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Arkansas K-12 Broadband and Infrastructure Report

Prepared for the AR Bureau of Legislative Research

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INTRODUCTION

STUDY SCOPE

This study was commissioned by the Arkansas Bureau of Legislative Research (BLR) to collect data on the broadband and networking capabilities of every K-12 public school in the state of Arkansas, including public charter schools (collectively "K12 schools"). This study was also commissioned to assess the readiness of the K12 schools for Act 1280 to facilitate digital learning through access to online classes and learning materials. The assessment portion of this study is based on the data collection portion of this study.

The BLR requested a "boots-on-the-ground" approach to the data collection portion of the study, sending personnel to each of the K12 schools to gather detailed information on the broadband and network capabilities in four primary areas:

1. K-12 Broadband Connectivity
2. District Infrastructure
3. ARE-ON Connectivity
4. District and IT Support Personnel

STUDY DRIVERS

There are 8 key drivers behind this study:

1. School/District/Co-op infrastructure to support Internet access
2. Current access capacity
3. Longevity of current access technology
4. Scalability of current access
5. Availability of broadband
6. Costs associated with current infrastructure
7. Projected broadband infrastructure costs
8. E-Rate support

ACT 1280

One of the overall goals of our study is to assess the current and future compliance with Act 1280 of 2013 entitled, "AN ACT TO PROVIDE DIGITAL LEARNING OPPORTUNITIES IN PUBLIC SCHOOLS; AND FOR OTHER PURPOSES". Section 6-16-1404 – 4 of the Act specifies that, "A quality digital learning environment shall be composed of… 4) Infrastructure that is sufficient to handle and facilitate a quality digital learning environment."

SETDA RECOMMENDATIONS

Act 1280 of 2013 only specifies a need for "sufficient" infrastructure; it does not provide quantitative criteria that must be met for infrastructure to qualify as sufficient. In the absence of

quantitative criteria, we utilized the recommendations of the State Educational Technology Directors Association (SETDA) in their 2013 report entitled “The Broadband Imperative” (http://www.setda.org/wp-content/uploads/2013/09/The_Broadband_Imperative.pdf). In it, they recommend 100kb/s per student in aggregate for 2014 increasing to 1Mb/s per student in aggregate for 2018.

Our Process

The 4 components of our study:

- **Discovery:** Identify and document “what we have and what it costs”
- **Assessment:** Assess compliance with Act 1280 through the 2018-2019 school year, and identify gaps and estimate additional costs for compliance
- **Design:** Produce efficient network design that addresses the gaps at each non-compliant school/district, as well as overall performance and scaling costs to ensure long-term compliance. We will also assess any network functionality synergies that may present opportunities for network functions consolidation and cost reduction
- **Report:** Provide final report including recommendations to the BLR

Summary of Study Data Sources & Personnel

CT&T utilized a large number of data sources and personnel to complete this study commissioned by the Bureau of Legislative Research (BLR). CT&T personnel included telecom and network engineers, designers, and consultants. CT&T also utilized E-Rate consultants, site survey contactors and additional telecom network engineering resources to complete the school site surveys, compile and review the data, prepare designs, and complete the report in a short time frame.

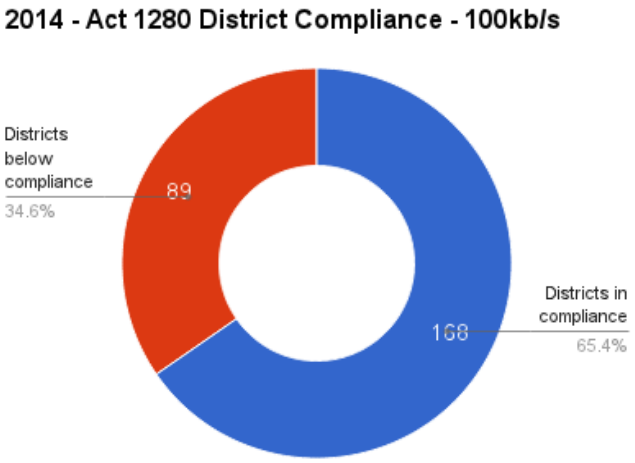
As requested by the BLR, CT&T utilized data from as many sources as possible, and verified the accuracy of the data where possible. The sources of the data include the Department of Education (ADE), the Department of Information Services (DIS), FCC & USAC E-Rate filing data, information from the Service Providers within the state for both existing and proposed services, ARE-ON, Education Superhighway including data previously gathered from school districts, Co-Op Technology Coordinators, several District Technology Coordinators, and boots on the ground surveys at the schools.

Connectivity for a large number of entities, such as the K-12 schools, is a continually moving target, where additional fiber facilities are being built, networks are being reconfigured, and plans are being made for future services and E-Rate filings. The comprehensive data collection has enabled CT&T to verify connectivity data for many of the schools in the state and to identify where there are gaps, inefficiencies, and how tax dollars at all levels can be efficiently utilized to provide the needed connectivity for the K12 schools in the state of Arkansas.

Summary of Findings

CT&T evaluated the readiness of the K12 school districts across the state of Arkansas, and found the following:

1280 Compliance



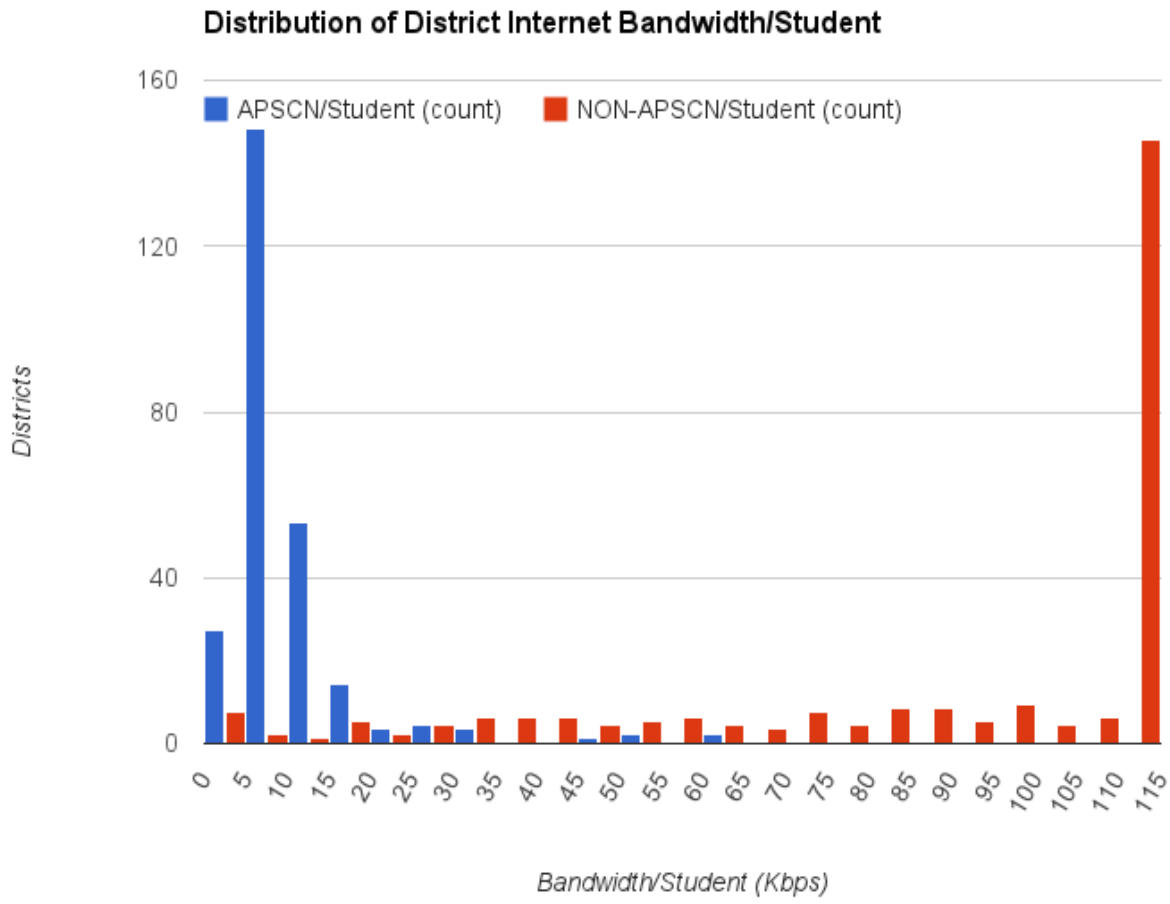
We find that 65% of public school districts and public charter schools in Arkansas meet the recommended guideline for Act 1280 compliance of 100Kb/s per student. Of the compliant school districts, there are a total of 8 that meet the 2018 recommendation of 1Mb/s per student.

Of the 89 school districts that do not meet the minimum recommended guideline, there are 5 districts that we feel are the least prepared and should be the priority for upgrading current Internet access speeds. The following table lists the Act 1280 compliance readiness of the top and bottom 5 districts.

Least Prepared Districts	Avg. Kb/s per student	Most Prepared Districts	Avg. Kb/s per student
White Hall SD	14	AR. School for the Deaf	830
Glen Rose SD	14	Exalt Academy of SW Little Rock	911
Star City SD	19	Haas Hall Academy	944
Earle SD	19	AR. School for the Blind	1,368
Searcy SD	22	Great River Ed. Svc. Co-Op districts	1,524

DEPARTMENT OF INFORMATION SERVICES

APSCN NETWORK



The data indicates that APSCN Connectivity is inadequate, above market rate, and major portions of costs are not currently E-Rate eligible. Considering the disparity in cost vs. capacity of the APSCN connections when compared to direct Internet connections, over 96% of school districts have chosen to procure additional bandwidth directly from Internet service providers.

We find 2 primary factors contributing to the cost disparity between direct Internet connections and APSCN connections:

1. ADE currently covers the $11.3M annual district expense for APSCN connectivity before E-rate reimbursement, which provides a 5Kb/s per student capacity. 5Kb/s is the capacity DIS has determined can be provided for the current budgeted cost of APSCN when factoring in the bid costs of the school, backbone, and Internet services with tax

and a 13.8% DIS markup plus DIS support costs.

2. DIS orders the majority of their connections via legacy network components which carry very high rate tariffs compared to ordering market price based non-regulated connections.

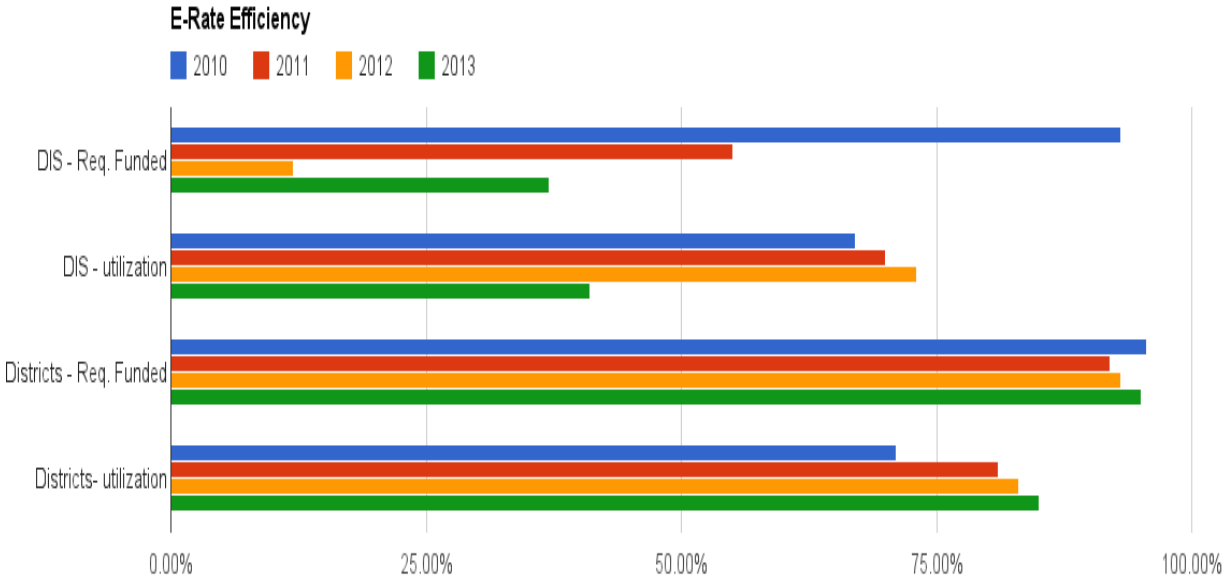
We also find no evidence of internal Service Level commitments to ADE by DIS in regards to:

- The availability of the network or datacenter platforms
- The overall quality of the connection to APSCN
- The mean-time to repair a service outage
- Response times of ADE personnel

DIS E-Rate Program Management

We find the DIS E-rate program to be ineffective at gaining appropriate E-rate funding and resolving issues that arise during the application process. On a statewide level, it should be expected that E-rate will fund/reimburse 80% of eligible infrastructure costs. Currently there are approximately $8.9M in E-rate reimbursement applications on hold pending further review by the FCC. The majority of DIS E-rate applications have been placed in this status beginning in FY2012.

