
# ONEnet Backbone Replacement

# Project Plan

## Phase One of K-12 Participation in the Third Frontier Network

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## Disclaimer

The K-12 Backbone Replacement Project Plan has been developed to provide an overview of the project history, rationale, investment and timeline.

Project information (including budget information, timelines, etc.) is a work-in-progress and subject to change without notice / revision. The information contained in this version should be considered as projections and may contain undiscovered errors. This document is prepared for educational purpose and not for commercial use.

## Acknowledgement

On behalf of the Ohio SchoolNet Commission (OSNC), we would like to thank and acknowledge the members of the ONEnet Committee who have invested thousands of hours in the development, implementation and oversight of the K-12 network. Staff of the Ohio Department of Education (ODE), Ohio SchoolNet Commission, Department of Administrative Services (DAS), Education Computer Network Data Acquisition Sites (OECN), Ohio Educational Telecommunications Network Commission (OETN), Toledo Public Schools and the Ohio Catholic Conference have worked together since 1999 to assist in the development of the K-12 network. We would also like to thank staff of the Ohio Board of Regents, Ohio Supercomputer Center and the Ohio Academic Research Network who have worked together with ONEnet since 2002 in building the Third Frontier Network. Finally, we would like to thank Governor Taft and the Ohio General Assembly for their dedication, support and contributions to K-12 education in Ohio, especially their past efforts to create the ONEnet network in 2000.

## Feedback

Feedback and suggestions to this document are welcome. Please send your comments to: Sam Orth or Scott Gaughan, Ohio SchoolNet Commission at onenet@osn.state.oh.us.

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# Executive Summary

## *Introduction and Background*

In March of 1999 the Ohio General Assembly issued the Ohio Schools Technology Implementation Task Force report which recommended that the state fund a statewide K-12 network for Ohio's schools. When the recommendations in this report were introduced into legislation (Am.Sub. HB 282) in FY2000, Governor Taft allocated $58.9M towards the initial phase of this K-12 network, known as ONEnet. The purpose of this initial allocation was to establish the foundation for an educational technology infrastructure that would provide equitable and efficient network access to Ohio's schools in order to support their data, video and voice applications.

ONEnet achieved its initial goal, and today ranks as one of the largest and most advanced K-12 networks in the country, serving approximately 4,500 school buildings and over two million educational users statewide. Governor Taft and the General Assembly have continued to recognize the importance of this initiative, and have invested approximately $130M in ONEnet to date.

ONEnet provides network services to all public and private K-12 schools in the state, linking classrooms to each other and the Internet, while providing access to data, voice, videoconferencing, electronic mail and other educational resources for students, teachers and administrators. Connection of the ONEnet network to the Internet provides connectivity between Ohio's K-12 schools and the public, giving parents, homeowners, businesses and others the ability to access school-provided web materials, electronic mail and other similar resources. ONEnet also serves as the principal communications mechanism for state educational agencies to deliver instructional, administrative, professional development, technical and other content to Ohio's schools. Student data collection (Educational Management Information Management System), school district accounting (USAS), library information management (INFOhio), Continuous Improvement Planning, Grants Administration and the Instructional Management System are just a few examples of state applications that use ONEnet.

Utilization of ONEnet continues to increase as districts implement new instructional and administrative applications that require more network bandwidth. This increased usage has exhausted the current backbone, and it will not be long before the network can no longer meet the expanding needs of Ohio's schools. In addition, as the cost of multimedia technologies continues to decrease – particularly videoconferencing and voice technology that utilizes the Internet – bandwidth requirements are expected to increase substantially, further accelerating the need for additional capacity.

### *Proposed Action*

In order to address the need for additional network bandwidth, Ohio SchoolNet and the ODE, on behalf of ONEnet, began discussions with the Ohio Academic Research Network (OARnet), in the winter of 2001, about the benefits of joining higher education's dark fiber project, now known as the Third Frontier Network (TFN).

TFN's goal is to create the premier next generation high-speed fiber optic network to ensure Ohio will be in a leadership position in research, education and economic development, as well as enhancing Ohio's role and reputation in networking technology. The Third Frontier Network was designed using a highly scaleable network architecture, enabling it to meet the demanding needs of multiple entities including K-12, higher education, and state agencies. The TFN design offers ODE and OSNC the opportunity to use the TFN to create a new ONEnet backbone.

K-12 participation in the TFN will increase ONEnet's capacity to provide voice, video, data, Internet bandwidth and other services to Ohio's public and private chartered school districts through the creation of a K-20 education network, using a shared, common infrastructure with the Ohio Academic Research Network (OARnet).

The Ohio SchoolNet Commission, on behalf of the ONEnet Committee, requests $8.019M in funding from the Ohio Department of Education's (ODE) line item 200-426 in FY2005/06 for the purpose of purchasing, installing and lighting a dark fiber backbone network for K-12.

The funding request for the project consists of the following components: a) $5.519M in FY05/06 to complete last-mile connections from 30 backbone sites to the Third Frontier Network (TFN) points of presence or POPs. The 30 backbone sites include the 23 Data Acquisition Sites (DA-Sites) of the OECN and the largest 7 urban school districts (as defined by ODE); b) funding in the amount of $1.5M in FY05 for network components located at TFN POPs and K-12 backbone locations to enable backbone connectivity to the network; and c) $0.5M in funding in FY05 and in FY06 for annual maintenance and operation of the K-12 portion of the TFN.

### *Evaluating the Opportunity*

It is essential that Ohio make this investment to expand capacity of the ONEnet network. The availability of high-capacity broadband service to schools remains an important challenge and worthy state goal. As schools acquire additional high-capacity services locally (via fiber or other similar offerings), the existing K-12 backbone, which provides 45 MB of capacity, will not be sufficient to handle the increased bandwidth demands of schools. Consequently, districts will be forced to leave the network to seek more cost effective, higher performing alternatives which may potentially result in the following adverse consequences:

- The loss of a standards-based educational technology network;
- Decreased end-user functionality;
- Increased operational costs due to lost economies of scale;
- The loss of investment in ONEnet;
- A reduction in interoperability– internal and external to the K-12 network;
- A less secure network with increased vulnerability; and
- The inability of the state's educational agencies to deliver instructional, administrative, technical and other content resources and services to Ohio's K-12 schools.

ONEnet's participation in the TFN includes many benefits, most importantly the preservation of the state's $130M investment and the long-term viability of the K-12 network. In addition to investment protection, K-12 participation in the TFN provides the following benefits:

Long-term Growth

TFN is a fiber-based, highly-scalable network using the latest advancements in optical networking known as dense wave division multiplexing (DWDM). DWDM technology is being used by most telecommunications carriers in the nation and will enable OARnet and ONEnet to meet the ever increasing demand of K-12 users well into the future.

The initial OC-3 deployment of TFN represents a 300% increase in network capacity, with the potential for exponential growth above that level, up to OC-192 (10 GB).

Cost Effectiveness

Fiber implementation can lower the total cost of network ownership (TCO) by eliminating multiple sets of infrastructure, simplifying system administration and maintenance, and consolidating voice, video, data and Internet circuits. Therefore, a converged network will reduce equipment and maintenance costs over time, yielding operational cost savings and a quicker return on investment (ROI).

Ease of Migration

The K-12 network currently operates on a transport protocol known as Asynchronous Transfer Mode (ATM); however, industry experts agree that the future of networking will be primarily based upon the deployment of an IP-based transport protocol. For this reason, we must ensure that any new deployment of backbone technology allows for an easy migration between the two platforms. The TFN design accounts for this migration in its initial deployment, and will easily allow for the integration of Gigabit Ethernet (Gig-

E) connections to the backbone, while simultaneously supporting legacy ATM connections. The support of both ATM and IP is possible due to the OC-48 capacity of the new K-12 backbone provided by TFN.

One Education Network

Uniting the K-12 and higher education communities into one education network will create numerous educational opportunities for the state's students and citizens. By combining the two networks, opportunities for K-12 and higher education partnership in online or virtual professional development, technical assistance, high-quality academic content, supercomputing and research instrumentation, among others, will be significantly enhanced.

***Investment and Budget***

ONEnet's objective is to convert the existing backbone of 30 high-capacity DS-3 connections to the TFN as soon as possible. When OBR/OARnet entered into their agreement to accomplish this objective, the annual cost to operate the existing DS-3 backbone was $2.16M. Based on this premise, the proposed K-12 participation in the TFN will represent a three-fold increase in backbone bandwidth from 45 MB to 155 MB at a reduced cost of 31%. After one-time costs are accounted for, the reduction from 2002 backbone costs will be 69%. Since 2002, OSNC has been able to negotiate more favorable pricing, and have consequently reduced the annual cost for DS-3 backbone service to $864,000.

