

## Wireless Primer for Western Massachusetts Towns

Lack of reliable, universal high-speed internet in small towns in Western Massachusetts has had a devastating effect on economic development, the quality of education, access to government services and professional opportunities. Ultimately it has impacted the long-term viability of our small towns, and helped create shrinking and aging populations.

It's long overdue for us to solve this problem, *once and for all*. And what will do that is a universal, municipal fiber-optic telecommunications network.

If our communities are to invest in telecommunications infrastructure, it's critical that money is spent prudently on a long-lived asset that will serve us for decades to come. WiredWest has examined the technologies for internet service and determined the only one capable of reliable, widespread and robust coverage in our region—and most importantly, has the capacity for today and tomorrow's modern, high bandwidth applications, is fiber-optic cable.

What will not solve the problem is building a system based on a limited capacity, coverage-challenged technology like wireless. Wireless can be an adjunct to fiber-optic cable systems, and certainly cellular coverage is a separate, desirable goal, but on its own, wireless cannot provide universal, affordable and robust high-speed internet in our region.

Several of our towns have experience with both fixed and mobile wireless, and case studies from towns that have tried fixed wireless are included in this document. Below are rates of satisfaction from a 2012 WiredWest Market Research survey of citizens in our towns, of mobile and fixed wireless service.

Service	Reliability		Cost		Speed	
	Satisfied(%)	Dissatisfied(%)	Satisfied(%)	Dissatisfied(%)	Satisfied(%)	Dissatisfied(%)
Mobile Wireless	67	34	51	42	67	34
Fixed Wireless	60	40	60	39	60	40

By contrast, Verizon FiOS, a fiber-optic network deployed in urban and suburban areas around the United States, was rated #1 in customer satisfaction, value and reliability according to the American Customer Satisfaction Index.

### What's behind those high rates of dissatisfaction with the service?

#### Coverage Challenges

The biggest impediment to deploying wireless internet in Western Massachusetts is our terrain of hills, valleys and heavy tree cover. Fixed wireless in particular has strict line-of-sight requirements between towers and home antennas, which dictates multiple towers and repeaters to get service to premises. Coverage by cell towers is also spotty.

When fixed wireless pilots were done, according to a presentation given by Sharon Gillett, the inaugural Director of the Massachusetts Broadband Institute, hills and trees were a problem and twice the predicted radio density was required.

Research was subsequently done that indicated high iron content of leaves in Western Mass due to high-iron soils. This serves to block signals when trees have foliage.

The need for so many towers is another challenge in our local communities, who often have heated debates and lengthy approval periods for locating both fixed wireless and cellular towers.

#### Poor Reliability

In the case studies following, there are a number of references to poor reliability, stemming from weather and technical

issues that produce what users have deemed unacceptably frequent and prolonged service outages.

### **Low Bandwidth**

The important issue about wireless is that it's a low bandwidth solution in a time of escalating demands on bandwidth consumption and development of modern, high-bandwidth applications. Although small improvements in the capacity of commercially-available wireless technologies do occur, they are still not able to meet the average home user's bandwidth needs, and most definitely are not sufficient to run a business, and drive local economic development.

### **High Service Costs**

The costs for service on most fixed wireless networks in Western Mass is approximately equivalent to the cost for satellite internet service.

Of the two wireless technologies primarily used for broadband (fixed wireless and mobile data), the mobile option however is extremely expensive. Here is the pricing for Verizon data plans based on monthly data usage allowances:

\$30 4GB/mo	\$40 6GB/mo	\$50 8 GB/mo	\$60 10 GB/mo	\$70 12 GB/mo
\$80 14 GB/mo	\$90 16 GB/mo	\$100 18 GB/mo	\$110 20 GB/mo	\$185 30 GB/mo
\$260 40 GB/mo	\$335 50GB/mo			

Compare the cost/benefit of the above prices and data allowances to a recent Sandvine survey showing subscribers without over the air or cable television service consuming an average of 212 GB per month of data.

### **Unknown Buildout Costs**

Some have suggested that wireless is cheaper to build than fiber. If you're looking to provide widespread coverage, expense will vary depending on topography, size of town and population distribution. No towns in Western Massachusetts that have had wireless have been able to serve the entire population. As you will note in the case studies, of the towns that invested in wireless, the amount spent per premise served varied from about \$1,700 to \$6,700.

We have only one town with an entirely designed wireless plan; the Town of Royalston. It was commissioned as part of the MBI last-mile grant program in 2012. The total cost to serve the majority of the town was \$2.5 million with costs per premise varying from \$3,460 to \$7,059.

### **Higher Long-term Costs**

Every seven to ten years, a wireless network requires reinvestment of most of the system. So if you compare the total investment in a wireless network over the expected decades-long lifespan of fiber, the total capital investment most likely exceeds the capital investment in a fiber network, but without fiber's benefits of coverage and capacity.

### **Wireless Case Studies:**

Mount Washington    New Salem    Princeton    Rowe    France

## Case Study: Town of Mount Washington

Over the last few years, in desperation, and before the MBI middle mile was connected to the town hall, the town tried to find ways to provide high speed internet to the town hall and to help residents find a solution for high speed connectivity. One provider put up wireless broadcast equipment in our telecom overlay zone on Mount Darby and suggested that they would be able to provide wireless internet service both to the town for its business, and to many of our residents as well.

