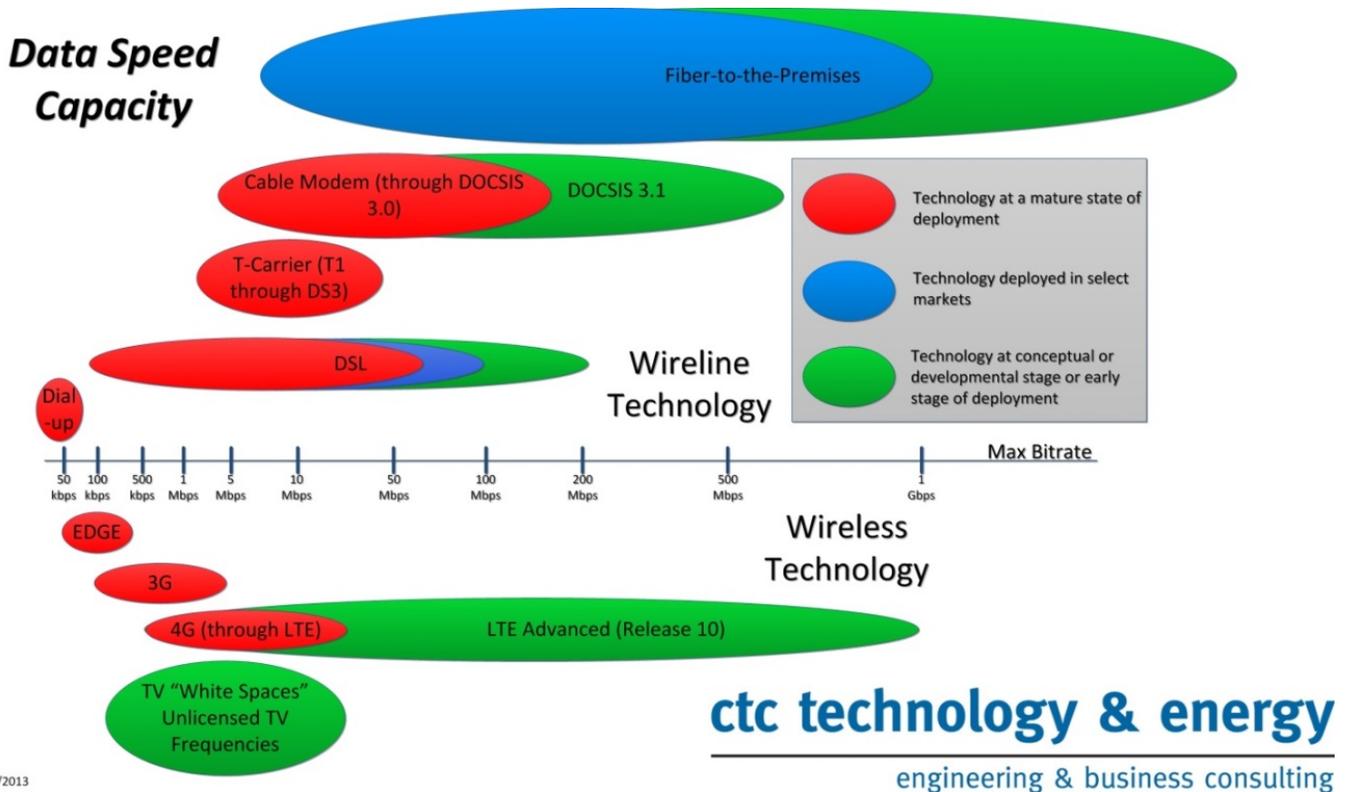
Figure 5. Data Speed Capacity
(Based on analysis by CTC Technology and Energy, www.ctcnet.us, October 29, 2013)

Internet access is most frequently advertised by its download speed; that is, how fast information is downloaded to your computer or device. However, upload and latency speeds are just as important when understanding broadband.

Download Speed, Upload Speed, and Latency
Download speed is the speed that information on the Internet (e.g., text and graphics) is transferred to your computer; that is, how long it takes your computer to load websites and download files to display on your screen. *Upload speed* is the speed that your computer can transfer or send information to the Internet. For example, if you want to send photos to a website to be printed by your local vendor, you "upload" the photos to the site. Download speeds

normally happen at faster speeds than uploads; however, that can depend on broadband connections or how web pages are created.

Latency is the amount of time it takes for a small packet of information sent from your computer to reach another computer on the Internet, and then return back to you. This measurement is also referred to as ***Ping*** and is measured in milliseconds (ms)[2]. When you send information from your computer (click a link, type in a web address, send an email) it waits for confirmation that the data packet was received, thus "latent" time. Latency and bandwidth are the two factors that determine the speed of your network connection.

Internet Speed Tests

Internet speed tests check the speed of your internet connection. It can let you know the upload and download speeds you are getting at a particular time and also provide the latency or "ping" with your connection. Many sites offer speed tests and an example is illustrated in Figure 6. Notice the test measures speed in kbps.

Using the chart in Table 1or a conversion program, you can convert to mbsp; which, in the example below is about 19.7 mbps. You cannot depend entirely on the reliability of speed tests to validate your connection speed. Speed tests can be unreliable because of the many factors that influence the tests, including the user's software and hardware settings, time of day and how frequently you visit a site. If you already have an Internet connection, and want to know your approximate speed, you can access a speed test here: http://linkwisconsin.org/lwi/speedtest.aspx
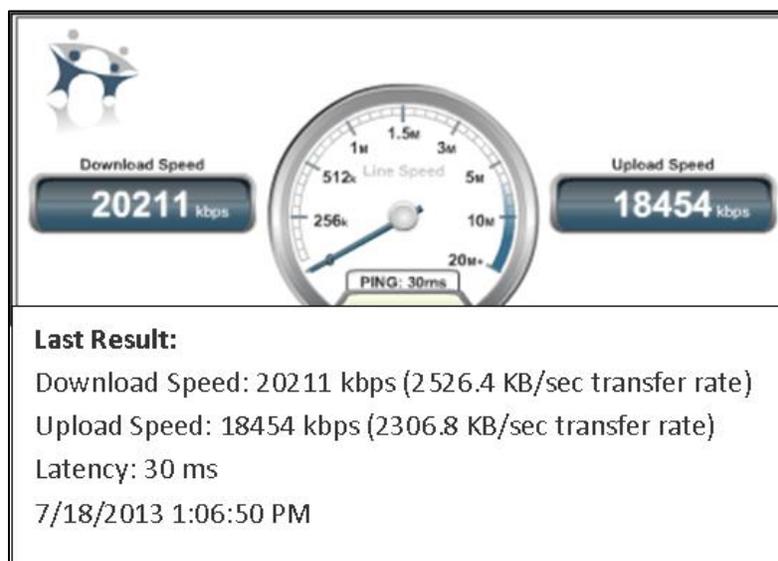
Figure 6. Speed Test Example

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[2] A millisecond is a thousandth (1/1,000) of a second.

BROADBAND TECHNOLOGIES

Many different types of broadband technologies are available and the speeds for these technologies vary as noted in Figure 5; not all broadband technologies are available in every location. Internet Service Providers (ISPs) determine the type of broadband technology they can provide and the locations they serve.

ISPs usually advertise broadband by download speeds, or as a download speed "up to" so many mpbs; therefore, understanding the actual technology when purchasing broadband can be difficult, and may not be as important as the broadband speed. However, some basic knowledge of the different broadband technologies, and the pros and cons for each, is important when comparing plan features and investing in a broadband service plan. Broadband technologies can be divided into two categories, wired broadband and wireless technologies (refer to Figure 7). As noted in the illustration, wireless networks are similar to wired networks in that they connect to a backbone, usually a fiber trunk. It is only the last mile that is a wireless connection.
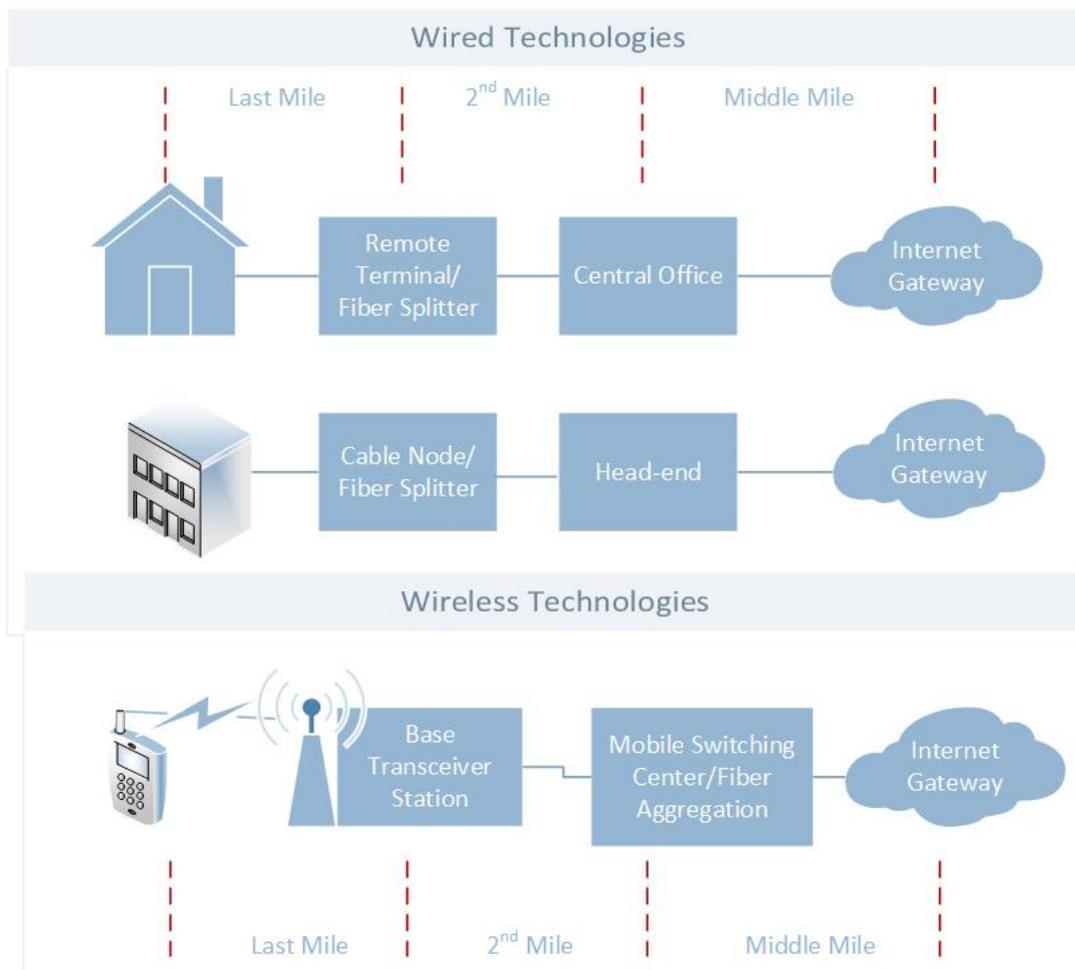
Figure 7. Wired and Wireless Connections

Wired Broadband

Wired broadband essentially means there is a physical connection to a physical location (a home or business) through a cable. There are three main types of wired broadband connections for consumer or residential use: DSL, coaxial cable, and fiber. DSL uses traditional copper wire telephone lines. Cable television companies traditionally provide service over coaxial cables. Fiber systems are comprised of glass fiber strands over which optical (light) signals are sent. (Other options for wired broadband include T1 or T3 lines and Broadband over Power Lines (BPL)). With the use of a router, all wired technologies can also provide a Wi-Fi network within the home or business.