Comparatively, the proposed annual K-12 cost for TFN backbone service is $1.488M per year ($0.659M after one-time costs). However, the cost per megabit for service will decrease from $19.20 per megabit for existing DS-3 service to $9.60 per megabit for OC-3 –(and even to as little as $4.25 per megabit after one-time costs). This represents a decrease in per-megabit backbone bandwidth costs of 50% and 78% respectively. Once the one-time capital acquisition costs are fully amortized, the cost to operate the TFN backbone will be $0.659M per year over the next 10 years. This represents an annual decrease of 24% from existing DS-3 service while realizing three times the capacity. Furthermore, K-12 schools will have the ability to upgrade backbone bandwidth to as high as 10 GB or OC-192 using existing fiber backbone infrastructure at approximately the same recurring cost plus the one time cost of upgraded equipment.

It is important to recognize that the deployment of the TFN began when there was significant excess fiber capacity available statewide, resulting in a greatly reduced cost of entry to the state. As fiber availability decreases, the corresponding acquisitions costs will increase. We cannot project a better time in the future to acquire fiber connectivity for the K-12 and higher education communities.

### *Conclusion*

The ONEnet Ohio program provides critical networking resources to the students, teachers and administrators of Ohio's schools. The past successes of ONEnet have created an environment where the delivery of educational resources through the use of technology has become commonplace, and relied upon.

As teachers continue to integrate technology into their curriculum and realize the benefits of collaboration, multimedia and Internet based tools, their demand for network resources will continue to increase. The ONEnet network has been successful in creating the demand for these services, and it has now reached a point where a restructuring of this valuable resource is necessary and critical to ensure that use of technology to improve student achievement continues.

Participation in the TFN is a logical extension of ONEnet, and such an extension will provide Ohio with a cost effective, fiber-based, highly-scalable infrastructure that enables increased collaboration and development of educational technology resources well into the future.

## Introduction and Background

In March of 1999, the Ohio General Assembly issued the Ohio Schools Technology Implementation Task Force report, which recommended the state fund a K-12 network for Ohio's schools:

> *"The State of Ohio should consider funding a state educational network which provides schools with universal access with low cost, high performance network capacity (1.5 MB). The state education network should be a simple, uniform, reliable, standards-based system that provides both basic and comprehensive services."*

When the conclusions of this report were introduced into legislation (Am. Sub. HB 283) in FY2000, Governor Taft allocated $58.9M towards the initial phase of this K-12 network, known as ONEnet. The purpose of this initial allocation was to establish the foundation for an educational technology infrastructure that would provide equitable and efficient access to Ohio's schools in order to support their data, video, and voice applications.

While Ohio SchoolNet serves as the project-managing entity for ONEnet, the ONEnet Planning Committee serves as a policy-oversight committee for the ONEnet project. The committee is comprised of staff from Ohio SchoolNet, the ODE, OECN, the DAS, the OETN, Toledo Public Schools and the Ohio Catholic Conference.

ONEnet achieved its initial goal, and today ranks as one of the largest, most advanced K-12 networks in the country, serving approximately 4,500 school buildings and over two millions students statewide. Governor Taft and the General Assembly have continued to recognize the importance of this initiative, and they have invested approximately $130M in ONEnet to date.

ONEnet provides network services to all public and private K-12 schools in the state, linking classrooms to each other and the Internet, while providing access to data, voice, videoconferencing, electronic mail and other educational resources for students, teachers and administrators. Connection of the ONEnet network to the Internet provides connectivity between Ohio's K-12 schools and the public, giving parents, homeowners, businesses and others the ability to access school-provided web materials, electronic mail and other similar resources. ONEnet also serves as the principal communications mechanism for state educational agencies to deliver instructional, administrative, professional development, technical and other content to Ohio's schools. Student data collection (Educational Management Information Management System), school district accounting (USAS), library information management (INFOhio), Continuous Improvement Planning, Grants Administration and the Instructional Management System are just a few examples of state applications which use ONEnet.

Utilization of ONEnet continues to increase as districts implement new instructional and administrative applications that require more network bandwidth. In addition, as the cost of multimedia technologies continues to decrease – particularly videoconferencing and voice technology that utilizes the Internet – bandwidth requirements are expected to increase even more substantially.

In order to address the need for additional network bandwidth, Ohio SchoolNet and the ODE, on behalf of ONEnet, began discussions with the Ohio Academic Research Network (OARnet) in the winter of 2001 to discuss the benefits of joining higher education's dark fiber project, now known as the Third Frontier Network (TFN).

### *Third Frontier Network – TFN*

The Third Frontier Network (TFN) is being created to provide advanced telecommunication services to support higher education and research in the State of Ohio. The TFN project consists of three phases: (1) a statewide fiber backbone, (2) last mile connectivity to 17 higher education institutions, and (3) last mile connectivity to all remaining higher education institutions in the State of Ohio. In addition, the completed project will assist in economic development opportunities and connect the research expertise of Ohio's industry and university researchers as outlined in the Governor's Third Frontier Initiative.

TFN's goal is to create the premier next generation high-speed fiber optic network to enhance research, education and economic development, as well as expand Ohio's role and reputation in networking technology. This network will provide the needed bandwidth capacity to sufficiently handle the increased demands and use of 1) the Internet as a learning tool in the classroom, 2) videoconferencing for delivering curriculum statewide, 3) multimedia applications delivered across the network and 4) the introduction of new technologies into the network, such as voice and video over IP. The TFN is a scaleable network which can provide the capacity to serve multiple independent networks, including higher education, K-12, and state agencies.

OARnet could choose to continue to provide and service the ever-increasing Internet needs of Ohio's colleges and universities, assuming "business as usual." However, augmentation of existing Internet connections will not meet the anticipated growth needs. Widespread use of various and sophisticated applications could individually require more bandwidth than is now available for all traffic. Further, accelerated adoption of collaborative relationships will require Quality of Service (QoS) levels far beyond what is currently possible with today's shared Internet backbone. More sophisticated applications (science, medicine, mathematics, genomics, etc.) will require a dedicated, high-speed channel where effective interactions assume the exchange of both data and video – flawlessly and automatically. Today's network cannot adequately support these applications. In order to remain competitive in these arenas, OARnet had to invest in the next level of technology that can only be provided through dark fiber.

In the winter of 2001, OARnet and the Ohio Board of Regents approached Ohio SchoolNet, on behalf of the ONEnet network, to gauge K-12 interest in participating in the TFN. Also participating in these early discussions were the Department of Development and the Department of Administrative Services.

***ONEnet***

The ONEnet Ohio network was created in 2000 to achieve the Governor's and General Assembly's goal of ensuring that every public school building was connected to a voice, video and data network at a minimum bandwidth of 1.5 megabits per second (equivalent to a T-1 line connection). This goal was originally established by the General Assembly in its Ohio Schools Technology Implementation Task Force Report issued in March 1999, and later adopted by Governor Taft in his first biennial budget.

The Ohio SchoolNet Commission and the ODE have jointly managed the ONEnet project. Initial phases of the project included both equipment and connectivity funding to connect local school buildings to the state's K-12 telecommunications network. The initial build-out of the ONEnet network is complete; however, the focus of the program is now on operational issues, such as bandwidth management, security, Internet access, application support and user authentication.

In addition to providing the necessary resources that connect all public buildings to the state's K-12 network, the statewide K-12 backbone's increased capacity would accommodate the anticipated increase in video, data and Internet traffic. This would allow more than 4,500 public school buildings and over 2 million users to be connected to the network. ONEnet includes a backbone consisting of high capacity (DS-3) circuits from Columbus to the 23 OECN DA-Sites and the state's 7 largest urban school districts as defined by the ODE. Each school district and its buildings then connect to the OECN DA-Sites or a central urban district site.

DS-3 backbone connectivity provides voice, video, data and Internet services among and between districts, and state agencies, through centralized services maintained by the DAS on ONEnet's behalf. These include video bridging services for over 800 K-12 distance learning sites and Internet service for all school districts.

Since initializing the network in 2001, the bandwidth requirements for K-12's use of the network have increased significantly. This is due to the following factors:

1. Educational users – teachers, students and administrators are using the Internet more frequently. Based on a survey of 99,531 teachers in 2004, teachers' use of network services such as email, the Internet, chat, online courses and other network services have increased significantly since 2002.

2. School districts are increasing the number of network delivered applications (i.e. student information systems, online learning, instructional management systems, library information systems, assessment applications and

transportation management).

3. School districts have seen an increase in enrollments due to the baby boom "echo," therefore increasing the need for additional bandwidth.

4. School districts rely on the K-12 network as their principal means of connecting to parents and their local community. As a result, the amount and types of information shared by the districts with their local community continues to increase. Districts also maintain websites for their districts and buildings.