The following chart shows the E-rate efficiency of DIS versus that of the school districts from 2011 – 2014:



While the APSCN network is intended to support access to the Internet and central applications, we have found that 35% of the traffic on the network backbone actually belongs to state agencies not affiliated with the education system in Arkansas. This type of utilization of

infrastructure is allowed by E-rate, but funding is limited to the portion of costs generated by the K12 schools.

We have found that ADE is being billed by DIS for 65% of the APSCN backbone transport capacity direct vendor cost, along with additional overhead charges of 14% for cost recovery, and 21% for maintenance network personnel payroll. When the allocation of direct backbone network costs are combined with DIS overhead charges, the amount billed to ADE and submitted for E-rate reimbursement by DIS is equivalent to the total cost of the APSCN backbone and transport connectivity.

Under the current rules of the E-rate program, the FCC may audit all E-rate filings for the past 5 years. If a funded application is found to be inaccurate or not in compliance with E-rate regulations, the FCC may request a refund of the funding previously provided for the service.

ARE-ON CONNECTIVITY

A number of models are available to interconnect state school districts with the ARE-ON network. We have provided 2 connectivity options that we feel are the most efficient methods for direct interconnection

Option 1 - provides ADE with the ability to own and manage major components of the transport network to include the fiber connections between the districts and ARE-ON, while leveraging the optical transport platforms of ARE-ON. We have presented 2 ways that option 1 can be achieved, either by new construction, or long term leases of dark fiber (1a).

Option 2 - provides ADE with a turnkey solution for a private backbone, by fully leveraging the platforms currently in place at ARE-ON. This solution in effect replaces the current APSCN backbone with the ARE-ON backbone.

The following table identifies the capital and expenses summary for each option.

	Annual Expense	**Capital**
Option 1 (new construction)	$2,830,250	$227,579,597
Option 1A (10 Year Fiber IRU)	$3,190,250	$109,925,000
Option 2 (ARE-ON turnkey backbone)	$6,282,896	$1,393,410

District IT Personnel

CT&T found a significant amount of experience among the IT staff that was interviewed for this survey. While there are districts with a small IT staff, there was a wealth of knowledge at the local level across the state. The IT staffs typically coordinate with neighboring districts in their region or Co-op to manage needs and planning. The technology coordinators in the regional Co-ops meet online weekly and in-person on a monthly basis to address technology challenges around the state with technology access, software application deployments and requirements.

We find that the vast majority of district IT staff are dedicated to their roles in their respective organizations and leverage the statewide knowledge base of peers. 70% of the IT leadership in the 257 districts and 15 Co-Ops has over 11 years of IT experience, with 60% possessing a 4 year degree. In addition to formal education, many IT directors participate in vendor led specialty training and industry recognized certification programs to remain current on all available technologies and their application in the educational enterprise.

In contrast, we observed an overall lack of technical guidance and standardization from the centralized technology functions at ADE and DIS. We received regular feedback throughout our discovery process that greater communication and planning needs to take place between ADE, DIS, and the technical leadership in the schools. The entire IT support environment must function cohesively, with the same goals and standards, before the state can be positioned to capitalize on any financial benefits gained through a more efficient networking model.

RECOMMENDATIONS

SHORT-TERM (0 – 12 MONTHS)

Our short-term recommendations are focused on the most expedient means to achieve the 2014 compliance target of 100Kb/s per student. We see the next 12 months as a period to achieve 100% compliance with Act 1280, while positioning for the next phase of network growth and architecture.

SCHOOL DISTRICT CONNECTIVITY AND ACT 1280 COMPLIANCE:

Establish adequate Internet access connectivity to the remaining 86 schools that do not meet the targets for 1280 compliance. The most efficient means to achieving this goal is appoint a technical project coordinator at the state level to ensure goals are met in the 2015-16 school year. A statewide contract can be an effective tool to achieve the lowest per unit cost for the additional capacities, but will require multiple service providers to achieve the goal. In addition to procuring additional bandwidth, we recommend taking immediate action to cancel the redundant APSCN connections to the districts.

We show the following cost savings if Internet access to non-compliant districts is increased, and redundant APSCN connectivity is cancelled:

	Pre-Discount	Effective Dollars
Annual APSCN saving	$11.9M	$10.6M
Annual projected Internet access costs (100kb/s): $10.4M	$10.4M	
Projected E-rate discount	-$8.32M	
Annual total after E-rate	$2.08M	$2.08M
	Projected annual savings:	$8.52M

A statewide RFP should be conducted to procure the additional capacities required by the districts for compliance. We do not recommend issuing an RFP for aggregation networks or backbone capacities prior to addressing district Internet access needs. It is our opinion that too many open questions remain around performance requirements, standardization of services, and capacity planning to establish clear requirements with service providers who would participate in the RFP process.

The majority of service providers indicated they are open to proposing a model where the schools could procure broadband connectivity to their network and only be charged for network transport capacity. The providers would then aggregate the amount of combined Internet access and provide a volume discount and incur a separate consolidated charge for the aggregated

Internet usage of all connected districts.

We recommend that DIS complete the upgrade of the Financial Management System in order to reduce the dependency on a private APSCN connection. DIS should also establish lightweight VPN access such as SSL or site-to-site IPSEC VPNs.

E-rate Reimbursements

We recommend immediate intervention in the DIS E-rate program. Over the last 60 days, ADE has outsourced go forward E-rate planning to Funds for Learning and hired a state E-rate coordinator to manage the program going forward. DIS remains responsible for the 3 years of reimbursements that are on hold with the FCC.

Our efforts to contact the Schools and Libraries division of the FCC were met with instructions for someone to be appointed by the state to act as the point of contact regarding the $8.9M of reimbursements that are currently on hold.

Technical governance

We recommend the establishment of defined roles for each member of the IT support environment from ADE technical staff to district IT leads. The establishment of an official "organizational structure" will be critical in the efficient evolution of the K-12 networks. In addition to a defined operational structure, a structure for program governance should be put into place that involves leadership from a cross-section of interested stakeholders (i.e. ADE, state legislature, and districts/co-ops. At a minimum, the governance model needs to address:

1. Coordination between State & District/Local Level
2. Ongoing review & oversight of K12 technology needs & approaches
3. Suggested technical responsibilities
4. Simplify access to state resources
5. Emphasis on enabling teachers to teach and students to learn

Long –Term (12-36 months)

Our long-term recommendations are focused on the most flexible and cost-effective method to scale bandwidth capacity to meet future demand at the school districts.

Direct Internet Access

It is our recommendation that the state network operates for 2015-2016 school year utilizing the direct Internet access model prior to considering backbone options. This will allow time to transition all schools from the APSCN network and gain insight to traffic utilization of the districts in an unconstrained environment.

While operating with a direct Internet access model, evaluate the need for a backbone with aggregation over the next several years. By exploring options available from the service

providers to decouple transport from Internet access and share in volume discounting for Internet access, the districts may experience the cost benefits of a regional aggregation model, without any of the network management demands brought about with operating in a regional aggregation model.

We recommend that 2 indicators be used when considering the need for a backbone architecture:

1. Cost savings through aggregation.
2. Application requirements for quality and security.

If one of these indicators moves toward the backbone model, they CT&T would recommend pursing a backbone architecture.

Bidding and Procurement

For all bids, including direct Internet access or an aggregation model, implement a bidding architecture that will facilitate the best provider response. The following are tiering and bidding recommendations:

1. Request not less than 100Mb/s minimum/district or demarc
    a. In most cases, this will drive fiber construction where it does not exist.
    b. Service providers are more likely to waive construction fees at that pricing level.
2. Implement standard bucket sizes that match service provider pricing strategies
3. Bid access on a per-site basis, rather than regions.
4. Allow Providers to win the business for areas that are able and willing to serve
5. Don't force multi-provider agreements in last-mile school connectivity
6. Address any remaining schools on a case-by-case basis.

BACKGROUND AND ASSESSMENTS

APSCN AND BROADBAND HISTORY FOR THE K12 SCHOOLS

HISTORY OF THE APSCN NETWORK

The Arkansas Public School Computer Network (APSCN) was created by state statute for the K12 schools. According to the APSCN website, it was "established in September 1992 for the purpose of implementing a statewide computer system linking all Arkansas public school systems and the Arkansas Department of Education (ADE) as required by Act 4 of 1992." The website further states the mission of the APSCN network is to: "provide all Arkansas public school systems electronic access to administrative computing services that provide state and local decision makers accurate, timely and comprehensive information".

Under Act 4 of 1992, the original network was to be constructed under a contract with IMPAC Learning Systems, Inc. using funds provided by a loan from the Arkansas Teacher Retirement System. The State Board of Education was designated with the oversight authority of the construction and operation of the network. In addition, a "Public School System Computer Network Advisory Council" was created to provide assistance and coordination among the groups connected with the network. The advisory council was to consist of citizens and users of the system appointed by the Director of the Department of Education.

According to an APSCN audit report completed December 22, 2000, financial software from two companies was evaluated in 1994, and DOS-based software from Pentamation was selected for financial and student information management and implemented starting with a pilot program at four school districts in the 1994-95 school year. In the four years following, school districts were incrementally added to the system with the exception of Little Rock, North Little Rock, and Texarkana school districts, which were not using the system at the time of the audit.

In 1998, APSCN became a division of ADE, and the Arkansas Department of Information Systems (DIS) began providing Local Area Network (LAN) support to APSCN. According to the APSCN LAN Support website, APSCN LAN Support was initially a function of the Arkansas Public School Computer Network. Together with the Arkansas Department of Education (ADE), DIS has increased the level of technical support services directly available to Arkansas Public Schools.

APSCN LAN Support is provided by nine field technicians located across the state with four lead technicians located in Little Rock providing phone support to all Arkansas public school entities each day. The APSCN Support Group provides all facets of LAN support to the school districts at the request of the district Technology Coordinator or System Administrator. APSCN LAN Support encompasses more than APSCN connectivity and is a separate budget line item.

The December 22, 2000 audit and subsequent update to the audit completed on June 8, 2001 discuss various problems and solutions identified at the time of the audit including support

issues, system upgrades, system slowness and a migration from telephone lines to T1 lines. The software systems at the time were divided into three operating divisions: FMS (Financial Management System), SMS (Student Management System), and SIS (Statewide Information System). In addition, hardware support was also provided for LAN (Local Area Network) and UNIX (Server support).

The Internet was initially added to the APSCN network at a rate of 2.9kb/s per student. The network was migrated to an ATM-based, frame-relay network, which was the core network for many years. In 2010, a Next Generation Network (NGN) initiative was begun to upgrade the capacity to 5kb/s per student and to migrate to Ethernet & IP with an MPLS backbone. Bidding was completed on contracts for the NGN network for the 2011-2016 timeframe.

Today, all of the school districts are connected to APSCN and utilize its systems with the exception of Little Rock School District (LRSD) which maintains its own financial and student management systems. LRSD has an arrangement to transfer state reporting information to ADE/DIS and accesses remaining applications via the Internet from DIS.

INTERNET CONNECTIVITY TO K12 SCHOOL DISTRICTS

EXISTING K12 CONNECTIVITY

Broadband Internet connectivity for the K12 schools is currently provided through a mix of ADE/E-Rate-funded APSCN and direct District/E-Rate-funded broadband connections. For APSCN broadband connections, the school districts have no control over which ISP is used. However, for direct broadband connections, the District chooses the ISP and files for E-Rate funding directly.

