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Big Broadband: One Component of a Complex System

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Abstract

Within the context of analyzing a trend in educational computer networking, this paper identifies the history of the Maine School and Library Network (MSLN) as well as the cause and funding for infrastructure upgrades that produced a state-wide dark fiber network. Whereas the physical media backbone is well designed and in place, and policy makers have been sold on the potential to harness the large amounts of bandwidth it is capable of carrying, the infrastructure to bring this bandwidth in and around many school Local Area Networks (LANs) is still lacking on multiple levels. This paper also discuses additional upgrades necessary physically and conceptually to support signal flow from network distribution hubs to school LANs, and the human resources to implement and grow successfully integrated systems that are capable of obtaining useful yields from the investment.

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In 2001 the Maine Learning technology Initiative (MLTI), backed by the policy of [then] Governor Angus King, became the first program in the nation to deploy a 1:1 laptop initiative for middle-school students statewide. This action also emboldened broad interest for computer-based learning for all levels in K-12 and higher education. Representatives of Apple, the University of Maine, the Maine State Library, MLTI, K-12 schools, and other invested private and public entities converged to support a new generation of learners to use digital technology. The underlying infrastructure necessary to support this large-scale commitment included the physical infrastructure in schools, between schools and the network, statewide network operations, as well as a diaspora of human resources to implement and grow the system. This paper will address Maine's educational trend toward Big Broadband, a term that broadly describes a fiber-optic media network with higher bandwidth than DSL. I will give a history of the issue and solution in Maine, discuss the current status, and suggest possible future trends.

Using computers constructively in education promotes the creation of digital content, harvesting data, and connecting with communities on the internet. The capacity of a network to provide adequate bandwidth is essential for the success of teaching with digital technology, in the same way that the capacity of a school hallway must be large enough to accommodate the flow of traffic in and out of classrooms and the building. The Maine School and Library Network (MSLN), built in 1996, was one of the first state-wide networks to be implemented in the US, and until about 2008 provided sufficient bandwidth to subscribing constituents. According to a 2009 case study for the American Library Association ". . . about 75 percent of Maine libraries that participated in the MSLN have one T1 (1.5Mbps) and the remainder have two T1 lines (the

maximum available through the MSLN)" (ALA Office for Information Technology Policy, 2010, p.12).

According to a ca. 2008 report by the University of Maine System IT, however, "While bandwidth capacity has increased since the initial MSLN installation, it is now at its practical limits and is no longer meeting current needs of schools and libraries; in its current structure, it cannot scale to meet future needs. Work must begin now to develop the next generation of MSLN" (University of Maine System ITS, n.d.) The 2008 Educause paper "A Blueprint for Big Broadband" summarized the necessity of a national broadband policy to govern high speed internet infrastructure extending to rural areas providing access for education and commerce. The article suggested in detail current and future applications including video, telework, telehealth, education (distance learning, video and gaming,) social networking, research, and legal distribution of digital media, as leading causes to support the expansion of Big Broadband (Windhausen Jr, 2008.) The holistic analysis and solutions suggested in that paper resulted in political influence that rippled into support for advocates in the state of Maine to expand and upgrade to a state-wide dark-fiber network.

A funding model for the $25 million dollar investment to Maine's telecommunications infrastructure supporting Maine's Research and Education Network (MaineREN) was developed including money from the Federal Recovery and Reinvestment Act of 2009, as well as new streams of revenue from private telecommunications companies. Various local districts also contributed to the cost of the upgrades, and support from the federal E-Rate program and the Maine Telecommunications Education Access Fund (MTEAF) were considered in the implementation and ongoing operating costs. The project, called The 3-Ring Binder (describing the network

topology) was completed in 2012, and currently provides the backbone to the network across the state. NetworkMaine manages the MaineREN, and a private company called Maine Fiber Company owns and leases other use of the network (under governance of the National Telecommunications and Information Administration's governance.)