DSL

DSL is a wired transmission that uses traditional copper telephone lines already installed to homes and businesses. Availability and speed of DSL service may depend on the distance from a home or business to the closest broadband-equipped telephone company central office or telephone exchange.

Figure 8 illustrates a typical DSL connection. A modem in your home connects the computer or wireless router to a copper telephone line using an **Ethernet** cable. The phone line connects to a digital subscriber line access multiplexer (DSLAM) at the telephone central office or, in some instances, at a remotely located junction box in outlying neighborhoods. The DSLAM, combines multiple signals into one aggregate connection and routes it to the ISPs Internet backbone.
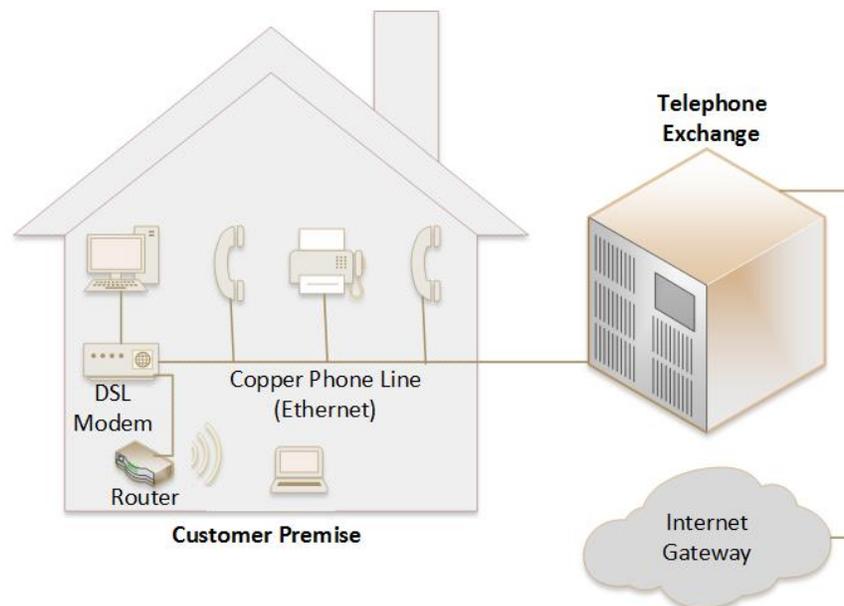
Figure 8. DSL Broadband Connection

There are four types of DSL transmission technologies:

- Asymmetrical Digital Subscriber Line (ADSL)
- Symmetrical Digital Subscriber Line (SDSL)

- High data rate Digital Subscriber Line (HDSL)
- Very High data rate Digital Subscriber Line (VDSL)

ADSL is primarily used by residential customers who surf the Internet, use email, and receive a lot of data but do not send much. ADSL allows faster downstream data transmission over the same line used to provide voice service, without disrupting regular telephone calls on that line. SDSL is typically used by businesses for services such as video conferencing, which need significant bandwidth both upstream and downstream. SDSL upstream speeds are equivalent to download speeds.

HDSL and VDSL are newer and faster forms of DSL typically available to businesses for use with high bandwidth applications like VoIP telephony and HDTV transmission; however, HDSL and VDSL are only available in limited areas.

DSL: *Advantages*
A major advantage of DSL service is that it works with existing wiring. The only equipment needed is a modem plugged into an existing phone jack and filters for each telephone in your home or office. Another benefit of DSL service is that each user has a dedicated link and the speed is constant and will not diminish if more people in your neighborhood are also using DSL. DSL provides reliable broadband service for most residential and small business customers.

DSL: *Disadvantages*
A major disadvantage of DSL service is the inability to deliver the service further than 18,000 feet from the central phone office or other DSLAM location. DSL cannot be reliably delivered to homes or businesses beyond this distance. Another disadvantage is that the upload speeds do not match download speeds. While DSL connections are adequate for the average consumer, with technology enhancements and innovation, the bandwidth that DSL offers may be outdated for many due to its bandwidth constraints.

Cable
Cable television companies provide broadband using the same coaxial cables that deliver pictures and sound to your TV set. A cable modem is an external device that normally has two connections: one to the cable wall outlet, the other to a computer. Cable Internet (see Figure 9) is usually faster than DSL.

Subscribers can access their cable modem service by simply turning on their computers, without dialing-up an ISP which is referred to as an "always on" connection. You can still watch cable TV while using broadband and get telephone service through Voice over Internet Protocol (VoIP) phone technology. Cable provider's market their services in bundles, which can be a cost effective way to purchase internet services. One type of bundle is the **Triple Play,** which includes television, telephone, and internet services. While cable broadband is faster than DSL, transmission speeds vary depending on the type of modem, cable network, and how many people in the neighborhood are using a cable connection.
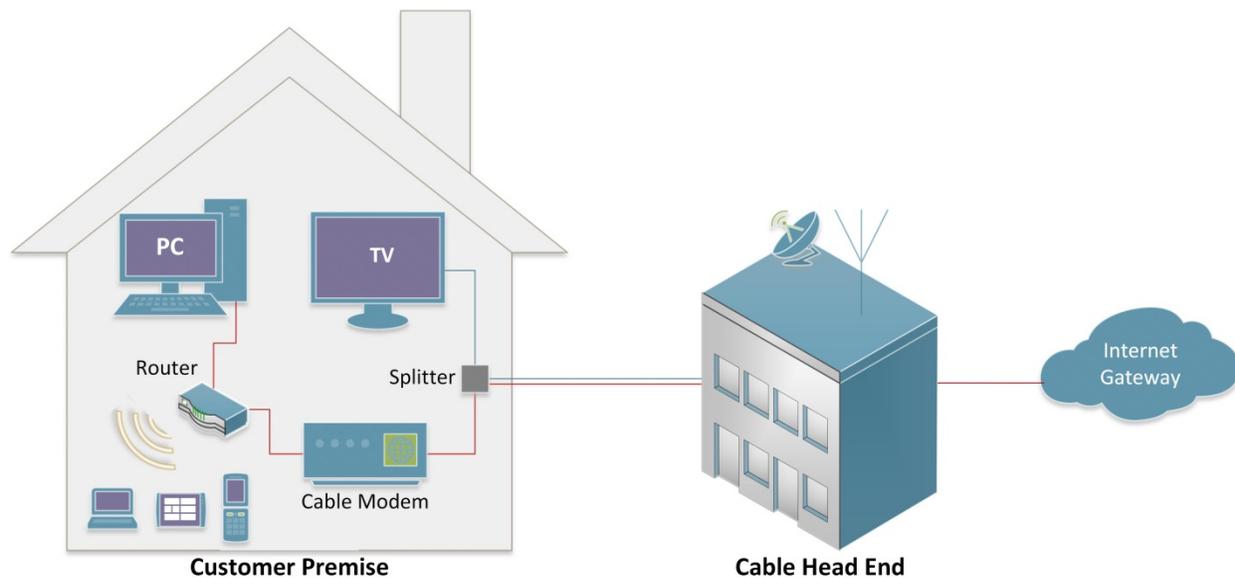
Figure 9. Cable Internet

Cable: *Advantages*

A major benefit of cable modem service is its availability to all cable company customers where the cable network has been upgraded to deliver cable modem service. The distance between your residence and the cable company will not affect your Internet speed. Cable is also generally faster than DSL.

Cable: *Disadvantages*

An obvious disadvantage of cable modem service for rural communities is the lack of cable service beyond the edges of the larger towns. Another disadvantage is that the connection is shared between you and other people on the network segment and therefore speed may vary greatly at different times of the day and can slow down significantly in a neighborhood where many residents using cable connections access the Internet simultaneously. For example, if you live in a neighborhood where cable modem penetration is high you may notice a significant increase in the time it takes to upload and download information in the evening when people return home from work and school. Another disadvantage is that upload speeds never match download speeds.

Fiber

Fiber optic technology converts electrical signals to light pulses (on/off) and sends the light pulses through transparent glass fibers about the diameter of a human hair. There is less signal loss or degradation with fiber optic technology than conventional copper wires or coaxial cables. Fiber transmits data at speeds far exceeding current DSL or cable modem speeds.

Figure 10 shows an example of a Fiber to the Home (FTTH) network. Fiber to the Neighborhood (FTTN) is a variation of the technology that runs the fiber to the curb outside, or to a location or "node" somewhere between the provider's facilities and the customer.

The actual speed depends on how close to your computer the service provider brings the fiber and how the service provider configures the service, including the amount of bandwidth used. For example, a provider can bring fiber to your home (FTTH) that connects to a box outside your home or the provider can bring fiber to the node (FTTN) which means the fiber is terminated in a neighborhood street cabinet possibly miles from your premise and then make a copper connection from the cabinet to your home. The same fiber providing your broadband can simultaneously deliver voice (VoIP) and video services (for example, video-on-demand like Netflix, etc.), and refer to these configurations as bundled services.
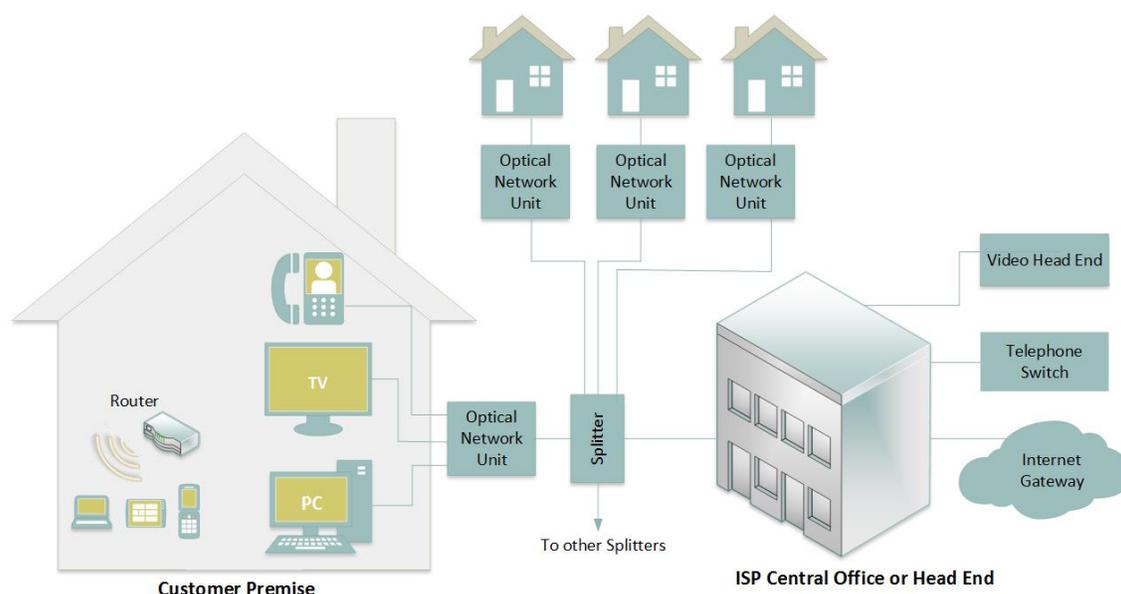
Figure 10. Fiber to the Home

Fiber: *Advantages*

There are many advantages to using fiber optic cable for telecommunications; the main advantage is the ability to provide higher bandwidth and greater distance between terminals. Compared to conventional copper wire, fiber optic cable can deliver more bandwidth than conventional metal wire. Because of its size, many optical fibers can be bundled into one outer covering, or jacket, allowing for a higher carrying capacity—more phone or cable lines going through one channel. Fiber optic cable can deliver more bandwidth than other broadband technologies at a lower cost of maintenance and allows for future expansion and opportunities as innovative and entrepreneurial concepts evolve.