It is the responsibility of APSCN to ensure that all K12 schools have broadband connectivity, but it is generally up to the district to implement network connectivity between their schools (i.e. a district “MAN”). In most school districts with MANs connecting their schools, only some of the schools have broadband connections. Schools without a direct broadband connection access the Internet over the MAN to another school that does have it. The topology of these MANs is typically “hub-and-spoke” with the school with the broadband connection at the “hub” and the other schools are “spokes.”

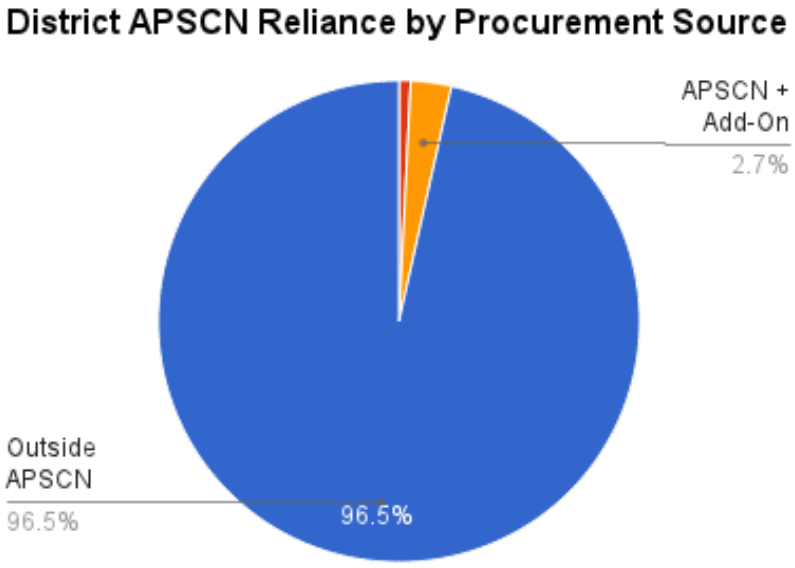
In school districts where there is no network connectivity between the schools, each school must have its own broadband connection. This means APSCN connects to multiple schools within those districts, which might also have direct broadband connections. These broadband connections may also facilitate communications between the schools within the district, allowing the school district to operate with a virtual MAN. Due to these added broadband connections, APSCN has 559 Demarcation points for 257 districts, averaging a little over two connections per district.

Funding Mix

The existing broadband connectivity at the district level falls into three funding & delivery categories:

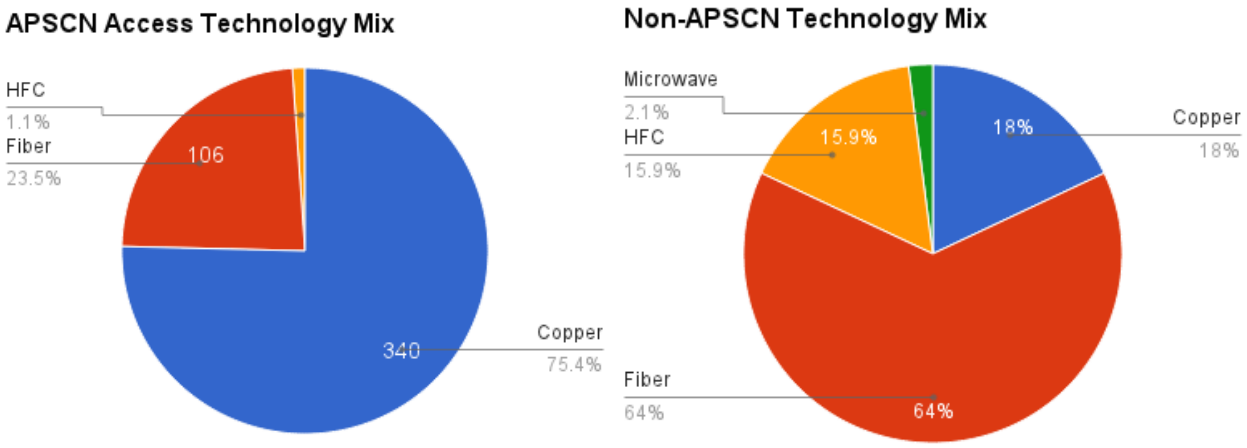
1. APSCN Provided Only
    a. Subsidized by E-Rate, Managed by DIS
    b. ADE covers the remaining amount.
2. APSCN with District Purchasing additional Internet Bandwidth from DIS
    a. Cost-Addition or Cost-Sharing Arrangement provided by DIS
    b. ADE covers the portion they would have purchased through DIS
    c. School covers the remaining amount of the capacity they desire.
3. Direct Internet Connection Outside APSCN to supplement provided connection
    a. Both are subsidized by E-Rate
    b. ADE covers APSCN connection, District covers direct connection.

The following chart shows the ratio of school connectivity utilizing the three methods above and reliance on APSCN. We have found that only two (2) charter school districts – Covenant Keepers Charter School and Imboden Charter School rely exclusively on APSCN, and seven (7) districts purchase additional bandwidth from DIS. The remainder purchase additional bandwidth directly from service providers:



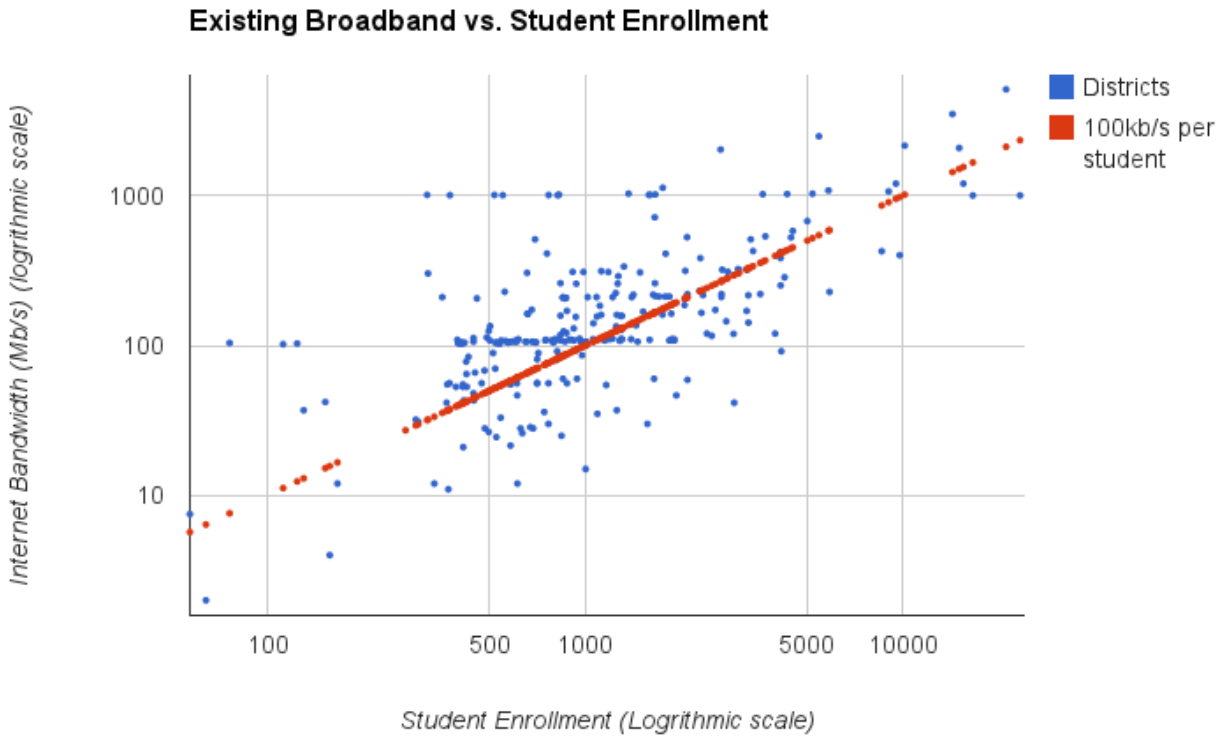
Connectivity Mix

The following diagram shows the mix of access technologies utilized in the existing network connections:



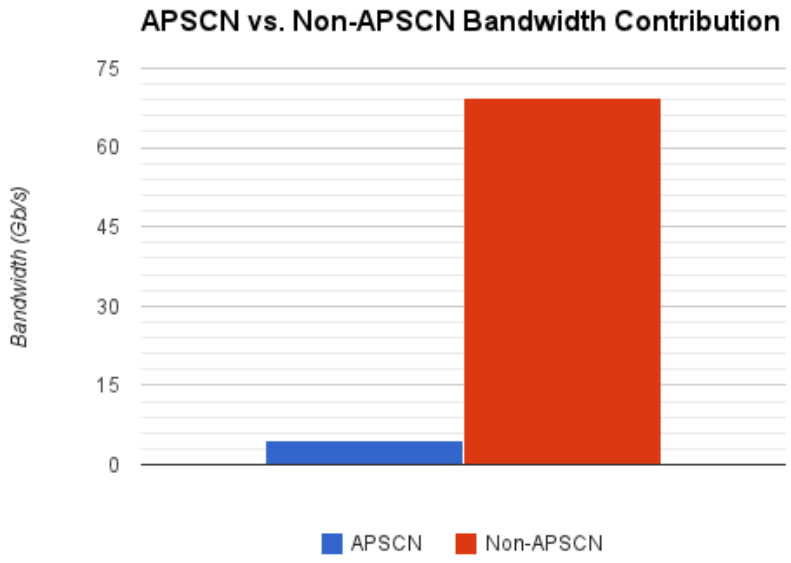
Connectivity Analysis

The following chart shows a distribution of Broadband Capacity vs. Student Enrollment for each district in the state, including both APSCN and non-APSCN connectivity, overlaid with a 100kb/s line in Red:



The following chart compares the amount of bandwidth contributed by APSCN on the left and by non-APSCN direct Internet connections on the right with the road to providing bandwidth for

compliance in 2018:

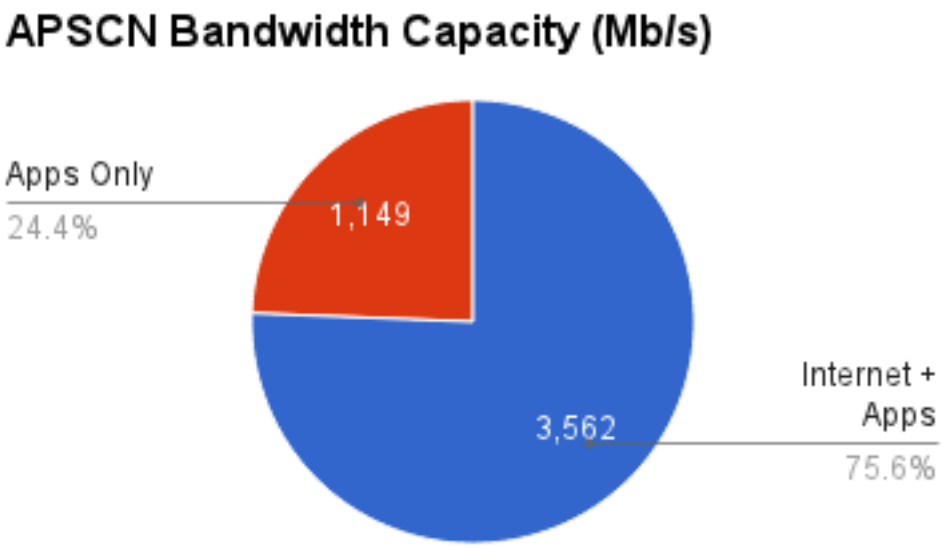


APSCN Connectivity Analysis

APSCN provides several services to the schools including hosting software for the financial management system (FMS), student management system (SMS), and the statewide information system (SIS) for K12 data sources & reporting. APSCN also provides LAN support and connectivity to the schools for access to the software systems as well as the Internet.

Schools have the option of purchasing additional bandwidth through APSCN. APSCN connectivity is not equivalent to Internet connectivity for all connections. Smaller connections typically have full access to the Internet; however larger connections typically are limited to a smaller bandwidth to the Internet.