Thomas Welch, Commissioner of the Maine Public Utilities says, "In Maine schools, the use of the Internet to improve education is ubiquitous. Students and teachers not only seek information and content online, but they are creating and publishing new content online. Rural schools can now close distances and create collaborations that previously would have never existed." (Welch, n.d., p.42). The reality, however, is that there's a lot of infrastructure beyond the edge router that is still outdated copper media, as is the media running the Local Area Network (LAN), which is also often managed by staff that do not have proper training to problem solve issues with signal flow. Shibles Hall on the University of Maine campus is an example of this type of deficiency. This building hosts the College of Education and Human Development, and despite a robust fiber optic line connecting the building to the network uplink in Neville Hall, the building itself is wired with Cat3 UTP, and only has one switch to carry the signal from one end of the building to the other. UMaine IT personnel are qualified, and actually quite talented in this case, but the process for upgrading the network infrastructure involves many bureaucratic steps that add additional cost and process. The barriers for upgrades maintain low standards for signal flow and download speeds, despite the Chancellor's demand for more content to be delivered via internet-based Learning Management Systems.

In their 2014 paper "Build it! … but what if they don't come?" Marcus and Elixmann quantified and analyzed bandwidth use in some Western European Countries and Japan. They

concluded that users did not consume as large amounts of bandwidth as lobbyists advocating for

bigger broadband claimed.

> "These data would seem to imply that the ultra-fast broadband networks that are
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> being built today are likely to be carrying far less traffic than their access speeds
>
> could permit; however, it does not necessarily imply that the current emphasis on
>
> ultra-fast broadband (at speeds of 30Mbps, 100Mbps or more) is misplaced. Ul-
>
> tra-fast access enables applications that would not otherwise be possible, and has
>
> numerous other advantages. It does, however, imply that the throughput require-
>
> ments for ultra-fast broadband networks might possibly be far more modest than
>
> many have assumed.
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> It likely also implies that the relationship between access bandwidth availability
>
> and bandwidth consumption is likely to be far more complex than many have as-
>
> sumed. Ultra-fast broadband is an important enabler, but is likely one of many.
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> Consumer preferences (for video, for example), digital literacy, and many other
>
> factors likely play a role. In other words, broadband access speed is probably only
>
> one component, albeit a large one, in establishing a virtuous cycle of usage of
>
> ICTs and the internet." (p. 73)

Educational Technology in Maine and the United States is probably more advanced than

those in Marcus and Elixmann's paper, but I do still see a parallel in their findings worth ac-

knowledging. Trends in education in Maine continue to move in the direction of larger network

traffic, including cloud computing, the flipped classroom, distance learning, and multimedia

viewing and distribution. The necessity of adequate bandwidth, signal strength and reliability in

school, library and home networks must be administered in parallel with high quality instruction in order to facilitate technology integration in contemporary learning experiences. Unacceptable response times discourage teachers and users from making use of available internet resources (A Framework for the Next Generation Maine School and Library Network, n.d.) Furthermore, on-going systemic issues with the physical network and bureaucratic protocol are draining other resources as faculty and staff transition to new standards.

Maine was a pioneer in the development of a state-wide Education and Research Network to support schools and libraries. We have also taken advantage of available public funding to upgrade network media while maintaining efficient architecture and topology to support future Wide Area Network expansion. What our schools still lack is funding to upgrade a lot of the copper media bridging from the network source to school Local Area Networks (LANs), as well as school LAN media infrastructure itself. The biggest crisis we face is on the human resources level because the current system of employment is not capable of supporting the workforce necessary to manage school LANs and use them to their full extent. 21st century education environments require a workforce of technically competent educators, technicians, and staff who are able to flexibly work on-site and via distance. By adopting the perspective of permaculture design principles we may be able to cultivate a workforce that can adapt to new creative ways of service. In integrated systems diversity is valued, individuals can self-regulate, operate with each other (and students,) and the available resources, including technology, are employed with little waste. This concept may seem utopian from the current vantage, but I wonder if digital natives will have a closer connection to this concept if we provide a more balanced diet of natural and digital consumption than we have practiced for the past two decades or so.

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