5. Teachers and administrators rely on electronic mail and other web-communication applications to communicate with each other and their constituents.

6. Multimedia use of the K-12 network (especially videoconferencing, video on demand and web casting / video streaming) is increasing. Over 8,000 hours per month of educational programming (via Ohio SchoolNet's Telecommunity and IVDL programs) is already occurring over the ONEnet network. This does not include videoconferencing between individual sites, which cannot be easily measured. With a decrease in the cost of videoconferencing equipment, it is anticipated that districts will expand their videoconferencing programs within existing school buildings and into new facilities – especially middle and elementary schools where the technology is not yet pervasive. The decrease in the cost of videoconferencing equipment is due in part to the use of Internet Protocol (IP) to deliver video conferencing applications. The decreased cost of this equipment coupled with the feasibility of providing video conferencing over the Internet, and the expansion of videoconferencing to more classrooms and buildings, will increase the bandwidth needs of the backbone substantially.

7. Many districts are implementing voice over Internet protocol (VoIP) telephone systems primarily due to funding received through Ohio School Facilities Commission construction grants. With over 65,000 handsets installed in Ohio's schools today, existing phone traffic is distributed over the public switched telephone network (PSTN). VoIP systems use the Internet Protocol for the transmission of telephone calls. While there is potential for considerable cost savings to districts that implement VoIP, providing this type of service across the K-12 network will require additional network resources and capacity.

Most school districts (greater than 98%) presently have 1.5 MB (minimum) of service to each school building. In fact, approximately 30% of the school buildings have higher than 1.5 MB connectivity between their buildings. Due to the reasons described above, and based on research by Gartner and others, it is anticipated that districts will need much higher bandwidth services to schools in the near future. Unfortunately, there are few high bandwidth alternatives from which schools can

choose. Other than postalized T-1 pricing which allows any school to purchase 1.5 MB of service for $400 per month regardless of location, there is no low-cost statewide pricing for DS-3 service (45 MB), OC-3 service (155 MB) or Gigabit Ethernet (GigE) service (1,000 MB; 1GB). Consequently, over 40% of the school districts have switched or are considering the switch to fiber for WAN connectivity to their DA-Site.

In addition to local fiber alternatives, we are encouraged by OIT/DAS' direction to extend and re-bid the State of Ohio Multi-Agency Services (SOMACS) agreement to support lower-cost and higher-speed last mile options. K-12 has traditionally gained tremendous cost savings over the lifetime of this agreement. Today, some school districts are already looking for higher speeds than are available via today's SOMACS agreement. These requests are making the decision to upgrade the K-12 backbone to the TFN even more imperative.

The availability of a high-capacity broadband service to schools remains an important challenge and worthy state goal. As schools acquire additional high-capacity services locally via fiber or other similar offerings, the existing K-12 backbone, which provides 45 MB of capacity, will not be sufficient to handle the increased bandwidth demands. Some K-12 backbone sites, which serve large populations of students, and provide high capacity connections to their districts, are already experiencing network bottlenecks. As a result, many districts now have considered leaving the K-12 network in favor of local connections with higher capacity and lower costs than the current state offering.

Alternatives for increasing backbone bandwidth through the telecommunications utility market are somewhat limited as bandwidth configurations higher than DS-3, such as OC-3 (155 MB), are very dependent on individual provider infrastructure. While DS-3 service is available at postalized rates through agreements established by the state, OC-3 service pricing is very dependent on geographic variables and can be considerably more expensive to acquire.

The state, through Ohio SchoolNet, made an investment in wiring all school buildings in 1995. While it was anticipated that districts would use the wiring for voice, video and data applications, it was not completely clear how districts would utilize the state's investment. Since then, the wiring has been used far beyond what was originally envisioned.

In a similar fashion, it is not possible to adequately predict-- especially with technology applications changing so rapidly-- the bandwidth requirements of schools on a finite basis. What is clear is that the bandwidth needs of K-12 are rapidly increasing. If the state wants to maintain a district's voluntary participation in the K-12 network, then it has to provide for the current and future bandwidth requirements of schools in a manner that produces a positive value proposition. Otherwise, the state will risk losing schools to other providers who can better meet their connectivity needs.

If the propensity for districts to leave the network were to significantly increase, the costs to maintain the network would also increase. This loss of leverage further decreases the state's ability to maintain a cost-effective value proposition for the remaining K-12 customers. As K-12 customers leave the network, the performance of the network (defined as user functionality, interoperability, and safety/security), would be seriously compromised as the ability to manage network standards would be diminished or lost. This would ultimately lead to a situation where inequities in access to technology by students throughout Ohio would be accentuated.

For these reasons, in May 2003, the ONEnet committee agreed to partner with the Ohio Board of Regents (OBR) in the development and implementation of the TFN. In response to district's future bandwidth requirements, ONEnet committee members saw the TFN as an opportunity to dramatically increase the backbone capacity of the network, enabling ONEnet to meet the current and future K-12 bandwidth needs *while reducing backbone costs per megabit.* More importantly, ONEnet committee members saw the partnership with OBR/OARnet as a way to combine the K-12 and higher education network into one K-20 education network for Ohio, which would lead to additional educational opportunities for Ohio's citizens.

Combining the K-12 and higher education communities into one education network would not only create numerous educational opportunities for the state's students and citizens, but it would also create a tremendous leveraging position of the taxpayer's investment by capitalizing on the economies of scale realized through the combined funding of TFN participants.

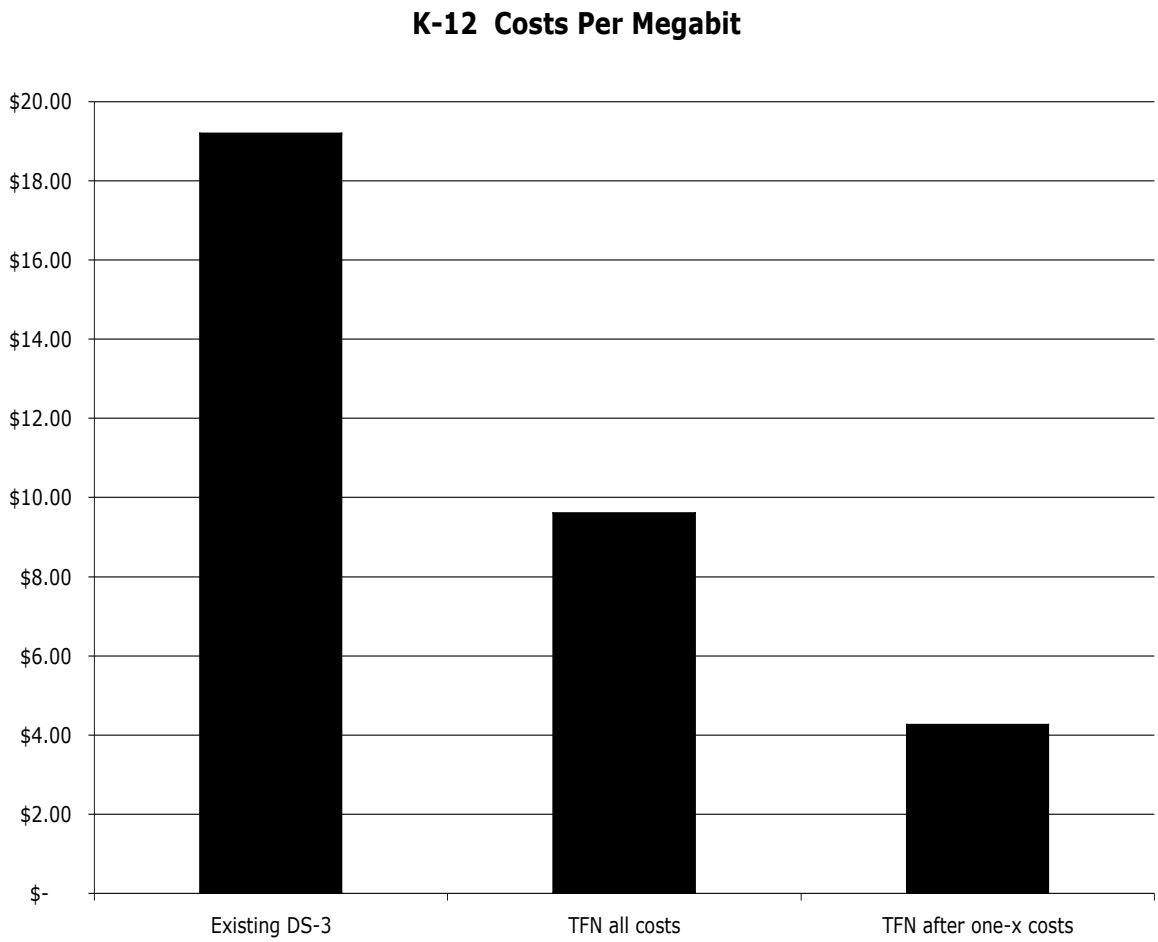
Subsequent to the decision by ONEnet to partner with OBR/OARnet, Ohio SchoolNet and the ODE entered into a Memorandum of Understanding (MOU) with OBR/OARnet for K-12's use of the TFN. In FY2003, Ohio SchoolNet and the ODE jointly invested $1.4M in the TFN, which provided ONEnet the right to use a dedicated portion of the TFN as the K-12 network backbone. The long-term goal will be to connect individual school districts to the network as additional colleges, universities and local governments are connected to TFN.

