Muskie School Capstones and Dissertations   Student Scholarship

Spring 2014

Broadband Policy in Maine: The Efficacy of the Current Approach and a Vision of the Future
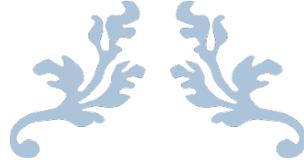
Ethan Wiley
University of Southern Maine, Muskie School of Public Service

BROADBAND POLICY IN MAINE

The Efficacy of the Current Approach and a Vision of the Future

ETHAN WILEY

EDMUND S. MUSKIE SCHOOL OF PUBLIC SERVICE
Capstone Requirement for the Master in Public Policy and Management
Professor Charles Colgan, Advisor
Spring 2014

Introduction

The Organization for Economic Cooperation and Development ranks the United States 19th in average advertised broadband download speed among the 40 nations on which it keeps such statistics.[1] Within the United States, the State of Maine ranks 49rd out of 50 when it comes to quality and availability of broadband service.[2] Furthermore, 62% of Maine broadband customers fall below the FCC minimum speed of true broadband (4mbps).[3] Figures like this reinforce the perception that Maine is struggling in a nation that, as a whole, continues to lag in internet connectivity. A 2011 report by the U.S. Chamber of Commerce ranked Maine number 1 in technology infrastructure[4]- a figure in stark contrast to the narrative, let alone the experience, that Maine was falling behind and out of touch with the digital world at large. This dichotomy, of rural deficiency versus leading infrastructure defines the modern broadband landscape in Maine. The changing nature of broadband in the state is an evolving discussion about the nature of government, the requirements for services, and the emerging conversation on capacity versus coverage.

The Organization for Economic Cooperation and Development is an international economic organization focused on economic progress and free trade. Its measurement of average advertised download speeds takes a broad look at the country as a whole and reports current statistics. The U.S. Chamber of Commerce is a lobbying group, focused primarily on the interests of businesses and trade organizations. Their 2011 report *Enterprising States: Recovery and Renewal for the 21st Century* was commissioned to highlight and detail enterprising policies and developments in various states. It is important to note that it details the *potential* for the state based on its infrastructure developments. The OECD and the Chamber of Commerce are measuring slightly different things but they highlight where the country and the state are. Maine is undergoing a dramatic increase in the development of broadband internet. This development has yet to translate to results of a similar magnitude in the market and adoption of that service. This transition is the basis for the existing public policy concerning broadband implementation and the stimulus for its continued progression.

The contemporary landscape of broadband growth is defined largely by the interplay between government authority, private providers and the consumers of increasingly more complex services. This change has come as the result of large shifts in public consensus on the significance of the social and economic benefits of broadband.[5] This has most recently been reflected in public policy through initiatives such as The National Broadband Plan at the federal level as well as state and local initiates to develop infrastructure.[6] These public plans have had to find a place in the previously private domain of internet service providers, who previously functioned as the sole wardens of development. This approach has been notable in Maine where public funds have been used to develop last and middle mile projects. In addition to this effort, federal stimulus money has been used to develop advanced networks designed to provide the backbone for superior internet connectivity for the state.

---

[1] Average and median advertised download speeds, September 2012. (2013, July 9). *Broadband and telecom - Organisation for Economic Co-operation and Development*. Retrieved January 15, 2014, from http://www.oecd.org/sti/broadband/oecdbroadbandportal.htm

[2] Net Index by Ookla. (n.d.). *Global Broadband and Mobile Performance Data Compiled by Ookla*. Retrieved April 12, 2014, from http://www.netindex.com/#source

[3] Maine Internet Speed Report . (n.d.).*Speed Matters*. Retrieved January 28, 2013, from http://www.speedmatters.org/

[4] Enterprising States: Recovery and Renewal For The 21st Century. (n.d.).*U.S. Chamber of Commerce*. Retrieved November 13, 2015, from http://www.edawn.org/images/uploads/docs/U.S._Chamber_Report_-_Enterprising_States_2011.pdf

[5] Given, J. (2010). Take your partners: Public private interplay in Australian and New Zealand plans for next generation broadband. *Telecommunications Policy, 34*(9), 540-549.

[6] About VTA. (n.d.). *Vermont Telecommunications Authority*. Retrieved February 15, 2013, from http://www.telecomvt.org/about

A combination of coverage and access are the biggest problems facing Maine today. The policy issues revolve around the capability of the current public approach to bridging the broadband divide. The changes that can be made to that approach, the needs of infrastructure that need to be met in order to deliver adequate services, and what- if anything- should be done to foster alternative technologies are also investigated. This paper discusses the changing realities of broadband in Maine, a state which faces large challenges but nevertheless is making strides towards global competitiveness. Where the state's future lies, and what this future will look like forms the rationale for this research. Other issues such as capacity, connectivity for services, and emphasis in advancement feature in the study of the changing nature of broadband development.

Today in Maine anemic internet speeds reinforce a digital divide between rural and urban areas. Even where adequate connectivity is possible its adoption rate lags behind. In order to overcome this technical solutions are necessary such as streamlining access and building capacity. It will require additional incentives to bring levels to an ideal state as well as public enlightenment to the increasingly vital role that broadband performs. Until this happens the deficit that the state faces in access and adoption will continue to hamper progress in business, health, education and other arenas.

Literature Review

Maine is a geographically large state for New England with a relatively low population density. The state features a large amount of rural territory which has defined both the past and as well as the future of broadband development. Much of the literature related to rural issues, particularly those surrounding technology, is very relevant to Maine. Since broadband policy affects the state as a whole it invariably leads back to the issues raised by its rural nature and the costs associated with improvement. The primary focus has been on expanding coverage in the state, predominantly as the result of government grants to small, mostly rural providers of internet service.

The first question when it comes to development is about the potential benefits. Naturally improved access brings with it a host of advantages, both social and economic, that faster more reliable connections can afford the user. Research suggests that rural users in many ways have the most to gain from improved internet connectivity.[7] This is because internet usage decreases, if not eliminates barriers that exist as a result of rural living. The largest of these is the barrier of distance, which limits access to services, markets, as well as social interactions.[8] This benefits not just individuals but small businesses as well.

These interactions feed social capital and play a role in reducing out-migration. The associated social and professional network can open markets for the growth and expansion of small businesses.[9] At the same time it opens these communities to education and healthcare services. Rural students engage in online courses for credit at a higher rate than urban and suburban peers.[10]

---

[7] Warren, M. (2007). The digital vicious cycle: Links between social disadvantage and digital exclusion in rural areas. *Telecommunications Policy*, 31(6), 374-388.

[8] Ibid.

9 LaRose, R., Strover, S., Gregg, J. L., & Straubhaar, J. (2011). The impact of rural broadband development: Lessons from a natural field experiment. *Government Information Quarterly*, 28(1), 91-100. [LaRose 2nd paragraph]

10 Horrigan, J., & Murray, K. (2006). Rural broadband Internet use. *Pew Internet & American Life Project*.

There is an indication that the growing usefulness of high-speed communications to rural locations may have a significant role to play in sustaining them in the long term.[11]

The feasibly of constructing networks to foster these positive effects relies on considerations of both cost and technology to do so. Much research exists on the use of wireless broadband to provide coverage to rural regions. The application of technology like this is the key to unlocking the adoption of internet services in rural areas at an attainable price.[12] At the same time there is some dissent in this. At least one study has found that the needs of rural broadband were not truly satisfied by any one existing technology.[13] This gives credence to the idea that alternative technologies have the best chance of effectively delivering needed services to certain areas.