This soon proved to be problematic. Coverage from the overlay zone was minimal at best and the town hall could not be served at all. The town agreed to have a repeater put on the town salt shed which is central to the town, fairly close to the town hall, and the tallest structure available. Still reliable service could not be made available to the town hall. A few residents were able to make connections but overall the availability was minimal. The town hall was finally provided service by putting an antenna in a nearby tree and running a wire to the office. Better than dial up, but whenever the wind blew the service would go in and out. The antenna in the tree became the joke of the town and an example of the futility of using wireless internet access in type of terrain we have.

I must say that the provider worked very hard to find ways to serve the town. Our problems with wireless were not for lack of trying. Technicians spent hours at homes throughout the town testing different locations and different types of equipment but after all of that effort they were able to serve about 10% of the residents. Maybe 12-14 households at best.

The story continues. The town now has MBI fiber which is fast and reliable, however the few residents that were able to get service from the wireless provider are plagued with outages. Stormy weather seems to regularly damage the broadcast equipment. Residents complain to the Selectboard at our regular meetings that not only is the service unreliable, but they can't contact the provider, the phone just rings. There may very well be too many service requests for the company to handle. In contrast the town maintains its right of way and very rarely has an electricity outage during stormy weather. Usually interruptions in service are interruptions somewhere else in the grid. And the town's fiber internet service has never failed due to weather.

I think the town has given wireless internet a fair trial and the verdict is that it is not a reliable option for residents in our community.

Jim Lovejoy  
Selectman  
Town of Mount Washington

## Case Study: Town of New Salem

New Salem was part of a wireless pilot undertaken by Pioneer Valley Connect. They used standard Wifi (802.11b). We had two access points mounted on buildings downtown. Only a handful of houses could get the signal, I think six was about the maximum. Bandwidth was not too bad when it worked, but the signal was not very reliable. We also were testing it in the library and often completely lost the link.

When the testing ended, a couple of households downtown and a couple of town buildings signed up to continue as paying customers. They were moved to the 900Mhz frequency which supported longer distances and the few subscribers were pretty satisfied with speed, though we still had outages. At that time the T1 that the Western Mass Connect had funded was removed and the provider (AccessPlus/CountryRoads) connected the local equipment wirelessly to Mt. Grace, using the same backhaul as the Warwick wireless network. They had planned to extend access to more of New Salem via wireless. Several people volunteered to host repeaters, but the provider could not find a way to reach most houses in town. I think that says more about the challenges in using wireless to reach many homes in western MA than any statistics about our pilot.

MaryEllen Kennedy  
WiredWest Delegate  
New Salem Broadband Committee

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## Case Study: Town of Princeton

The Princeton wireless system was build about 6-7 years ago by the Princeton Municipal Light Department (PMLD) for around \$550k, after a lengthy study of various wired options costing \$4-6M.

The system was represented as "pre-WiMax" technology, which I infer is probably 802.16 standards. At the time it was stated that the system was an interim solution and would last 4-5 years.

The system was operated by PMLD for maybe 4.5 years, and then sold to Ayatch Technology Solutions (<http://www.ayacht.com/pmld-wireless-isp/>). According to their web site, the system primarily uses unlicensed 900MHz spectrum with a 5.8 GHz backbone, and a couple of years ago two poles were upgraded to 3.65 GHz technology (stated as "LTE"). Note: the information provided is to the best of my knowledge - I had exemplary direct access the then PMLD Manager that built the system, no direct access to the current system owner for additional information or confirmation.

The system topology is 23 transceiver poles place throughout Princeton's 35 square mile footprint, all with line-of-sight to the master antenna on top of Mt. Wachusett. Each neighborhood pole has 1.5Mb bandwidth (excepting the two LTE poles), shared among a number of premises in the neighborhood. The pole I utilize is the 2nd most loaded at 22-23 households; some have maybe 12-14 households. I would estimate maybe 25-40 total users on the LTE poles.

When PMLD rolled out the system, there were initially around 350 subscribers; I would guess just over 300 currently.

There are two residential subscription options - \$40 for 1Mb service, and \$60 for 1.5Mb service. I am subscribed to the 1.5Mb service, which I am told buys me somewhat of a 'priority' on my pole. My actual speed ranges from maybe .9M (literally at 2:30 am) to .5-.6Mb during a weekday, to less than .3Mb on a weekday during school after the kids are dismissed. There have been times during school-closed weather when the actual speed is less than decent dial up (30k). LTE subscribers inform me they typically get 4mb speeds, but it varies between 2 and 6Mb.

As a part of the Princeton Broadband Committee (PBBC) town survey 16 months ago, we challenged residents to test their Internet speeds via speedtest.net. Virtually all wireless subscribers received an **F grade** for comparative speed, although one person reported receiving a D-minus in the middle of the night. Most DSL subscribers receive a D or D+ grade.