ONEnet's objective is to convert the existing backbone of 30 high-capacity DS-3 connections to the fiber network as soon as possible. When the MOU with OBR/OARnet was signed, the annual cost to operate the existing DS-3 backbone was $2.16M. Based on this premise, the proposed K-12 participation in the TFN will represent a three-fold increase in last mile bandwidth from 45 MB to 155 MB at a reduced cost of 31% as compared to 2002 levels. After one-time costs are accounted for, the reduction from 2002 backbone costs will be 69%.

Since 2002, OSNC has been able to negotiate more favorable pricing, and has consequently reduced the annual cost for DS-3 backbone service to $864,000. Once the one time capital acquisition costs are fully amortized, the cost to operate the K-12 portion of the TFN will be $0.659M per year over the next 10 years. This represents an annual decrease of 24% from existing DS-3 service while realizing

three times the capacity. Furthermore, K-12 will have the ability to upgrade TFN bandwidth to as high as 10 GB or OC-192 using existing fiber infrastructure. It should be noted that OC-3 capacity is anticipated to be a constraining factor at most DA-Sites by 2008, at which time an increase in speed for the connections to Gigabit Etheret (Gig-E) is predicted.

While the proposed annual K-12 cost for TFN backbone service is $1.488M per year ($0.659M after one-time costs), the cost per megabit for service will decrease from $19.20 per megabit for existing DS-3 service to $9.60 per megabit for TFN service, and to $4.25 per megabit after one-time costs. This represents a decrease in the cost per megabit of backbone service of 50% and 78% respectively.



## Current Status

The Ohio State University issued a Request For Proposal (RFP) on behalf of OBR/OARnet and K-12 in December 2003. Thirteen companies responded in February 2004 to the 2nd Phase of the TFN. Since then, Ohio SchoolNet has been working with RFP respondents to review and finalize vendor offerings and negotiate terms, conditions and pricing. The TFN phases are:

- Phase 1 – Statewide Core Backbone
  Create 1,600-mile core backbone connecting 15 geographically dispersed hubs throughout Ohio.

- Phase 2 – Last Mile Connection to Major Universities and K-12 Backbone
  Provide last mile connections to 17 major research universities and 30 K-12 backbone locations from Points of Presence (POPs) in Phase 1.

- Phase 3 – Connect Remaining HE Institutions
  Provide last mile connections to more than 70 remaining higher education institutions from Phase 1 hubs.

- Phase 4 – Connect Industry Research Centers to HE
  Create expanded partnerships between higher education and industry
  Connect K-12 school districts to TFN.

Several cost models for last-mile connections between the K-12 backbone sites and the TFN POP locations have been identified – each with different advantages. While Ohio SchoolNet's recommendation is included in the following "Costs" section, a summary of the options is included as an appendix.

## Investment and Budget

There are four cost components associated with this project:

1. Purchase of the K-12 backbone lambda service on the TFN;

2. Operating funds for K-12's use of the TFN backbone (maintenance and operational support);

3. Purchase of last-mile connectivity from 30 K-12 backbone sites (23 DA-Sites and 7 urban sites) to the TFN POP locations; and

4. Network electronics located in the TFN POP locations and K-12 sites to connect K-12 sites to the TFN backbone.

### K-12 backbone lambda service

K-12 purchased the right to use the TFN backbone to access a dedicated channel, known as a lambda, on the network at the initial rate of OC-48 with the flexibility to increase future bandwidth capacity up to OC-192. OSNC/ODE jointly invested $1.4M in FY2003 to purchase a TFN lambda to serve K-12 schools. OARnet's pricing structure was based on a cost-recovery model designed to not generate a profit. OARnet's backbone cost model was based on a 20-year fiber lifecycle and 8 individual lambdas. Total construction costs, approximately $11.2M, included a 12.5% amortization for each lambda or $1.4M.

### K-12 TFN Maintenance & Operations

Annual operating costs include fiber maintenance, collocation fees, optical equipment maintenance, engineering and support staff and other operational costs. K-12's portion of the Maintenance & Operations fees are $.5M per year.

### K-12 Backbone Last-mile Connections

It is important to determine the most efficient method of connecting the 30 K-12 sites to the TFN backbone. Through the evaluation of existing and leased dark fiber connections, as well as traditional monthly services, viable alternatives have been determined for last-mile connections. Since there were no single vendor solutions for last-mile connectivity for all K-12 sites on a statewide basis, Ohio SchoolNet has established cost / services models across multiple vendors to provide a statewide solution.

Four different scenarios were considered within the multiple vendor models. The scenarios include the following terms and payment schedules: 1) 10- and 20-year minimum payment up front, 2) 10- and 20-year minimum recurring costs, 3) 10-year minimum payment up front, and 4) 10-year minimum recurring costs. To secure the most cost effective and equitable solution, it is recommended to proceed with a 10-year option for all sites with minimum recurring costs. This will allow for substantial savings over the current cost structure in FY06 and beyond. The following better illustrates the recommended funding summary:

**Summary By Year**

| | FY05 | FY06 | FY07 to FY14 | GRAND TOTAL |
|---|---|---|---|---|
| One-time* | $2,694,081 | $2,694,081 | | **$5,388,162** |
| Annual Recurring | $ 65,344 | $ 65,344 | $522,755 | **$653,443** |
| TOTAL COST | $2,759,425 | $2,759,425 | $522,755 | **$6,041,605** |

***NOTE: One-time costs are equally split over a two-year timeframe due to funding availability, but could be expended fully in year one if funding was available. Actual funding amounts per year may vary.**

## K-12 Network Electronics

The TFN design calls for the use of the most advanced optical technology electronics, Dense Wave Division Multiplexing (DWDM). DWDM technology is employed by most major carriers in the United States because of its scalable and highly efficient use of fiber optics. DWDM enables carriers to independently operate separate networks over a single pair of fiber optic cable by dividing the optical signal into distinct optical colors known as wavelengths (or lambdas). This eliminates or reduces the need to purchase / install costly multiple fibers.

The electronics built into the TFN (Cisco ONS15454) will enable the backbone to operate up to 32 distinct networks over a single pair of fiber, each capable of running at speeds up to 10 GB, equivalent to OC-192. Plans to expand this capability to handle 64 wavelengths are planned for release in 2005.

The TFN design also takes into consideration the state of change that currently faces most network engineers. The K-12 network currently operates on a transport protocol known as Asynchronous Transfer Mode (ATM); however, industry experts agree that the future of networking will be primarily based upon the deployment of an IP-based transport protocol. For this reason, we must ensure that any new deployment of backbone technology allows for an easy migration between the two platforms. The TFN design accounts for this migration in its initial deployment, and will easily allow for the integration of Gig-E connections in the backbone, while simultaneously supporting legacy ATM connections.

In addition to accommodating a migration from ATM to IP, the network design also allows for the localization of traffic among schools connected to the K-12 backbone site. Inter-school traffic, using common K-12 backbone sites, is routed within those schools rather than coming to Columbus to be routed. The new network design will allow multiple K-12 backbone sites on a common segment of the TFN backbone to be shared without forcing the traffic back to Columbus. This improved efficiency on the backbone is accomplished by routing and switching strategies and the physical network deployment. Even traffic between colleges and unversites and K-12 sites will be localized, further improving the efficiency of the network.

The estimated equipment costs, including engineering and installation, are $1.5M. Equipment maintenance fees for Year 1 – Year 5 are included in the purchase price; it is anticipated that maintenance fees for Year 6 – Year 10 will average between 10%-15% of the purchase price. Based on these estimates, maintenance costs will range between $140,000 and $210,000 annually for Year 6 – Year 10.