As population density declines so do broadband market opportunities. Historically, this is the largest factor contributing to higher costs. As a result there is a disparity in connectivity between urban and rural areas nationwide. This disparity is frequently referred to as the digital divide and its presence is the subject of a lot of research related to rural broadband development. It is not unique to the United States. Previously such a gap had to do with broadband itself, with urban areas enjoying the initial roll out of the technology almost a decade and a half ago. As urban areas of the country have at least gained access in large part, much of the gap that exists now is found in penetration levels and quality of service as well as financial considerations such as cost of access.[14]

There are multiple dimensions to this divide. Early surveys found there was a divide along racial lines in the United States with Black and Hispanic households lagging behind white households.[15] Recent studies have shown that this divide has evaporated.[16] Instead the divide that exists now is mostly one of location. Further research shows that this gap is closing- albeit slowly- in some sectors. A 2010 study comparing the national approaches of both Canada and the United States found that historically, emphasis was placed in different areas by each country. Canada emphasizes rural areas, and places a special focus on cultural development with its approach. The United States by contrast focuses on bringing down access costs, which may account for the elimination of race-based disparities. Overall the study found that Canada's approach had made greater headway in closing the digital divide in broadband when it came to penetration levels.[17]

The divide in rural areas is not just one of access but of adoption. Even where access becomes available the adoption rates of that service by rural residents are behind that of their urban counterparts.[18] As was discussed earlier, rural regions, like those found extensively in Maine stand to gain a great deal from improved access to the internet. It stands to reason that they would have a higher adoption rate. Nevertheless the opposite is true- even when adjusting for demographics.[19] The resulting conclusion is that rural residents have less interest in broadband, potentially as the

---

11 LaRose, R., Strover, S., Gregg, J. L., & Straubhaar, J. (2011). The impact of rural broadband development: Lessons from a natural field experiment.

12 Ibid.

13 Galloway, L. (2007). Can broadband access rescue the rural economy? *Journal of Small Business and Enterprise Development*, 14(4), 641-653.

14 Howard, P. N., Busch, L., & Sheets, P. (2010). Comparing digital divides: Internet access and social inequality in canada and the united states. *Canadian Journal of Communication*, 35(1)

15 Prieger, J. E. (2003). The supply side of the digital divide: Is there equal availability in the broadband internet access market? *Economic Inquiry*, 41(2), 346-363.

16 Ibid.

17 Howard, P. N., Busch, L., & Sheets, P. (2010). Comparing digital divides: Internet access and social inequality in canada and the united states.

18 LaRose, R., Gregg, J. L., Strover, S., Straubhaar, J., & Carpenter, S. (2007). Closing the rural broadband gap: Promoting adoption of the internet in rural america. *Telecommunications Policy*, 31(6–7), 359-373. doi:10.1016/j.telpol.2007.04.004

19 Ibid., Prieger, J. E. (2003). The supply side of the digital divide: Is there equal availability in the broadband internet access market?

result of youth out-migration, poverty, and educational shortfalls.[20] This results in a paradox of broadband adoption. The factors that most stand to be alleviated prevent them from adopting.

The current incarnation of the digital divide in the United States relates primarily to disparities in access; this gap is slowly closing and will continue to.[21] The concept of a divide endures since, as history has shown, technological advancements will benefit certain areas first. The expense of new technologies will be prohibitive to those that cannot afford to adopt them. It is clear that a purely market-based solution to the expansion of broadband penetration, particularly in rural areas is too slow to bring needed services. Finding the proper role of government in encouraging adoption and incentivizing development is not easy however.

The role of government- the quintessential American debate- is particularly pertinent to the role of broadband development. Broadband mirrors the role-out of other utilities such as electricity nearly a century ago in that it is a mixed good which can be handled purely by the market but with elements that make it ideal for public support. This can be seen with the need for last mile and middle mile projects. This refers to projects where development and necessary infrastructure improvements aren't profitable enough to warrant investment on their own by the private sector. This is most often the miles between towns- the middle mile- or the last mile or two on a road with too few houses to make connecting them cost-effective by the internet service provider. Nevertheless access of this type can be seen as a public good, with applications for safety, services such as telemedicine, and connectivity for economic purposes. As a result there is a public interest in having an infrastructure to take advantage of.

One of the best analogies for the development of broadband is rural electrification which took place during the first half of the 20th century. During this period the United States lagged behind Europe in connecting its rural areas to electricity. This was because electric companies refused to provide service to rural areas and if they did it was at steep prices. One of the New Deal agencies created by President Franklin Roosevelt was the Rural Electrification Administration. Created under the Rural Electrification Act of 1936 the Administration was charged with making loans to "persons, corporations, States, Territories, and subdivisions and agencies thereof, municipalities, peoples utility districts and cooperative nonprofit, or limited-dividend associations".[22] This framework allowed the government to directly subsidize the development and connection of rural parts of the country through loans. These could be delivered to private providers or public cooperatives that sprung up during this period to provide service.

There are arguments against government intrusion into the broadband market. They primarily stem from the idea that regulation and control from a central government source does more harm than good. Such regulation would stifle innovation and de-incentivize the production and creation of new infrastructure.[23] Several studies pointed to this being the case in broadband development. In addition, government having an active role was found to have negative effect on

[20] Ibid.

[21] Howard, P. N., Busch, L., & Sheets, P. (2010). Comparing digital divides: Internet access and social inequality in canada and the united states.

[22] Rural Electrification Act of 1936. (n.d.).*Center for Columbia River History*. Retrieved December 5, 2013, from http://www.ccrh.org/comm/moses/primary/electrif.html

23 Picot, A., & Wernick, C. (2007). The role of government in broadband access. *Telecommunications Policy*, 31(10–11), 660-674. doi:10.1016/j.telpol.2007.08.002, Crandall, R. W., & Alleman, J. H. (Eds.). (2002). Broadband: Should We Regulate High-Speed Internet Access?. Brookings Institution Press.

the development of alternative infrastructures.[24] This came about from favoring one form of technology over another.[25]

Running counter to this pocket of dissent was a larger body of literature whose conclusions encouraged the used of government support to ensure the implementation and penetration of broadband. Most of this has to do with the use of low-level initiatives to get results. Notable in this is the use of municipal broadband projects. These local government initiatives range from small partnerships with local private ISPs to developing complete public utility systems with the municipality acting as the ISP. In some cases this extends into major public works which provide broadband service as a public utility. The use of programs like this to bridge the gap between what the private sector is willing to develop and what the public sector can provide has shown to be an effective, if not necessarily uniform, method of development.[26,27] Related to this is the concept of regulation to prevent monopolistic practices.[28]

An example of the first type can be seen here in Maine where towns can partner with ISPs as their sponsor to receive ConnectME grants which can go towards development. A more radical example is a city like Chattanooga, Tennessee. Chattanooga developed its own fiber network and administers it through its public utilities service. With a population of 170,000, the city offers gigabit internet service to all residents in a 600 square-mile radius.[29] Other cities like Bristol, Virginia, Provo, Utah and Burlington, Vermont have undertaken similar projects to deliver fiber directly to the home from a public network.[30]

Many studies have concentrated on macro comparisons between countries developing broadband. These types of studies often focus at least in part on Asia where countries such as Korea, Singapore and Japan have all taken aggressive approaches to tackling broadband.[31] These investigations have shown that despite somewhat mixed approaches and results these countries enjoy far faster connectivity and greater penetration that the US does. Most of the European Union employs a top-down regulatory approach to the issue of broadband development something which the United States lacks.[32] Instead the US is unique for its private impetus for development mixed with local initiatives to fill in the gaps.

It is clear which approach has been more effective; with the US lagging behind these other countries in strength of networks and penetration. It would be premature to judge these countries purely on these statistics alone however. Maine obviously has hurdles to development including geography and population density that most Asian countries do not have. As a result direct comparisons simply cannot be made. Instead what Maine should take away from the literature on the topic of government involvement is the role of public-private cooperation to achieve results and cost-effectiveness.

---

24 Picot, A., & Wernick, C. (2007). The role of government in broadband access. *Telecommunications Policy*. de Bijl, P. W., & Peitz, M. (2004). Dynamic regulation and entry in telecommunications markets: a policy framework. *Information Economics and Policy*, 16(3), 411-437.

25 Wallsten, S. J. (2005). Broadband penetration: An empirical analysis of state and federal policies.

26 Picot, A., & Wernick, C. (2007). The role of government in broadband access.

27 Crandall, R. W., Litan, R. E., & Lehr, W. (2007). The effects of broadband deployment on output and employment: A cross-sectional analysis of US data-brookings institution.