Fiber: *Disadvantages*

Installing fiber and lighting the fiber cable is expensive and maybe cost-prohibitive for many providers serving rural areas. Fiber cable is fragile and also requires equipment to convert electrical signals into light signals and then reconvert them back into an electrical signal at the receiving end.

Broadband over Power Lines

BPL is the delivery of broadband over the existing low- and medium-voltage electric power distribution network. BPL speeds are comparable to DSL and cable modem speeds. BPL can be provided to homes using existing electrical connections and outlets. BPL is an emerging technology but is not available in Wisconsin.

Broadband over Power Lines: *Advantages*

BPL can use existing power lines decreasing the cost of installing a new transport infrastructure and the ability to connect a modem to any electric receptacle. BPL also sends and receives data at the same high speed. You can upload mail, video files, and business data as quickly as you can download similar files.

Broadband over Power Lines: *Disadvantages*

A major hurdle for BPL in rural areas is the cost of equipping the power lines to carry the broadband signal. Financial analysis of several pilot projects determined that there would need to be between four and six homes per transformer to deliver broadband service at prices equivalent to DSL or cable modem service.

Dial-up

Dial-up connections are not typically considered broadband Internet; however, in some locations, dial-up Internet access is the only available connection technology. Dial-up is less expensive than other broadband offerings and it may be adequate for some uses (i.e., text only email), but may not support other uses like gaming, watching videos, etc. because of inadequate bandwidth.

Leased Lines (T1)

T1 (or T3) lines are reserved circuits that are usually leased or rented from a company for telecommunications. These lines operate over copper or fiber cables and are used mainly by businesses to connect offices that are geographically separated with voice and data communications. Leased lines are expensive and rarely used for residential purposes.

Wireless Broadband

Wireless broadband services are similar to wired broadband in that they connect to an internet backbone usually a fiber-optic trunk; however they don't use cables to connect to the last mile or business/residences. Instead they use Wireless Fidelity (Wi-Fi) connections or radio waves. A computer or mobile device has a wireless adapter that translates data into a radio signal and transmits the signal using an antenna. A wireless router receives the signal, decodes it and then sends it to the Internet through a wired Ethernet connection.

Fixed Wireless

Fixed wireless is a type of high-speed Internet access where connections to service providers use radio signals rather than cables. Fixed wireless offers connections speeds between 1 and 10 mbps and use transmission towers similar to cell phone towers that communicate to a resident's

transceiver equipment that, as the name implies is fixed at the premise. The transceiver equipment communicates with the providers' ground stations. Refer to Appendix C: Wisconsin Broadband Service Providers, for a list of fixed wireless broadband providers.

Wi-Fi

Wireless fidelity (Wi-Fi) is a fixed, short-range technology that is often used in combination with DSL, fixed wireless, fiber, or cable modem service to connect devices within a home or business to the Internet using a radio link between the location and the service provider's facility. Wi-Fi service can be available in your home or at community locations (airports, coffee shops, schools, businesses, etc.) and are often called "hotspots." A Wi-Fi network uses radio waves, similar to two-way radio communications. A computer has a wireless adapter that translates data into a radio signal and transmits it using an antenna. A router receives the signal, decodes it, and then sends the information to the Internet using a physical connection, usually via an Ethernet cable, a cable that carries the broadband signal between the modem, router, computer, and other wired Internet capable devices. Figure 11 shows how a wireless/Wi-Fi network works.
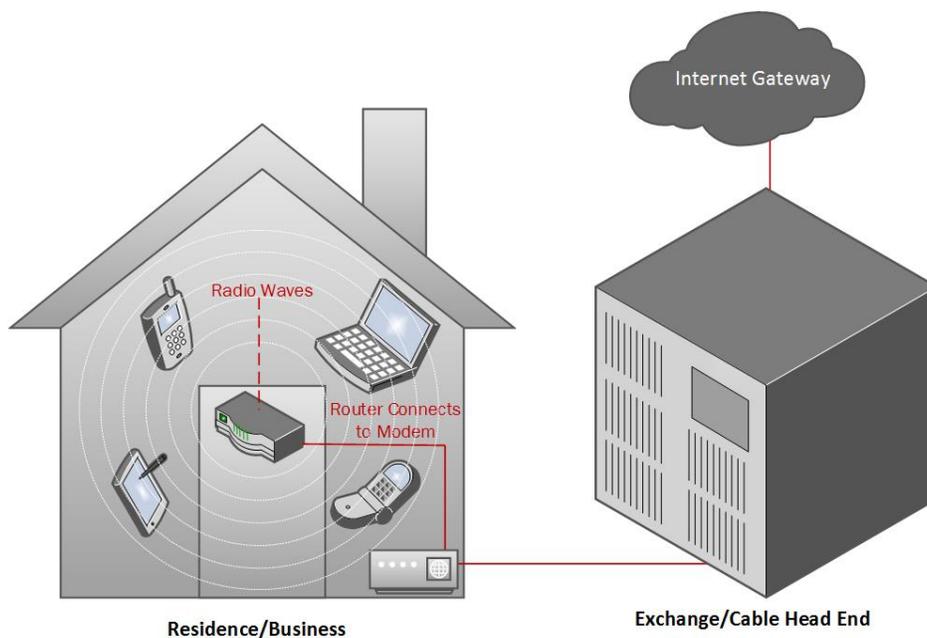
Figure 11. Wi-Fi Network

Mobile Wireless (3G, 4G)

Mobile wireless is high-speed wireless broadband connection that is accessible from random locations. The locations depend on the provider's cellular towers and monthly service plans. Many technologies make up wireless networks, but no matter the technology or acronyms you read or hear, mobile wireless networks are radio systems.

Mobile wireless services are continually being upgraded to provide data transmission speeds considered to be broadband. The faster mobile wireless networks are referred to as **3G** or **4G**.

The "G" stands for "generation," meaning 3rd and 4th generation or the evolution of broadband cellular networks; supposedly, each generation provides a faster more secure wireless network. A mobile wireless service requires a base station that is connected to a high capacity landline data transmission network to reach the Internet. In other words, it's never wired OR wireless; ultimately, it has to be both. Wireless broadband in common usage means that the so-called "last mile" connection to the user is done via radio signals from a tower to a cell phone or other wireless devices (e.g., a tablet).

Wireless standards are defined by the International Telecommunications Union (ITU) and as technologies evolve, some attributes that help define the parameters and differences between generations of wireless networks include the radio frequency bands, the network architecture, and components (i.e. types of antenna) used. Two technologies used with 4G networks include 4G LTE (Long Term Evolution) and Wi-Max. While all wireless technologies coordinate traffic telling devices when to send and receive signals, the difference in the technologies (in this case 4G) is how they accomplish the task.

Long Term Evolution (LTE)
LTE is a 4G technology that is based on GSM (Global System for Mobile Communication) or EDGE technology and the UMTS (Universal Mobile Telephone Service)/HSPA (High-speed packet access) network technologies. LTE provides increased peak data rates, reduced latency, scalable bandwidth capacity than 4G predecessors, and is backwards compatibility with existing GSM and UMTS. LTE can manage multi-cast and broadcast streams and handle quick-moving mobile phones. It uses an IP-based network architecture that allows for seamless handovers for voice and data to older model cell towers that use GSM, UMTS or other 3G technologies; it is said to be the 4G technology of choice because of its scalability and speed.

Wi-Max
Wi-Max (Worldwide Interoperability for Microwave Access) is another 4th Generation (4G) form of wireless Internet that is similar to Wi-Fi but can provide even faster speeds and cover larger distances. Wi-Max consists of a tower, similar to a cell phone tower, and a receiver often built into a laptop or computer system. Wi-Max is a technology that provides fixed and fully mobile Internet access; it is a contender for "last mile" connectivity in rural and emerging markets where laying fiber, cable, or DSL is not cost effective. In some cases, Wi-Max can be used for redundancy or back-up if a primary wire line connection is down.

Many smaller Wireless Internet Service Providers (WISPs) use Wi-Max or similar technologies to provide Fixed Wireless service. Other companies are deploying Wi-Max to provide mobile broadband or at-home broadband connectivity across whole cities or countries. Because a Wi-Max network is more cost effective than DSL or fiber optic, broadband can be made available in locations that previously did not have broadband options. Figure 12 shows an example of how Wi-Max works.
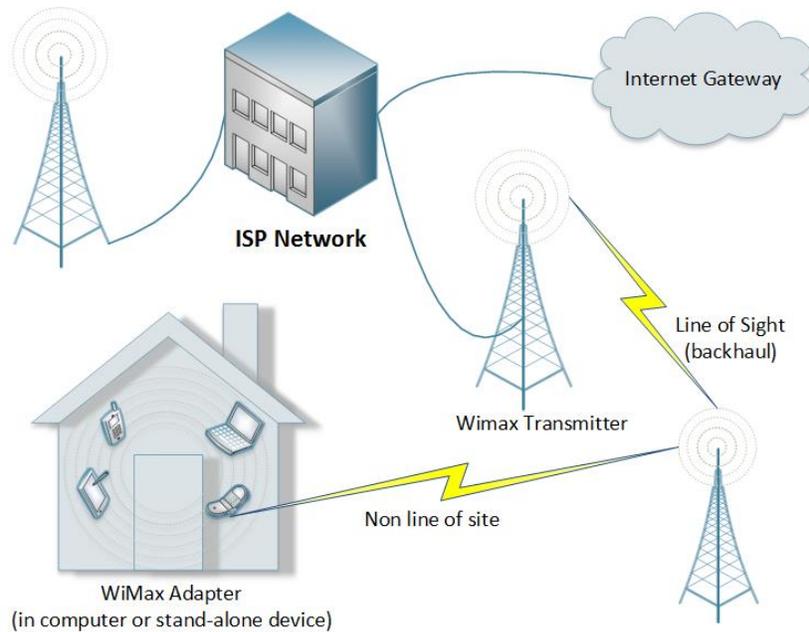
Figure 12. Wi-Max

With Wi-Max, there is a non-line of sight between a small antenna on your computer that connects to the Wi-Max tower. The non-line of sight means that lower-wavelength transmissions are not as easily disrupted by physical obstructions (trees, buildings, mountains, etc.) and are better able to diffract, or bend, around obstacles. The line-of-sight backhaul is a fixed dish antenna that points straight at the Wi-Max tower that connects to the Internet backbone via the ISP. A line-of-sight connection is stronger and more stable, so it can send a lot of data with fewer errors.