The following chart shows the total aggregate bandwidth of the APSCN connectivity network between the K12 schools and the core APSCN network. This represents the total capacity of the individual connections to the schools at just over 4.7Gb/s, and the percentage of that capacity that can access the Internet:



The total monthly cost of the APSCN connectivity network is $1,008,140.65/month as of September, 2014. This represents the amount billed by DIS to ADE before E-Rate reimbursement and includes all overheads and certain support costs that are charged back by DIS. It also includes the cost of the Internet, backbone, network equipment, content filtering, and a small amount for Distance Learning that is being phased out. We have provided a detailed breakdown of these monthly costs in Appendix 4.

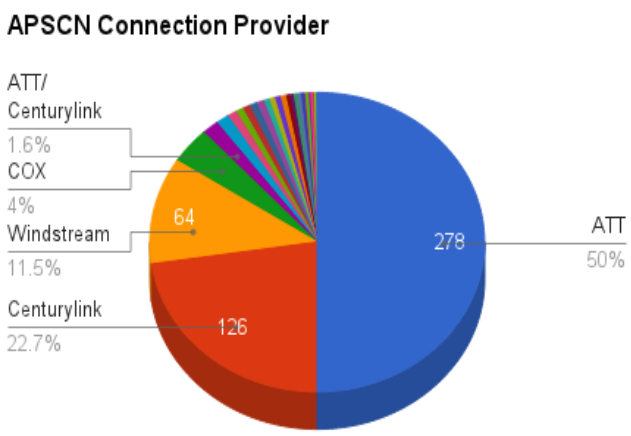
The $1M monthly cost can be broken down to a cost/Mb. Based on the amount of Internet capacity available; the monthly cost would be $283.02/Mb. As a cost/Mb for the total capacity available for both Internet as well as the APSCN-hosted software applications, the monthly cost would be $214.00/Mb. The following table breaks down the cost/Mb for each element of the DIS billing for the APSCN network represented for Internet capacity only and for Total capacity:

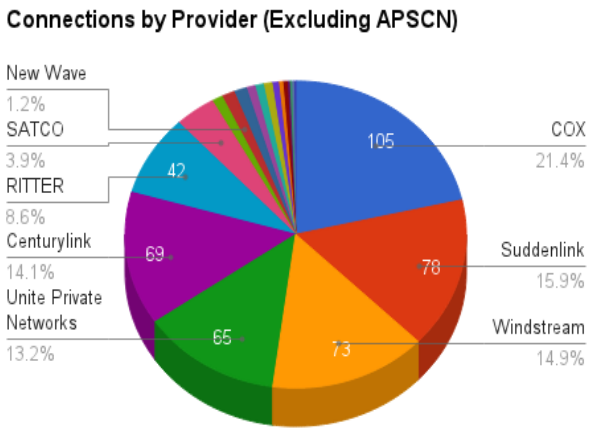
	Internet	Total
	3.5Gb/s	4.7Gb/s
School Connections	$143.73	$108.68
Overhead	$69.68	$52.69
Backbone	$44.61	$33.73
Internet	$10.19	$7.71
Equipment	$6.56	$4.96
Video	$4.40	$3.33
Content Filtering	$3.87	$2.92
Total cost per Mb	$283.02	$214.00

$108.68/Mb is the average cost/Mb for the school connections to the APSCN network. The Internet cost of $10.19/Mb represents the rate that is billed to ADE by DIS before overheads which is spread across several Internet connections that DIS maintains.

DIS purchases the equipment that is utilized for the state network and then leases it to ADE for the APSCN network. It should be noted that the cost/Mb for the equipment and content filtering should drop with additional capacity up to the point that equipment must be upgraded since they are relatively fixed costs based on the number of endpoints.

APSCN Connectivity has been primarily bid on five (5) year contracts with options for two (2) one year extensions. There have typically been four (4) service providers that have provided the majority of the connections for the APSCN bids: AT&T, CenturyLink, Windstream, and Cox. The four providers also provided transport connectivity through 22 other independent service providers representing just over 10% of the K12 connections.





WAN NETWORKS

WAN Networks provide the connectivity between school districts and a service provider that connects them to the Internet or to other networks outside the region. This is the most critical and typically the most costly piece of connecting schools and school districts.

Through review of the information gathered in this study, CT&T has found 160 school locations through review so far that do not have existing fiber optic facilities capable of providing service. These sites are likely to require fiber construction to meet Act 1280 requirements over the next several years. The following chart lists the ten highest-cost locations to connect with fiber

based on our best estimate cost to complete. The full list of schools is contained in Appendix 1:

SCHOOL NAME	DISTRICT NAME	COST TO COMPLETE
Umpire High School	Cossatot River	$1,330,000
Cord-Charlotte Elementary School	Cedar Ridge	$680,000
Mt. Vernon/Enola High School (Mt. Vernon)	Mt. Vernon/Enola	$220,000
Magnet Cove High School	Magnet Cove	$180,000
Glen Rose Kindergarten	Glen Rose	$130,000
De Queen Primary / Preschool	De Queen	$80,000
Marvin Primary School	Mulberry/Pleasant View	$74,000
Gentry High School	Gentry	$68,000
Hardin Elementary School	White Hall	$67,000
De Witt High School	DeWitt	$60,000

DISTRICT INFRASTRUCTURE

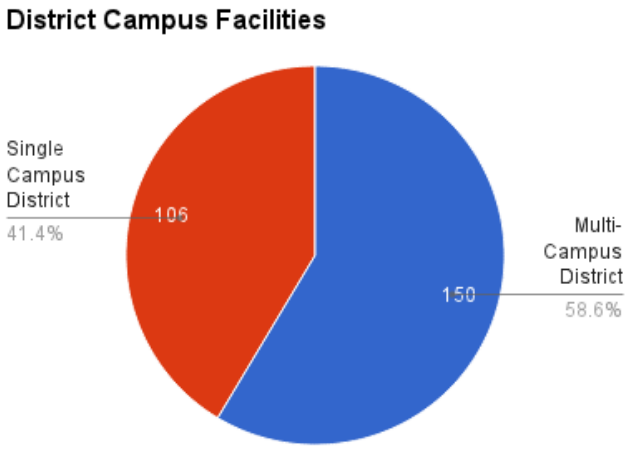
EXISTING INFRASTRUCTURE

The site survey data collection is contained in a repository separated by school district containing the completed site survey forms, pictures, network diagrams, telecom service bills and other information collected on site. The level of detail varies by district, school, and site survey with very good information available for nearly all school districts.

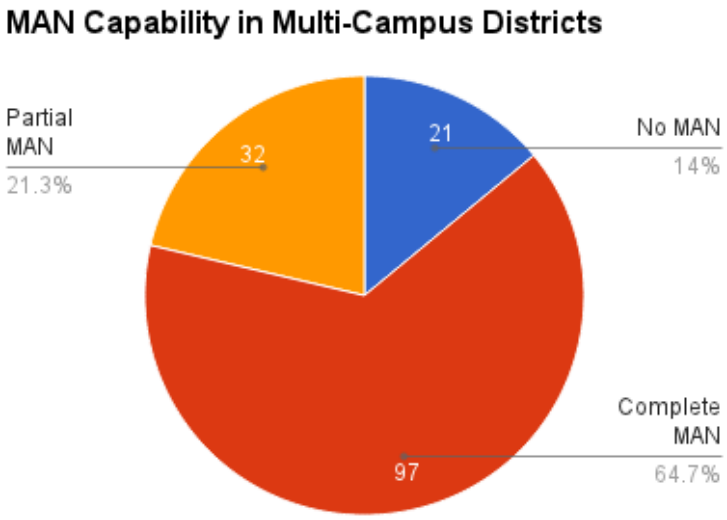
Additional detail on the primary networking components of the district infrastructure and their impacts to growth is included at the end of this report.

MAN NETWORKS

School Districts utilize MAN (Metro Area Networks) networks to connect schools that are on different campus locations, generally located either across town or in neighboring towns. School Districts located on a single campus typically have district-owned fiber connecting the various schools located on the campus. Based on the site survey and school district information from ADE, the number of districts with multiple campuses compared with a single campus is show in the following graph. 150 of the 256 districts have multiple campuses that would require a MAN for communication within the school district:



Of the 150 districts with multiple campuses, there are 97 with complete MAN networks, 32 with partial MAN networks, and 21 that do not have MAN networks as shown in the following graph.



A list of the multi-campus districts with a MAN Connection and who owns the MAN Connection can be found in Appendix 2. In some cases, the district owns some or all of the fiber that connects their schools together. These are shown as “Owned” in the table.

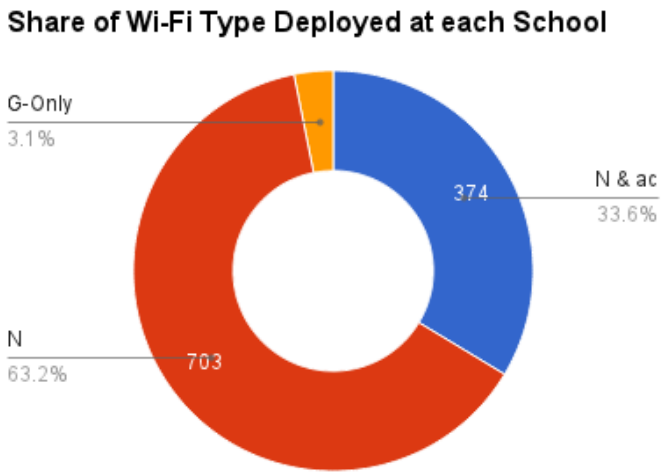
LAN NETWORKS

School Districts utilize LAN networks to connect computers and devices within a school location, typically within the same building, and also between buildings on the same campus. All of the schools surveyed have some level of LAN configuration. There are varying levels of cabling including Category 5, 5e, and 6 cable, fiber – usually between buildings or wings of a building, and Wi-Fi.

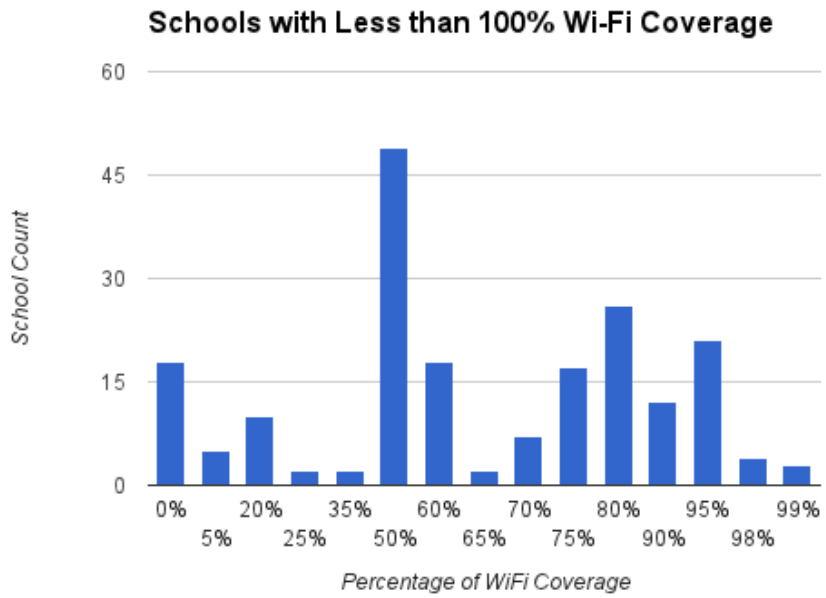
Traditional networking requirements dictated that some method of cable or wiring was required to communicate at sufficiently fast speeds. Newer Wi-Fi technologies have enabled networking without wires at speeds sufficient to preclude wiring as well as to support handheld devices including smart phones and tablets. 802.11N networks have been widely deployed over the last few years, and Wave 1 802.11ac network products have become widely available in the marketplace in 2014. Wave 2 802.11ac products will facilitate significant additional bandwidth and distance capability compared with previous Wi-Fi products.

Many of the school districts have been in the process of upgrading Wi-Fi infrastructure from 802.11N to Wave 1 802.11ac and to facilitate additional devices for a 1:1 environment with tablet devices for each student. The additional bandwidth demands for a 1:1 deployment will require additional access points, newer Wi-Fi standards and well-planned deployments.