28 Picot, A., & Wernick, C. (2007). The role of government in broadband access.

29 Electric Power Board About. (n.d.). Electric Power Board. Retrieved April 20, 2013, from https://www.epb.net/

30 Mitchell, C. (2007, August 9). Burlington Telecom Case Study. *Institute for Local Self Reliance*. Retrieved April 15, 2014, from http://www.ilsr.org/burlington-telecom-case-study/

31 Aizu, I. (2002). A comparative study of broadband in asia: Deployment and policy. *Asia Network Research*, 1-25.

32 Picot, A., & Wernick, C. (2007). The role of government in broadband access.

Public-private partnerships are not new, and they are certainly not unique to telecommunications. They involve a private entity, in this case a telecommunications provider taking on a project with public support. In most cases, particularly in Maine, the private entity assumes most of the risk.[33] The cost of using the service is borne exclusively by the users of that service as opposed to taxpayers. Increasingly these partnerships are seeing a role in development in the telecommunications sector. Most often these have been seen in Europe and South East Asia, particularly in Australia and New Zealand.

Public-private partnerships in broadband development have become appealing as a result of the evolution of the service itself.[34] This is because when internet use first came about- and then later with broadband- it was considered a luxury item.[35] As a result only private firms were delivering the service. As broadband became increasingly necessary for delivery of services and business applications so too did public perception change concerning its potential. This public 'attitude' is an important driver of broadband penetration.[36] As this evolution occurred there became more and more public interest in the infrastructure associated with the delivery of broadband as well as the access to it. When public interest in ensuring a robust network that private providers might be unwilling to undertake on their own a natural outgrowth of public policy has been increasingly to lend public support to private providers. This ensures that public interest is met without drastically remaking the market.

One element of telecommunications, particularly when it comes to the internet, is the rapid changeover in technologies. One theme present in much of the literature is the desire by public forces to create networks that are "future proof".[37,38] This most likely results from a desire to not spend public money on a project that will be quickly obsolete since this would only stand to further demonstrate the follies of central planning. Long-term cost effectiveness is key. The impetus is on the public sector to provide a resource that compliments the efforts of the private sector. It is important with this approach however not to incentivize projects that would have been undertaken regardless of public support. This undercuts the efficiencies that can be found in private development.[39]

Typically developments made in networks by one telecommunications firm cannot directly benefit another. This is because the fixed costs paid by the first firm to develop infrastructure are not borne by those that follow. This delivers an unfair advantage and creates a disincentive for firms to develop infrastructure that they cannot reap the majority of returns from. This was a concern with creation of the Three Ring Binder; an 1100 mile long dark fiber network developed in Maine- the details of which are discussed in the next section. Existing telecommunications firms initially feared that its creation undercut their investments in infrastructure in the state. As a preemption to issues such as this the Three Ring Binder project sought to stipulate that public efforts to develop infrastructure cannot be seen to benefit one company over another.[40] As a result

33 Hurst, C., & Reeves, E. (2004). An economic analysis of ireland's first public private partnership. *International Journal of Public Sector Management*, 17(5), 379-388.

34 Given, J. (2010). Take your partners: Public private interplay in australian and new zealand plans for next generation broadband. *Telecommunications Policy*, 34(9), 540-549.

35 Grosso, M. (2006). Determinants of broadband penetration in OECD nations. *Australian Communications Policy and Research Forum*,

36 Flamm, K., & Chaudhuri, A. (2007). An analysis of the determinants of broadband access. *Telecommunications Policy*, 31(6), 312-326.

37 Given, J. (2010). Take your partners: Public private interplay in Australian and New Zealand plans for next generation broadband.

38 Kittredge, F. (2013). Maine's three ring binder.

39 Falch, M., & Henten, A. (2010). Public private partnerships as a tool for stimulating investments in broadband. *Telecommunications Policy*, 34(9), 496-504.

40 Ibid.

open access must be maintained. This serves the dual purpose of developing an advanced infrastructure while simultaneously maintaining competition for its use. This roll out of fiber networks allows for multiple uses as well since different technologies can make use of it as well, which furthers the advantages of competition.[41] This progression is advantageous because government intervention favoring one technology over another can be harmful to development.[42]

The strength of Maine's approach is validated throughout much of the literature. The ConnectME Authority distributes grants to private ISPs regardless of size or technology. This helps build networks without damaging competition or harming access for consumers. With the advent of the Three Ring Binder fiber network no company can control more than 20% of network capacity in any market area. This commitment to open access ensures free competition. This project was designed to be 'future proof' as well, which will give the state a competitive edge for years into the future.[43]

The ability to completely connect Maine will require the use of alternative technologies in addition to those currently deployed like fixed wireless, cable and DSL. The ability for these technologies to exist alongside of, and many cases compete directly with, more conventional means is important to ensuring 100% connectivity in the State. Maintaining an unbiased approach is important to foster this.[44] Having a fiber line directly to every home is unfeasible, and removing the bottleneck for ISPs is only the first step. The last miles of the network have to deliver service to areas which are often remote and suffer from geographic barriers to service. Traditional wireless technology has made large headway in connecting previously un-connected parts of the state but it is not ideal for all connections. This is a result of the shortcomings in range of current wireless broadband which continues to have range and terrain issues even though it is becoming more widely used.

Several alternative technologies have been suggested that would be theoretically feasible in Maine. The first is repurposed TV whitespace which has shown promise as an emerging technology but is largely untested though this is changing. In theory it could provide a service much like conventional wireless while being immune to geographic barriers. Perhaps best of all its range requires far fewer towers to broadcast from. Another potential technology which has yet to see any real play in Maine is power line carrier service. This technology works by using electric lines for data transfer. The Federal Communication Commission has considered this a necessary component of technology competition.[45] The advantage is that anyplace power lines ran so too could internet access. The technology still has limitations, and it is unclear how well it would be able to compete in a market through which it could control only limited shares.[46]

The application of this technology will be important for delivering the next generation of services. The largest driving force behind broadband development is the need for infrastructure to provide services such as health, education and public facilities.[47] This in large part plays into the increasing public interest in developing fiber networks like the one developed in Maine. As

---

[41] Aron, D., & Burnstein, D. (2003). Broadband adoption in the United States: An empirical analysis. *Available at SSRN 386100*

[42] Wallsten, S. J. (2005). Broadband penetration: An empirical analysis of state and federal policies.

[43] Kittredge, F. (2013). Maine's three ring binder.

[44] Höffler, F. (2007). Cost and benefits from infrastructure competition. Estimating welfare effects from broadband access competition. *Telecommunications Policy*, 31(6), 401-418.

[45] Crawford, S. P. (2013). *Captive audience: the telecom industry and monopoly power in the new gilded age.*,52

[46] Tongia, R. (2004). Can broadband over powerline carrier (PLC) compete? A techno-economic analysis. *Telecommunications Policy, 28*(7), 559-578.

[47] Given, J. (2010). Take your partners: Public private interplay in australian and new zealand plans for next generation broadband.

broadband has advanced so too have the applications that go along with it. The advent of face-to-face communications through the internet was a big step towards bringing down the barriers of distance for productivity in health, education and other applications.[48] In particular the area of telemedicine has seen new opportunities arise from the increased infrastructure available for it to utilize.

The benefits of broadband are numerous and obviously well documented but in studying Maine's case it is important to keep a picture of issues related to cost in mind. Historically broadband has been driven through private demand of both business and residential customers. This demand was met by private firms in line both with what they were prepared to invest and what the end users were willing to pay for service. The nature of technology and the desire to minimize a digital divide between areas with service and those without drove concerns about funding to speed up the diffusion of broadband.[49] At the same time as broadband became increasingly integral to a wide variety of applications the real concern that sections of the populations would be left behind entirely became a driving force in broadband policy.[50]

The idea of public intervention in the private broadband market has been documented previously.[51] The role of government, the advent of public-private partnerships and best policies to foment growth are all important parts of the literature as it relates to understanding the cost issues of broadband. Independent public networks like those seen in municipal broadband networks are one option but there is far more evidence favoring a mixed approach.[52] One of the conventional tools that policy makers have is subsidies to incentivize private firms to expand their service and for consumers to increase their adoption of a service. These subsidies can take two main forms. The first is to subsidize the upfront fixed cost of expanding services. The second is to subsidize the consumption which incentivizes expansion as well as adoption.

