Analysis of the Broadband Fiber Optic Communications Initiative in Western Massachusetts

The Good News:

The 1,200+ mile MassBroadband 123 network is complete – over 120 communities in western and north central Massachusetts are connected and their anchor facilities are operational. The State has allocated a further $40M towards providing broadband access to every home and business.

The Bad News:

A statement from The Massachusetts Broadband Institute (MBI) handout at their informational meetings:

> "MBI has a fiduciary obligation to ensure that State funds are expended in ways that best advance the public objectives of the broadband initiative."[1]
>
> And from their web site: "The Massachusetts Broadband Institute, a division of MassTech, is working to extend affordable high-speed Internet access to all homes, businesses, schools, libraries, medical facilities, government offices and other public places across the Commonwealth."[2]

I believe that MBI has failed on these counts and that the poorest and most under-served towns are now faced with a dilemma: they must either approve General Obligation bonds to fund the unknown total local installation costs and accept the full liability of any failure by WiredWest (WW) to generate sufficient revenues, or forgo these high speed services and be saddled with limited or no internet access.

I don't believe our Legislature would knowingly allow such a situation to develop. MBI and WW has forced this outcome by their insistence that the network must be 100% fiber optic to every home without any alternative system engineering studies or economic projections of alternative approaches. It is all or nothing – with the "all" being the most expensive and least appropriate of several methodologies.

Enumerated Risks to the Member Towns:

The draft last mile finance plan summary outline from Mintz Levin PC[3] states:

> 11. The operating results of the WiredWest business over time are uncertain and will depend on take-up rates, pricing for various services, operating costs, competition, technology change and many other factors.

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[1] http://broadband.masstech.org/sites/mbi/files/documents/building-the-network/mbi-wiredwest-municipal-outreach-presentation-11062014.pdf, slide 6. Underlines in quotes added for emphasis.

[2] http://broadband.masstech.org/press-releases/mbi-named-broadband-organization-year-natoa, September 14, 2012.

[3] http://broadband.masstech.org/sites/mbi/files/documents/building-the-network/last-mile-finance-plan-outline-sandomirsky-mintzlevin-10282014.pdf

12. Based on current projections, the towns would not be able to count on significant revenues coming back through their MLPs [municipal lighting plants] for several years.

14. Towns would remain legally liable on the G.O. bonds regardless of WiredWest operating results.

Demand for Services:

WW's tentative Rate Sheet shows a multi-tiered cost structure with prices for Voice over Internet Protocol (VoIP) at $10-30 over basic internet access costs. Cable Television-like services with basic channels and a DVR will be priced at $70 and up from the combined basic internet + phone rates.

Using these expanded charges as a basis for estimating WW revenue is very high risk. WW has no exclusivity in providing anything but basic internet service.

VoIP is a commodity service that can be purchased from numerous providers. Cable TV (CATV) is obsolete. Internet Protocol Television (IPTV) is rapidly superseding CATV as a provider of video services. Netflix, Google, Amazon, Hulu, iTunes, HBO and hundreds of other providers will provide programming on demand. Competition will drive pricing. We no longer need 100 or 150 channels of static content with its huge network bandwidth load to each house.

Consumers will subscribe directly with various providers, with none of the revenues going to WiredWest. Therefore, any MBI / WW revenue projections based on anything but basic internet charges are unsupported in my view.

Interest Projection:

WW is estimating that $60-79M will need to be town financed. At a 5% bond interest rate, interest charges will be about $3.5M per year - less the interest on any principal paid down. Assuming 15k customers at $600 per year each, gross revenue will be $9.0M per year. Assuming that WW operating costs consume 60% of this gross revenue, then interest costs alone can just be met with the "profit". There is nothing left for principal pay down.

The answer to our dilemma is to deploy technology solutions that do not require a town buy in, and to find partners who will support this final build out. Robust wide bandwidth communications available at every doorstep is the State mandate – and not the details of the connecting technology to get there.