Satellite

Satellite broadband is sometimes the only option available to users in very rural or sparsely populated areas. Like telephone and television services, satellites orbiting the earth provide necessary links for broadband. With satellite service, you must have a clear view of the southern sky. Satellite service can be disrupted by weather conditions and changes in line of sight to the orbiting satellite.

Satellite may have a higher monthly service charge than other broadband options and the need to purchase more home or business equipment compared to the other options. Because satellites are located a significant distance from customers, there are issues of "latency" and therefore a noticeable time lag between sending and receiving data by the end customer. Figure 13 shows how a satellite network connections works.
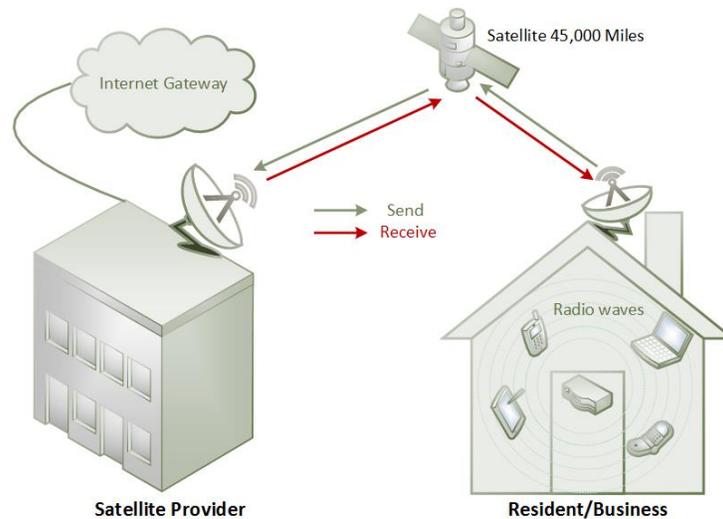
Figure 13. Satellite Internet

Downstream and upstream speeds for satellite broadband depend on several factors, including the provider and service package purchased the consumer's line of sight to the orbiting satellite, and the weather. Satellite speeds may be slower than DSL and cable modem, but they can be about 10 times faster than the download speed with dial-up Internet access. Service can be disrupted in extreme weather conditions.

Satellite Broadband: *Advantages*

A major advantage of satellite broadband is its ability to deliver service to any location with a clear view of the southern sky. It can be used in rural areas that have no other viable options.

Satellite Broadband: *Disadvantages*

Satellite broadband offers lower broadband connection speeds than typical DSL, cable modem, and wireless broadband services. Upload speeds are also slow on most systems. Satellite broadband costs more to install and monthly fees are usually higher than wired broadband. Other disadvantages include latency time and potential of poor signal reception due to inclement weather.

BROADBAND NETWORK SECURITY

Broadband network connections can be very secure; however, the security of a network connection depends on the technology and equipment used, the security measures implemented by the ISP or organization that owns and maintains the network, and the user. For specific information on the security equipment and technology for a specific network, contact the information technology professional and/or ISP. The following sections describe what users can do to keep their network and computer secure and safety measures to adopt for computer and Internet use. As digital stakeholders, you can educate constituents on the quality of life benefits

that broadband bring into a community and reinforce safe computing practices for residents and businesses.

Safe Networks

For consumers, there are two main features between the Internet Service Provider (ISP) and your computer that are crucial for safe computing: a firewall and data encryption. A firewall is a hardware and/or software-based network security system that controls incoming or outgoing data. The firewall determines if it will allow data packets through the network to your computer or if it should block the data; firewalls are the bridge between an internal network computer (i.e., your home or business) and another network (such as an external network or the Internet). The ISP should have a firewall, and your computer has a firewall that can help block email viruses and phishing scams (the fraudulent process of attempting to acquire information such as user names, passwords, credit card details etc. by masquerading as a trustworthy entity).

Network or data encryption is another layer of security that the ISP provides. If you access a wireless or Wi-Fi network that requires a password, the data being sent is encrypted and adds that extra layer of security. If you go online using an open network that you don't know or trust – for example, at Internet cafés, hotels, etc., the service provider or anyone in the vicinity can monitor all traffic on the network that passes between your computer and the Wi-Fi hotspot. Note, that if you are using an open network but logging into a business or organization's Virtual Private Network (VPN), then you are transmitting data over the VPN which allows for secure network access.

Safe Computing Practices

By following safe computing practices, users have the ultimate control of how safe broadband is. Safe computer practices mean users should:

- Install antivirus software on their computer
- Set automatic updates for the operating system and ensure web browsers are running the latest version
- Use long, complex passwords for the computer and wireless network. A strong password is 8-10 characters and includes numbers and symbols. Be sure to change passwords every 90 days and don't select the option for the computer to remember the password ("remember me")
- Use a different password for each account
- Log out of accounts on public computers
- Turn off the computer when it is not in use
- Avoid installing Internet toolbars and add-ons
- Be aware of the links clicked and software downloaded
- Never reply to suspicious emails, tweets, or posts with any personal or financial information. Don't fill out forms or sign-in screens that link from these messages

- Talk with kids about safe computer practices; encourage parents to set parental controls on home computers and install security measures through a provider to ensure the safety and well-being of children; work with digital immigrants on similar safety features as they migrate to the new way of connecting in a global world.

Internet safety is an important topic for children and adults. Additional information about keeping your computer or mobile device secure is available at: http://www.onguardonline.gov/topics/secure-your-computer

PURCHASING BROADBAND

It is not uncommon for a "digital immigrant" to ask the question "how do I get Internet?" and understand that a paid service is required. But researching broadband options can be a challenge. Residents and businesses need to have an idea of how much bandwidth they need and what they are willing to pay for. In addition they need to know the Internet Service Providers (ISPs) that serve the location or address where the broadband connection is needed. The following subsections provide guidelines for determining bandwidth needs and tools to help identify ISPs that serve a specific address or location.

How Much Data Does a Person Need?

The amount of data and bandwidth needed depends on two main factors: how many users or devices require connection at the same time and the function each device or user is performing. The Federal Communications Commission (FCC) provides households with some basic bandwidth guidelines when multiple devices are utilizing the same connection. Table 2 lists the guidelines produced by the FCC.

This is a matrix that contains upload and download speeds that are needed for different online tasks. This matrix provides additional detail and will determine bandwidth needs for different applications.

Number of Users Laptop, Tablet, or Game Console	Light Use Basic functions: email, web surfing, basic streaming video	Moderate Use Basic functions plus ONE high-demand application running at the same time (streaming HD, video conference, or online game)	High Use Basic functions plus MORE THAN ONE high demand application running at the same time
1 user on 1 device	1 to 2 mbps	1 to 2 mbps	6 to 15 mbps
2 users or devices at a time	1 to 2 mbps	1 to 2 mbps	6 to 15 mbps
3 users or devices at a time	1 to 2 mbps	1 to 2 mbps / 6 to 15 mbps	more than 15 mbps
4 users or devices at a time	1 to 2 mbps / 6 to 15 mbps	6 to 15 mbps	more than 15 mbps

Basic Service = 1 to 2 mbps*

Medium Service = 6 to 15 mbps

Advanced Service = More than 15 mbps

*mbps (megabits per second) is the standard measure of broadband speed. It refers to the speed with which information packets are downloaded from, or uploaded to, the Internet

Table 2. FCC Bandwidth Guidelines

What are Data Caps?

Internet data (or bandwidth) caps are monthly limits on the amount of data an Internet user can upload or download over his/her paid connection; sometimes data caps can discourage Internet use and the innovative applications the Internet can spawn. Internet service providers (ISPs) apply data caps to service plans to prevent individual users from consuming the entire data capacity over a cable or shared resource. Many ISPs offer shared data plans meaning that the total amount of data used in a billing period (2Gb, 4Gb, 6Gb, 8Gb, or 10Gb) is divided among many different users.

Table 3 illustrates the amount of data consumption for different internet activities and can be a guide for determining what data plan to purchase from an ISP. The ISP that provides service to your area may have similar resources for you to determine bandwidth needs and availability. Consult the provider or visit the provider website for specific information.

	500MB	1GB	2GB	5GB	12GB	50GB
I want to stream video	**80** Videos	**165** Videos	**330** Videos	**825** Videos	**1,980** Videos	**8,250** Videos
I want to stream music	**283** Songs	**570** Songs	**1,140** Songs	**2,850** Songs	**6,840** Songs	**28,500** Songs
I want to download apps, games and songs	**120** Downloads	**255** Downloads	**510** Downloads	**1,275** Downloads	**3,060** Downloads	**12,750** Downloads
I want to post photos and video	**1,400** Photos	**2,850** Photos	**5,700** Photos	**14,250** Photos	**34,200** Photos	**142,500** Photos
I want to go online	**450** Webpages	**600** Webpages	**1,200** Webpages	**3,000** Webpages	**7,200** Webpages	**30,000** Webpages
I want to email	**900**+ Emails	**2,500**+ Emails	**5,000**+ Emails	**12,500**+ Emails	**30,000**+ Emails	**125,000**+ Emails
I want to make phone calls on Skype	**510** Minutes	**1,020** Minutes	**2,040** Minutes	**5,100** Minutes	**12,240** Minutes	**51,000** Minutes
These data consumption amounts are estimates; actual usage may vary. *This chart refers to the amount of data (Megabytes); each ISP may provide a similar chart or tool that provides similar information.						

Table 3. Data Consumption Estimates
Source: http://connect2compete.org/faq/bandwidth.php

Advertised vs. Real Rates

Advertised speeds are rarely, if ever, possible to achieve. For downloading, rates vary depending on how far the home connection is from the service provider, how many users on the network and other factors. Providers can't predict exact speeds for a location and therefore speeds are often advertised in a range. Some reasons why a person might not get the advertised transfer rate include:

- Time of day they access the network; during peak time the network can only handle so much data
- The distance they are from the provider equipment—in most cases, the closer to the provider equipment the faster the data will transfer
- The type of broadband connection
- Equipment or programs installed (i.e., firewalls, wireless adapters, outdated computer technologies) can impact access

Running a speed test and contacting the service provider can help a user get the service being paid for.

Find a Broadband Service Provider

There are many different service providers that offer broadband in Wisconsin. These include traditional and competitive telephone companies who provide landline phone services in addition to Internet services to homes, cellular service providers, cable companies, wireless Internet service providers and satellite service providers. However, the locations they serve and the types of broadband connections vary. Not all broadband technologies are offered by each of the providers nor do they serve every household in the general territory they claim to serve.