The first of these options, subsidizing the consumption of broadband directly, has two main goals. The first is to promote adoption of the service. This has the advantage of attracting consumers who would otherwise not place enough value on the service to adopt it. The increase in consumption incentivizes providers to expand service. In addition, this it has the added benefit of increasing other services which utilize broadband like financial or entertainment amenities.[53] Estimations done on this approach indicate that properly executed consumption subsidies can have a net benefit.[54] There are however challenges such as smaller consumer surplus and higher revenue costs on the provider's side. This means that the value that the average consumer places on broadband would be lower. At the same time the service providers would find that their costs were higher compared to revenue because they would need to account for more of the fixed costs of developing the service.

The alternative to consumer subsidies are subsidies targeting the fixed costs of entering markets. Historically, telecommunications has been characterized by large upfront fixed costs to enter markets, which in turn lead to higher rates and lower demand. These costs have had a

[48] Hentea, M., Shea, M. J., & Pennington, L. (2003, October). A perspective on fulfilling the expectations of distance education. In (pp. 160-167). ACM.

[49] 49 LaRose, R., Gregg, J. L., Strover, S., Straubhaar, J., & Carpenter, S. (2007). Closing the rural broadband gap: Promoting adoption of the internet in rural america.

[50] Goolsbee, A. (2002). Subsidies, the value of broadband, and the importance of fixed costs. *Broadband: Should we regulate high-speed internet access*, 278-294.

[51] Picot, A., & Wernick, C. (2007). The role of government in broadband access.

[52] Falch, M., & Henten, A. (2010). Public private partnerships as a tool for stimulating investments in broadband.

[53] Goolsbee, A. (2002). Subsidies, the value of broadband, and the importance of fixed costs.

[54] Ibid.

prohibitive effect on providers developing services in areas with very high fixed costs and thus questionable market returns.[55] Providing subsidies designed to alleviate these high fixed costs which prevent providers, particularly small ones, from entering markets is highly effective. The reason for this is that it drives penetration in markets which otherwise would be prone to the types of gaps that policymakers are seeking to avoid.[56] The focus on these marginal areas has been the central part of Maine's strategy in pushing expansion of broadband.

Maine Today

It is important to understand where we are and how we got here. In the early days of internet infrastructure telephone lines bore all of the data being transmitted. The greatest challenge to connecting homes and businesses was managing long distance rates. The connection of these homes and businesses was mandated by the same rules that required access to wired telephone services. By the late 1990's dial-up internet started to be phased out in favor of broadband connections which featured higher speeds and capacities. Connections such as these had different infrastructure requirements, and were economical only in well-populated areas in which development was sure to pay off from having a sufficient customer base from which to draw revenue from. Throughout much of the United States disparities began to arise between rural and urban areas in connectivity. Using various methods, such as wireless, rural areas began to catch up as connectivity disseminated outwards from population centers.

In these early days of broadband the market was the arbiter of development. Breaking out of dial-up internet were several technologies that could deliver service affordably. The first of these was cable, delivered through the same coaxial lines and by the same carrier that delivered consumer cable television services. Competing with this technology was digital subscriber line or DSL which delivered service through telephone lines as dial-up had but used higher frequencies in the wire so as not to disrupt phone service. The FCC at the time encouraged this competition along with other technologies such as satellite and power line carrier service. The hope was to maintain competition between technologies which would theoretically ease the need for government regulation.[57]

Existing parallel to these advancements in wired broadband were developments in wireless technology. This worked by allowing data to travel along certain spectrums of frequencies. In the early days only a few frequencies were available for use which limited the ability for wireless companies to operate. Urban companies could not build sufficient capacity while rural providers couldn't build enough to be viable cost-wise.[58] The Federal Communications Commission, the federal agency in charge of managing the wireless spectrum, made more frequencies available over the years. This opened up a larger availability for existing providers, as well as new ones entering the market. The gradual expansion of infrastructure, mainly in the form of broadcast towers allowed for more coverage to fill in the gaps of service.

In Maine one of the largest drivers of the effort to close the broadband gap has been the ConnectME Authority. The Authority is a component of the state government created in 2006 as part of the Advanced Technology Infrastructure Act. It was charged with a dozen different duties

---

[55] Falch, M., & Henten, A. (2010). Public private partnerships as a tool for stimulating investments in broadband.

[56] Goolsbee, A. (2002). Subsidies, the value of broadband, and the importance of fixed costs.

[57] Crawford, S. P. (2013). *Captive audience: the telecom industry and monopoly power in the new gilded age*. New Haven [Conn.: Yale University Press, 55.

[58] Ibid, 238.

ranging from expanding availability and access to determining criteria to define unserved and underserved areas, gathering information, and encouraging the use and adoption of broadband.[59] Since its inception, ConnectME has helped improve access to high-speed internet in the state from 86% to 93% and adoption of that service from 40% to 75% during that time.[60] The bulk of this has been accomplished through last mile and middle mile projects. These are projects where development and necessary infrastructure improvements aren't profitable enough to warrant investment on their own by the private sector. This is most often the miles between towns- the middle mile- or the last mile on a road with too few houses to make connecting them cost-effective by the internet service provider. While broadband has become increasingly cheaper to roll out in towns as well cities the rural routes throughout Maine that connect them are less than lucrative to develop. By offering grants to encourage internet service providers to connect the last few miles of road and the middle miles between towns coverage in the state has expanded by 30%.

ConnectME is funded by a 0.25 percent tax on telecommunications and it has used this revenue to fund nine rounds of grants. During this time over 114 separate grants totaling over $9 million were processed to five different Maine internet service providers. These providers varied in size and were located all over the state. In theory any ISP is eligible to receive a grant- usually less the $100,000- to co-fund specific projects. The ISPs need a public or community partner, often a municipality or a community development organization, to be eligible for funding. This method, of government investment forming the base incentive to private companies, has formed the basis of Maine's broadband development scene. In the case of ConnectME's grants they typically fund no more than 50% of the project cost, leaving the private partner to contribute the remaining cost of the development.

Since broadband was first rolled out in the late 90s what was then considered to be adequate in terms of speed has since changed. The Federal Communications Commission has raised the bar of what is considered to be true broadband to 4mbps.[61] Sixty-two% of Maine households fall below this threshold.[62] This distinction is somewhat arbitrary, nevertheless it serves as an important benchmark for comparison. The state overall has a median download rate of 4.8mbps which is both behind the national average as well as neighboring states like New Hampshire and Massachusetts. At the same time the number of connections with speeds above 10mbps lags behind the country and New England.

Fig 1.[63]

Percentage of Connections Greater than 10mbps	
Maine	11.5%
New Hampshire	31.9%
Massachusetts	33.8%
National Average	19.3%

Fig 2.[64]

Median Download Speed in Mbps	
Maine	4.8
New Hampshire	8.2
Massachusetts	9.4
National	6.4

The result of this is an increasi

[59] ConnectME Charter. *Connectme*. (2012). Retrieved January 29, 2013, from http://www.maine.gov/connectme/index.shtml
[60] Connectme. (2012). Retrieved January 29, 2013, from http://www.maine.gov/connectme/index.shtml
[61] Maine Internet Speed Report . (n.d.).*Speed Matters*.
[62] Ibid.
[63] FCC Internet Access Services: Status as of June 30, 2012. (2013, May). Industry Analysis and Technology Division Wireline Competition Bureau. Retrieved April 14, 2014, from http://transition.fcc.gov/Daily_Releases/Daily_Business/2013/db0520/DOC-321076A1.pdf
[64] National Broadband Map. (n.d.). National Broadband Map. Retrieved April 19, 2014, from http://www.broadbandmap.gov/

ng discussion over where the state's focus is headed. Until now coverage has been paramount- the vast areas that went either unserved or underserved when the Authority was created was the most pressing concern. Now that the state enjoys at least a 93% coverage rate- an uptick of roughly a percentage point per year over 7 years- more attention is being focused on the quality of service which that coverage provides. ConnectME has delivered $9 million worth of grants in order to do this. It is estimated that the connection of the rest of the state would require a similar amount of money. As connectivity extends further and further afield population density declines and technologies like wireless serve fewer customers with the same fixed costs. Many of these same areas also feature difficult terrain like hills, forests and mountains which hamper a wireless signal and require more complex- and more expensive- infrastructure. Diminishing returns on coverage for the amount of dollars spent through grants means that fewer households will be covered using the same amount of funds. While resources are directed at addressing specifically rural concerns the state as a whole begins to fall behind as the bar is raised ever higher for connectivity requirements.