**Summary Total Costs in Millions (M)**

| | One-time | FY05/06 | FY07-FY14 | 10Year Total |
|---|---|---|---|---|
| K-12 Backbone Lambda Service | $ 1.40 | $ - | $ - | $ 1.40 |
| K-12 TFN Maintenance & Operations | $ - | $ 1.00 | $ 4.00 | $ 5.00 |
| K-12 Backbone Last-mile Connections | $ 5.39 | $ 0.13 | $ 0.52 | $ 6.04 |
| K-12 Network Electronics | $ 1.50 | $ - | $ 0.94 | $ 2.44 |
| Totals | $ 8.29 | $ 1.13 | $ 5.46 | $ 14.88 |

***network maintenance costs estimated at 12.5% per annum in years 6-10.**

## Project Investment

The Ohio SchoolNet Commission (OSNC), on behalf of the ONEnet Committee, requests $8.019M in funding from the Ohio Department of Education (ODE) from line item 200-426 in FY2005/FY2006 for the purpose of purchasing, installing d and lighting a dark fiber backbone network for K-12. The network will be used to provide voice, video, data and Internet bandwidth, and other services to Ohio's public and private chartered school districts in the State of Ohio.

The funding request for the project consists of the following components:

1. $5.519M in FY05/06 to complete last-mile connections from 30 backbone sites to the Third Frontier Network (TFN) points of presence or POPs. The 30 backbone sites include the 23 Data Acquisition Sites (DA-Sites) of the Ohio Education Computer Network (OECN) and the largest 7 urban school districts (as defined by ODE);

2. $1.5M in FY05 for network components located at TFN POPs and K-12 backbone locations to enable backbone connectivity to the network;

3. $0.5M in funding in FY05 and in FY06 for annual maintenance and operation of the K-12 portion of the TFN.

## Source of Funds for Investment

The primary source of funding for the ONEnet network is ODE's line item 200-426. Specifically, for Ohio Education Computer Network, "up to $18,592,763 in each fiscal year shall be used by the ODE to support connection of all public school buildings to the State's education network, to each other, and to the Internet" as directed by the General Assembly, 200-426, In addition, the ODE receives $3,412,500 per year to supplement the connection of chartered non-public schools to the network.

The General Assembly has been extremely generous in supporting educational technology for Ohio's students. Funding from 200-426 for the K-12 network provides for the following network components and services:

1. Public and non-public chartered school districts receive $3,000 per school building per annum to connect to the state K-12 network;

2. DS-3 backbone connectivity is provided to the 23 DA-Sites of the OECN and the 7 largest urban school districts. 27 sites receive $27,000 per annum for backbone connectivity and 3 sites receive $39,600 per annum for backbone connectivity for a total of $.864M per annum for backbone connectivity; and

3. 600 MB of Internet service (20 MB per K-12 backbone site) is purchased through the Department of Administrative Service's Internet service provider (ISP). The annual cost of Internet service is $1.14M.

The current level of funding in 200-426 is sufficient to provide for existing levels of ONEnet services as described in items 1-3 above. This will also provide additional funding resources to transition the K-12 network backbone from existing DS-3 service to the TFN. This is due to the decrease in the cost of the DS-3 service in FY04 from $2.16M per year to $.864M per year, and the decrease in the cost of ISP service in FY04 from $2.12M to $1.14M per year. In addition, it is anticipated that not all chartered non-public districts will participate in the K-12 network, resulting in additional funding that can be utilized toward this project. Current funding levels in 200-426 would be sufficient to achieve the DS-3 to TFN migration in FY05 and FY06 even assuming a 6% reduction from FY05 original appropriation levels.

**Network Planning Assessment**

The need for increased capacity is a constant in network planning and cannot be avoided. The original ONEnet capacity plan has provided for the needs of K-12 users for six years. As previously mentioned, the initial TFN design calls for a three fold increase in the amount of network capacity in the backbone, while allowing an easy migration to much higher capacities when necessary. There are numerous factors contributing to the need for increased capacity; the primary of which are outlined below.

1. Increased use of the Internet as a learning tool – The Internet requirements of the ONEnet network have increased 100% since its inception five years ago.

2. Increased use of videoconferencing across the network – recent reports indicate there were over 8,000 hours of programming per month traversing the ONEnet network. With the continued reduction in the costs of this equipment, and the introduction of video over IP into the network, it is safe to assume that we will see a dramatic increase in the use of this technology.

3. The introduction of new technologies into the network (including voice over IP) has the potential to demand a significant increase in network capacity needs. While this technology could have a significant impact on the network (in terms of capacity planning), it also comes with the potential of lowering total operating costs to the districts by reducing telecommunications expenditures. Therefore, it should not necessarily be discouraged.

4. Increased use of multimedia, and other centralized services – districts continue to introduce more multimedia applications into their curriculum planning; therefore, the network must be designed to handle this increased burden. With proper network design and capacity planning, significant reductions in the total cost of ownership can be realized through the implementation of centralized resources such as Internet caching, video storage, video streaming, and video bridging. A high-capacity, highly scalable network provides for the opportunity of centralized services and minimizes (or eliminates) the duplication of efforts and expenses at the district level.

**Collaborative Contributing Partners**

As other state and educational entities learn about the dark fiber initiative, there is a growing interest in becoming collaborative partners in this effort. As additional entities join the network, there is an opportunity for combined leveraging of additional state resources, which would subsidize or reduce the annual operating costs of TFN. These opportunities are fostered by existing partners in the K-12 and higher education networks.

For example, through the ONEnet project, Ohio SchoolNet and the ODE share a common infrastructure with DAS to support voice, video and data. DAS and Ohio SchoolNet leverage videoconferencing equipment owned by Ohio SchoolNet to provide video services to the K-12 community and state agencies. Similarly, K-12 purchases 600 megabits of Internet service through DAS's contract, which helps reduce ISP costs for other state agencies.

Expanded partnerships will also provide additional opportunities to reduce operating costs and enhance customer value (i.e. joint ISP purchases, network operations, videoconferencing, voice services, video distribution, content-filtering and network security would be stimulated by multiple TFN partners).

This type of network presents many exciting opportunities and sobering challenges. As a result, the following gives further perspective for both areas of consideration.

## Challenges

While there are numerous benefits for adopting fiber and associated applications, there are some important issues to consider as well. The project team examined several risks that may slow implementation or at least reduce the capabilities of the initial project rollout. There are three primary risks for the project:

1. Operating Budget Reductions

   Without funding resources from line item 200-426, there are not sufficient funding resources to complete the project. Other funding sources outside of 200-426 would be necessary to implement the project.

2. Time to Market

   As indicated above, some districts have expressed their dissatisfaction with current network performance and costs, and districts have indicated the potential for leaving the network. At the same time, many districts are increasing their connectivity to their respective DA-Site via fiber or other high speed options; this will heighten the demand being placed on the connection from the DA-Site to the state backbone. This moves the bottleneck from the local connectivity to state backbone connectivity and increases the dissatisfaction with the current network performance.

3. Equity Considerations

   While some districts are implementing fiber and other high-speed connections to the OECN, others do not have the local resources for similar opportunities.

## Benefits

A statewide fiber network would provide every school (offices, classrooms, labs, teacher / student workstations, etc.) with connectivity and consistent access to electronic resources and the Internet. The evolution towards this type of network provides for better performance and functionality with the lowest possible operational costs over time. Through a collaborative educational network, better overall network performance and troubleshooting can be achieved as well. The private network also would ensure student information, financial transactions, and other sensitive information is kept safe and secure. Overall, a fiber-based network would provide a flexible foundation upon which all types of new applications and services can be deployed quickly and easily.

The obvious benefit for participation in the Third Frontier Network is the preservation of the $130M investment already made to the ONEnet program. The TFN is merely an enhancement to the current ONEnet infrastructure, and the requested funding

amount in FY2005/2006 represents less than 10% of the overall investment to date. Aside from investment protection, the project also offers the capability of providing a wide range of new services directly supporting educational achievement, or indirectly supporting achievement by building additional capacities into the K-12 educational environment. Examples include the following:

1. Increased collaboration between higher education and K-12 institutions;

2. Enhanced distance learning opportunities for students in elementary, middle and high school classrooms;

3. Lower costs for schools and more than 70 K-12 content providers already connected to the K-12 network (museums, zoos, etc.) as they transition from higher cost ATM video conferencing equipment to IP videoconferencing equipment;

4. Increased online professional development opportunities for teachers and administrators. Student teachers would not be limited geographically to a local region of the state and could complete their internships remotely;

5. Increased security and protection of student identifiable information than in a network consisting of multiple disparate providers not coordinated and controlled by a state initiative;

6. Enhanced interoperability and opportunities for post-secondary enrollment;

7. Access by K-12 science teachers to higher education research (instrumentation) and computing facilities;

8. Use of the most cost effective and high-quality video and voiceconferencing equipment technology, resulting in reduced meeting costs for administrators and regional and state agencies that use the network to meet “virtually” instead of traveling across the state;

9. Reduced long-distance telephone costs as the state’s data network is enhanced to provide statewide voice services;

10. Provide an avenue for digital curriculum, video content, and video on demand services in real-time streams from within or outside the classroom walls (any where / any time access);

11. Ease of migration to new or enhanced services;

12. Reduced network support costs as there would only need to be the ability to manage voice, video and data integration in a single network (as opposed to separate or varied voice, video and data networks);

13. Increased economies of scale through higher education and K-12 purchasing cooperatives;

14. Reduced overall network costs through centralized (or regionalized) servers, software license management and IP telephony / VoIP migrations efforts; and

15. Better network planning and management aided through higher education telecommunications research.

A fiber network has several advantages over traditional communication methods. It not only has the ability to reach the high speeds of today's technology demands, but also has the ability to transmit voice, video and data simultaneously over the same equipment. Fiber implementation can lower the total cost of network ownership (TCO) by eliminating multiple sets of infrastructure, simplifying system administration and maintenance, and consolidating voice, video and data circuits. As these varying circuits evolve to meet the demands of the users, they grow significantly more complex and expensive because organizations must scale up multiple networks instead of one.