Broadband providers are represented on the National and LinkWISCONSIN broadband availability maps and would need to be contacted for more specific areas they actually serve.

Use the LinkWISCONSIN Maps

The Public Service Commission's broadband mapping effort helps determine broadband availability for Wisconsin locations. The LinkWISCONSIN maps (http://wi.linkamericadata.org/) can help ascertain if broadband is available in a specific area, the type of technologies used, which ISPs offer coverage to various areas, and how to contact the ISP for further information. The data collected for the state map feeds into the National Broadband Map; however, due to processing time, the National Broadband Map (which maps broadband penetration across the nation) tends to lag the state map by about six months.

Note: Users should be aware that these mapping efforts are based on a two-mile census block and dependent on data provided to the PSC by the provider. Federal rules for provider participation require them to respond to an order within a census block within 7 to 10 days to be counted. Some specialty providers such as business oriented higher-end fiber providers that do not meet the criteria are not counted on the map.

The process for using the maps to find a provider is illustrated in Figure 14. These maps are a starting place to get to know providers that serve your constituent base. Use the maps as a tool to learn what broadband technologies are offered and the speeds available, identify gaps in broadband access, and identify needs and opportunities for the constituent base you serve. If you don't have adequate broadband service in your community refer to the section "Advocate for Broadband" and learn what you can do to get connectivity that meets the needs of your constituent base.

How to Use LinkWISCONSIN Mapping Tool to Find a Provider

1. Go to http://wi.linkamericadata.org/

2. Enter a street address or name of a public facility and click Find.

3. Chose the broadband coverage map you want to view.

4. Click on the address to get a list of providers.

5. Contact the provider to ensure coverage at your residence.

6. Refer to Appendix C: Provider Comparison Worksheet, and compare your broadband options between service providers.

You can refine your search to change views or boundaries; start at step two.

Figure 14. LinkWISCONSIN Availability Maps

Follow Traditional Methods

In addition to the LinkWISCONSIN maps, other avenues are available for finding Internet providers in your geographic location. The Yellow Pages (available both in print and online versions) always list the Internet providers and cable companies. Note however that these listings are normally under the term "Internet" and not broadband. Friends, neighbors, and community members may also have connectivity through a provider that may serve a specific location and have experience with the provider service.

As ISPs grow their business and market their services, promotional materials in the mail sometimes offer a "deal" or package price. These promotions can be cost effective to get started but are often with a temporary cost; ensure you do your research and compare options before subscribing.

Explore Connect2Compete

As the need for broadband grows, so do opportunities to encourage broadband adoption. One option to explore might be Connect2Compete, a national non-profit organization that is working to make high-speed Internet and devices affordable to every type of American. By bringing together leaders from communities, the private sector, and leading foundations, C2C has a big goal to improve the lives of Americans regardless of their age, race, or education level and help you access technology through Digital Literacy training, discounted high-speed Internet, and low-cost computers. Visit the C2C website (http://www.connect2compete.org/) to learn if you or your constituents are eligible for Internet service.

Compare Provider Options

Appendix B: Provider Comparison Worksheet is a tool to compare broadband services and help you understand the challenges faced by consumers when purchasing broadband services. The chart is categorized as follows to simplify the comparison process:

- Broadband Technology
- Speed/Bandwidth
- Upload/Download
- Latency
- Data
- Security
- Email
- Equipment/Installation
- Customer Service
- Plan Pricing

Not all broadband technologies are available in every location. The LinkWISCONSIN maps are a guide to

LinkWISCONSIN Broadband Definitions
(by download speeds):

Unserved—less than 768 kbps
Underserved—between 768 kbps and 4 Mbps
Served—at least 4 Mbps (**FCC Definition**)

Note: 768 kbps can be considered broadband; however, until connectivity reaches FCC's definition of 4 Mbps download and 1 Mbps upload, bandwidth speeds lower than the FCC's definition limit the type of modern applications a user can perform.

Figure 15. LinkWISCONSIN Broadband Definitions

determine the number of broadband providers that serve an address within a two-mile census block. The maps specify the broadband technologies available (cable, wireless, fixed wireless, and DSL technologies), the maximum upload/download speeds, and feedback from consumers (refer to Figure 15). You can view data by county or specific address, identify broadband gaps, and also use the chart to compare options for served and underserved areas. Data from these maps ties into the National Broadband Maps that are updated every six months with information provided to the FCC by ISPs.

ADVOCATE FOR BROADBAND

The Internet is here to stay and the high-speeds broadband can provide will benefit Wisconsin for economic development, healthcare initiatives, public safety, education and quality of life. Ten years ago streaming movies from the Internet was new; today streaming is an Internet sensation with the ability to stream TV shows and compete with other TV services. That streaming ability, included with almost any new television set, DVD, or game console purchase, requires minimum broadband speeds of 1.5-3 mbps, (refer to Table 3). However, broadband is not just about the entertainment industry; video streaming enables telemedicine programs to expand care to rural communities and broadband enables the catalog-based manufacturing company to sell products to consumers or businesses as an e-commerce entity. It also enables public schools to deploy laptops or tablet computers and ensure student learning beyond the school day. New innovations will continue and have an impact on cities and rural communities alike; access to broadband speeds that allow for these changes must be available for communities to thrive.

Ask the Right Questions

It's fair to say "Wisconsin HAS Broadband;" however, the question to ask is "does the broadband access meet your constituent bandwidth needs?" For example, the state-wide map of broadband providers in Figure 16 shows that all counties in Wisconsin have broadband access; but as one looks at the bandwidth for the wired and wireless availability, options for adequate bandwidth diminish. As the coverage is defined by bandwidth, note the changes and then compare the maximum download speeds; many Wisconsin areas only get access to 3 mbps download compared to the FCC broadband definition of 4 mbps down and 1 mbps upload. When comparing broadband coverage, ask the following:

- Do the broadband speeds available for business, residents, and anchor institutions meet their current needs? What about future needs?
- What prevents my community from getting better broadband speeds?
- What strategies can I use to get faster broadband in my area?

The following sections provide educational resources and strategies that will help you and your constituent base understand broadband and what you can do to help your community be an adopter of technology and resources to meet the needs of your community.
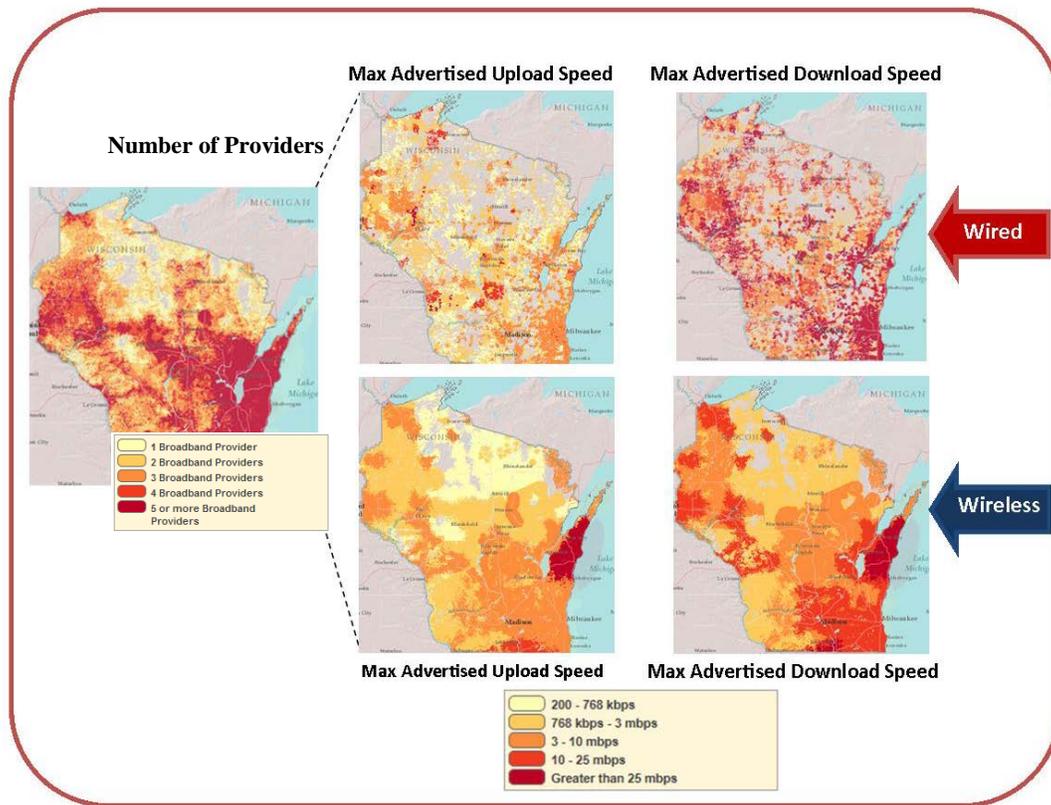
Figure 16. Wisconsin Broadband Speeds (Wired and Wireless)

Educate Constituents about Broadband Adoption

Education and understanding the importance of broadband in Wisconsin communities is essential for broadband adoption. Many tools and educational resources exist to help you and your constituent base understand broadband, the needs of a community, and the demands that businesses and residents face now and in the future. A few resources that will be beneficial include the following:

- Wisconsin's Playbook for Broadband Progress
- Broadband availability and Demand Data
- LinkWISCONSIN Statewide Analytics
- State of Wisconsin Department of Administration
- Wisconsin's Technology Council
- Wisconsin Department of Justice
- Department of Agriculture, Trade and Consumer Protection
- Wisconsin Department of Public Instruction Division for Libraries and Technology
- Center for Community Technology Solutions Resources for Broadband Adoption
- Connecting Communities Curricula
- Wisconsin Telecommunications Associations and Other Agencies
- Connect2Compete

Wisconsin's Playbook for Broadband Progress

Wisconsin's Playbook for Broadband Progress is a short primer that provides actionable initiatives (plays) to expand broadband availability, adoption and applications throughout the state. The initiatives or "plays" in this resource were compiled by the PSC with input from the Wisconsin Regional Planning Teams inclusive of businesses, citizen leadership, government and the provider community. The playbook is available at http://www.link.wisconsin.gov/lwi/docs/WI_Playbook.pdf.

Broadband Availability and Demand Maps

The LinkWISCONSIN Availability Maps (refer to the section "Use the LinkWISCONSIN Maps") are an ongoing effort to provide citizens and digital stakeholders with the information about the broadband technologies and bandwidth available in Wisconsin.

Data from the Public Service Commission's LinkWISCONSIN Demand Survey identifies un-served and underserved locations and is specific to a consumer/business address. This information helps answer the following questions and can be used by digital stakeholders to identify broadband gaps and understand why some consumers chose not to subscribe to broadband services. Questions you might ask include:

- Does the address have an Internet connection; If yes, is the connection adequate
- What is the current connection type?
- What devices access the Internet from this location?
- What is the maximum you are willing to pay for an Internet connection?
- What is your desired speed?

