A FRAMEWORK FOR THE NEXT GENERATION

MAINE SCHOOL AND LIBRARY NETWORK

Prepared by University of Maine System ITS at the request of
the Commissioner of the Maine Department of Education

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Overview

In January of 2008, EDUCAUSE[1] published a white paper **A Blueprint for Big Broadband[2].** The paper makes a strong case for a national initiative **'to build open, big broadband networks of at least 100 Mbps[3] (scalable upwards to 1 Gbps[4]) to every home and business by 2012'.** While it may be optimistic to expect this level of connectivity to every home and business in rural states like Maine within that timeframe, it is a reachable goal, as a minimum, to provide this level of service to all our schools and libraries.

More specifically the introduction to the same EDUCAUSE white paper summarizes the need for high-speed networks to support modern teaching methods at all levels, emphasizing the benefits of virtual field trips, 3D virtualization, simulations, and social networking with peers in other cultures.

The purpose of this paper is to demonstrate that it is feasible and affordable to connect all the schools and libraries in Maine at a minimum of 100 Mbps over the next few years. To do so will require a new strategy in procuring service and a recognition that no single technology will best serve all regions of the state.

Maine cannot afford multiple projects to provide high speed networks to all educational, research, and non profit institutions but it can support a common effort to serve all by combining and leveraging the resources of many. This will necessitate close collaboration between interested groups but the end result can be a level of connectivity that would not be possible individually.

[1] EDUCAUSE is a nonprofit association whose mission is to advance higher education by promoting the intelligent use of information technology.
[2] http://www.educause.edu/ir/library/pdf/EPO0801.pdf
[3] Mbps – Megabits per second
[4] Gbps – Gigabits per second or 1000 Megabits per second

Background

MSLN has been in operation for over 13years and has been highly successful. Over this period of time the number of computers in schools and libraries has grown almost exponentially. The advent of laptops in the middle schools through the MLTI project and continuing expansion into high schools is creating a tremendous load on the network. Additional demands are being created by the consolidation of administrative applications through MEDMS, Northwest Evaluation Association applications (NWEA), Maine Infonet and Minerva library applications, and others. Many of these applications require interactive online data entry and reporting requiring high performance networks with low delay characteristics. A growing number of video based resources have become available, particularly over Internet2. These resources provide elementary through high school students with virtual tours and provide opportunities students to collaborate with peers in other parts of the country and the world. While bandwidth capacity has been 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.

Current MSLN Architecture

- Schools and libraries have been aggregated into a single homogeneous network where most schools and libraries are connected and managed as a single statewide network.

- Two primary telecommunications technologies were used to deploy this network and that same infrastructure has served the MSLN network for the past 13 years. These technologies consist of Frame Relay and ATM.

    - **Frame Relay:** Most schools and libraries are connected with telecommunications circuits using a technology called Frame Relay. Initial connection speed was at 56 Kbps, but now all schools and libraries using this technology have been upgraded to what are called T1 circuits, approximately 24 times the original connection bandwidth.
    - **ATM:** Approximately 90 school and libraries participate in the DOE Distance Learning Project. This requires much higher bandwidth capacity to support multiple streams of quality video than is provided over the Frame Relay circuits. Locations participating in this project are connected with a transport technology called Asynchronous Transfer Mode (ATM). Because of the higher bandwidth available with ATM, Internet bandwidth is provided along with the video streams on the same ATM circuits. This Distance Learning Project has been in operation using this telecommunications technology for the past 12 years.

The Need for a New Architecture

- This Frame Relay/ATM architecture, while it has served MSLN very well for more than a decade, is no longer the infrastructure of choice for deploying and scaling networks.

    - Frame Relay is not scalable cost effectively. Thus most schools and libraries are limited to T1 (1.5 Mbps) circuits. Although these circuits are symmetric, the download capacity is less than what is available in most homes where there are 1 or 2 computers. By contrast schools and libraries need to accommodate from tens to hundreds of computers with this single connection.
    - In many cases two T1s have been installed to bring relief to schools and libraries that have been limited for some period of time. This approach, while providing some temporary relief, is neither scalable (beyond two T1s) nor cost effective and still provides less download capacity than is available in most homes where broadband is available.
    - ATM, while popular over a decade ago, is no long a cost effective technology to deploy high capacity networks. Termination equipment is expensive and circuit costs are high compared to other technologies. As a result, there has been no enhancement to this infrastructure in over 10 years. Unfortunately, no alternative technology is currently readily available statewide in Maine.
    - In the recent public discussions regarding the sale of land lines in northern New England, it has been pointed out that the current ATM infrastructure needs to be upgraded to a more modern technology to better serve Maine citizens.