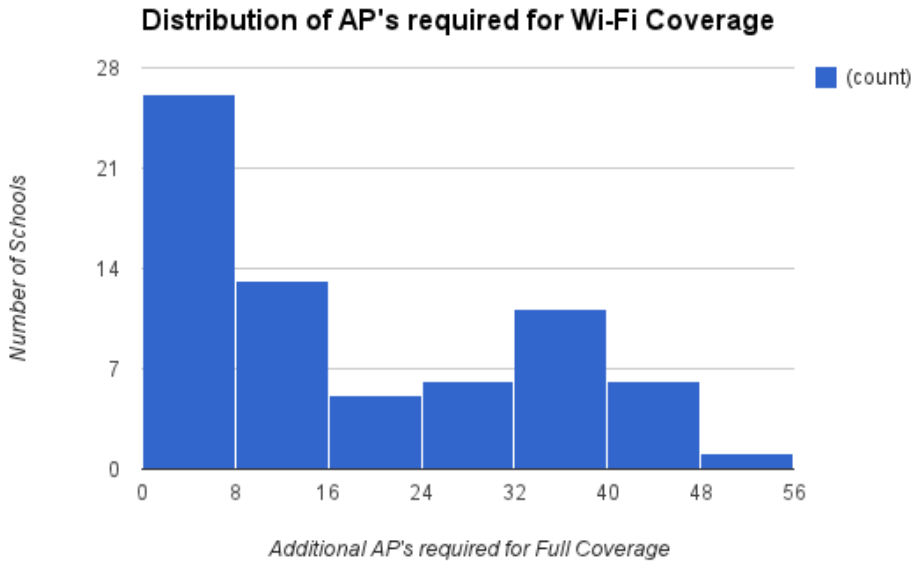
Approximately a third of the K12 schools in the state have deployed Wave 1 802.11ac equipment as shown in the following chart, with the majority of the rest supporting 802.11N:



From the site surveys, 786 schools reported having 100% Wi-Fi coverage. The following chart shows the distribution of coverage reported among an additional 196 schools, with 18 schools reporting 0% coverage:



Approximately 68 schools reported an estimated number of additional access points (AP's) that would be required to achieve full coverage or device capacity for their schools. The chart below shows the distribution of AP's required. 24 schools reported that no additional AP's were required:



ARE-ON CONNECTIVITY

The BLR requested a good faith attempt to estimate or determine the cost of connecting each public school district and public charter school to the ARE-ON network. In order to make an accurate determination of the costs and present the BLR with viable connectivity options; CT&T evaluated two (2) separate network models that can be used to interconnect the entities.

ARE-ON CONNECTIVITY OPTION 1

The first option for connectivity to the ARE-ON network is one that would establish State owned or controlled fiber connectivity between all district hubs and ARE-ON points of presence.

CT&T has assessed and compiled a list of 458 demark locations that would require dedicated fiber connectivity to the ARE-ON network either via point-to-point fiber routes, or regional aggregation hubs. This level of connectivity will require the construction of approximately 3,250 miles of fiber, which is estimated to take a period of 36-48 months from construction start to completion.

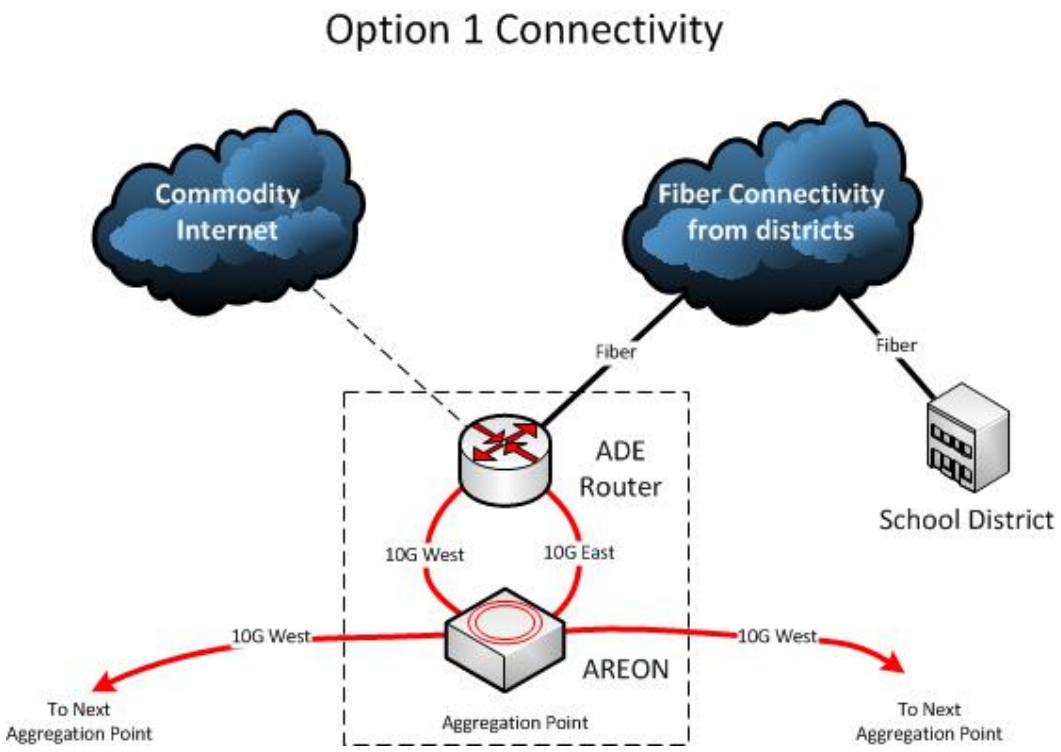
In addition to owning the fiber, option 1 would enable the schools/ADE to have full control of the overall architecture of their access network and wholesale costs by establishing ADE points of presence within the ARE-ON network access locations. In these ADE “service points”, the aggregate traffic from regions of the state will appear and allow for ADE to maintain overall policy and establish desired quality of service (QOS) parameters for how each application’s traffic will be routed. These service points will also act as interface points with wholesale service providers offering volume based Internet access at a fraction of current APSCN cost levels.

With tightly coordinated effort between ADE and ARE-ON, it is estimated that regional segments of a network this size could go live beginning in month 18 continuing with completion between 36 and 48 months.

A budgetary calculation was also made using fiber leased through a 10 year indefeasible right of use (IRU) with service providers who have existing fiber infrastructure. The costs for this option were arrived at using current IRU market rates for Arkansas and similar states in the southeastern US. The costs associated with this option are identified as Option 1a.

While the IRU presents a lower cash outlay than new construction of fiber, the term of the lease is finite but normally allows additional renewals up to 20 years. As with any lease, a lease renewal will require additional funding.

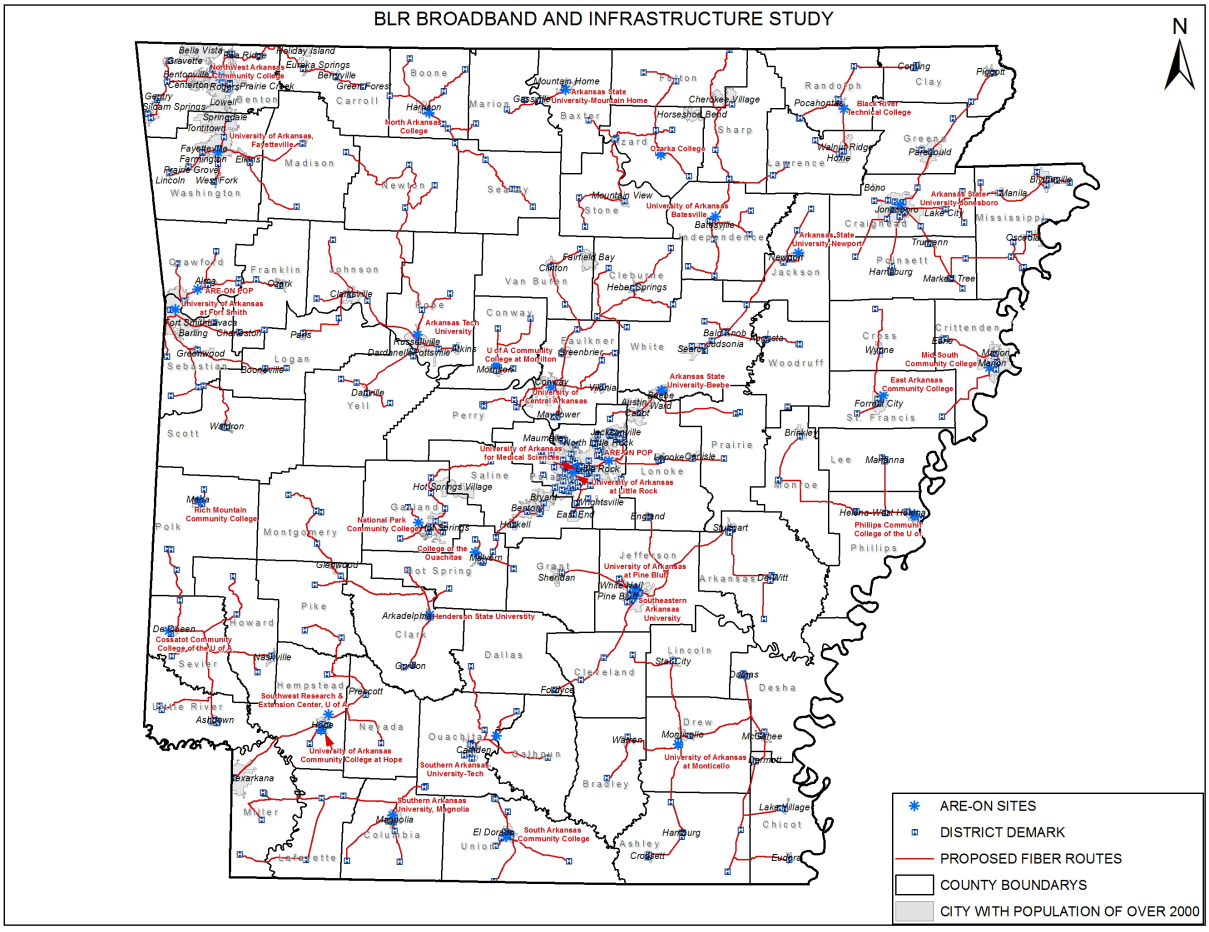
Option 1a should compress the timeline to full implementation of this model by 12-18 months.



OPTION 1 COMPONENTS:

- ADE owned routers/switches at datacenter and ARE-ON hubs
- ADE leased 1G and 10G wavelengths to connect ADE "Points of Presence" (POP) and form K-12 Backbone
- ADE Service POPs serve as aggregation points to purchase wholesale Internet connectivity from service providers to include ARE-ON
- Internet traffic exits/enters the K-12 Backbone at the regional POP level, and on-net traffic traverses the private ARE-ON wavelength connectivity until it reaches destination POP
- **ADE owned fiber connectivity between ADE POP and school districts**

Figure 1.1a



Option 1 Cost Estimates

Construction estimates for dark fiber connectivity from District hubs to nearest ARE-ON point of presence:

BLR fiber routes.xlsx

Option 1 – Construction of fiber between ARE-ON and Districts

Construction Segment	**Miles**	
District Hubs to ARE-ON POP	3,250	$221,311,187
ARE-ON to DIS MAC Datacenter	4	$343,410
	Total:	**$221,654,597**

Capital component		
Construction		$221,654,597
Platforms		$5,925,000
	Total Capital:	**$227,579,597**

Platform Related Expenses		**Annual**
Platform Mgmt, Maintenance, and Support		$2,681,250
ARE-ON founding member rate		$95,000
Leased services		$414,000
	Total Annual Expense:	**$3,190,250**

ARE-ON and Districts

Capital component		**Subtotals**
10 Year Fiber IRU		104,000,000
Platforms		$5,925,000
	Total Capital:	**$109,925,000**

Option 1/1a cost summary

	Annual Expense	Capital
Option 1 (new construction) - Totals	**$3,430,250**	**$227,579,597**
Option 1A (10 Year Fiber IRU) - Totals	**$3,430,250**	**$109,925,000**

Option 1 Benefits

- ADE maintains a private network that is purpose built to the meet the needs of K-12 public schools in Arkansas
- Traffic aggregated to regional hubs allows greatest Internet access purchasing flexibility for ADE
- Ease of scaling backbone capacity needs by adding capacity in 1G and 10G increments
- Capacity increases only require incremental capital for interfaces
- Owned fiber access infrastructure to support all future bandwidth demands