Fig 3.[65]

FCC Speed Tier	Speed	Population with Access in Maine
Tier 1	768kbps - 1.5mbps	93.1%
Tier 3	3mbps – 6mbps	84.9%
Tier 5	10mbps – 25mbps	20.8%

As a result more grants will be undertaken to not just improve coverage but to provide that coverage with a certain level of speed. Figure 3 above shows that while 93% of households have access to basic service only 84% have access to true broadband as defined by the FCC. This discussion over capacity versus coverage will be a key part of Maine's future development. Tying into this is the ever-present subject of the proper role of government. An example of this is the long debate over whether or not internet access should be regulated like other utilities. What this might mean for Maine is a requirement that full coverage be provided to all households. Similarly what the role of government is in determining development. Currently grants are proposed and carried out by private parties. It is possible- although controversial- that the government could provide more direction than it does in terms of what gets developed, how and what the final service would look like.

At first glance the barriers to entry of high costs, operating impediments such as high fixed costs and potentially small market size make internet service a natural monopoly. In the early 2000's it was the strategy of the FCC and market groups to encourage competition between types of service, be it cable, DSL, wireless, or satellite in lieu of regulating the markets within each individual category of service. Nevertheless, nationally 90% of new wired internet subscriptions are going to cable.[66] Maine's expansive rural nature has never made it ideal for cable service and it has always used a mix of technologies. As a result internet, particularly in Maine, is not a good example of a natural monopoly where service would be provided best by a single firm.

Modern high-speed internet requires fiber-optic cable. Even wireless is just the end of a cord that runs as part of a much larger network. Stringing fiber to every household is cost

[65] Developing Broadband in Maine Baseline Update 2013. (2014, March 28). *James W, Sewall Company for the ConnectME Authority*. Retrieved April 12, 2014, from http://www.maine.gov/connectme/grants/ntia/docs/2013_BaselineUpdate.pdf
[66] Reardon, M. (2010, October 29). With Internet TV, cable wins even if it loses.*CNET News*. Retrieved January 14, 2014, from http://news.cnet.com/8301-30686_3-20021118-266.html

prohibitive, but to provide a corridor that runs throughout the state that ISPs can leverage to their advantage is feasible. Nevertheless the barrier that most small ISPs delivering service in the state had was connecting their small networks to the greater internet with enough bandwidth to properly serve their needs. A middle mile fiber project to bridge this gap was necessary. Enter the Three Ring Binder, a multi-year project that has recently been completed. Named for the three rings of fiber that form a larger ring around the state the 1,100 mile long network delivers fiber throughout rural Maine.[67]

For years ISPs in Maine, particularly small ones, serving rural areas and receiving ConnectME grants, suffered from a lack of bandwidth. An ISP could connect sparse households through a wireless "canopy" generated and repeated by towers. It could also connect through copper wires in residential areas, but this network had to be connected to the internet at large via the national grid. The process of doing so was expensive, requiring groupings of lines purchased from larger providers. This typically ran a very high overhead and represented a dramatic burden for Maine ISPs and relatively poor service for consumers. It was clear that the biggest bottleneck to service in the state of Maine was in the middle mile between the ISP and the national infrastructure which provided service.

In 2009 the Obama administration succeeded in passing The American Recovery and Reinvestment Act. Part of this was $7.2 billion intended for the development of rural broadband. The availability of these funds was an opportunity to see real development in the state, something which drew together technology interests such as ISPs, educational institutions, businesses and the ConnectME Authority. The Broadband Technology Opportunities Program, part of The Recovery Act, awarded a $25.4 million of federal grant money to Maine companies, who provided an additional $7 million in matching capital. Realizing that the available federal capital could only fund so much it was apparent that best course was to build the foundation of a network which private companies could expand upon.[68]

The solution was a fiber network which could act as a highway connecting these local networks throughout the state. This highway acted as the middle mile that the various ISPs all serving various areas needed to provide network backhaul. This backhaul was the backbone that allowed the last mile; the mile of connection either wired or wireless between the carrier and the customer to exist. The University of Maine proposed a fiber network that would run in three rings around the state. Each ring served to reinforce the others so that a disruption in service at any one point could be covered through redundant loops in the system. The resulting three year construction project created a dark fiber network which connected with New Brunswick and New Hampshire at either end.[69]

[67] Kittredge, F. (2013). Maine's three ring binder. *Maine Policy Review*, 22(1), 30-40.

[68] Ibid.

[69] Chutchain, K. (2012, August 6). Broadband network nears completion. *Mainebiz*. Retrieved April 19, 2014, from
    http://www.mainebiz.biz/article/20120806/CURRENTEDITION/308029999/broadband-network-nears-completion

A dark fiber network is a network that provides neutral infrastructure. Fiber optic cable works by transmitting data through light pulses. It is up to the company operating the network to 'light' these cables. Since the majority of funding was coming from a public source it was important that the network not become part of a monopoly and as a result a maximum of 20% of the network can be operated by any one company in a given area. This fosters competition as well as discourages collusion since a minimum of five providers can operate in a given area using this network infrastructure. Throughout much of the US collusion between major telecoms has created a stagnation of development and artificially high prices for consumers. The Three Ring Binder is somewhat unique in that it's a public investment, privately run, open access network.

The provision of this backbone to rural carriers certainly gives them the tools they need. The challenges that face them in completing coverage to that final 7% of Maine households are of a different sort. In Maine the greatest barrier to development has always been terrain. Throughout much of rural America, particularly in the West, distance and space are the greatest barrier, and simply expanding infrastructure can alleviate that difficulty. In Maine, wireless broadband from towers have connected many households but it requires almost a direct line-of-sight to the tower. Hills- let alone mountains- stand in the way of wireless and it is not economically feasible to run physical infrastructure out to these areas. This problem is pronounced in the larger rural areas like Washington County where a diffuse population means more area that must be covered. Other rural counties such as Somerset or Piscataquis in the Central Highlands suffer from hilly, sometimes mountainous terrain. There are a number of potential solutions for this problem.

As part of the National Broadband Plan put forward by the FCC parts of the analog wireless spectrum have been made available. These were the same frequencies used for broadcast television before they transferred to digital. This resulting 'white space' provides a spectrum through which wireless internet can be broadcast. Unlike traditional wireless towers which can only broadcast so far, as well as being limited by terrain, this technology can transmit much farther. Terrain is not an issue since at this spectrum it is fairly universal in the same way that television was when it was broadcast in the same way. Best of all it won't require rabbit-ears. Whitespace is still in the trial phase, with small ISPs using the necessary equipment to test the efficacy of the technology in delivering service in Maine.

There are other alternatives as well in delivering access to the remote regions of rural Maine. In addition to the use of repurposed white space cellular providers form another potential source of connectivity. Since 4G wireless has rolled out for smartphones, tablets and other devices cell towers have improved their capacity. Small ISPs can partner with cell providers, offering on the ground personnel and support to cut costs for the larger companies in return for access to their infrastructure.

A review of the literature shows that while there may be a debate on the nature of rural broadband and its effect on business there for more urban areas there are clear advantages. It was clear through interviews that economic development was a key driver in infrastructure improvement. At the same time it was not the only driver. Services such as education, public safety and telemedicine are driving the need for more advanced communication structures. The consensus seems to be that they are equal drivers of development. There is a public private partnership in funding for many projects in the state. This is in many ways reflective of the dual nature of the needs that those projects fulfill. A municipal project to connect a town both provides services but also creates an incentive for economic development.

There is an emerging demand for municipal networks in Maine. The Three Ring Binder project delivered an 1100 mile dark fiber network across the state. This network however is analogous to an interstate highway without on ramps. It was designed to serve as a baseline for other entities to build upon both private as well as public. This development has inspired planners and municipal officials and their experiences are fueling a wave of development at this level. This is because quality middle mile projects are increasingly seen as necessary- even vital- to connecting communities as part of economic development initiatives. Connecting towns and cities which do not directly lay along the course of the existing fiber routes is expensive and takes time but its one tool of many that can adequately prepare these communities for hi-tech applications in both the public and private sector. The growth of GDP is important for these areas but increasing employment is an even bigger goal. Connecting office parks and industrial areas are seen as an important approach to not just adding jobs but hi tech jobs applicable to the modern economy. Investments in broadband infrastructure have a measurable return in job creation and economic output.