A converged network could then reduce equipment and maintenance costs. Over time, this would prove to be a cost saving solution that illustrates operational cost saving measures and ROI while also helping to consolidate equipment and staff. Direct benefits could also include multi-agency cost savings, increased employee productivity, and improved service offerings for staff, students and administrators.

It is important to recognize that the deployment of the TFN began when there was significant excess fiber capacity available statewide, resulting in a greatly reduced cost of entry to the state. As fiber availability decreases, the corresponding acquisitions costs will increase. We cannot project a better time in the future to acquire fiber connectivity for the K-12 and higher education communities.

The project team recognizes there are risks associated with this project; however, the rewards for Ohio's K-12 students, teachers and administrators outweigh the risks. TFN has the support of the Ohio colleges and universities, OBR, various public policy groups, the Governor's office and other important entities, indicating that the project is a highly visible, critical initiative that is needed to move the state and Ohio's K-12 students forward. In fact, OBR recently received a federal appropriation through the Ohio delegation to accelerate higher education's application of the TFN. Federal supporters of the TFN have high expectations for higher education and K-12 partnership in the TFN.

**Downside of not doing the project**

While the risks of taking action are always quickly identified, it is equally important to recognize the risks of *not* taking action. The following examples illustrate the risks to consider if K-12 does not participate in the TFN.

1. The State of Ohio will sacrifice control over its backbone; most immediately, the connecting institutions that comprise the backbone. Without the ability to increase bandwidth, reduce costs, and increase service levels and applications, K-12 risks the loss of school districts to other private providers. Moreover, they will continue to suffer drawbacks by not having a more dynamic environment, some of which include the inability to expand rapidly, the lack of traffic management and QoS, the inability to offer bandwidth-consuming native data services and recurring higher costs.

2. Previous investments in ONEnet will be wasted if enhancements are not made. The benefits of a standards-based network that have been gained through ONEnet will be lost due the independent status of districts leaving the network. This will result in decreased interoperability statewide and failure to realize the numerous opportunities and benefits associated with a more efficient, robust network.

3. One of the key aspects of the Governor's TFN Initiative is to encourage K-12 interaction with higher education and potentially state and local government. One of the key expectations of the TFN is to provide a robust infrastructure to support and encourage collaboration in terms of expertise, instruments and data. Without K-12 participation in the TFN, it will be difficult to meet this expectation.

4. As school districts leave the network, OIT/DAS will have reduced volume buying power for network services, potentially leading to higher costs for the rest of state government and potentially a higher economic burden on the state budget.

5. Today's environment makes it an excellent time to evaluate a K-12 optical network. There is an opportunity to ride the demand curve by moving away from an inflexible, costly model and implementing a fiber-based network that creates value for K-12 backbone sites. In doing so, Ohio SchoolNet can begin creating a position for future growth and value. A more efficient network infrastructure and converged service offerings enables ONEnet to remain a step ahead of alternative providers. If the opportunity is not leveraged, then the state will create opportunities for other providers to quickly differentiate themselves, potentially decreasing the number of districts participating in the K-12 network.

6. Ohio SchoolNet and many of the K-12 backbone sites are discovering the inability of higher speed circuits to meet today's bandwidth needs. This represents the lack of investment by the telecommunication companies in updating and expanding their infrastructure. That being said, the providers are catching up with the technology, as some have already unveiled (and in some instances executed) innovative strategies to provide competitive bandwidth services and pricing.

7. The state will lose its ability to deliver educational content into the classroom, moreover, school districts and regional service entities will not be able to share educational content and programming as easily as they have in the past.

Ohio schools can have a fully integrated voice, video, data and Internet network that would sufficiently handle the dynamics and processes incurred within many of their infrastructures. Furthermore, fiber optics can reduce costs and improve overall productivity. The decision to deploy fiber-based infrastructures and solutions is no longer a question of "if," but rather of "when."

**Government Support**

The Governor has announced the TFN as a key component of his Broadband Initiatives. The Governor continues to support the project through public and government meetings, including the creation of the Broadband Coordinating Council chaired by the Governor's Science and Technology Advisor, Frank Samuel.

**Project Timeline**

The following list summarizes events and dates (prior and forthcoming) associated with this project:

| | |
|---|---|
| OSNC and ODE commence discussions with OBR/OARnet | August 2002 |
| ONEnet Committee endorses K-12 participation in TFN | May 2003 |
| OSNC/ODE sign MOU with OBR/OARnet | May 2003 |
| OSNC/ODE make payment for TFN lambda | June 2003 |
| Last-mile RFP | January 2004 |
| Last-mile RFP analysis and negotiation | March 2004-present |
| Project Plan Approved | FY 2005 |
| 30 sites sign new MOU with OSNC | FY 2005 |
| 30 sites sign contracts with recommended providers | FY2005/2006 |
| Fiber implementation begins | FY2005 |
| K-12 TFN Migration Complete | July 1, 2006 |

**Actual completion dates subject to funding availability and timing.**

## Conclusion

The ONEnet Ohio program provides critical networking resources to the students, teachers and administrators of Ohio's schools. The past successes of ONEnet have created an environment where the delivery of educational resources through the use of technology has become commonplace, and relied upon.

As teachers continue to integrate technology into their curriculum, and continue to realize the benefits of collaboration, multimedia and Internet based tools, their demand for network resources will continue to increase. The ONEnet network has been successful in creating the demand for these services, and has now reached a point where a restructuring of this valuable resource is necessary and critical, to ensure that use of technology to improve student achievement continues.

Participation in the Third Frontier Network is a logical extension of ONEnet, and will provide Ohio with a cost effective, fiber-based, highly scalable infrastructure that enables increased collaboration and development of educational technology resources well into the future.

# Appendices

**A. Am. Sub. H.B. 95**

**B. Network Logical Architecture**

**C. Innovate PowerPoint**

## Appendix A

### Am. Sub. H.B. 95 – FY2004 & FY2005 State Budget

OHIO EDUCATIONAL COMPUTER NETWORK

The foregoing appropriation item 200-426, Ohio Educational Computer Network, shall be used by the Department of Education to maintain a system of information technology throughout Ohio and to provide technical assistance for such a system in support of the State Education Technology Plan pursuant to section 3301.07 of the Revised Code.

Of the foregoing appropriation item 200-426, Ohio Educational Computer Network, up to $18,592,763 in each fiscal year shall be used by the Department of Education to support connection of all public school buildings to the state's education network, to each other, and to the Internet. In each fiscal year the Department of Education shall use these funds to assist data acquisition sites or school districts with the operational costs associated with this connectivity. The Department of Education shall develop a formula and guidelines for the distribution of these funds to the data acquisition sites or individual school districts. As used in this section, "public school building" means a school building of any city, local, exempted village, or joint vocational school district, or any community school established under Chapter 3314. of the Revised Code, or any educational service center building used for instructional purposes, or the Ohio School for the Deaf and the Ohio School for the Blind, or high schools chartered by the Ohio Department of Youth Services and high schools operated by Ohio Department of Rehabilitation and Corrections' Ohio Central School System.

Of the foregoing appropriation item 200-426, Ohio Educational Computer Network, up to $1,884,355 in each fiscal year shall be used for the Union Catalog and InfOhio Network.