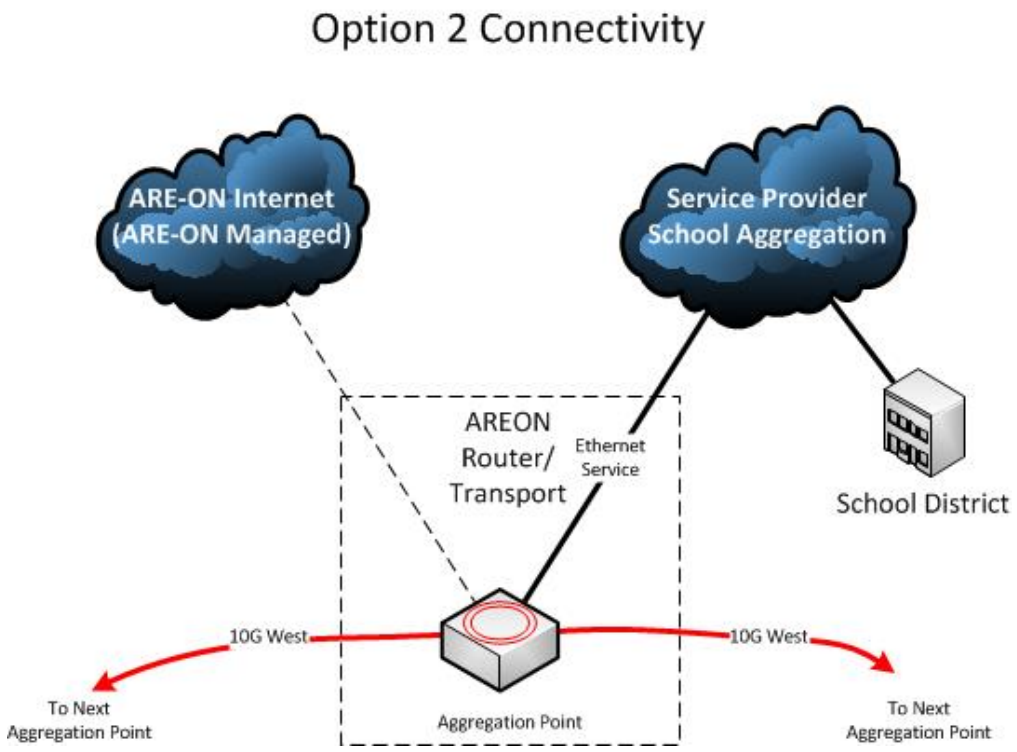
Option 1 Challenges

- Centralized operational complexity increases sharply; platform expertise will be required
- Platform will require 24X7 Network Operations personnel (outsourcing estimates are included in costs analysis)
- Platform will also require greater centralized planning and coordination with Co-Ops and Districts when implementing network policy
- Act 1050 interpretation

ARE-ON Connectivity Option 2

The second option we are proposing for connectivity to the ARE-ON network is one that would provide the most expedient means for establishing interconnection between ARE-ON and the school districts.

In this model ARE-ON will serve as the transport backbone and Internet Services provider to the school districts. ARE-ON will connect directly to local transport Service Providers at ARE-ON hub locations. The Service Providers will aggregate broadband connectivity from the schools and present an aggregate interface to the ARE-ON network. The ARE-ON IP network platform will act as a “virtual router” on behalf of the school districts, and route IP traffic to the Internet or on-net traffic to its destination via ARE-ON’s MPLS backbone.



OPTION 2 COMPONENTS:

- "Virtual router" presence on existing ARE-ON IP network hardware
- ARE-ON provides fully managed backbone and Internet access
- **Service providers aggregate school traffic and transport to specified ARE-ON huts**

Option 2 Cost Estimates

Construction	Miles	Total
ARE-ON to DIS MAC Datacenter	4	$343,410

Capital component	
Construction	$343,410
ARE-ON Network Interfaces	$1,050,000
Total Capital:	**$1,393,410**

Expenses (year 1)	Annual
ARE-ON founding member rate – includes 2 x10G circuits	$95,000
Leased services	$44,400
APSCN aggregation network Current	$6,143,496
Annual Expense Total:	**$6,282,896**

Option 2 Cost Summary

	Annual Expense	Capital
Option 2 Totals	**$6,282,896**	**$1,393,410**

Year two through five expenses can be easily assessed once an overall migration strategy is decided. Based upon the cost data of non-APSCN connections, we forecast a minimum 60% cost reduction in aggregation network expenses beginning in year two

Option 2 Benefits

- ADE maintains a private backbone that is purpose built to the needs of K-12 public schools in Arkansas
- Traffic aggregated to regional hubs allows greatest Internet access purchasing flexibility for ADE
- Ease of scaling backbone capacity needs by adding capacity in 1G and 10G increments

- Replaces APSCN annual backbone costs of $2,413,632.36
- Leased transport for traffic aggregation reduces capital outlay to operationalize model

Option 2 Challenges

- Will require a function to coordinate and manage interconnection program
- Does not address broadband access needs of school districts
- Act 1050 interpretation

District and Support Personnel

Purchasing Power in each District

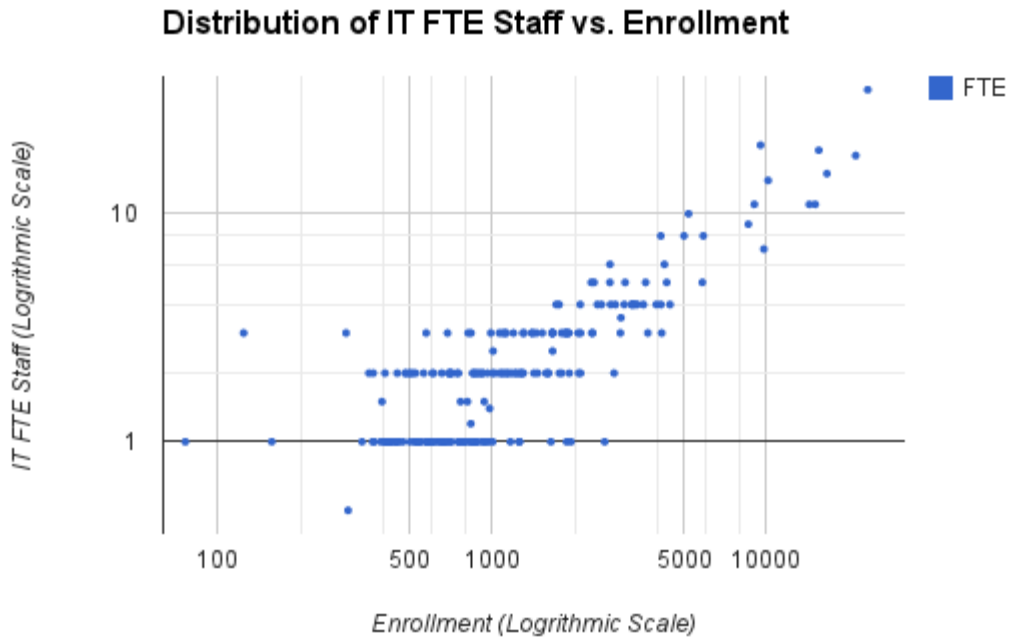
The contact with purchasing power for telecom services at each school or district is included in the attached site survey database.

Network Service Personnel

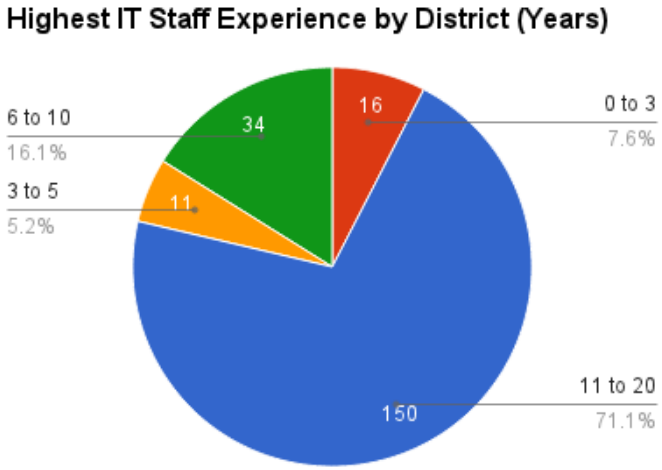
There are a few districts that outsource their IT or have other arrangements. The following is a list of districts that have outsourced IT or other operations:

1. Imboden Charter School – outsources to Millennium 3 in Jonesboro
2. El Dorado – outsources to Vartek, headquartered in Dayton, OH.
3. Lisa Academy – Managed by SHI in San Antonio, TX
4. Siatech Little Rock Charter School – Managed from Office in California
5. Exalt Academy of Southwest Little Rock – outsources to Wired! Technology Partners
6. Little Rock Preparatory Academy – outsources to Wired! Technology Partners
7. Responsive Ed Solutions – all locations managed from headquarters in TX
8. Blevins – Does not have a dedicated IT staff member, handled part-time by a teacher
9. Mt. Vernon-Enola – has one (1) part-time position

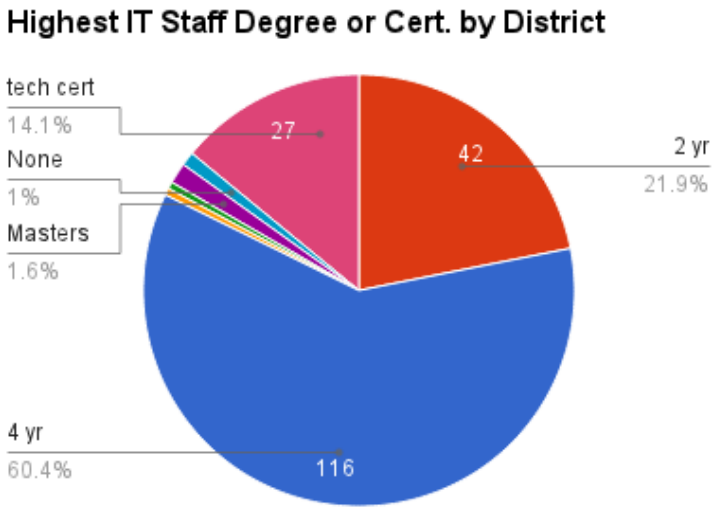
The following chart shows the Distribution of IT Full-Time Equivalent (FTE) staff vs. enrollment for the districts in the state:



The following chart shows the years of experience for the highest ranking full-time equivalent IT staff member by district. Over 70% of the highest ranking members have 11-20 years of experience. Several staff members had in excess of 20-25 years of experience, which was not separately tracked in this study:



The following chart shows the highest degree level or certification for the highest ranking full-time equivalent IT staff member by district. Over 60% of the highest ranking members have 4-year degrees or higher. Several IT staff members have 6 or 8 years of higher level educations or a Master's degree, which was not specifically tracked in this study:



A wide variety of certificates degrees and job-related training have been achieved by the IT staff across the school districts in the state. The following list includes the certifications that were reported by the IT staff in the site surveys:

1. Associates Degree
2. Apple
    a. ACMT
3. Bachelor's Degree in IT
4. Cisco:
    a. CCNA
    b. CCNA Wireless
5. CompTIA
    a. A+ Certification
    b. Network+ Certification
6. Extreme Networks
    a. ESE
7. Information Systems:
    a. ITIL

8. Masters
    a. MIS
    b. MBA – IT Management
9. Microsoft
    a. MSCA
    b. MCP
10. Novell:
    a. CAN
    b. CNE
11. US Navy Sonar Technician
12. VMWare:
    a. VCP
13. Other Vendor-Specific Certifications

APSCN LAN SUPPORT

APSCN LAN support is a service provided by APSCN (a division of ADE) and provided/managed by DIS since 1998. It is funded through a separate budget line-item from the support and overhead costs associated with the APSCN connectivity network.

SUMMARY & OBSERVATIONS

Through interviews with technology coordinators around the state, it was evident that the IT staff around the state stretch their budgets to meet the needs of their respective student bodies. Their attention is focused on providing the technology and access that teachers and students need to facilitate learning in the classrooms.

The IT coordinators expressed thankfulness for the support they receive through APSCN LAN support from DIS for network issues and planning. They mentioned that network problems were resolved very quickly in most cases from APSCN LAN Support. They also expressed frustration with the level of coordination between the state-provided IT software resources, and the co-op and district level. Teachers have to manage two and sometimes three or more passwords to access resources provided by the state and local districts.