There are continuing changes that can be made to the current approach. While there is debate academically about whether or not public, private or hybrid approaches are best in Maine publicly there has yet to be any real debate. The majority of development is carried out by private companies with assistance from the public sector for specific projects. In a field which is centered on the deployment of technology it is inevitable that newer equipment and methods of delivery will arise. This evolution of knowledge and tech has to contend with pre-existing paradigms. An example of this is the nature of internet access as a utility. Throughout the literature there is a discussion over whether to ease right-of-way rules for utility corridors so that infrastructure can be completed more efficiently. This issue specifically didn't seem to be a critical concern for development in Maine however.

One feature of Maine is its host of relatively small internet service providers. In total there are 33 providers in the state offering wired and wireless services, not including mobile.[70] Municipalities in Maine are served by 4.7 ISPs on average.[71] While the majority of internet access in the state is handled through Time Warner Cable or FairPoint Communications virtually all of ConnectME grants are going to smaller companies. There are also mid-size providers such as Great Works Internet (GWI) and Bee Line Cable. Companies like Axiom Technologies, Premium Choice Broadband, Pioneer Broadband, Cornerstone Communications and others are examples of small startup ISPs in the state.

With many of these providers being relatively small they lack the capacity to build their own fiber networks. These providers have had trouble accessing existing infrastructure as well. In particular telephone pole access can be problematic. FairPoint Communications, Inc. controls 80% of the Maine market and acts as a gatekeeper to the telecommunications infrastructure those poles provide. Under the law providers are given access to poles but first must approach FairPoint to do so. The process can last more than a year in some cases. This is problematic since grants from ConnectME require projects to be completed within a year meaning that providers will have to reapply. To answer this the legislature passed a bill in 2013 to establish a working group to address

---

[70] Developing Broadband in Maine Baseline Update 2013. (2014, March 28). *James W, Sewall Company for the ConnectME Authority.*

[71] Developing Broadband in Maine Baseline Update 2013- Appendences. (2014, March 28). *James W, Sewall Company for the ConnectME Authority.* Retrieved April 12, 2014, from http://www.maine.gov/connectme/grants/ntia/docs/2013_BaselineUpdate.pdf

the issues related to access around broadband infrastructure development. Whether this is a solution to the continuing problem of access remains to be seen.

In the meantime many Maine communities are starting to feel like they are being left behind. The gap between what is available and what is ideal is widening in many places. The public emphasis at the state level is very much on last-mile projects. In the meantime middle-mile projects to connect municipalities to faster service are being stymied by a lack of support as well as a lack of available capital. Nevertheless dark fiber networks are increasingly seen as important in the state and will continue to be significant. From there it is a matter of finding a provider to light the line with adequate bandwidth to suit the needs of individuals and businesses within those communities.

The Future

The state's future lies very much in the inevitable but slow march of expansion that has characterized the last five years. As technologies like fiber become cheaper for the purposes of widespread development it makes more financial sense to expand these dark fiber networks throughout the state. This will arrive in addition to infrastructure improvement undertaken by ISPs for their own benefit since it will be feasible for them to begin a fiber rollout on their own. External pressure from competition in areas with affordable gigabit internet will create market incentives for providers to offer improved services to consumers. As this happens greater application can be developed from this connectivity in the form of services as well as business and economic utility.

One of the largest areas of expansion in technology has been witnessed in the field of health. The internet exponentially increased the capabilities of telemedicine and the industry is in the midst of incorporating this new dimension into its apparatus. Currently the greatest push has been on the development of electronic medical records. It is a provision of the 2010 Patient Protection and Affordable Care Act that providers make use of electronic medical records lest they face a penalty. To aid in this transition subsidies were made available to incentivize providers to adopt new record systems. In Maine the Office of Health information and Technology has dispersed $75 million and intends to disperse nearly an equal amount in the future. This is one of the largest areas in which information technology is expanding. Part of the FCC's National Broadband plan is a recommendation for $29 million a year in upgrades to the Indian Health Services infrastructure.[72] This is one example of how health information technology will require a robust physical infrastructure to carry it forward.

Electronic medical records are only the beginning though. Greater connectivity and technology that takes advantage of it will come to affect practices. For example, doctor's offices in regions without certain types of providers can now teleconference with these specialists at a distance. One hospital in Maine recently lost its psychiatrist and, unable to find a replacement, was able to arrange teleconferencing between patients who required the service with a provider offsite.

---

[72] Federal Communications Commission. *The national broadband plan.* Retrieved January 29, 2013, from http://www.broadband.gov/plan/

This is a major change in the delivery of behavioral health services. This is not limited to specialists however, it is possible for patients to be diagnosed wirelessly by a doctor or even a nurse. This is helpful for small communities at a distance from service centers in the state.

This same changeover will form the basis for reforms in payment in programs like Medicaid and Medicare. The fee-for-service model, whereby a charge is assessed for every service rendered, has been the only model for years in the United States outside of some instances of managed care. The result is that if a patient breaks a bone and goes to a provider to receive an x-ray and are charged for the service. If that same patient is referred to another provider they may take a new x-ray and charge a fee. As a result of broadband infrastructure two doctors' offices can rapidly exchange things like x-rays- requiring no duplication of services- or payment. This is particularly useful in Maine where medical services are rapidly consolidating into only a handful of providers statewide. Being able to rapidly exchange information across the state is key to making this type of merger cost effective.

Broadband is key because it allows for certain single procedures to be shared between providers. This eliminates duplication of services and results in a major cost savings system-wide. This is just the beginning however since now quality can factor into the model of care. Under an accountable care model a primary doctor is responsible for coordinating the healthcare of an individual. The quality of care that individual receives in in the interest of the provider and they can use the same enhanced connectivity to conference more efficiently. A capitated rate can be customized to each patient based on the rapid update of data related to their specific outlook. The greater quantity of data system-wide can feed into databases to fuel predictive models and inform best practices and cycle back into improving the quality of care provided.

One of the best examples of this is in home care. Older Americans commonly must leave their homes for stays in nursing facilities. This, as well as care in the home which often follows is expensive and if it could be minimized a tremendous cost savings could be achieved. This is where broadband comes in. Simple diagnostics and electronic medical records don't require much bandwidth, enough so that all hospitals as well as many primary care facilities have adequate access in Maine. Transferring larger files, teleconferencing and other more advanced methods of telemedicine require certain amounts of bandwidth. This is where the investment in broadband access pays off. The immense cost savings in healthcare and other services make a robust network for access imperative.

One of the other elements driving demand is education. Distance learning, where students connect to a classroom remotely or are involved any online collaboration can be a useful tool. This tool can be used to bring students into the classroom who otherwise wouldn't have access. It can also be an opportunity for schools, particularly the University of Maine System to attract students. Public schools in Maine have experienced declining enrollments, and while this decline may not continue indefinitely it does mean fewer graduates. Maine's universities draw heavily from Maine high school students and with fewer available they will need to attract increasing numbers from outside the state. One method to do this is offer increased distance learning opportunities to students residing outside of Maine.

As distance learning becomes more viable to draw additional students in to the classroom for the first time it can be used to draw students back into higher education. Roughly 200,000 Maine residents have some college education but have failed to complete their degree. Offering financial incentives in the form of scholarships directly designed to serve this population is one part of bringing these individuals back into the University of Maine system and the community colleges.[73] The other part is making that education accessible. Since many of these are people are working adults it is important to deliver that opportunity in manner through which they can take advantage of. Distance learning and classroom participation and collaboration can do this and by expanding residents' access to broadband the state could realize tens of thousands of skilled workers in its labor force.