- In addition to the need for increases in bandwidth capacity to the Internet, many schools and libraries are seeing the need for greater regional capacity between the buildings within their district.

    - Schools and libraries are identifying efficiencies by consolidating applications in a central location and providing access to this central site. This includes locating servers at one location rather than replicating them at many sites. This reduces the cost of hardware, data center space, and technical support. However, it requires greater bandwidth between the sites than is available under the current architecture.
    - Schools and libraries are already looking at recent technologies to reduce operating cost. A good example is the use of Voice over IP (VoIP) which allows sites to centralize their phone systems across an entire district with minimal ongoing cost after initial installation. Again this requires greater and controllable bandwidth between locations.
    - The consolidation of school districts now under way would benefit greatly from increased bandwidth between all the sites within a district.

- In order to address their growing needs not met with the current MSLN architecture, some schools have opted out of MSLN and negotiated alternative connections from ISPs in their area that are able to provide them greater bandwidth cost effectively. While this brings some bandwidth relief to individual schools or districts, it is not a good outcome from an overall school and library network perspective. A single homogeneous network provides added benefits not possible with a collection of separately managed networks.

    - **Access to advanced national high performance networks**
      Alternative providers are usually not able to route traffic over the expanding national research and education networks such as Internet2.
    - **Economies of scale**
      Maintaining a single homogeneous system allows for economies of scale in content filtering, centralized help desk, and network management.
    - **Coordinated application support**
      A homogeneous system facilitates the support for common applications such as Course Management Systems (i.e. Moodle), the DOE MEDMS project, the centralized library systems shared by libraries across the state, and the MLTI. For some applications such as the many video resources, the servers reside within the regional and national research and education networks, making it easier to provide end-to-end support through a common network. Coordinating multi-site video conferencing applications is also more effective through a common network.
    - **More efficient network traffic management**
      When schools and libraries elect alternative providers, they no longer benefit from the advantages of a single homogeneous system where traffic is controllable and manageable end-to-end. In those cases traffic may traverse many different ISPs (and go through several states) before reaching its destination, even though the destination is geographically close to the origination site.
    - **More efficient allocation of Internet Address space**
      Generally, Internet addressing is allocated within ranges provided to each ISP and as a result must be changed whenever a different ISP is selected. Typically Internet address space is not ‘portable’ across providers.
    - **Efficiency of a single centralized Help Desk**
      With multiple independent networks, each institution is responsible for all their management issues and must deal directly with individual providers. A single help desk common to all MSLN participants is no longer available, nor are common applications such as e-mail, web hosting, and content filtering.

    As more institutions are forced to seek alternative services a collection of many independent networks will result rather than a single network serving many institutions, often requiring Internet and e-mail addressing changes.

Distance Learning Network Requirements

As mentioned earlier, the Department of Education Distance Learning Network has been in operation for some 12 years and serves some 90 sites across the state. The majority of these sites are High Schools. Much has been learned from this effort and there have been many successes. In general, the technology has worked very well but some administrative issues, such as the number of sites with common schedules, limited the ability to reap full benefits from the project. Nonetheless, there is a continued need and interest in expanding this effort by upgrading to current technology and incorporating what has been leaned from more than a decade of experience. A number of actions are necessary in order to achieve continued and increased benefits from this project.

- **Upgrade Distance Learning Technology**

  The technology used in the Distance Learning Network is aging and has not been refreshed in over 12 years. While it was state of the art technology when designed and installed, it is no longer what has become common practice for distance education across the country.

  Newer technologies now offer equal quality and greater flexibility at much lower cost than the original design and are rapidly being adopted across the country and the globe. This is not unusual in the evolution of most technologies; the more recent iterations are cheaper to install and maintain then the early deployments.

  This situation is not unique to Maine. In the same timeframe as Maine's initial deployment, St Clair County in Michigan deployed a similar technology. In recent years they have evolved and expanded their distance learning network by transitioning to these more cost effective technologies.

  The newer architecture is more flexible, does not require expensive specialized distance learning rooms, and better accommodates small groups that have been typical of the Maine project.

  An upgrade of the Distance Learning Network need not be disruptive nor should it require the large equipment costs of the original project. In fact, current locations could be migrated to newer technologies over a few years. Because of the much lower cost of maintenance for the new equipment, most sites could be migrated to more recent technology entirely with a few years of maintenance cost savings.

- **Expand and Support Distance Learning Technology Across K12**

  Resources have developed nationally that use the more modern distance learning equipment. Many of these resources are targeted to the middle and elementary school students in addition to high school students. By coordinating the MSLN to a new scalable architecture, these technologies can be extended beyond the

current high school locations to middle and elementary schools that can share resources as well as access many national resources.