Last Mile Fiber:

This is a misnomer for this project. In reality it is the last several miles and every house on every dead end cow path needs fiber brought to it. I can think of nothing more wasteful when at least 95% of these houses will probably never need the full capabilities of a fiber connection – and the attendant expensive fiber interface unit at every dwelling. Wouldn't a more realistic solution be to provide a high reliability, high speed and low cost connection to every house – and have the capability to readily provide fiber to those who need and can afford it?

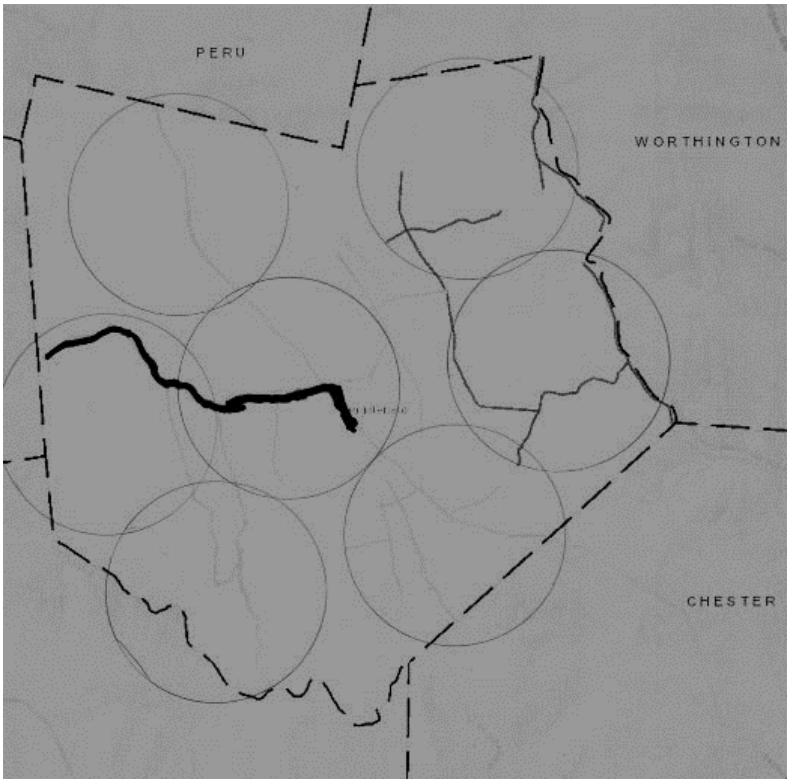
The WW planning shows no imagination or flexibility of thought. Their Champagne network and our town beer budgets will leave half of the most underserved towns relying on tin cans and string for communications.

From “Our Values” on the WiredWest web site:

> “Future-proof: Building a high capacity network for our region is essential – but the upfront costs are high. Thus, the network must last a long time and be capable of highly scalable, economic upgrades as needs increase.”[4]

The Solution is Circles:

I took a map of Middlefield, MA scaled 1 inch = 1 mile. I then drew two inch contiguous circles until I had all the homes in the town covered. It took seven of these 2” circles to accomplish this.



(Sketch at half size)

These now represent one mile radius circles - and now we are truly in the “Last Mile” of network connectivity to every location. I then calculated that perhaps 7 or 8 miles of point to point fiber optic cable would connect the existing backbone (in heavy black) to the center of every circle. Digital Subscriber Line (DSL) networks can reliably provide 10 Megabits per second (Mbps) downloads at a distance of one mile over standard telephone twisted pair cable. Wireless networks provide reliable high speed connectivity at this one mile maximum distance.

This technique is called fiber to the neighborhood (or fiber to the node) and is typically used in urban or suburban CATV systems where coaxial cable provides the final connection link to the home. I modify the definition here so every connective technology is included and can be utilized. An engineering evaluation

[4] http://wiredwest.net/about-us/value-mission-and-values/.

can decide where the optimum node center is located and the appropriate technology to connect to each home.

WW has presented evidence that wireless networks are not useable here. Their evaluation was for very wide area networks served by one distant transponder. Wireless in the neighborhood is a different system and does not suffer the shortcomings of their test cases. At a one mile maximum nearly all wireless communications are line of sight.