Improving the quality of the workforce through education is just element that feeds into economic development. Providing the infrastructure that small businesses can tap into for the purpose of maximizing their competitiveness is another element driving demand for broadband in Maine. This can be seen through the creation of dark fiber networks at the municipal level as a strategy for economic development. Residential service demands for recreational purposes are always existent as well. Nationally the number of broadband subscribers who do not utilize any form of multi-channel video service like satellite or cable television has now reached 9%. This number is small in and of itself but it represents a notable uptick over the last few years.[74]

In addition these networks can deliver municipal services like public safety. Federal efforts to expand public safety networks are one of the elements driving infrastructure development. Over the next ten years Firstnet, a nationwide public safety network is slated to be built in each state. This wireless network functions through wireless towers the same way wireless broadband already in service does. It uses a specific band of the wireless frequency to deliver data and communication to public safety officials.[75] The expansion of towers throughout the state for this purpose will increase coverage for rural residents since the construction of towers is the most expensive part of developing wireless infrastructure.

Developing a dark fiber network which connects one community to a larger network is not the type of project that ConnectME is equipped or designed to aid with. Municipalities are increasingly exploring advanced networks like these on their own. Grants designed around community development, both from the federal level as well as the state, are helping to fill this gap. Often matching funds, much like with ConnectME grants are used. Assistance from the Economic Development Administration as well as block grants for development at the state level are being utilized for this. Broadband development is being seen as an important category of community development nationwide and the development of networks by municipalities is seen a well-founded category to provide grant funding for. Connecting a town or city, even if it's limited to only the community anchor institutions such as hospitals, libraries municipal buildings and business parks can have a positive economic impact.[76]

[73] New College Scholarships for Maine Adults Offered by University of Maine System. (2014, April 8). *UMaine News*. Retrieved April 18, 2014, from https://umaine.edu/news/blog/2014/04/08/new-college-scholarships-for-maine-adults-offered-by-university-of-maine-system/

[74] Research Notes 3Q 2013. (2013, October 2). *Leichtman Research Group, Inc*. Retrieved April 18, 2014, from http://www.leichtmanresearch.com/research/notes09_2013.pdf

[75] FirstNet About. (n.d.). *First Responder Network Authority*. Retrieved April 18, 2014, from http://firstnet.gov/about

[76] Sanford Fiber Optic Network Design and Analysis. (2014, April 9). *Tilson Technologies and The Sanford Regional Economic Growth Council*.

In the immediate future broadband development in the state will be dominated by the debate of capacity vs coverage. Currently more than 60% of Maine residents fall below the FCC threshold of true broadband.[77] This threshold will continue to rise. The state is starting to enjoy a much more widespread rollout of fiber optic connections which will allow more communities to achieve even higher speeds. Currently the Three Ring Binder is not unlike a major interstate without any on-ramps. This will change and fiber networks will spring up across the state to tie into this. Existing ISPs will then use this infrastructure to deliver service, the question in all of this is how long and how much.

ConnectME money that went to unserved areas during the first few rounds of the grant process helped to connect those areas however the connection speed was well below what is currently considered to be broadband. It may be necessary for incentives to be made available to upgrade areas that technically have access but fall behind competitively. These areas will continue to not be viable in the market and may potentially need continuing support. To help this situation future rounds of grants will require a higher rate of bandwidth be provided.

One technology that can provide connection are cellular providers like US Cellular or Verizon. Verizon offers home connection however it runs into the same problem that satellite internet providers have which is high prices relative to other types of connections. Some ISPs in the state have used the cellular tower infrastructure in some places to reinforce the existing wireless broadband infrastructure. Since local ISPs can offer infrastructure support the arrangement can be mutually beneficial.

Using handheld devices like smartphones and tablets are increasingly a means by which people are accessing the internet. In Maine nearly 48% of households now use some sort of mobile device. At the same time though less than 3% of those users use that device as their only means of connection.[78] True fourth generation (4G) wireless, which features gigabit download speed is still a ways off in Maine and the US. In the meantime 4G LTE, an improvement on the third generation network architecture is increasingly available. This isn't a practical alternative to residential broadband on a large scale despite the convenience of mobile base stations. This is because the stringent data caps on most cellular wireless services make such connections cost-prohibitive.

Ultimately education surrounding broadband may be just as crucial as the installation of physical infrastructure. One notable example of this is in the frequent criticism that a certain percentage of the population is too old to ever make use of the infrastructure since they have no interest in using the internet. This neglects the fact that this same population by and large values its self-sufficiency and the ability to remain at home as they age. Technology in the medical field will allow safe, cheap care in the home through telemedicine. All segments of the population stand to benefit greatly and the 75% take rate on broadband in the state will rise as the usefulness of this service becomes more apparent. As municipalities develop their own dark fiber networks the debate about the usefulness of broadband will move further into the public square and the discussion will become a much broader one in Maine. Regardless of the details of that exchange over time broadband will achieve the same vital status as other utilities.

---

[77] Ibid.

[78] Developing Broadband in Maine Baseline Update 2013. (2014, March 28). *James W, Sewall Company for the ConnectME Authority*.

The statute concerning the ConnectME Authority specifies that the unserved must be addressed before the underserved are given priority. This approach has greatly improved the coverage area of broadband in the state. Completing the task of connecting the remaining unserved areas will take time under the current model. The inevitable march of development has meant that while many areas of the state are connected they increasingly lack competitive speeds. This gap will continue to expand and has the potential to represent a whole new type of digital divide in the state. This divide has three tiers, the served, the underserved and the unserved. As a result the State needs to address this proactively by allowing ConnectME to incentivize improving existing connections in addition to providing service to areas of the state which lack any sort of connection.

The approach to achieving this has relied mostly on incentives on the supply side to providers to generate coverage. The high barriers to entry in telecommunications has made establishing new markets prohibitive in areas with potentially low returns. The grants that ConnectME has provided at the state level has given providers an incentive to expand coverage. This same approach could be adapted to help improve the capacity of existing networks. ConnectME is funded by a 0.25 percent tax on telecommunications and has used this revenue to fund nine rounds of grants. During this time over 114 separate grants totaling over $9 million were processed to five different Maine ISPs. The result has been a large increase in coverage and the same could be witnessed in capacity. With federal grants providing the network backhaul in the form of the Three Ring Binder an initiative to subsidize expansions in capacity could be very effective at raising the state's connectivity.

Increasing the existing telecommunications tax from 0.25 percent to 0.50 percent or even to a full percentage point would fund both the continued expansion of coverage but incentivize providers to bring their network speeds up to a competitive level through grants targeting improvements. Currently when planning a round of grants ConnectME can require certain levels of speed from providers accepting grants. Increasing this while expanding grants can bring about increases in capacity. This effort creates an incentive to bring the fiber networks in the state into play as well, a process that has been unfortunately slow.

The increased revenue generated from increasing this tax can work to fund other initiative as well. There is a public perception of a low consumer surplus with broadband in Maine and the US as evidenced by the take rate of 75%. South Korea, by contrast, has a take rate of 98%.[79] The biggest barrier to broadband is actually less in the supply then it is on the demand. A large percentage of the population eschews the service because they don't realize its relevance. In a market where the overwhelming majority of consumers search for goods and services online 59% of Maine businesses don't have website.[80] Research has shown that public perceptions of broadband are an important component of driving penetration levels and expanding infrastructure. The applications of broadband in the field of healthcare are particularly important and have a broad bearing on the population. An enlightened perception on the benefits of the service will improve

---

[79] Households With Broadband Access, September 2012. (2013, July 9). *Broadband and telecom - Organisation for Economic Co-operation and Development*. Retrieved January 15, 2014, from http://www.oecd.org/sti/broadband/oecdbroadbandportal.htm

[80] Broadband- The Road to Maine's Future, December 2013. *Report of the Governor's Broadband Capacity Building Task Force*. Retrieved April 17, 2014, from maine.gov/connectme/about/docs/.../broadbandfullreport.pdf

access and quality by creating higher demand for the service. In addition it highlights the role of broadband and its function as a public good.

Previously mentioned were grants to providers, which act as subsidies on the supply side of broadband. The alternative to this are subsidies on the consumption end of the service. These subsidies have the benefit of increasing use of the service however research has shown that the cost of doing so is inefficient compared to the uptake. Nevertheless consumer surplus in these cases remains a net positive.[81] For Maine to raise its tax on telecommunications or other affairs to fund consumer subsidies would be an inefficient means to drive adoption. This is partially a result of an aged demographic which doesn't perceive a use for broadband at any price point. Currently the largest amount of money being spent is in the healthcare realm. Eventually it may make sense to use targeted consumer subsidies for specific purposes. For example a subsidy to adopt broadband for the purpose of telemedicine. Or, alternatively, a subsidy for educational purposes for families which might otherwise be less likely to utilize the service.