In fact, a number of school districts in Maine have initiated projects on their own to bring this technology to all their schools and, in some cases, have collaborated with neighboring districts to develop regional resources. Many of these projects have been funded with grants from the US Department of Agriculture through Rural Utility Services (RUS) grants for Distance Learning and Telemedicine. Three grants in 2006 totaled over $1M and in 2007 seven grants totaling over $2.8M were awarded to Maine schools districts. These grants are funding interactive videoconferencing and infrastructure equipment to over 100 schools in these districts, over half of which are elementary schools.

As an example, one of the 2006 grants was awarded to the Jay School Department and provided equipment for 4 elementary, 3 middle, and 4 high schools across two school administrative districts. The equipment has recently been installed and was used for a videoconference between 1st, 2nd, and 3rd graders in Maine with peers in school in Brazil. Earlier it was used to connect to the Columbus Zoo for a virtual tour.

An exciting 2007 RUS award was to the Greenville School Department. This grant was initially inspired by the work of educators and students in Jackman, ME with students in schools in Louisiana after hurricane Katrina, many of the students sharing common French origins. With support from the Rural School and Community Trust, a proposal for a RUS grant was submitted and awarded for a multi-state distance learning project. The project includes sites in Maine, Mississippi, South Carolina, and Vermont and will be supported by two of the Rural School and Community Trust sites.

A summary of the 10 RUS awards, as documented at the USDA web site, appears at the end of this report.

It is clear from these efforts that there is an interest and a need to expand distance leaning technologies beyond high schools into middle and elementary schools to allow our students to share their social and cultural backgrounds, to participate in virtual field trips, or even to interact with students in other countries. To allow all our schools to develop these capabilities will require a major upgrade to the MSLN infrastructure

- **Upgrade Telecommunications for Distance Learning**

As mentioned previously, the telecommunications technology used for the Distance Learning Network is called ATM. While this was the most cost effective high speed bandwidth available in Maine over 12 years ago, newer services have developed and are based on networking standards widely used in local area networks. These services are typically much cheaper for high capacity bandwidth, require much less expensive termination equipment, and have much lower

maintenance, operating, and support costs. Furthermore, these are the very same services that are the most cost effective in delivering general Internet services. Thus, any location with sufficient capacity can use the same service to support distance learning initiatives as well as Internet services.

Since there is as much demand for these capabilities at the elementary and middle school level, higher capacity must be brought to all locations.

Vision for the next generation MSLN

In order to assure the continued success of MSLN, it is necessary to develop a strategy that will lead to a scalable network with much greater capacity than is available today. This will require new technology to be delivered to institutions, most often in the form of fiber cabling. While this may appear to be an unreachable goal, it can be demonstrated that high capacity of up to 100 Mbps can be delivered practically and cost effectively to most schools and libraries in Maine. Such an undertaking will by necessity evolve over time and will not reach all locations in the short term. However it can very quickly address the needs of those sites that are most in need of expansion while continuing to maintain a single homogeneous MSLN.

Many K12 systems across the nation are struggling with the same dilemma. Many have determined the best approach is to pool their resources with their state's research and education networks in order to gain the most benefit at the least cost. The same opportunity exists in Maine as a collaborative effort by the education and research community are pooling resources and deploying a high capacity backbone across the state.

- Optical fiber is the cabling of choice for scalable high capacity networks and is possible for many communities in Maine.
    - Optical fiber is recognized as the 'future proof' media. This means that with community or consortium owned fiber network capacity can be scaled to very high rates by upgrading only the end equipment. With today's equipment bandwidth capacity on optical fiber can scale from several Megabits per second to 10 Gigabits per second with no additional cabling required.
    - To deliver the required capacity in the new network most commonly requires fiber optic cabling to each building. On the surface this appears to be an unrealistic goal, but it is not. In fact, many schools and libraries already have fiber to their buildings as part of their cable TV franchisees although it is often not being used for their Internet access. For example, many towns in Penobscot Valley have fiber distribution from a central point to all their schools, libraries, and municipal buildings. A single high speed connection to these central points of fiber connections can very

quickly provide from 10 Mbps to 100 Mbps to each location with very minimal investment in equipment.

- Some communities have had private fiber installed to connect schools and libraries in their town or district. Here again, bringing a single high capacity connection can serve all locations with the same scalable bandwidth. Examples include the communities of Dexter and Scarborough.
- Some communities who do not as yet have fiber connections to their schools may be able to contract with local cable TV providers, local telephone carriers, or other private enterprises to interconnect their institutions with optical fiber cabling. While this requires an upfront expenditure, the costs can be averaged over time (say 5-10 years) such that the resulting yearly cost for much greater capacity is not appreciably different than the cost of delivering current MSLN services.
- For those communities where there are currently no opportunities for private fiber, new telecommunication expansions in the state may open up new avenues over the next few years.
- When there are no feasible options for direct fiber connections between buildings in a district, direct fixed point-to-point wireless service can provide 100 Mbps over tens of miles cost effectively. While not as attractive as direct fiber connections, this is a practical solution for service to islands off the coast of Maine as well as some very rural communities.