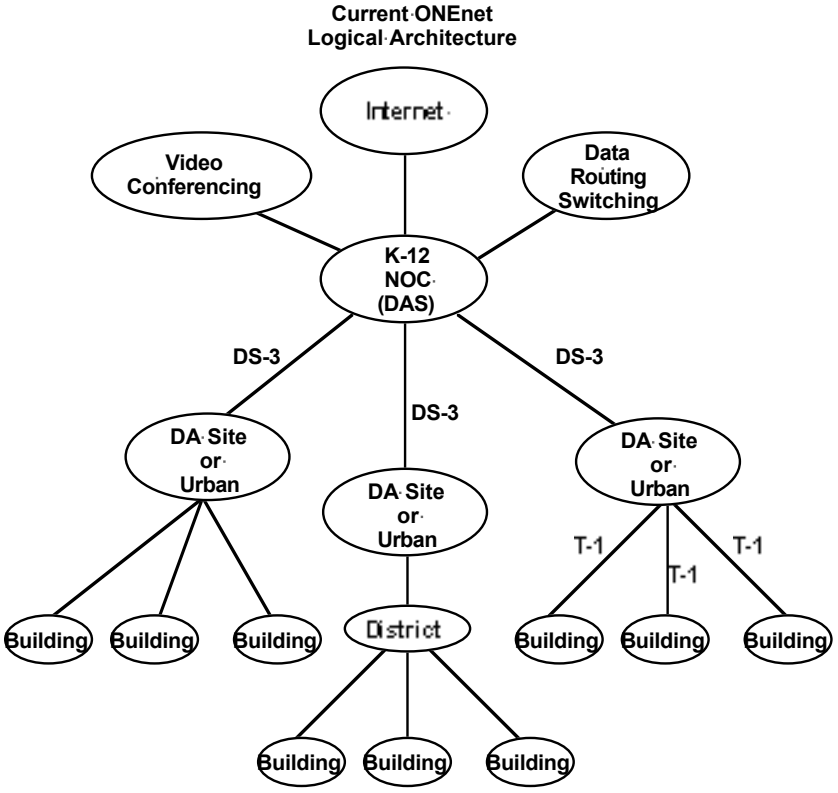
The Department of Education shall use up to $3,412,500 in each fiscal year to assist designated data acquisition sites with operational costs associated with the increased use of the state's education network by chartered nonpublic schools. The Department of Education shall use the same per building amount as used to provide connectivity subsidy funds to public school buildings.

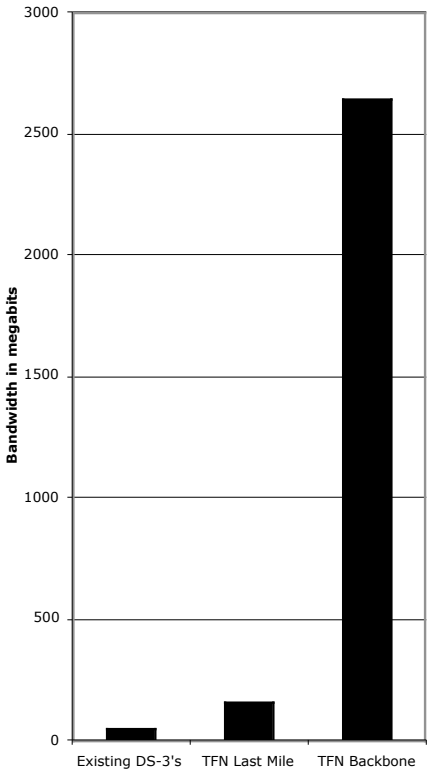
The remainder of appropriation item 200-426, Ohio Educational Computer Network, shall be used to support development, maintenance, and operation of a network of uniform and compatible computer-based information and instructional systems. The technical assistance shall include, but not be restricted to, development and maintenance of adequate computer software systems to support network activities. Program funds may be used, through a formula and guidelines devised by the department, to subsidize the activities of designated data

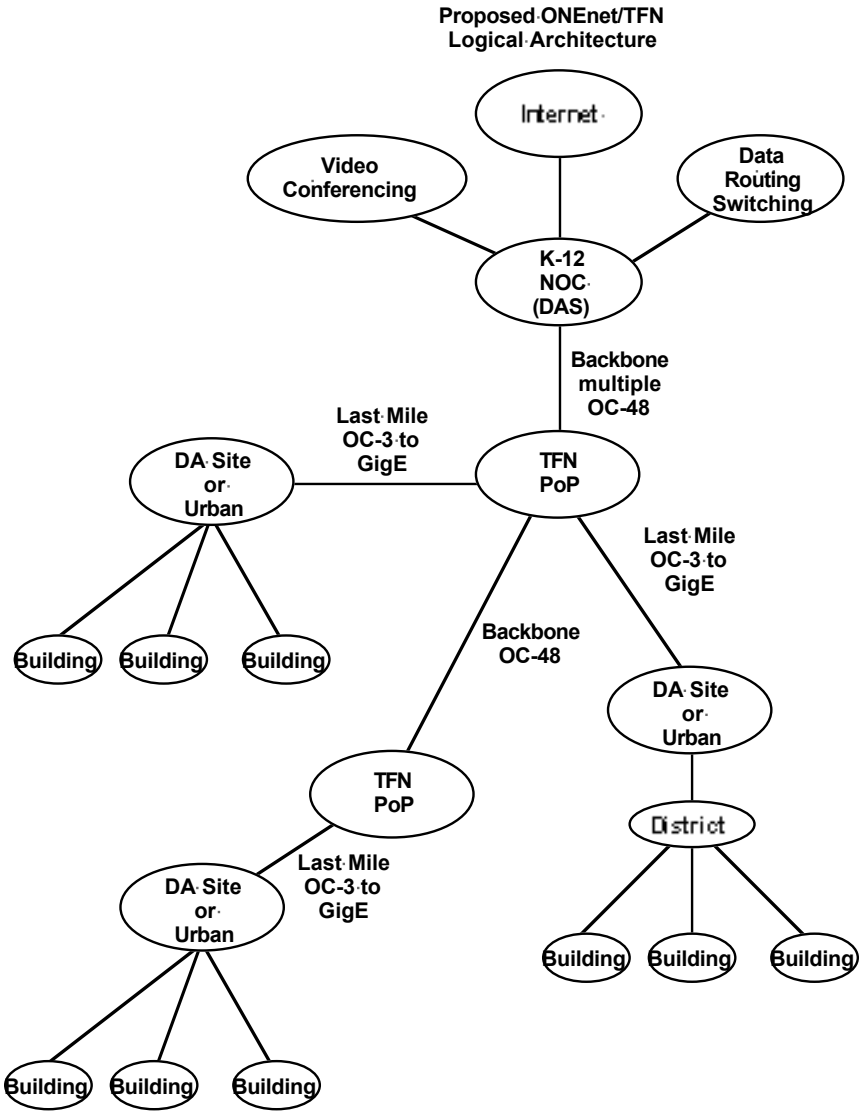
acquisition sites, as defined by State Board of Education rules, to provide school districts and chartered nonpublic schools with computer-based student and teacher instructional and administrative information services, including approved computerized financial accounting, and to ensure the effective operation of local automated administrative and instructional systems. To broaden the scope of the use of technology for education, the Department may use up to $223,762 in each fiscal year to coordinate the activities of the computer network with other agencies funded by the department or the state.

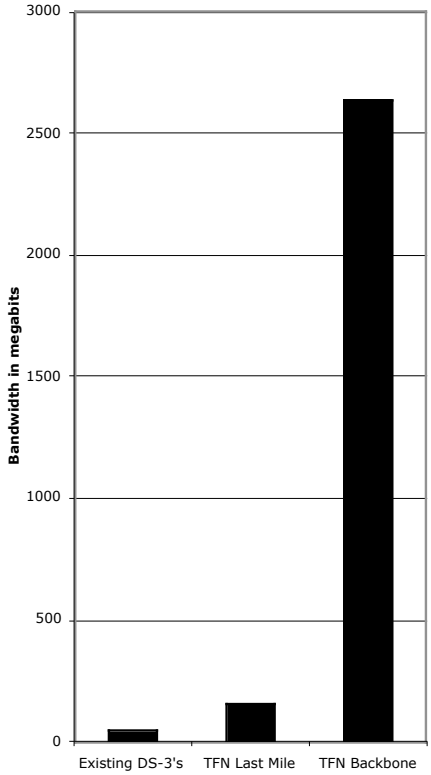
In order to improve the efficiency of network activities, the department and data acquisition sites may jointly purchase equipment, materials, and services from funds provided under this appropriation for use by the network and, when considered practical by the department, may utilize the services of appropriate state purchasing agencies.