Reliability varies by pole, pole loading and also by subscriber - there are periods where the system is relatively stable (although as noted not the speed), and frequent periods where a pole (or several or all) have been down for 24-36 hours.

In my role as a Princeton Selectman, I talk to a lot of resident subscribers, and I have yet to meet one that is a 'happy camper' - **absolutely everyone complains about the system reliability and horrific lack of speed**. No one can watch even a short YouTube video without stutter/buffering, let alone stream a Netflix movie. A colleague on the Princeton Broadband Committee plugged in his Garmin GPS to update the map database and received the message that his Internet connection was too slow to perform the download. He also tried to download a movie from iTunes (\$10 for 24 hour rental); the 24 hours expired before the movie's download completed. We could probably fill a thick notebook with all similar stories and experiences.

The Princeton wireless Internet subscribers are actually jealous of Princeton DSL subscribers, which is ironic in that a large portion of DSL subscribers are likewise dissatisfied with DSL speeds. With our local K-8 school increasing utilizing online content, even DSL users (1.5 to 2.2M typical speeds) complaint that it takes 40 minutes for their children to view a '10 minute video' homework assignment; for wireless users, it can often take up to 2 hours for the 10 minute video to download. It is not an uncommon site for there to be kids with laptops in cars parked outside the Princeton Library on evenings the library is closed.

Small business and residents that attempt to telecommute are extremely frustrated. Pretty much every Internet user in Princeton is **extremely vocal** to the Select Board, Town Administrator, and members of the Princeton Broadband Committee.

I don't believe they achieved total break-even on their initial wireless investment, and sold the system to Ayatch for I think around \$35k, so the electric ratepayers were on the hook. As we say in Princeton, the taxpayers and the PMLD ratepayers are **all the same people**, with the wireless subscribers a subset of both (Princeton has less than 1% commercial property tax revenues, and virtually 100% of town business are owned by town residents.).

Two articles on our whitespace wireless research can be found on the PBBC web site ([www.princetonbroadband.com](http://www.princetonbroadband.com)). The 2nd article on the page was written in response to a 'letter to the editor' by a former PBBC member, and the first article (without word count restraints) was authored by PBBC Chair John Kowaleski.

I am available to anyone and everyone within reason who might need to hear this information in person, and issue an open invitation to those that would come to Princeton to personally experience how (choosing my words carefully) horrible wireless Internet is.

Regards,

Stan Moss

Princeton Board of Selectmen

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## Case Study: Town of Rowe

In a word, we were disappointed with the results of our effort to set up a wireless broadband network.

I think we spent about \$35k to reach a section of Rowe around Davenport Road that is too far from Central Offices or Remote Terminals for DSL to reach. In addition, there was an \$18k preliminary study to do testing and making the plan for the network.

We were presented with coverage maps supposedly showing the area around each radio that would be able to receive service. The coverage maps were based on a few sample tests. However, what the maps did not show is that within each coverage area, there are many places where the “shadows” of terrain and trees would make it impossible to connect without building tall towers on individual subscriber’s home – at their expense. We ended up with a couple of very happy customers because the alternative for them was dial-up. We also had some very disappointed and angry people who though from the initial proposal that they would be able to get connected, only to find that the company that was set up to operate the network was unresponsive and basically ended up telling them that they couldn’t get connected.

The contractor for the network (AccessPlus) did warn us that there may be such cases and refused to guarantee any number or percentage of houses within the so-called coverage area could actually get connected. We didn’t realize how big a problem it would be. I think in ideal areas where there is line-of-sight access to one high spot surrounded by a large flat area it might make sense. But in hilly, forested terrain, wireless broadband (at least the technology that we used) doesn’t cut it.

We had 10 houses in a primary target area of which only two were finally able to get service. I believe those 2 are happy with their 1Mbps service. In addition, 3 houses get free wireless service even though they are within DSL range because they agreed to host network radios on their ideally located houses. The library and Rowe Conference Center had service but found it unacceptable (slow and unreliable) so they found other alternatives. I think one other house has service that he is happy with. So summing up, \$53k spent for a total of 8 connections, 3 of which were unnecessary because they can get DSL and 2 of which have since dropped the service because it was so bad. At least 3 others that I know about attempted to get service but were told that they couldn’t get a signal or would have to pay for a tower to get the radio high enough. This is all as of the initial roll out in 2010. There may be some additional connections that I don’t know about and probably a few more that tried but couldn’t get connected. There were some meetings at which we heard from a number of disappointed and angry residents.

The estimated life of the radios is 10 – 15 years, and I don’t know what will happen then. The radios are owned and operated by the contractor and they may decide not to replace them if they are not making money. This was an experiment. The only proposal in response to our RFP that would give any guarantees was going to cost well over \$1M. The three houses that are happy with their service probably think it was worth it, however, the rest of the Town has a legitimate complaint that we didn’t get our money’s worth. In hindsight, I’m not sure we did the right thing by proceeding with a project that benefitted so few and had no guarantees.

Personally, I think fiber is the only viable solution. It will last the longest both physically and in terms of the technology not becoming outdated. Wireless has too many limitations in hilly, forested terrain. But, of course, the devil is in the details so I could be proven wrong.

David Dvore  
Rowe