- Once a district or community has interconnected their institutions, a single high speed connection can be made to a common backbone, thus maintaining a single homogeneous network for all. This may take a number of possibilities.

    - Some districts that have already interconnected their institutions lie in the path of the emerging Maine Research and Education (R&E) backbone network[5]. In such cases a high speed connection can be made directly to this backbone without incurring any substantial cabling costs. Two examples of this are the Bangor and Orono communities. More will develop as the R&E network expands along two redundant paths, thus crossing many cities and towns along the way.
    - Other districts that already have interconnections may be relatively close to this backbone. For a moderate one time expenditure, private optical fiber cabling can be installed to connect such communities directly to the R&E backbone network. Examples of this situation are the communities of Hampden and Winslow. There are many more.
    - Some regions have been fortunate to interconnect their institutions within their districts but lie at great distances from the R&E network backbone. Even here they can often be brought to the backbone using existing carrier facilities such as a cable TV provider or other telecommunications

[5] http://www.noc.maine.edu/doc/Maine_RE_Network.pdf

carriers. The net result is the same; all buildings of the community benefit from high capacity connections while still participating in a single common network. An example of this is Naples, where buildings are connected by private fiber and the high speed connection to MSLN is provided by the local cable TV provider. The cost of the high speed connection is not appreciably higher than the cost of a pair of T1 circuits that are sometimes used to bring relief to many overloaded locations.

- Of course, these options will not be immediately available in all locations served by MSLN. In such cases it will be necessary to reallocate dollars saved from directly connected sites to improve service to those locations using traditional carrier facilities.

Building the Next MSLN Infrastructure

The approach suggested above in not currently available in some areas of the State. Migrating to this architecture can not be done immediately in a 'one size fits all' basis. Furthermore, the options vary by region or community making it difficult to issue a single procurement (RFP) to serve the entire state. Doing so merely provides the least common denominator of facilities available statewide and does not assure the most cost effective service for each individual area.

The cost of deploying a network to serve a community of users (schools and libraries) can be substantially reduced when combined with the efforts of others who are doing the same things. Much as procuring goods for a large collaborative is more cost effective than each group undertaking individual procurements, combining the efforts of many and combining their resources can lead to greater benefits for all than could be accomplished individually.

MSLN should consider joining into a partnership with the research and education community to participate in a common effort to deploy a scalable modern network. Many states have already created such partnerships or are in the process of doing so. The states of Connecticut, Rhodes Island, and Missouri have formed such collaborative partnerships. This is occurring in rural states like Maine as well as in urban areas. One very successful statewide partnership of education, medical, judicial, and government institutions is the Iowa Communications Network (ICN).

- The formation of such a partnership in Maine has been advocated in a number of recent reports.

    - In a report "Achieving Prosperity of All Maine Citizens"[6], a product of the Governor's Task Force on PK-16 education, a recommendation that 'All Maine PK-16 institutions work to leverage resources to provide efficient use of collective technologies'

[6] http://mainegov-images.informe.org/education/pk16_task_force/achieving_prosperity_for_all_maine_citizens_report.pdf

- A document outlining a framework for discussion advocates that 'the Department of Education, Maine Community College System, University of Maine System, and Maine Maritime Academy work jointly to develop telecommunications and technology infrastructure'.
- In a report to the Governor's Telecommunications Infrastructure Steering Committee the Maine PK-20 Telecommunications and Technology Infrastructure Board[7] advocated a common forum for State Government, Public institutions, Libraries, Private Colleges, and others to leverage their resources in a common effort to provide efficient use of the collective technologies.

- Such an approach would benefit MSLN and other communities of users in a number of ways.

  - As a participant in a broader effort, MSLN would have a seat at the table and be better able to advocate for the needs of the schools and libraries. MSLN would be in a true partnership rather than a vendor-customer relationship thus being able to better influence policy and direction.
  - The MSLN community would benefit from the expertise and advice of other participants, who may be able to assist districts in procuring the necessary connectivity.
  - The resulting service to MSLN would be greater and more scalable capacity than could be procured as a separate network.
  - Some of the equipment expenditures to deploy this common network can often be used as matching dollars in grant applications such as the RUS grants mentioned above, thus further leveraging other funding sources to support K12 and library grant applications.

- Others in the research and education community would benefit as well; the added financial resources that MSLN would bring to the partnership can leverage expansion into areas that might not otherwise be possible individually.