You can access the Demand Survey data through the Wisconsin Dashboard Console at: http://wisconsindashboard.org/console. An example of data from the survey is illustrated in Figure 17. There are three choices on the console to view data: Wired (the maximum advertised speed by census block for wired providers); Wireless (the maximum advertised speed for wireless providers for each census block); or availability (the maximum advertised speed for any technology for each census block). Each two-mile census block is outlined by the very fine lines within the state map.

Census blocks are color coded. Red signifies that the maximum available speed is lower than the 786 mbps download speed which is the National Telecommunications and Information Administration (NITA) definition of broadband; orange meets the NTIA definition but not the FCC broadband definition (4 mbps download); yellow meets the FCCs download speed definition but is less than 10 mbps; and green is maximum advertised speed in excess of 10 mbps and is most likely a cable provider or service that brings fiber to the home.

This census block data links to the national broadband map and is collected by the FCC every six months.
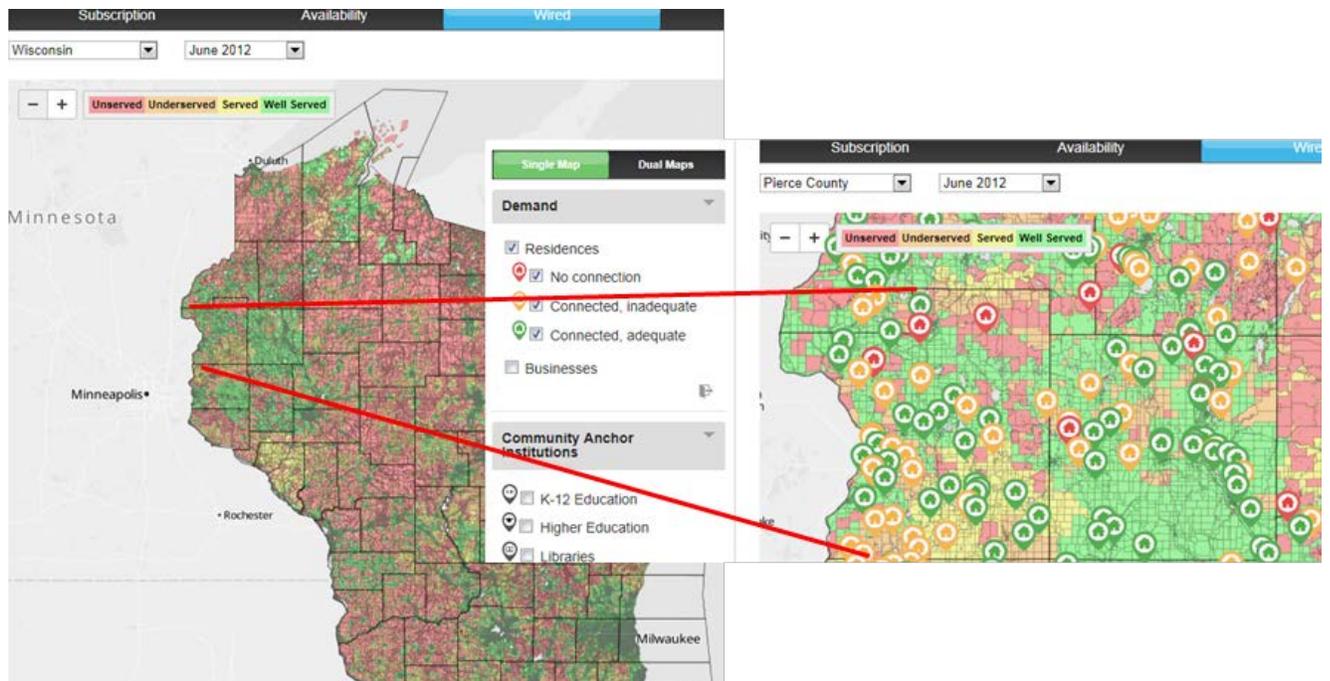
Figure 17.Wisconsin Dashboard

The colored "house" icons in the map represent demand survey data and are specific to an address location. Viewing and researching this data will help you identify opportunities where broadband needs exist and can be a tool to better understand demand in geographical locations.

With data provided via the Wisconsin Dashboard, you can begin to ask the questions and determine other options of bringing connectivity into areas where gaps exist. For example:

- Work with local Internet Service Providers (ISP) (telephone, cable, cellular companies, and other entities) and inquire about plans for expanding broadband options that match speeds defined by the FCC.

- Check with satellite providers, to see if they service locations with broadband or if they plan to expand service to the area.

- Work with the local library to see if they have public computers with Internet access. Ensure they consider applying for the federal E-rate program, which subsidizes broadband to libraries and schools.

- Work with your peers and other local government officials, such as your mayor, town board, county commission or city council members, or state legislatures and ask how you can work together to attract broadband service providers to the area.

Keep in mind that it is expensive to extend a broadband network; ISPs need to recover any infrastructure costs and therefore the more households and/or businesses willing to subscribe to service, the more likely it is that an ISP can provide access to an area.

LinkWISCONSIN Analytics

In addition to the mapping tools referenced in the section "Broadband Availability and Demand Maps" the analytics page is your link to resources that support the mapping data, cost models for deploying broadband, regional investment plans for each of Wisconsin's nine regions, and educational modules to help advance broadband in our state. The resources provided support both broadband availability and adoption.

State of Wisconsin Department of Administration

The Wisconsin Department of Administration (DOA) (http://doa.wi.gov/) oversees the states agencies and centralized programs inclusive of the Bureau of Business Services who oversees TeleComm administration, TEACH, and the Department of Enterprise Technology for the state. Information on BadgerNet (BCN), Wisconsin's state-wide network, and educational information from the Office of Security is available for business, teachers, and residents from the DOA.

Wisconsin Technology Council

The Wisconsin Technology Council (http://www.wisconsintechnologycouncil.com/) exists as a catalyst for tech based development in Wisconsin and has three main goals: 1) to provide policy guidance to lawmakers, the governor, state agencies and other Wisconsin institutions; 2) Serves as an in-state networking role through the Wisconsin Innovation Network (WIN); 3) Be an economic catalyst through other Wisconsin economic development programs.

Wisconsin Department of Justice

The Wisconsin Department of Justice (http://www.doj.state.wi.us/) exists to protect public safety and the people of Wisconsin. Consumer resources include information on identity theft, consumer alerts, Internet crimes against children, social networking sites and safety tips for parents on usage of the Internet and social media.

Department of Agriculture, Trade and Consumer Protection

The department of Agriculture, Trade and Consumer Protection (http://datcp.wi.gov/Consumer/Factsheets/index.aspx) regulates business practices and provides information to educate, protect, and inform consumers. The site provides consumers with fact sheets and publications about computers and the Internet and telecommunications industry in addition to many other resources unrelated to broadband/internet.

Wisconsin Department of Public Instruction (DPI) Division for Libraries and Technology

This department within the DPI (http://pld.dpi.wi.gov/pld_libtech) works with libraries and school districts on programs such as E-rate and BadgerNet and provides resources to better understand broadband and internet access and the programs available to school districts and libraries in Wisconsin.

Center for Community Technology Solutions

The University of Wisconsin Extension's *Center for Community Technology Solutions* (http://broadband.uwex.edu) works with Wisconsin communities to connect with broadband and technology innovations that help local communities advance quality of life and help economies grow through technology.

Through partnerships with the Public Service Commission and other state agencies, as well as many different resources and hands-on activities, the center's goal is to develop technology leaders so that communities can create a broadband vision and increase access and capacity for communities to thrive. Videos (http://www.youtube.com/wibroadband1) created by the Center tell the story of broadband in Wisconsin and the benefits to e-commerce, telehealth, education, community capacity and so on. Resources and toolkits available about Wisconsin models for building subscribership, creating Community Area Networks, developing technology councils, and facilitating ideas to connect with high-speed infrastructure needs that meet community broadband goals and vision are also available through the center.

Connecting Communities Curricula "Design the Future"

In its "Connecting Communities" curricula, the National e-Commerce Extension Initiative, provides resources to get everyone in a community on the same page—citizens, businesses, local, state and regional experts—to really understanding the value of broadband. Developing a shared vision is the first step to becoming a "connected" community and the resources available from the National e-Commerce Extension initiative is a starting point to designing the future for your community.

Wisconsin Telecommunications Associations and Other Agencies

More and more resources are available for you and your constituents to learn about and adopt broadband in your communities. Companies and businesses that already provide broadband service may be interested in expanding options to meet the needs of its consumers. Many associations that promote broadband and understand the technologies and services in your communities can also be resources for your community to build infrastructure and provide the needed education to advance broadband. In addition, check the ISP websites for additional education and training resources. A list of providers is located in Appendix C: Wisconsin Broadband Service Providers:

- *Wisconsin Library Association* (http://wla.wisconsinlibraries.org/): advocates and supports library workers and promotes library services for the people of Wisconsin.
- *Wisconsin State Telecommunications Association* (WSTA): http://wsta.site-ym.com/ : The website for the state-wide telecommunications association with information about government affairs, state-wide telecommunications events, and weekly updates impacting the telecommunications industry.
- *Wisconsin Cable Communications Association (WCCA)* (http://www.wicable.tv/aws/WCCA/pt/sp/wicablelaws): The trade association for

Wisconsin Cable companies provides information on the economic impact of cable, in the state and the different technologies cable provides as well as information about government affairs including the Wisconsin laws that govern the cable industry.

- *Wireless Internet Service Providers Association (WISPA)* (http://www.wispa.org/) and the Wisconsin Wireless Association (WWA) are the voice of the wireless industry in Wisconsin and can be a resource for news and regulatory information for wireless access in the state.
- *National Telecommunications and Information Administration (NITA)* (http://www.ntia.doc.gov/): The U.S. Department of Commerce's department that is responsible for advising the President on telecommunications and information policy issues. Information on this site includes nationwide information on internet policy, broadband, national mapping efforts, spectrum, digital literacy and more.
- *Access Wisconsin (http://accesswis.com/Default.aspx):* One of the managing partners of the BadgerNet Converged Network which provides wide area network, Internet transport and video applications to state government and educational entities.

Strategies to Advance Broadband Access in Your Community

It's often noted that the only way to get broadband into a community is through adequate funding. Additionally, rural areas are challenged by greater geographical distances, topographical barriers, and low population density. However, creative communities overcome some of these barriers by:

- Working with local officials, decision makers, and citizens
- Bringing private providers together with community to build subscribership (the Three Lakes Model)
- Being informed about public policy
- Utilizing Demand Survey Data to understand barriers and strategize opportunities
- Creating a Technology Council similar to Door County
- Forming a Community Area Network (CAN) to ensure public safety, telemedicine, educational enhancements, and high bandwidth access for quality of life issues in your community
- Implementing "Dig Once" Policies
- Providing access to public infrastructure

Regions in Northwest Wisconsin and Door County strategically organized efforts like Superior Days and the Door County Legislative Day and worked with local and statewide officials to advance broadband as a significant issue impacting those regions.