Conclusion

In order to address the shortfall of its broadband internet development the State of Maine adopted a model of grants designed to incentivize private investment in unserved areas. These public-private partnerships effectively increased broadband coverage to 93% of the state. This approach has been seen worldwide as an effective method of developing telecommunications infrastructure. The literature on the development of broadband broadly supports this approach with rare exceptions.[82] At the same time the dispersal of large federal grants to a private provider for the development of dark fiber networks in Maine delivers a high quality backbone to the state's broadband networks. The Three Ring Binder and other fiber projects have the state on track to being globally competitive. This comes without dramatic public support or private financial burden.

These tremendous strides that the state has taken can be amplified and expanded though increased information of just what these achievements can do for the states and its people as a whole. The application in the field of health information technology, education, public safety and other services can serve as catalysts for broadband adoption. At the same time an eye on the expansion of capacity will ensure that the state retains a competitive edge in delivering these services as well as welcoming the economic development that such and infrastructure can provide. Finally, making broadband, particularly in the form of fiber in mind as part of an overall planning picture statewide can help streamline the process by which communities become connected. Making this process affordable is the largest part of making it achievable. The result will be a competitive state with improved standard of living for all.

REFERENCES

---

[81] Goolsbee, A. (2002). *Subsidies, the value of broadband, and the importance of fixed costs*.

[82] Wallsten, S. J. (2005). Broadband penetration: An empirical analysis of state and federal policies.

Aizu, I. (2002). A comparative study of broadband in Asia: Deployment and policy. *Asia Network Research*, 1-25.

Aron, D., & Burnstein, D. (2003). Broadband adoption in the United States: An empirical analysis. Available at SSRN 386100

Average and median advertised download speeds, September 2012. (2013, July 9). Broadband and telecom - Organisation for Economic Co-operation and Development. Retrieved January 15, 2014, from http://www.oecd.org/sti/broadband/oecdbroadbandportal.htm

Broadband- The Road to Maine's Future, December 2013. Report of the Governor's Broadband Capacity Building Task Force. Retrieved April 17, 2014, from maine.gov/connectme/about/docs/.../broadbandfullreport.pdf

Chutchain, K. (2012, August 6). Broadband network nears completion.Mainebiz. Retrieved April 19, 2014, from http://www.mainebiz.biz/article/20120806/currentedition/308029999/broadband-network-nears-completion

Crawford, S. P. (2013). Captive audience: the telecom industry and monopoly power in the new gilded age. *New Haven* [Conn.: Yale University Press.

Crandall, R. W., & Alleman, J. H. (Eds.). (2002). Broadband: Should We Regulate High-Speed Internet Access?. *Brookings Institution Press.*

Crandall, R. W., Litan, R. E., & Lehr, W. (2007). The effects of broadband deployment on output and employment: A cross-sectional analysis of US data-*Brookings institution.*

Connectme. (2012). Retrieved January 29, 2013, from http://www.maine.gov/connectme/index.shtml

ConnectME Charter. *Connectme.* (2012). Retrieved January 29, 2013, from http://www.maine.gov/connectme/index.shtml

de Bijl, P. W., & Peitz, M. (2004). Dynamic regulation and entry in telecommunications markets: a policy framework. *Information Economics and Policy*, *16*(3), 411-437.

Electric Power Board About. (n.d.). Electric Power Board. Retrieved April 20, 2013, from https://www.epb.net/

Enterprising States: Recovery and Renewal For The 21st Century. (n.d.).*U.S. Chamber of Commerce.* Retrieved November 13, 2015, from http://www.edawn.org/images/uploads/docs/U.S._Chamber_Report_-_Enterprising_States_2011.pdf

Falch, M., & Henten, A. (2010). Public private partnerships as a tool for stimulating investments in broadband. *Telecommunications Policy, 34*(9), 496-504.

Federal Communications Commission. *The national broadband plan*. Retrieved January 29, 2013, from http://www.broadband.gov/plan/

FirstNet About. (n.d.). *First Responder Network Authority*. Retrieved April 18, 2014, from http://firstnet.gov/about

Flamm, K., & Chaudhuri, A. (2007). An analysis of the determinants of broadband access. *Telecommunications Policy*, 31(6), 312-326.

Galloway, L. (2007). Can broadband access rescue the rural economy? *Journal of Small Business and Enterprise Development, 14*(4), 641-653.

Given, J. (2010). Take your partners: Public private interplay in Australian and New Zealand plans for next generation broadband. *Telecommunications Policy, 34*(9), 540-549.

Goolsbee, A. (2002). Subsidies, the value of broadband, and the importance of fixed costs. *Broadband: Should we regulate high-speed internet access*, 278-294.

Grosso, M. (2006). Determinants of broadband penetration in OECD nations. *Australian Communications Policy and Research Forum,*

Hentea, M., Shea, M. J., & Pennington, L. (2003, October). A perspective on fulfilling the expectations of distance education. In Proceedings of the 4th conference on Information technology curriculum (pp. 160-167). *ACM*.

Horrigan, J., & Murray, K. (2006). Rural broadband Internet use. *Pew Internet & American Life Project*.

Households With Broadband Access, September 2012. (2013, July 9). *Broadband and telecom - Organisation for Economic Co-operation and Development*. Retrieved January 15, 2014, from http://www.oecd.org/sti/broadband/oecdbroadbandportal.htm

Howard, P. N., Busch, L., & Sheets, P. (2010). Comparing digital divides: Internet access and social inequality in canada and the united states. *Canadian Journal of Communication*, 35(1)

Hurst, C., & Reeves, E. (2004). An economic analysis of Ireland's first public private partnership. International Journal of Public Sector Management, 17(5), 379-388.

LaRose, R., Strover, S., Gregg, J. L., & Straubhaar, J. (2011). The impact of rural broadband development: Lessons from a natural field experiment. *Government Information Quarterly*, 28(1), 91-100.

LaRose, R., Gregg, J. L., Strover, S., Straubhaar, J., & Carpenter, S. (2007). Closing the rural broadband gap: Promoting adoption of the internet in rural America. *Telecommunications Policy*, 31(6–7), 359-373. doi:10.1016/j.telpol.2007.04.004

Maine Internet Speed Report. (n.d.).*Speed Matters*. Retrieved January 28, 2013, from http://www.speedmatters.org/

Mitchell, C. (2007, August 9). Burlington Telecom Case Study. *Institute for Local Self Reliance*. Retrieved April 15, 2014, from http://www.ilsr.org/burlington-telecom-case-study/

National Broadband Map. (n.d.). National Broadband Map. Retrieved April 19, 2014, from http://www.broadbandmap.gov/

New College Scholarships for Maine Adults Offered by University of Maine System. (2014, April 8). *UMaine News*. Retrieved April 18, 2014, from https://umaine.edu/news/blog/2014/04/08/new-college-scholarships-for-maine-adults-offered-by-university-of-maine-system/

Prieger, J. E. (2003). The supply side of the digital divide: Is there equal availability in the broadband internet access market? *Economic Inquiry*, 41(2), 346-363.

Reardon, M. (2010, October 29). With Internet TV, cable wins even if it loses.*CNET News*. Retrieved January 14, 2014, from http://news.cnet.com/8301-30686_3-20021118-266.html

Research Notes 3Q 2013. (2013, October 2). *Leichtman Research Group, Inc.* Retrieved April 18, 2014, from http://www.leichtmanresearch.com/research/notes09_2013.pdf

Sanford Fiber Optic Network Design and Analysis. (2014, April 9). *Tilson Technologies and The Sanford Regional Economic Growth Council.*

Wallsten, S. J. (2005). Broadband penetration: An empirical analysis of state and federal policies.

Warren, M. (2007). The digital vicious cycle: Links between social disadvantage and digital exclusion in rural areas. *Telecommunications Policy*, 31(6), 374-388.