  - Current participants in the R&E deployment include Jackson Laboratory and Mount Desert Biological Laboratory. The design includes the potential to connect others in the research community including Eastern Maine Health and Private Colleges (Bates, Bowdoin, and Colby) involved in biotechnology research

- This approach may be of concern to some regarding Federal E-Rate issues since it involves the sharing of facilities by organizations that are not eligible for Federal E-Rate support. The Federal E-Rate regulations provide for such sharing arrangements and therefore this should not be a deterrent from participating is such partnerships.

[7] http://mainegov-images.informe.org/mpuc/broadband/activities/PK20TeleTechInfrastrBdDRAFTRpt-1.pdf

Funding

Funding for MSLN services is provided by a combination of Federal E-Rate and State MTEAF funds for those who participate directly in MSLN. Application for Federal funding is primarily on a consortium basis on behalf of all participants. Those who have elected to receive network services from outside the MSLN network apply for Federal E-Rate funding on their own and do not generally received MTEAF funding. As new and different architectures are explored, new approaches to funding will also be necessary.

- Not all elements of supporting a network are eligible for Federal E-Rate, for example content filtering. Another element that is not eligible is the cost of acquiring private cabling, such as optical fiber to interconnect institutions in a region or district. However, the lack of Federal support is not a sufficient reason not to pursue such alternatives if it provides more cost effective service in the long term.

- MTEAF funding should be reviewed and revised to provide support for alternative means of bringing service to a building, even if such alternatives are not eligible for Federal assistance. If it is the best long term solution, MTEAF should fund a portion of the cost to encourage the evolution of the network to a long term solution. The level of funding provided by MTEAF should, at a minimum, be at least what it currently funds for a connection with T1 circuits.

- While Federal support is not available for certain elements such as private fiber, it is available for the support of any high speed links to the region or district if provided by a carrier. Thus the ongoing cost for a high speed circuit serving multiple schools and libraries is eligible for Federal E-Rate and should be supported by MTEAF funds as well. This is similar to the current funding for ATM circuits.

- Much of the network infrastructure can also be shared with other academic institutions, research organizations, and municipal governments even though these are not eligible for Federal E-Rate support. This should not be a deterrent from such collaborations as mechanisms exist in the Federal E-Rate guidelines for eligible and non eligible entities to share facilities with the Federal support prorated based on the eligible use. A section of the Federal E-Rate application process guidelines is titled "**Cost Allocation Guidelines for Consortia Comprising Both Eligible and Ineligible Entities"**[8] and describes various scenarios for calculating costs and eligible discounts for shared services. In some cases, this may make the application process somewhat more involved but the benefits far outweigh the added complexity. Those involved in the deployment of the current research and education backbone can be a great resource in identifying parties in a community that can share facilities in a region and can provide

[8] http://www.usac.org/sl/applicants/step06/cost-allocation-guidelines-consortia-comprising.aspx

assistance to districts to determine the services or share of services eligible for Federal support.

- Clearly this approach to providing the most cost effective solutions for each region carries some complexities regarding Federal E-Rate. Individual communities must participate in the process and in some cases, make separate E-Rate applications based on their individual situations rather than depend on a common consortium application. But this is being done successfully in other states and can be replicated in Maine. The process could be clearly outlined to assist communities in their applications. Other participants in the research and education network can also provide assistance to districts to determine the services or share of services eligible for Federal support as well as providing application assistance.

Connection Scenarios

This section provides a number of different scenarios for migrating communities with different characteristics to a new architecture. These are intended to demonstrate the feasibility for each type of district to upgrade to a scalable network architecture. As illustrated, the most cost effective solution for one region or district may not be available or affordable in other regions. The best overall strategy is to use a collection of technologies that, as a whole, provide for the most cost effective solution for each district while maintaining the overall objective of providing 100 Mbps service to all sites.

The pricing details, where included, are estimates only and should not be considered as absolute. This also should not be interpreted as the actual shared costs within a consortium of users. Rather, they are intended to demonstrate that this level of service is supportable with the existing level of funding for the current MSLN.

- **Communities that lie in the path of the Research and Education network currently being deployed.**

  Some communities already have optical fiber interconnecting all their schools and libraries. Such an example is the City of Bangor.

  - As part of its franchise agreement with the cable TV company, Bangor has fiber connections to each of its schools and the public library back to City Hall. As part of the installation of private fiber from Bangor to Orono for the research and education network, a connection was made to the Bangor City Hall, thus providing connectivity to all schools and the library. That connection is not currently in use but each school and the library could immediately be provided with 100Mbs of service with little or no added infrastructure cost. While the private fiber is not eligible for Federal E-Rate, the service provided over it is.