In their long-term planning efforts, the Town of Three Lakes intentionally planned for broadband infrastructure that focused on the four key elements of their community: technology, tourism, economic development and the arts. By mapping out current coverage and bringing providers

together with community members they now provide a patchwork of solutions—wireless, wired, fixed wireless—that provide prospective and current residents and businesses with broadband access that allows them to grow and survive 12-months out of the year and not merely due to seasonal interests.

Understanding public policy and regulation in Wisconsin can encourage change to help Wisconsin move forward. Wisconsin's Playbook for Broadband Progress helps examine, dialog and execute several "plays" that offer potential ways to advance broadband coverage in the state. In addition, the department of Agriculture, Trade and Consumer Protection regulates business practices of the telecommunications industry (phone, cable, satellite, and internet service) and provides consumer fact sheets inclusive of telecommunications laws that consumers and digital stakeholders should know and understand.

Examining and using data from the Wisconsin Dashboard Console not only provides you with availability and subscription rate information for residents and businesses based on their need, you can also use this data to identify potential reasons why people don't adopt broadband or identify broadband gaps and work with providers, county organizations, and state-wide learning institutions to bring broadband to areas void of connectivity. Through the Demand Mapping effort (Figure 18), Fond du Lac County partnered with Hilbert Communications (Bug Tussel Wireless, LLC) to leverage Midwest Disaster Area Recovery Bonds for broadband infrastructure

Figure 18. Fond du Lac Demand Survey Results

tower build-out in 2013-14, setting an example of public/private partnerships in Wisconsin.

Wisconsin has had success with Community Area Networks (CANs), a collaboration that creates a private network through thoughtful planning and shared resources that connect anchor institutions and boost quality of life for communities (Figure 19). The strength of a CAN is its ability to collaborate and share resources and applications. CANs work with private entities and public partners to create networks to enhance quality of life in the communities they serve.
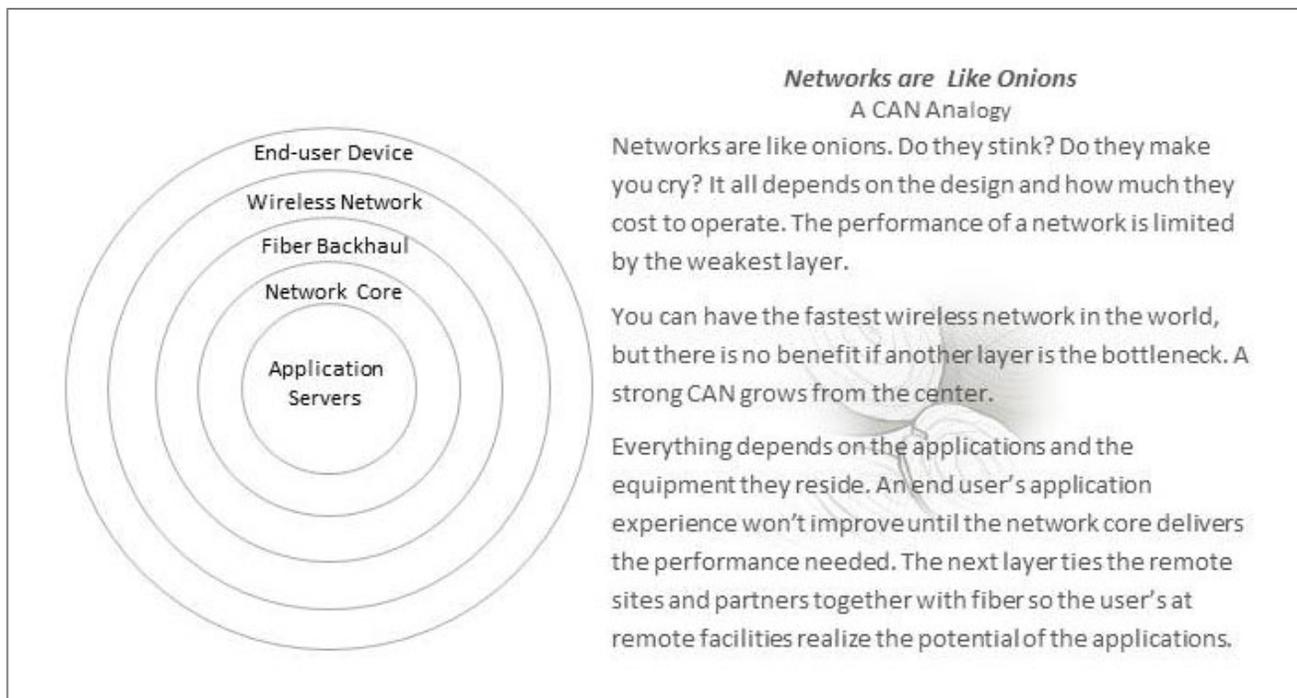
Figure 19. CAN Network Model

Technology councils, similar to one created in Door County, can take a lead and help identify a broadband problem and work with anchor institutions, businesses, providers, and concerned citizens, to identify and implement solutions to bring better access into a community.

"Dig once" policies help to reduce the number and scale of repeated excavations for the installation and maintenance of broadband utilities in a highway. "Joint use" means mandating that broadband utilities install at the same time, in the same trench, or in the same conduit(s). It may also mean the first utility in places extra conduits, and subsequent utilities negotiate to occupy one or more of the empty conduits. The State of Arizona has a strategy of burying both conduit and fiber at the time of road construction. They refer to this as building two roads for the price of one (burying the fiber costs about as much as the paint on the road). This fiber is made available to providers on a cost recovery basis. The dirt is dug up and the road installed once, and therefore costs are reduced. The open network also encourages competition. Wisconsin communities can work together to create guidelines and policies that benefit both broadband and environment sustainability.

The cost and ease of access to public infrastructure like water towers, tall buildings, public rights of way, streets, and public lands create an opportunity for ISPs to invest in broadband in both rural and urban communities. Working with ISPs and planning committees can greatly influence and generate opportunities to enable broadband penetration for the business and residents where you live.

Getting Broadband to un-served or underserved areas is a challenge and digital stakeholders play an important role in addressing business and consumer broadband needs. Working together and finding creative solutions can help communities survive the changing technological landscape.

ADDITIONAL INFORMATION

The goal of the LinkWISCONSIN initiative is to expand broadband access and usage. LinkWISCONSIN and the Public Service Commission (PSC) are available as resources for all broadband-related issues. You can contact the PSC for additional information by emailing: PSCStateBroadbandOffice@wisconsin.gov.

APPENDIX A: GLOSSARY OF TERMS

The following terms are taken from http://techterms.com and the Northern Regional Broadband Networks Forum glossary of terms from the link below. Additional terms are available from these sites.

http://broadband.uwex.edu/wp-content/uploads/2011/03/glossary-of-broadband-terms.pdf

TERM	DEFINITION
3G	A marketing term for 3rd generation wireless technology with transmission speeds generally less than 1 mbps.
4G	A marketing term for 4th generation wireless technology with transmission speeds greater than 1 mbps.
ADSL	Digital Subscriber Line Internet Service that provides greater bandwidth for downloads at the expense of upload speeds, typically 2mbps or lower for downloads and up to 512 kbps for uploads. ADSL is the most common form of DSL used in home networking.
Asymmetric	In broadband, asymmetric refers to different upload and download speeds.
Backbone	A backbone is a robust central transmission line (or a collection of transmission lines) that links many smaller local networks via connections known network access points. It can be a local backbone for a group of office buildings or local area, linking smaller networks to create a wide area network (WAN); or the Internet backbone itself.
Bandwidth	Bandwidth describes the maximum data transfer rate of a network or Internet connection. It measures how much data can be sent over a specific connection in a given amount of time.
Brain Drain	Brain drain is the large-scale emigration of a large group of individuals with technical skills or knowledge.
Broadband	Commonly refers to high-speed Internet access that is always on and faster than the traditional dial-up access.
Broadband Speed	The amount of data that a user can download or upload per second. Broadband speed is measured in kilobits per second (kbps), megabits per second (mbps) or gigabits per second (gbps).
Cable Modem	A device used to connect a single computer or a network to a cable company's service for Internet access. The same physical cable coming into the house or office also provides TV and voice (VoIP) service.
CMTS	(Cable Modem Termination System) A computer-based device that enables cable modems to send and receive packets over the Internet.
Dark Fiber	A fiber strand that is not being used by any entity and carries no Internet traffic, i.e. fiber that is not "lit" by equipment transmitting data via light.
Download	This is the process in which data is sent to your computer. Whenever you receive information from the Internet, you are downloading it to your computer.

TERM	DEFINITION
DSL	Digital Subscriber Line Internet service. DSL provides high-speed networking over ordinary phone lines using broadband technology. DSL technology allows Internet and telephone service to work over the same phone line without disconnecting either service
DMVPN	Dynamic Multipoint Virtual Private Network is a is a secure network that exchanges data between sites without needing to pass traffic through an organization's headquarter virtual private network (VPN) server or router.
EDGE	Enhanced Data GSM Environment is a faster version the Global System for Mobile (GSM) wireless service and enables the delivery of multimedia and other broadband applications to mobile phone and computer users.
Ethernet	A type of data transmission service that links computers in a building. Ethernet consists of hardware, software, and an Ethernet cable. All computers on an Ethernet network attach to the same cable and therefore a protocol defines how data is transmitted. Traditionally, Ethernet operates at 10 mbps, although 100 mbps and 1,000 (a Gigabit).
Fiber	Also referred to as fiber strand. Optical fiber is made of flexible glass that can support very high data transfer rates. An individual glass fiber, roughly the thickness of a human hair, is capable of carrying a distinct signal transmitted in the form of pulses of light. A single strand of fiber is capable of transmitting over a million simultaneous telephone calls, or nearly 80 gigabits of digital information per second (80,000,000,000 pulses of light per second) using current telecommunications equipment.
Fiber Optic Link	Any optical transmission channel designed to connect two end terminals or be connected in series with other channels.
Fiber Optics	Optical fiber (or "fiber optic") refers to the medium and the technology associated with the transmission of information as light pulses along a glass or plastic strand of fiber. Optical fiber carries much more information than conventional copper wire and is in general not subject to electromagnetic interferences and the need to retransmit signals. The capacity is limited only by the equipment on each end of the fiber. Half of the 2009 Nobel Prize in Physics was awarded to Charles K. Kao, who pioneered the use of fiber optics.
FTTH or FTTP	Fiber to the Home or Fiber to the Premise. The engineering practice of using fiber optic cabling throughout a community.
gbps	Gigabits per second. Data rate of 1,000,000,000 bits per second (bps); also 1,000 mbps.
GSM	Global System for Mobile communication is a digital mobile telephony system that is widely used in Europe and other parts of the world.
HDSL	Digital Subscriber Line Internet service that provides equal bandwidth for both downloads and uploads, offering data rates up to 2,048 kbps.
Internet Gateway	The closest peering point between a broadband provider and the public Internet for a given consumer connection.