Connectivity to state resources was also mentioned as a challenge for teachers and administrators. Several applications including FinancePLUS and eSchoolPLUS (from SunGard) have access restricted to the APSCN/DIS network due to current application or security limitations. Therefore the applications must be accessed from a location on a connected campus or through a separate VPN login, hindering access for teachers or admin staff away from campus or off-network access.

E-RATE SUMMARY

WHAT IS E-RATE

E-rate is a federal reimbursement program with $3.9 billion+ annually for ***connectivity*** to and in schools and libraries. For the 2015-2016 and 2016-2017 E-rate years, an additional $1.5 billion has been added for Category Two.

E-rate is managed by the Schools and Libraries Division (SLD] of the FCC.

WHAT DOES E-RATE FUND

Category 1 – no cap on funding

- Digital transmission (MAN/WAN) and Internet access services
- Voice services (being phased out)
- Category 1 examples
  - Digital transmission services (MAN / WAN)
  - Internet service
  - Dark and lit fiber
  - Local and long distance telephone service
  - Hosted VoIP
  - Cell phone service

Category 2 – capped at $150 pre-discount cost per child to be spent over 5 years

- Internal Connection Components
- Managed Internal Broadband Service
- Basic Maintenance of Eligible Internal Connections Components
- Category 2 examples
  - Access point / Antenna
  - Wireless controller systems
  - Cabling / Wiring
  - Firewall services
  - Caching services or servers
  - Switches
  - Racks for eligible components
  - UPS for eligible components
  - Software to support eligible components

FUNDING PRIORITIES

- Category One requests for the entire nation are funded first
- Category Two funding depends on how much money is left after funding Category One. Funding begins with 85% applicants and continues downward until the funds are depleted.

The table below identifies 4 categories used to determine E-rate utilization efficiency:

1. Pre-discount: Amount intended to spend by applicant
2. Requested: Amount requested to be off-set by E-rate
3. Funded: Amount actually funded by E-rate
4. Disbursed: Amount of approved E-rate funding utilized

2010-2014 E-Rate Performance 1

Year	Applicants	Prediscount	Requested	Funded	Disbursed
2010	All	$36,193,435.86	$28,761,018.37	$27,122,917.29	$18,750,413.19
2010	Districts	$18,054,005.88	$14,585,982.41	$13,943,057.78	$9,923,633.01
2010	DIS	$18,139,429.98	$14,175,035.96	$13,179,859.51	$8,826,780.18
2011	All	$49,665,587.36	$39,404,897.13	$28,026,357.79	$21,416,459.64
2011	Districts	$21,317,371.15	$17,016,693.93	$15,682,119.68	$12,731,882.78
2011	DIS	$28,348,216.21	$22,388,203.20	$12,344,238.11	$8,684,576.86
2012	All	$52,803,057.14	$41,984,461.96	$20,560,151.59	$16,781,450.30
2012	Districts	$24,192,112.52	$19,291,419.90	$17,875,429.56	$14,825,507.41
2012	DIS	$28,610,944.62	$22,693,042.06	$2,684,722.03	$1,955,942.89
2013	All	$37,519,932.98	$29,910,820.14	$22,693,691.01	$17,969,609.11
2013	Districts	$25,812,162.23	$20,573,225.90	$19,555,708.00	$16,685,826.45
2013	DIS	$11,707,770.75	$9,337,594.24	$3,137,983.01	$1,283,782.66
2014	All	$47,413,159.32	$37,821,437.06	$26,557,820.86	$2,700,713.53
2014	Districts	$34,160,025.05	$27,256,373.30		
2014	DIS	$13,253,134.27	$10,565,063.76		

In 2010, both the Arkansas Public Schools and the Department of Information Systems (DIS) were awarded funding as requested of the E-rate program. The schools utilized 71% of the funds awarded and DIS used 67% of awarded funds. Factors that may contribute to funds not being used include expenses that are lower than projected or notice of funding that comes too late to put new services in place.

In 2011, the schools received 92% of the funds requested and DIS received 55%. School utilization was 81% and DIS utilization was at 70% for the funds awarded.

In 2012, the schools received 93% of the funds requested and DIS received 12%. The majority of the DIS requests are being held for further review. School utilization was 83% and DIS utilization was at 73% for the funds awarded.

In 2013, the schools received 95% of the funds requested and DIS received 37%. The majority of the DIS requests are being held for further review. School utilization was 85% and DIS utilization was at 41% for the funds awarded.

In 2014, 70% of the school applications are currently funded. This is likely to increase as the funding cycle is still active. DIS believes their applications are being held until the 2012 and 2013 requests are resolved.

EDUCATION SUPERHIGHWAY REPORT COMPARISON

Prior to this study commissioned by the BLR, ADE partnered with EducationSuperHighway (ESH) to study K12 broadband in the state of Arkansas. CT&T met with ESH during the course of this study to understand the existing body of work in progress and to understand our goals and differences. ESH subsequently released their report on December 5, 2014 as this report was being finalized.

COMPARISON

With respect to the existing K12 services and the APSCN network, the results of this study largely agree with the ESH report. Minor variations in figures are primarily a result of the larger data set and methodology used to compile this study as well as upgrades at several schools that were being completed at the time of this study.

The ESH study recommends moving forward immediately with a Direct Internet Access architecture for the coming school year and disconnecting the current APSCN connectivity network. CT&T agrees with this recommendation as providing the best short-term path to additional bandwidth and network savings and the least amount of disruption. We also agree with their expense projection to accomplish this component.

ESH also recommends immediately beginning the planning for an aggregated backbone network to be implemented beginning in 2016 to facilitate cost savings through an aggregated approach. CT&T recommends waiting to implement a backbone until either cost savings or application quality dictate the need for a backbone.

CT&T is not opposed to a backbone approach; however CT&T questions the level of cost savings achievable by a state network through an aggregated approach. Service providers aggregate Internet access in essentially the same way that an aggregated state network would do so and they have existing Internet aggregation in place.

The service providers have an even larger pool of subscribers to aggregate than a statewide K12 network, effectively driving the incremental cost of Internet access close to zero and leaving the majority of the cost in the access/transport network to the schools. This cost delta can also be seen in the estimates for connecting the schools to ARE-ON. The overwhelming majority of the infrastructure is between the schools and the network, rather than between the network and the Internet.

CT&T recommends evaluating this cost along with network and application requirements on a regular basis through a carefully structured RFP to determine when implementation of a backbone would be advantageous for K12 schools and the state.

NETWORKING COMPONENT DESCRIPTIONS

BROADBAND CONNECTIVITY VERSUS NETWORK CONNECTIVITY

In the context of this study there are two types of connectivity being assessed at the K12 schools. Broadband connectivity is synonymous with connectivity to the Internet. In this study broadband means a connection between a K12 school and an Internet Service Provider (ISP) providing that school with Internet service on that connection.

Network connectivity is a broader term that can encompass many forms of connectivity. In this study network connectivity includes all forms of connectivity except for broadband, making them mutually exclusive terms. Collectively "broadband and network connectivity" encompasses all forms of connectivity at the K12 schools.

LANS, MANS, AND WANS

Because network connectivity covers such a broad range of configurations, capabilities, and technologies, it is often further sub-divided into one of three categories based on its size and scope: LANs (Local Area Networks), MANs (Metropolitan Area Networks), and WANs (Wide Area Networks).

- LANs are within a building or small local area (such as a cluster of adjacent buildings). They may use wireless (Wi-Fi) or wired (Ethernet over Cat 5/6 cabling) technology, but the prevailing trend has been towards wireless unless distance or building materials requires cabling. They do not involve service providers, just the local network administrator.
- MANs are between non-adjacent buildings within a confined geographical area, typically a metropolitan area (MANs connect LANs). They may also use wireless (WiMAX, LTE) or wired (Ethernet over copper or fiber), but the prevailing trend has been towards wired connections with wireless acting as a backup. They almost always involve local service providers.
- WANs are between geographical areas over long distances (WANs connect MANs). WAN providers often operate only a single location, or POP (Point Of Presence) in the metropolitan/geographical area to connect WAN links to MANs. WANs are never wireless, but may be wired or hybrid (wired with some wireless in the transmission path) although the prevailing trend is away from hybrid transmission paths. They always involve long haul service providers.

Although some aspects of the network connectivity within school districts might qualify as "WAN" connections, in this study we reduce the network connections within school districts to just LAN and MAN with LAN connections being within a building or between adjacent buildings

and MAN connections between non-adjacent buildings within a school district.

Networking Components

Although broadband and network connectivity are mutually-exclusive, they do have some common attributes. Although only broadband connectivity is directly connected to the Internet, most network connectivity also utilizes the Internet Protocol (IP) because it's the standard for communication between computers. For those connections that use IP, they also share a standard set of networking components for IP communications.

Routers

Routers are networking components that make decisions about what route IP packets take through the network. IP breaks messages into one or more packets, each of which has a header that contains a destination IP address identifying the destination of the packet and ultimately the message. Routers look at that destination IP address to determine what path that packet should take.

Most broadband connections are delivered to a router first to terminate the broadband connection. These routers are often provided by the ISP and may be delivered with a managed service. For the K12 schools that have more than one broadband connection (for example, APSCN and a direct connection to an ISP), they will likely have a router per connection dedicated to the ISP.

Switches

Switches are networking components that also make decisions about what route IP packets take through the network, but they do so at a lower level and only for a localized portion of the network. Unlike routers, which maintain topology information necessary to make routing decisions based on the destination IP address, switches maintain localized topology information so that they can switch packets from the incoming interface to the outgoing interface.

Switches do the heavy lifting in LANs and in some MANs by making the low-level connection between computers and networking components, such as routers. They also make connections between networking components, such as between two provider routers at the end of two broadband connections.

Firewalls

Firewalls are networking components that protect networks by determining what packets should not be allowed to enter or leave the network. Firewalls can be implemented as rules inside of routers or as separate networking components. Most of the school districts have implemented their firewalls separate from their routers.

Content Filters

Content filters are networking components that protect network users by blocking content that might be considered inappropriate. They are similar to firewalls in their content blocking, but differ in their purpose and the level of scrutiny they provide. Firewalls look at all packets to see if they match predetermined rules based on the packet headers. Content filters look at user messages and seek to match parameters that would flag the content as potentially inappropriate.

Load Balancers

Load balancers are networking components that combine more than one connection of the same type (broadband or network) into a single virtual connection. They balance the load between the connections, protect against failures, and ensure consistent performance. They can also be called by other names, such as traffic managers or WAN failover devices. They must be implemented as separate networking components. Most schools with more than one broadband connection have load balancers.