- Bangor has 11 schools and 1 public library. Under current guidelines each is eligible for a minimum of a T1 (1.5 Mbps connection). This is not how Bangor institutions are connected since Bangor High School and the Bangor Public Library each have an ATM connection. However the cost of a T1 connection for each location is used for illustrative comparison purposes. The current circuit cost of a T1 connection is $360/mo for a total of $4320/mo. This is funded by both Federal E-rate and MTEAF funds. Assuming the statewide average of federal support at 60%, the MTEAF portion for Bangor would be $1728/mo.
- In addition, the Internet service provided over these connections is fully eligible and costs $105/mo per site or $1260 per month for all connections in Bangor. Once again, assuming the statewide average of federal support at 60%, the MTEAF portion for Bangor would be $504/mo.
- The total MTEAF monthly outlay would then be:

$1728	Current MTEAF funding for Bangor (transport)
$ 504	Current MTEAF funding for Bangor (Internet)
$2232	Total MTEAF expenditure

- For this same expenditure of MTEAF funds ($2232 a month for T1 1.5 Mbps service) plus Federal E-Rate subsidies for eligible services all Bangor locations could be provided with 100 Mbps service under a collaborative partnership. Furthermore, the connection could be scaled to 10 times that amount with some one time moderate expenditures for equipment. No additional infrastructure or cabling would be necessary.
- A number of communities fall in this category and could connect to the R&E network at little or no additional cost. Examples include but are not limited to:

  - Bar Harbor
  - Brewer
  - Ellsworth
  - Holden
  - Northeast Harbor
  - Orono
  - Southwest Harbor
  - Tremont
  - Veazie
  - Waterville

- **Communities that are in close proximity to the path of the R&E network currently being deployed.**

  Some communities already have optical fiber interconnecting all their schools and libraries and are in moderately close proximity to a node of the research and education network. Such an example is Old Town.

  - Like many communities Old Town has fiber connections to all its schools and library back to a central location. However this central location is approximately 4 miles from the nearest node of the R&E network. In these situations a number of approaches are possible.

    - A private fiber could be installed to connect to the nearest R&E network node but this is often cost prohibitive to be undertaken by a single organization. A better approach is to work with other organizations in the area, private or public, which may have a similar need for dark fiber. Joining others in such a collaborative effort is often a cost effective way of obtaining direct fiber connections. Institutions involved with the R&E network deployment can be helpful in bringing interested parties together and organizing a joint project.
    - Communities like Old Town that have dark fiber between their sites through their cable TV franchise agreements may be able to add an additional fiber run to the nearest R&E node to their agreement for a nominal fee.
    - When there are no opportunities for direct fiber connections, a 100 Mbps circuit can be leased from a local carrier to connect directly to one of the R&E core nodes. In such a case, the circuit would be fully eligible for Federal E-Rate discounts, and since it would be shared by multiple sites, it would be affordable at current funding levels.

  - A number of communities fall in this category and could connect to the R&E network at little or no additional cost. Examples include but are not limited to:

    - Augusta
    - Belfast (MSAD 34)
    - Brunswick
    - Bucksport
    - Hampden (MSAD 22)
    - Lewiston
    - Old Town
    - Portland
    - Scarborough
    - Wiscasset

- **Communities that have local fiber connections but lie too far from the path of the R&E network to consider private dark fiber.**

  A number of communities have managed to interconnect their schools and libraries with optical fiber but lie at great distances from any currently envisioned node of the R & E network. Some of these communities have connected some or all of their sites to a central location thus providing high speed capacity between their individual locations. In most cases they have consolidated their Internet access to this central location in the form of multiple T1s or, for those participating in the DOE Distance Learning Network, over an ATM connection.

  Even with this consolidation of Internet service, the demand for Internet service far outweighs the available composite capacity. In many instances, this has discouraged teachers for making use of available Internet resources because of unacceptable response times.

  A good example of districts in this category is the Lake Region School System (MSAD 61) in Naples. Because of their proximity, the two schools and the superintendent's office have been interconnected with fiber and, for some time, the Internet service was provided over a pair of shared T1 circuits. Unfortunately this level of service was not sufficient to meet the demand and teachers were electing not to use Internet resources due to unacceptable response. In fact, after this was implemented, usage on these existing circuits actually declined.

  To alleviate this situation, Naples sought alternative solutions and was able to acquire a service from the local cable TV carrier to provide a connection of up to 100 Mbps to MSLN. This service is fully eligible for Federal E-Rate discounts. Unfortunately this is not one of the services currently supported with MTEAF funding. Nonetheless, Naples considered this important enough to fund the difference from their local budgets. Since the installation of this new service, usage has quadrupled and teachers are incorporating more Internet resources into the classroom. Naples is now looking to extend the fiber connections to other sites in their region to share this high bandwidth service.