TERM	DEFINITION
ISP	Internet Service Provider. A company that supplies Internet connectivity to home and business customers. ISPs operate networks that connect end-users to the Tier 1 Internet, allowing them to access resources worldwide. ISPs function as on-ramps to the Internet.
kbps	Kilobits (kb) per second. Data rate of 1024 bytes (binary or data world) or 1000 bytes (decimal) per second.
Last Mile	Segment of telecommunications network that connects the local provider to the customer. The type of cable and distance to the telecommunications offers determines the bandwidth and services available to the customer. Also known as the local loop.
Latency	This is the amount of time it takes a packet of data to move across a network connection. When a packet is being sent, there is "latent" time, when the computer that sent the packet waits for confirmation that the packet has been received. Latency and bandwidth are the two factors that determine your network connection speed.
Line of Site	An unobstructed path between sending and receiving antennas.
LTE	Long Term Evolution. A 4G mobile wireless technology used by Verizon and others.
mbps	Megabits (mb) per second. Data range of 1,000,000 bits per second (bps); also 1,000 kbps.
Middle Mile	Generally refers to the transport and transmission of data communications from the central office, cable head-end, or wireless switching station to an Internet point of presence.
Node	A node is any device connected to a computer network. Nodes can be computers, personal digital assistants (PDAs), cell phones, or various other network appliances. On an IP network, a node is any device with an IP address.
Non Line of Site	Radio transmission across a path that is partially obstructed, usually by a physical object such as a building, trees, mountains, etc.
Optical Fiber	A wire like thread of transparent glass or plastic used in fiber optics to carry light signals and images.
Ping	A test to see if a system on the Internet is working. "Pinging" a server tests and records the response time of the server.
Phishing Scam	The fraudulent process of attempting to acquire information such as user names, passwords, credit card details etc. by masquerading as a trustworthy entity
Second Mile	Generally refers to the transport and transmission of data communications from the first point of aggregation (such as a remote terminal, wireless tower location, or fiber node) to the point of connection with the middle mile transport.
SDSL	Digital Subscriber Line Internet Service that provides equal bandwidth for both downloads and uploads, offering data rates up to 3,000 kbps.
SHDSL	Digital Subscriber Line Internet Service that provides equal bandwidth for both downloads and uploads, offering data rates from 192 kbps to 2,320 kbps. Utilizing one copper wire pair, SHDSL is an affordable option for small businesses

TERM	DEFINITION
Triple Play	A marketing term used by telecommunications providers to describe the availability of voice (telephone), video (cable television) and data (Internet), generally "bundled" as a combined, discounted service.
Upload	Uploading is the exact opposite as downloading. It is sending a file from your computer to another system.
VDSL	Digital Subscriber Line Internet Service that provides enough bandwidth to support applications like high-definition television. VDSL can achieve data rates up to approximately 51.8 mbps, making it the fastest available form of DSL.
VoIP	Voice over Internet Protocol. Technology that enables broadband users to send and receive telephone calls over the Internet.
Wi-Fi	Wireless Fidelity. Strictly speaking Wi-Fi refers to the wireless standard IEEE 802.11. Wi-Fi is used to create wireless networks which use radio transmissions over short distances to create connections between devices without wires or cables.
Wi-Max	A mobile wireless technology with significantly greater range than Wi-Fi.

APPENDIX B: PROVIDER COMPARISON WORKSHEET

QUESTION	Provider 1	Provider 2	Provider 3
Name:	_____	_____	_____
Broadband Connection Type	☐ DSL ☐ Cable ☐ Fiber ☐ Satellite ☐ Wireless	☐ DSL ☐ Cable ☐ Fiber ☐ Satellite ☐ Wireless	☐ DSL ☐ Cable ☐ Fiber ☐ Satellite ☐ Wireless
What Connection Speed Will You Guarantee?			
Upload			
Download			
Latency/Ping			
Data			
How much data storage do I get?			
Does this plan have a data cap?			
What is the cost if I exceed the data cap?			
Security			
What security features do you offer?			
Does this service include firewall protection?			
Is my data encrypted with this service?			
Does this plan include parental controls?			
Email			
Does this plan filter spam?			
How many free email accounts are included?			
How much email space is included for each account?			
Equipment/Installation			
Is there an installation charge? If so how much is it?			
What equipment is needed?			
Is equipment rented or purchased? How much?			
Do you charge equipment insurance fees?			
Customer Service			
Do you have 24/7 support?			
Will I speak with an agent when I call?			
Are training opportunities available, and included in the plan price?			

Plan Pricing			
Is this price promotional or permanent?			
What taxes and additional fees will I pay?			
Does this rate include any rental/purchase and insurance fees?			
Are rebates or actions required to lock in this plan price?			
What is the total monthly fee I will see on my bill?			

APPENDIX C: WISCONSIN BROADBAND SERVICE PROVIDERS

Table 4 lists the service providers in Wisconsin that are represented in the LinkWISCONSIN availability maps. If a service provider is not on the list it is either because they do not meet the requirements for participation (speed of service, delivery of service etc.) or it is a provider about which the Public Service Commission and LinkWISCONSIN team is unaware; therefore, contact the Wisconsin Public Service Commission and they will contact the provider for mapping information.

The LinkWISCONSIN mapping effort includes data from the following satellite providers: Skycasters, StarBand Communications, Hughes Network, and ViaSat. Note that satellite data is difficult to map because, even though a provider may advertise good coverage, mapping efforts take into consideration terrain, location, and other criteria that affect reception.

Table 4. Wisconsin Broadband and Service Providers (June 2013)

PROVIDERS	DSL	CABLE	FIBER	SATELLITE	FIXED Wireless	MOBILE Wireless
24-7 TELCOM, INC.	X				X	
AMHERST TELEPHONE COMPANY	X		X			
AT&T MOBILITY LLC						X
AT&T WISCONSIN	X		X			
BALDWIN BROADBAND LLC			X			
BALDWIN TELECOM, INC.	X					
BAYLAND COMMUNICATIONS, INC.	X					
BAYLAND TELEPHONE, INC.	X					
BERGEN TELEPHONE COMPANY	X					
BERTRAM COMMUNICATIONS, LLC					X	
BLOOMER TELEPHONE COMPANY	X		X			
BRUCETEL COMMUNICATIONS LLC	X		X			
BUG TUSSEL WIRELESS, LLC					X	X
CELLCOM						X
CENTURYLINK	X					
CHARTER COMMUNICATIONS		X				
CHIPPEWA VALLEY CABLE, INC.		X				
CHOICETEL LLC			X			
CIRRINITY					X	
CITIZENS TELEPHONE COOPERATIVE, INC.			X			
CLEAR LAKE TELEPHONE COMPANY LLC	X					
CLEARWIRE						X
COCHRANE COOPERATIVE TELEPHONE COMPANY	X		X			
COMCAST		X				
COMMUNITY ANTENNA SYSTEM, INC.		X				
COMPUTER CONNECTIONS					X	
COON VALLEY FARMERS TELEPHONE COMPANY			X			
COUNTRY WIRELESS					X	
CRICKET COMMUNICATIONS, INC.						X

PROVIDERS	DSL	CABLE	FIBER	SATELLITE	FIXED Wireless	MOBILE Wireless
ELEMENT MOBILE						X
E-VERGENT WIRELESS					X	
EXCEL.NET, INC.					X	
FARMERS TELEPHONE	X					
FAST-AIR INTERNET, INC.					X	
FASTBYTES WIRELESS					X	
FRONTIER	X					
FRONTIER COMMUNICATIONS - MONDOVI	X					
FRONTIER COMMUNICATIONS - ST CROIX, INC.	X					
FRONTIER COMMUNICATIONS - VIROQUA	X					
FRONTIER COMMUNICATIONS OF WISCONSIN	X					
FRONTIER RHINELANDER TELEPHONE COMPANY	X					
GENEVA ON-LINE, INC.					X	
GENUINE TELECOM	X					
GRANTSBURG TELCOM	X		X			
HAGER TELECOM, INC.	X					
HILLSBORO TELEPHONE COMPANY, INC.	X					
HUGHES NETWORK SYSTEMS				X		
INDIANHEAD TELEPHONE COMPANY	X					
INTERNET KMORAINE					X	
JCWIFI.COM					X	
LAGRANT CONNECTIONS, LLC	X					
LAKEFIELD TELEPHONE COMPANY	X					
LAKELAND TELECOM, INC.	X	X				
LAVALLE TELEPHONE COOPERATIVE	X		X			
LEMONWEIR VALLEY TELEPHONE COMPANY	X		X			
LEVEL 3 COMMUNICATIONS, LLC			X			
LITEWIRE					X	
LUCK TELEPHONE COMPANY	X		X			
MANAWA TELEPHONE COMPANY	X					
MARQUETTE-ADAMS TELEPHONE COOPERATIVE	X		X			
MEDIACOM		X				
MEGAPATH CORPORATION	X					
MERCURY NETWORK CORPORATION					X	
MERR.COM		X	X			
MHTC	X				X	
MIDCONTINENT COMMUNICATIONS		X				
MILLTOWN MUTUAL TELEPHONE COMPANY	X		X			
MOSAIC TELECOM	X					X
NELSON TELEPHONE COOPERATIVE	X					
NETWURX					X	
NEWWIS					X	
NEXTGEN COMMUNICATIONS, LLC		X				

PROVIDERS	DSL	CABLE	FIBER	SATELLITE	FIXED Wireless	MOBILE Wireless
NIAGARA TELEPHONE COMPANY	X					
NORTHERN TELEPHONE AND DATA	X				X	
NORTHWEST COMMUNICATIONS	X	X				
NORVADO	X		X			
NSIGHT TELSERVICES	X					
PACKERLAND BROADBAND		X				
PRICE COUNTY INFORMATION SYSTEMS LLC	X					
PRICE COUNTY TELEPHONE COMPANY	X					
RAPID CABLE		X				
REEDSBURG UTILITY COMMISSION			X			
RICHLAND-GRANT TELEPHONE COOPERATIVE	X		X			
SHARON TELEPHONE CO.	X					
SIREN TELEPHONE COMPANY, INC.	X		X			
SKYCASTERS, LLC				X		
SOLARUS	X		X			
SONICNET INC.					X	
SONICPCS					X	
SPRING VALLEY TELEPHONE COMPANY, INC.			X			
SPRINT						X
STARBAND COMMUNICATIONS, INC.				X		
T6 BROADBAND					X	
TDS	X					
THREE LAKES CABLE TV		X				
TIME WARNER CABLE		X				
T-MOBILE						X
TRI-COUNTY COMMUNICATIONS COOPERATIVE	X		X			
TW TELECOM	X		X			
UNION TELEPHONE COMPANY	X		X			
USCELLULAR						X
VERIZON WIRELESS						X
VERNON TELEPHONE COOPERATIVE, INC.	X		X			
VIASAT COMMUNICATIONS				X		
WAUPACA ONLINE					X	
WEST WISCONSIN TELCOM COOPERATIVE			X			
WESTERN WISCONSIN COMMUNICATIONS		X				
WITTENBERG CABLE TV COMPANY		X				
WITTENBERG TELEPHONE COMPANY	X					
WITTENBERG WIRELESS			X			
WIZTECH, LLC					X	
WONDERWAVE.NET INTERNET, INC.					X	

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