DEFINITIONS

ADE – Arkansas Department of Education
AP – Access Point (Wi-Fi)
APSCN – Arkansas Public School Computer Network, a Division of ADE
ARE-ON – Arkansas Research Education Optical Network
BLR – Bureau of Legislative Research
CT&T – Engineering & Consulting Firm Completing Study
DIS – Arkansas Department of Information Services
E-Rate – Federal Program Managed by the FCC & USAC
ESH – EducationSuperHighway
FCC – Federal Communications Commission
FFL – Funds for Learning
FMS – Financial Management System (APSCN)
IRU – Indefeasible Right of Use – for use of dark Fiber optic cable from another carrier
MAN – Metro-Area Network – Typically connectivity between sites in a metro or school district
MPLS – Multi-Protocol Label Switching
POP – Point of Presence
SETDA – State Educational Technology Directors Association
SIS – Statewide Information System (APSCN)
SMS – Student Management System (APSCN)
SSO – Single-Sign On
USAC – Universal Service Administration Company
VPN – Virtual Private Network
WAN – Wide Area Network – Typically connectivity between sites over a larger regional area
Wi-Fi – Wireless-Fidelity

APPENDICES

APPENDIX 1

The following table shows the cost to complete fiber builds to the schools identified to be lacking fiber:

SCHOOL NAME	DISTRICT NAME	COST TO COMPLETE
Umpire High School	Cossatot River	$1,330,000
Cord-Charlotte Elementary School	Cedar Ridge	$680,000
Mt. Vernon/Enola High School (Mt. Vernon)	Mt. Vernon/Enola	$220,000
Magnet Cove High School	Magnet Cove	$180,000
Glen Rose Kindergarten	Glen Rose	$130,000
De Queen Primary / Preschool	DeQueen	$80,000
Marvin Primary School	Mulberry/Pleasant View	$74,000
Gentry High School	Gentry	$68,000
Hardin Elementary School	White Hall	$67,000
Mena School Bus Garage	Mena	$63,000
De Witt High School	DeWitt	$60,000
Jonesboro Juvenile Detention School	Jonesboro	$58,000
Pleasant View Jr High	Mulberry/Pleasant View	$57,000
Magnet Cove Elementary School	Magnet Cove	$52,000
Louise Durham Elementary School	Mena	$52,000
Gurdon Primary School	Gurdon	$47,000
Van Cove Elementary School	Cossatot River	$46,000
Hartford High School	Hartford	$43,000
Holly Harshman Elementary School	Mena	$42,000
Pinewood Elementary School	Pulaski County Special	$40,000
North Pulaski High School	Pulaski County Special	$40,000
Wilmot Elementary School	Hamburg	$39,000
Gurdon ALE/Bus Garage	Gurdon	$38,000
Mount Ida Elementary School	Mount Ida	$36,000
Dollarway High School	Dollarway	$35,000
Nashville High School	Nashville	$35,000
Des Arc Elementary / PRE-L School	Des Arc	$34,000
Adkins Pre-K Center	Pulaski County Special	$34,000
Responsive ED High School	Responsive Ed Solutions	$33,000
Beebe Early Childhood Center	Beebe	$33,000
Lafayette County High School	Lafayette County	$33,000

Gilette Elementary School	DeWitt	$31,000
Little Rock Prep Academy Primary	Little Rock Prep Academy Primary	$31,000
Maintenance & Child Nutrition	Hot Springs	$31,000
Reed Elementary School	Dumas	$31,000
De Witt Elementary School	DeWitt	$30,000
Marion Juvenile Detention Center	Marion	$30,000
Smackover Admin Office	Smackover-Norphlet	$28,000
Earle High School	Earle	$27,000
Rison Elementary School	Cleveland County	$27,000
Murrell Taylor Elementary School	Pulaski County Special	$27,000
CARLISLE HIGH SCHOOL	Carlisle	$27,000
Monticello Elementary School	Monticello	$27,000
Mount Pleasant Elementary School	Melbourne	$26,000
AR SCHOOL FOR THE BLIND	AR School for the Blind	$25,000
Jacksonville Middle School	Pulaski County Special	$24,000
Rosebud High School	Rosebud	$24,000
New Horizons Alternative School	Batesville	$24,000
Mount Ida High School	Mount Ida	$23,000
Tolleson Elementary School	Pulaski County Special	$22,000
LISA Academy West Middle	Lisa Academy	$22,000
Nashville Junior High School	Nashville	$22,000
Mt. Vernon/Enola Elementary School (Enola)	Mt. Vernon/Enola	$22,000
Bates Elementary School	Pulaski County Special	$21,000
Responsive Ed Solutions Quest Middle School Pine Bluff	Responsive Ed Solutions	$21,000
Junction City Elementary School	Junction City	$20,000
Nashville Primary School	Nashville	$20,000
Hackett Elementary School	Hackett	$20,000
Mulberry High School	Mulberry/Pleasant View	$19,000
AR SCHOOL FOR THE DEAF	AR School for the Deaf	$19,000
Scranton High School	Scranton	$19,000
Haas Hall Academy	Haas Hall Academy	$19,000
Exalt Academy of Southwest Little Rock	Exalt Academy of Southwest Little Rock	$18,000
Kirby Elementary School	Kirby	$18,000
Allbritton Upper Elementary School	Pulaski County Special	$18,000
McCrory Elementary School	McCrory	$18,000
WHITE HALL SD ROTC	White Hall	$17,000
Mena School District Admin	Mena	$17,000
Pangburn Elementary School	Pangburn	$16,000
WMSD Annex/Transportation Center	West Memphis	$16,000

Hamburg High School	Hamburg	$16,000
Batesville Juvenile Detention	Batesville	$16,000
Gentry Primary School	Gentry	$16,000
Hillcrest Elementary School	Hillcrest	$16,000
Gentry Intermediate School	Gentry	$15,000
Cedar Park Elementary School	Truman	$14,000
Star City High School	Star City	$14,000
Mount Ida Middle School	Mount Ida	$14,000
Bigelow East End High School	Beebe	$13,000
Horatio Elementary School	Horatio	$13,000
LISA Academy North Little Rock Elem	Lisa Academy	$12,000
Imboden Area Charter School	Imboden Area Charter School	$12,000
Centerpoint Primary School	Centerpoint	$11,000
Hamburg Middle School	Hamburg	$11,000
Gentry Middle School	Gentry	$11,000
Junction City High School	Junction City	$11,000
Rector High School	Rector	$11,000
Anne Watson Elementary School	Malvern	$11,000
Kirby High School	Kirby	$11,000
Nashville Elementary School	Nashville	$11,000
De Queen Admin	DeQueen	$10,000
Malvern School District Admin	Malvern	$10,000
Jacksonville Transportation North	Pulaski County Special	$10,000
Buffalo Island Central East Elementary	Buffalo Island Central	$9,000
Mayflower Elementary School	Mayflower	$9,000
Greenland High School	Greenland	$9,000
Ashdown Support Services Building	Ashdown	$9,000
Cossatot River High School	Cossatot River	$8,000
Beebe Middle School	Beebe	$8,000
Buffalo Island Central West Elementary	Buffalo Island Central	$8,000
Little Rock Prep Middle school	Little Rock Prep Middle school	$8,000
Jacksonville Lighthouse Charter Elem	Jacksonville Lighthouse Charter	$7,000
Woodlawn High School	Woodlawn	$7,000
Poyen High School	Poyen	$7,000
Hamburg Admin Office	Hamburg	$7,000
Eudora Elementary School	Lakeside (Chicot)	$7,000
River Valley Tech Center	South Conway County	$7,000
Mena Middle School	Mena	$7,000
Buffalo Island Central Junior High	Buffalo Island Central	$7,000
Garfield Elementary School	Rogers	$7,000
So. Miss. Co. Elementary at Wilson	Rivercrest	$6,000

Piggott High School	Piggott	$6,000
De Witt Jr. High School	DeWitt	$6,000
Dumas School Admin Office	Dumas	$6,000
Smackover Preschool	Smackover-Norphlet	$6,000
Mountainburg Middle School	Mountainburg	$6,000
Marmaduke High School	Marmaduke	$5,000
Mountainburg Elementary School	Mountainburg	$5,000
Piggott Elementary School	Piggott	$5,000
Wickes Elementary School	Cossatot River	$5,000
Lonoke Schools Career Center	Lonoke	$5,000
Strong High School	Strong-Huttig	$5,000
Responsive Ed Solutions Quest Middle Little Rock	Responsive Ed Solutions	$5,000
Dermott Elementary School	Dermott	$5,000
McGehee Elementary School	McGehee	$5,000
Rector Elementary School	Rector	$5,000
McCrory High School	McCrory	$4,000
Glen Rose Admin	Malvern	$4,000
Southside School District Admin	Batesville	$4,000
Central Elementary School	Dumas	$4,000
Horatio High School	Horatio	$4,000
Kingsland Elementary School	Cleveland County	$4,000
Buffalo Island Central High School	Buffalo Island Central	$4,000
Arnold Drive Elementary School	Pulaski County Special	$4,000
Concord High School	Concord	$4,000
Earl School District Admin	Earle	$4,000
CARLISLE ELEMENTARY	Carlisle	$4,000
Mountainburg High School	Mountainburg	$4,000
Concord Elementary School	Concord	$3,000
McGehee High School	McGehee	$3,000
Covenant Keepers Charter	Covenant Keepers Charter	$3,000
Earle Elementary School	Earle	$3,000
Flightline Upper Academy	Pulaski County Special	$3,000
Responsive Ed Solutions NW Arkansas Classical Academy	Responsive Ed Solutions	$3,000
Magazine Elementary School	Magazine	$3,000
Badger Academy/Bus Barn?	Beebe	$3,000
Horatio School District Admin	Horatio	$3,000
Umpire Elementary School	Cossatot River	$3,000
PARON ELEMENTARY SCHOOL	Bryant	$3,000
Jacksonville Lighthouse Middle	Jacksonville Lighthouse Charter	$2,000
Cosmetology Morrilton	South Conway County	$2,000

Tyronza Elementary School	East Poinsett County	$2,000
Centerpoint Intermediate School	Centerpoint	$2,000
Portland Elementary School	Hamburg	$2,000
Sparkman High School	Harmony Grove	$2,000
Harrisburg District Admin.	Harrisburg	$2,000
Sparkman Elementary Schools	Harmony Grove	$2,000
Izard Co. Consolidated Elementary School	Izard County Consolidated	$2,000
e-STEM Elementary	Little Rock	$1,000
Millsap Intermediate School	Mulberry/Pleasant View	$1,000
	Total:	**$5,283,000**

APPENDIX 2

List of schools with MAN Service Provider

School District	MAN Provider	School District	MAN Provider
Alma	Cox	Crossett	Windstream
Arkadelphia	SuddenLink	De Queen	Windstream
Arkansas Arts Academy	Cox	Decatur	Cox
Ashdown	AT&T	Deer & Mount Judea	Ritter
Augusta	CenturyLink	Des Arc	CenturyLink
Batesville	Suddenlink	Dollarway	Pine Bluff cable
Bauxite	AT&T	Dover	Suddenlink
Benton	City of Benton	Dumas	CenturyLink
Bentonville	Cox	El Dorado	Conterra Ultra Broadband
Berryville	Cox	Emerson-Taylor-Bradley	Walnut Hill
Blytheville	Ritter	England	CenturyLink
Booneville	Unknown	eStem Public Charter	Windstream
Bryant	Windstream	Farmington	PGTelco
Buffalo Island	Ritter	Fayetteville	Cox
Cabot	Owned	Flippin	NATCO
Calico Rock	CenturyLink	Forrest City	Windstream
Carlisle	ConnectView	Fort Smith	Cox
Centerpoint	Windstream	Greenbrier	Windstream
Clarendon	Windstream	Greene County Tech	Paragould Light Water & Cable
Conway	Conway Corporation	Midland	CenturyLink
Cossatot River	Windstream	Monticello	SATCO

School District	MAN Provider
Greenwood	Cox
Hamburg	Nexus Wireless
Harmony Grove (Ouachita)	SATCO
Harrison	Cox
Helena/West Helena	Windstream
Hope	Windstream
Hot Springs	AT&T
Jessieville	Suddenlink
Jonesboro	Suddenlink
Lakeside (Chicot)	Skyrider Communications
Lavaca	Pinnacle
Lee County	Windstream
Lincoln	PGTelco
Little Rock	Unite Private Networks
Magnolia	SATCO
Malvern	AT&T
Mansfield	Cox
Marion	Comcast
Marked Tree	Ritter
Marvell-Elaine	Windstream

School District	MAN Provider
Mount Ida	Unknown
Mountain Home	CenturyLink
Nettleton	Suddenlink
Newport	Suddenlink
North Little Rock	Windstream
Osceola	Ritter
Ozark	Suddenlink
Palestine-Wheatley	Windstream
Pea Ridge	Unite Private Networks
Pine Bluff	Unite Private Networks
Pocahontas	Suddenlink
Pottsville	Suddenlink
Prairie Grove	PGTelco
Pulaski County Special	AT&T
	CenturyLink
Riverside	Ritter
Riverview	Windstream
Rogers	Cox Windstream
Russellville	Suddenlink
Searcy	White County Cable

School District	MAN Provider
Mayflower	Computer Works
South Conway County	Windstream
South Pike County	Windstream
Springdale	AT&T
Stuttgart	CenturyLink
Texarkana	Windstream
Van Buren	Cox
Vilonia	Windstream
Warren	SATCO
Watson Chapel	Unknown
West Memphis	Windstream
Westside (Johnson)	Windstream
White Hall	AT&T

APPENDIX 3

Attached to this document includes:

1. Master Site Survey Database
2. Master Service Provider Database
3. Complete E-Rate Data.
4. Breakdown of monthly DIS invoice to ADE