  This case demonstrates that it is possible to support high bandwidth services to remotes areas as well as urban areas by selecting the most effective solution for the region. Other communities that have managed to interconnect some or most of their sites to a central location and could benefit from this approach include:

    - Cape Elizabeth
    - Jay
    - Buxton (MSAD 6)
    - Cumberland Center (MSAD 51)
    - Dexter (MSAD 46)
    - Farmingdale (MSAD 16)

- Fort Kent (MSAD 27)
- Kennebunk (MSAD 71)
- Lincoln (MSAD 67)
- Madison (MSAD 59)
- Oakland (MSAD 47)
- Searsport (MSAD 56)
- Skowhegan (MSAD 54)
- Thorndike (MSAD 3)
- Waterboro (MSAD 57)
- Yarmouth

- **Communities whose sites are located too far apart to make direct fiber connection feasible**

  Many districts in Maine are rural in nature and their schools and libraries reside at such distances that direct fiber connections are not feasible and no opportunity exists to obtain fiber connections from local providers. Even in these cases multiple locations can be interconnected to a central location with high speed wireless connections. In fact, some school districts in Maine have already moved forward independently and acquired such services.

  - The largest deployment of high speed wireless connections is in the Rumford area. Here 6 sites have been interconnected to a central location using 100 Mbps wireless circuits operating over a licensed spectrum. These services are fully eligible for Federal E-Rate discounts, which in Rumford's case, is 78%. Here again, funding to interconnect these sites within the area was provided through local funding and Federal E-Rate discounts but these circuits are not directly supported with MTEAF funds.

    This project illustrates the many benefits of interconnecting sites in a district or region to a central location.

    - Connection to a central location allows the other sites to share the existing ATM circuit to Mount Valley High School. In the future, a higher bandwidth service could replace the existing ATM circuit at a lower cost and opportunities for direct fiber connections may also develop. This combination would provide continued high speed service at an even lower ongoing cost.
    - The district has implemented a Voice over IP (VoIP) phone system in each of its schools. With the interconnection of the various locations plans are to consolidate in one location all equipment supporting this phone system. This will provide a region wide phone system at drastically reduced ongoing costs.
    - Currently a variety of servers are in operation at a number of schools. The communications provided by the high bandwidth wireless service will allow the First Class, Power School, and

local library servers to be consolidated in one central location, further reducing support and operational costs.

- In the unlikely and infrequent loss of Internet service, the connected schools in the district can continue all their communications and services without interruption.

- Two other rural areas have also recognized the need to interconnect their sites and, because of distances, have procured similar wireless services. Each is leasing 100 Mbps wireless circuits to interconnect their sites.

  - MSAD13 (Bingham) three locations
  - MSAD31 (Howland) two locations

As these examples demonstrate wireless technology can be very cost effective in providing high speed bandwidth in situations where direct cabling is not possible. This is an ideal technology to serve truly remote areas such as schools and libraries located on islands off the coast of Maine.

These connection scenarios demonstrate that it is a reasonable and feasible goal to connect schools and libraries with a minimum 100 Mbps circuits and that some areas have already begun the process on their own. Clearly, not all situations will fall exactly into one of these categories. In some cases hybrid solutions combining of a number of these technologies will be necessary. What is important is that MSLN begin the planning and coordination to evolve MSLN to this next generation by joining forces with others, particularly the research and education community.

USDA Rural Development Distance Learning Grants

2007 Grant Awards

Maine School Administrative District # 59

Maine $465,848 Areas Serving: Kennebec (part); Aroostook, Franklin, Kennebec (part), Somerset Contact: Sandra MacArthur Telephone: 207-696-3323 Fax: 207-696-5631 Congressional District: ME -1 Allen; ME-2 Michaud

The Maine Rural Education Enhancement Project is a consortium of five rural school districts. The five districts will use video-conferencing equipment to share resources and expand educational offerings, using some traditional distance learning methods such as shared live and archived classes and a new group project involving students across sites and of different ages. In addition to the students and teachers, the project will impact adults through continuing and adult education courses.