## Appendix B – Network Logical Architecture




Proposed ONEnet/TFN
Logical Architecture
Internet
Video Conferencing
Data Routing Switching
K-12 NOC (DAS)
Backbone multiple OC-48
Last Mile OC-3 to GigE
DA Site or Urban
TFN PoP
Last Mile OC-3 to GigE
Backbone OC-48
Building
Building
Building
DA Site or Urban
TFN PoP
District
Last Mile OC-3 to GigE
DA Site or Urban
Building
Building
Building
Building
Building
Building


3000
2500
2000
1500
1000
500
0
Bandwidth in megabits
Existing DS-3's
TFN Last Mile
TFN Backbone

Ohio SchoolNet

Schools on the move

# Ohio SchoolNet Commission Third Frontier Network Proposals Evaluation

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# Agenda

- Project Scope
- Methodology
- Analysis
- Scenarios
- Next Steps

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# Project Scope

- Assist in determining the most efficient method of connecting the thirty (30) K-12 sites to the Third Frontier Network (TFN) backbone.
- Evaluate existing fiber, leased dark fiber, and traditional monthly services to determine viable alternatives.
- Develop comprehensive recommendations to assist current and future network and technology infrastructure development.
- Help determine solutions that improve overall performance and decrease operating costs.

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# Methodology

- Discussion with Ohio SchoolNet staff on services, redundancy, building locations, and overall strategic approach.
- Initial review of thirteen bids that were received.
- Develop an issues list of questions, clarifications and confirmations needed by bidder after a thorough review of all RFP information.
- Develop a spreadsheet that details the bids received by location with bandwidth, upfront cost, recurring costs, term, total costs, and average monthly costs.

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# Methodology

- Determine preliminary total project costs by analyzing each site's best case and most feasible cost on a TCO basis for ten and/or twenty years.
- Submit questions and RFP response clarifications in writing from all bidders.
- Verify bidder's proposed POP location against preferred location and network equipment design.
- Utilize updated information from bidders to revise the spreadsheet and determine preliminary award recommendations.

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# Methodology

- Interview the seven (7) bidders that provide the most viable alternatives for consideration.
- Review financial information on all bidders to determine long-term viability.
- Review advantages and disadvantages of the different award scenarios.
- Determine final award recommendations based on analysis of all information.
- Review award recommendations with SchoolNet staff for concurrence.

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# Analysis

- We analyzed various alternatives for minimizing the number of providers such as:
  - Dark Fiber build out to all thirty locations with one provider (Fibertech) would cost $17 million plus $1.4 million in annual recurring cost for 20 years
  - Leased Bandwidth (OC3) to all thirty locations with one provider (Time Warner) would cost $106,250 per month or $13 million over 10 years
- Since these were not cost effective alternatives we looked at the best scenarios with multiple providers being awarded

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# Analysis

- We eliminated several bidders (IBM, M& D Cable, Time Warner Telecom, and XO Communications) from further consideration after bid clarifications were received based on lower cost options being available.
- We also received and analyzed up front payment options to determine how we could minimize annual payments.
- This resulted in 4 different scenarios for consideration – 10 & 20 Year minimal up front, 10 & 20 Year minimal recurring, 10 Year minimal up front, and 10 Year minimal recurring

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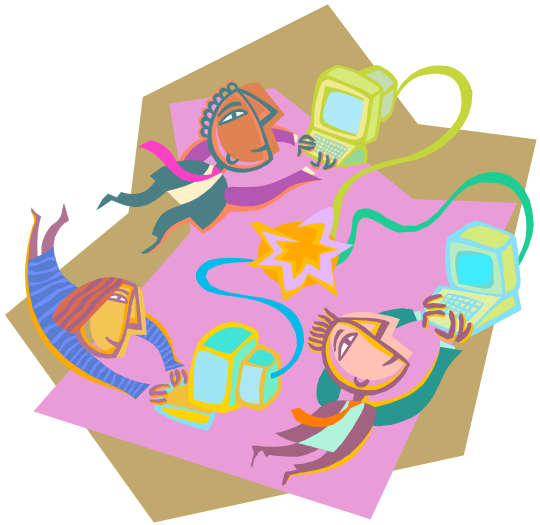
# Scenarios

1. **Minimal Up Front – Mixed Term of Contract**
2. **Minimal Recurring – Mixed Term of Contract**
3. **Minimal Up Front – All sites on 10 Year Term**
4. **Minimal Recurring – All sites on 10 Year Term**



# Scenario 1

- 4 sites on 10 year managed fiber solution, 6 sites on 10 year traditional monthly services, 2 sites on 20 year managed fiber solution, 18 sites on 20 year dark fiber solution
- Total Cost of Ownership over 20/10 years is $7,517,646; $2,511,765 up front and $5,005,881 in recurring costs

Pros

- Lower capital cost
- Lower recurring cost than current fees
- Good TCO on site by site basis
- ROI in 4 to 4.5 years
- Flexibility to upgrade with dark fiber sites; provider independent

Cons

- Mixed length of contract
- Legal fees to structure relationship with some providers
- For 12 sites, upgrade available but at unknown cost; provider dependent

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# Scenario 2

- 4 sites on 10 year managed fiber solution, 6 sites on 10 year traditional monthly services, 2 sites on 20 year managed fiber solution, 18 sites on 20 year dark fiber solution
- Total Cost of Ownership over 20/10 years is $6,404,550; $5,414,086 up front and $990,464 in recurring costs

Pros

- Lower recurring cost than current
- Best TCO on site by site basis
- ROI in 3.5 to 4 years
- Flexibility to upgrade with dark fiber sites; provider independent

Cons

- Higher capital cost
- Mixed length of contract
- Legal fees to structure relationship with some providers
- Financial risk based on large upfront payments
- For 12 sites, upgrade available but at unknown cost; provider dependent

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# Scenario 3

- 17 sites on 10 year dark fiber solution, 8 sites on 10 year traditional monthly services, 5 sites on 10 year managed fiber solution
- Total Cost of Ownership over 10 years is $7,512,258; $1,371,544 up front and $6,140,714 in recurring costs

## Pros

- Lowest capital cost
- Lower recurring cost than current fees
- ROI in 4 to 4.5 years
- All sites on 10 year contract term

## Cons

- Uncertainty for all sites after initial contract term
- For 13 sites, upgrade available but at unknown cost; provider dependent

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# Scenario 4

- 17 sites on 10 year dark fiber solution, 8 sites on 10 year traditional monthly services, 5 sites on 10 year managed fiber solution
- Total Cost of Ownership over 10 years is $6,041,605; $5,388,162 up front and $653,443 in recurring costs

## Pros

- Lowest recurring cost
- Good TCO on site by site basis
- ROI in 3.5 to 4 years
- All sites on 10 year contract term

## Cons

- Higher capital cost
- Financial risk based on large up front payment
- Uncertainty for all sites after initial contract term
- For 13 sites, upgrade available but at unknown cost; provider dependent

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# Summary – By Provider

| | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 |
|---|---|---|---|---|
| Vendor A | 1,072,772 | 1,072,772 | 326,940 | 326,940 |
| Vendor B | 825,145 | 750,716 | 463,227 | 397,642 |
| Vendor C | 377,882 | 377,882 | 474,212 | 345,912 |
| Vendor D | 285,650 | 280,264 | 220,190 | 217,017 |
| Vendor E | 331,002 | 251,740 | 595,397 | 536,701 |
| Vendor F | 79,500 | 79,500 | 37,908 | 37,908 |
| Vendor G | 1,032,000 | 1,032,000 | 925,200 | 925,200 |
| Vendor H | 3,513,696 | 2,559,676 | 4,469,184 | 3,254,285 |
| Total Cost | $7,517,646 | $6,404,550 | $7,512,258 | $6,041,605 |

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# Summary – By Cost

| | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 |
|---|---|---|---|---|
| Upfront | 2,511,765 | 5,414,086 | 1,371,544 | 5,388,162 |
| Total Recurring | 5,005,881 | 990,464 | 6,140,714 | 653,443 |
| Total Cost | $7,517,646 | $6,404,550 | $7,512,258 | $6,041,605 |

## Annual Recurring Cost (ARC) Comparison

| | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 |
|---|---|---|---|---|
| ARC (1-10) | 472,442 | 95,986 | 614,071 | 65,344 |
| ARC (11-20) | 28,147 | 3,060 | 0 | 0 |

# Summary – By Price Range

| | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 |
|---|---|---|---|---|
| < $160K | 16 | 18 | 17 | 17 |
| $160K - $260K | 5 | 5 | 1 | 3 |
| $261K - $500K | 4 | 4 | 8 | 7 |
| > $500K | 5 | 3 | 4 | 3 |

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# Next Steps

If approved, SchoolNet should manage the implementation process carefully since this will be a major, long-term (10 to 20 year) investment.

**There should be clear accountabilities and directives that can be measured against actual results.**

# Next Steps

- Finalize information from all providers
- Communicate updated information to all thirty K-12 sites
- Compile final report and documentation
- Secure project funding
- Negotiate best and most favorable contract terms

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