We can guess at the magnitude and complexity of a fiber to the neighborhood network to serve the 45 member towns. If we scale from the Middlefield example, then perhaps 350 nodes would be required. MBI's network engineers could provide a basic analysis and costing of the fiber optic and optional network implementations. At $50k per node, the total node cost would be $17M leaving $23M for cabling.

Technical Flexibility - "Huts":

At the node center I envision a 10 or 20 foot long waterproof shipping container type enclosure painted a reflective white with internal insulation to minimize summer heating. These Huts will contain equipment racks for every communication device and the control interface electronics required to provide neighborhood (3.1 square mile) connectivity to the fiber optic backbone. Operating power will be provided by photo-voltaic panels and sealed batteries. Commercial power is the backup. An air to air heat exchanger is used to prevent summer overheating and to provide protection against condensing humidity. The exchanger will also provide heat during winter maintenance.

The Hut will be assembled and tested at a central location. Communication access panels, power entry and grounding points will be universal. A gravel base and a telephone pole for wireless is all that will be required for the site preparation. The steel body and robust locking mechanism provide security. Video monitors and internal alarms can also be easily provided.

Emergency Communications:

The remote areas of Western Massachusetts are plagued by inadequate emergency communications. There are large areas where radio communications are not reliable or even available. The State has instituted a major upgrade to its communication network. I wonder if it may be more limited in coverage than its predecessor due to the higher frequency of operation.

We are presently trying to mitigate a dangerous Middlefield radio coverage condition in a river valley on our eastern edge. Our Police Chief could not communicate during a rescue attempt on his part at what turned into a tragic drowning.

I would suggest that low power emergency service repeaters could be co-located at each node. Communications from low powered portable radios would now be 100% reliable over the entire built out network region. There would be no more black (radio) holes. Opportunities for regional dispatch, GPS unit locators and inter-operability are guaranteed over the massive fiber optic network. The system dispatching turf battles would be a relic of the past. I believe this technology would have solved our local problem stated in the previous paragraph.

Our small towns could now use one radio frequency mitigating the need for separate fire, police and public works radios (and networks) for usages that amount to a few hours a month. These equipment savings, along with negating the need to have one or more "local" dispatchers at several thousand dollars a year,

would be a significant saving and advantage to our town. The distant mountain top repeaters and their upkeep would be a thing of the past.

A back up radio link to a central dispatch would be provided via a gain antenna at each node in case of a fiber network failure. Our installed telephone pole would also carry the required emergency service antennas. The shared use of the node site and network presents a potential avenue of sharing the system build out expenses to minimize the cost to each service.

Commercial Interest and Opportunities:

Rumors abound that the Commercial TELCOs want to abandon rural hard wired networks in favor of wireless (cell phone) telephone service. Maintaining rural copper wire is expensive, with fewer and fewer paying customers per mile.

Is it possible to construct an agreement with the TELCOs which might have as elements the use of our nodes to host 4G services which would give them an instant rural system possibly at little cost in exchange for using their spare copper wire network and poles for our potential local high speed DSL connections? I see any amount of agreements that would mutually benefit the Phone Companies and WW. Someone just has to ask the right question.

I query if other yet unknown service providers would contribute in exchange for local access?

Why did I write this Analysis?

I am a Middlefield Selectman and I will have to decide the possible financial future of our town by December 31st by answering the WW request for commitment. This document is my due diligence. The decision by our Selectboard is one of the three steps WW requires to decide the probability of whether Middlefield will have a fiber optic future or not.

I wonder how many of our small towns are qualified to make such a decision, given that this action is irrevocable for the next 20 or 25 years. I believe many will opt for not supporting the bonding initiative and will not bring the issue to town vote. I am looking for a third option that adheres to the mandates laid down by our legislature while mitigating the financial and access risks that I feel this initiative presents to every town.

I am also a WW alternate delegate and a member of our Town's Communication Committee. I am a retired Electrical Engineer with 50 years of Radio Frequency specific experience with issued patents. I co-owned a laser R&D company doing Government sponsored research on high powered CO2 lasers. I have been a licensed Amateur Radio operator since 1958 and have built Amateur emergency repeater systems.

Howard Knickerbocker
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