Southern Aroostook Community School District No. 9

Maine $393,761 Areas Serving: Aroostook, Penobscot Contact: Mr. Terry Comeau Telephone: 207-757-8223 Fax: 207-757-8257 Congressional District: ME-2 Michaud

Rural Development funding will place videoconferencing equipment in 15 sites which will enable the schools to connect to one another to share content, expertise, and staff to expand upon our students' learning opportunities. Additional courses and access to a wide-ranging education standard in urban areas will be offered. Students will benefit by being better prepared for state and college entrance exams, the demands of higher education, and the job market

Maine School Administration District No. 27

Maine $267,341 Areas Serving: Aroostook Contact: James Grandmaison Telephone: 207-834-3189 Fax: 207-834-3395 Congressional District: ME-2 Michaud

Aroostook County has historically been built upon the agriculture and foresting industries. Jobs in these fields do not require high levels of education and residents previously had found easy work as unskilled laborers. Telecommunications equipment would be placed in each of their sites, enabling them to expand course offerings by connecting their sites to share teachers and classes. Their schools are limited in their ability to provide large numbers of courses due to low student enrollment and limited finances. They will connect their schools to Aroostook Mental Health Center to provide improved services for our special needs students. Placing videoconferencing equipment at all sites will allow the streaming and archiving system to provide content creation and distribution and view content on demand.

Greenville School Department

Maine, Mississippi, North Carolina, South Carolina, Vermont, Virginia $428,474 Areas Serving: ME-01 Kennebec, ME – 02 Piscataquis, Somerset, MS – 01 Chicksaw, Panola, NC – 01 Vance, SC – 03 Saluda, VT 00 (All) – Washington, VA – 08 Arlington Contact: Ms. Heather Perry Telephone: 207-695-3708 Fax: 207-695-3709 Congressional District: ME – 01 Allen, ME – 02 Michaud , MS – 01 Wicker, NC – 01 Butterfield, SC – 03 Barrett, VT – 00 (All) Welch, VA – 08 Moran

This multi-state project will utilize web-based and interactive video conferencing to strengthen academic achievement and provide professional development activities for students and educators in partner school districts.

Maine School Administrative District #54

Maine $486,410 Areas Serving: Aroostook, Somerset Contact: Mr. David Person Telephone: 207-858-5453 Fax: 207-474-8268 Congressional District: Michaud

This project will provide enhanced educational opportunities for 10 schools in one of the most rural areas of Maine. The project will support interactive videoconferencing, web-based learning, streaming and archiving and development of core network infrastructure.

Maine School Administrative District 21

Maine $378,661 Areas Serving: Androscoggin, Franklin, Oxford, Penobscot, Somerset Contact: Katherine Harvey Telephone: 207-562-6075 Fax: 207-562-7059 Congressional District: ME-2 Michaud

The TEC-NET project will provide students with an expanded curriculum, enhanced foreign language instruction, and increased achievement. Participants in the project will have a minimum of T-1 connections to the Internet. Ten sites will receive interactive videoconferencing equipment and one site will receive infrastructure equipment to allow them to expand their access to video conferencing to all of the classrooms.

Maine School Administrative District No. 48

Maine $399,817 Areas Serving: Penobscot, Piscataquis, Somerset Contact: Mr. Kelly Carter Telephone: 207-368-5091 Fax: 207-368-2192 Congressional District: ME-2 Michaud

The project will use distance learning technologies to form a rural alliance focused on improvement of the quality of life in rural Maine communities. Twelve school campuses and seven communities will benefit from a diverse and competitive curriculum and extended learning opportunities. Residents will have access to unlimited learning resources, an opportunity to achieve important career skills, technology to inspire higher academic achievement and test scores, and equip rural life-saving personnel with up-to-date skills that urban areas already use.

Cobscook Community Learning Center

Lubec, Maine $249,965 Areas Served: Cumberland, Knox, Lincoln, Penobscot, Washington Contact: Mr. Kevin Thompson Telephone: 207-733-2233 Fax: 207-733-2262 Congressional District: ME-01, 02

Rural Development funds will be used to bridge project sites and cultures with distance learning technologies which will include web-based education, streaming/archiving/ interactive distance learning via videoconferencing, and the upgrade of network infrastructure where necessary to support the project.

Jay School District

Jay, Maine $454,079 Areas Served: Anderson, Franklin, Penobscot, Somerset Contact: Mr. Frank Williams Telephone: 207-897-4336 Fax: 207-897-9319 Congressional District: ME-02

Rural Development funds will be used to provide an information highway to share knowledge, expertise, and resources among twelve schools in four rural and economically distressed counties of Maine. All sites will utilize computer-based videoconferencing for collaborations between individuals and groups. Collaboration between students and staff will be available on demand. Over 48,000 residents will receive enhanced educational opportunities in these communities.

Millinocket School Department

East Millinocket, Maine $350,881 Areas Served: Aroostook, Knox, Penobscot, Washington Contact: Ms. Sara C. Alberts Telephone: 207-746-3500 Fax: 207-746-3516 Congressional District: ME-01, 02

Rural Development funds will be used to install interactive videoconferencing which will provide distance learning connectivity to 15 sites located in 4 counties as well as provide telemedicine opportunities to residents in the Millinocket and East Millinocket communities.