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RESEARCH REPORT

**Estimated Internet-Related Costs for
Kansas Public Libraries and Schools**

**Prepared for the
Kansas Task Force on Internet Access**

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EXECUTIVE SUMMARY

- It would cost an estimated \$82 million per year to provide a minimum level of direct Internet connections to all Kansas schools and libraries. Much of this cost is implicitly contained within existing school and library budgets.
- This figure assumes that there would be one networked computer per 30 students, one computer per 2,000 library patrons, and one computer per teacher or library staff person. This is a comprehensive figure which includes computers, area networks and statewide networks, as well as planning, training, technical support, and staff time for applications. The costs are based on many other modeled assumptions, and actual experience could be different and probably would change over time.
- Most of these costs are “variable” costs, i.e. costs which depend on the numbers of users being served. According to the model:
 1. The cost to connect one additional district to the Internet backbone is roughly \$39,000 per year.
 2. The cost of networking for one additional building is roughly \$5,400 per year.
 3. The cost to serve one additional student is roughly \$23 per year (excluding additional staff costs).
 4. The cost to serve one additional teacher is roughly \$1,500 per year.
 5. The total cost of computers, local networking, and related staff for a typical district is roughly \$220,000 per year.
 6. The cost to serve one additional librarian is roughly \$1,400 per year.
 7. The cost to serve one additional potential library patron in the general population is roughly \$.34 per year.
- The breakout of annual costs by function is roughly:
 1. \$24 million for computers at clients’ workstations;
 2. \$3 million for computers for local databases, applications, e-mail addresses, and bulletin boards;
 3. \$10 million for area networking;
 4. \$5 million for statewide networking, databases, and Internet access fees; and
 5. \$40 million for personnel costs.
- Much of this annual cost is already included in existing budgets. In particular:
 1. Up to \$28 million in teacher and librarian time would be shifted to Internet-oriented activities from non-Internet-related activities;
 2. Some \$5 million to \$10 million is already being spent on computers; and
 3. Several million dollars are already being spent for area networking and Internet access.

- Costs at higher levels of service would increase to :
 1. \$126 million with 6 students per computer; and
 2. \$400 million with 1 student per computer.

CHAPTER 1. INTRODUCTION

This paper provides estimates of the costs of providing direct connections to the Internet in public libraries and schools in Kansas. The concept of “cost” is comprehensive, including explicit and implicit personnel costs as well as hardware and telecommunications charges. The main purpose of this report is to support statewide policy on Internet access. In particular, the costs are structured in such a way as to support an analysis of inequality between urban and rural, rich and poor, large and small school districts (the actual analysis is contained in Burress, 1996).

This paper assumes some familiarity with the technical jargon of the Internet and computing hardware. Most of this jargon is explained in Burress, Livingston, and Oslund, 1996 (especially Chapter 2).

The comprehensive cost concept used here is summarized in Table 1.1, adapted from Burress, Livingston, and Oslund, 1996, p. 19. For further explanation of these cost items, see Chapter 2.

Chapter 2 of this report explains the assumptions, model, and data sources which were used to derive these results. Chapter 3 contains the actual results. Chapter 4 provides some brief analysis of the results. An appendix contains some specific cost information provided by KANREN (Kansas Research and Educational Network).

Table 1.1
The Structure of Internet Access Costs

Capital costs

On site costs

personnel costs

planning

hardware and software

uses: curriculum, library operations

installation

initial training (costs for trainers, trainees, materials, travel, and venue)

equipment costs

workstation: computer, software, chair, desk, printers

LAN: wires, network interface cards, hubs, network server (i.e., a computer for shared resources), software, routers

WAN: wires, network server, e-mail server, server for other utilities (e.g., web site), software, routers, connection boxes for higher and lower level networks(e.g., CSU/DSU)

Costs elsewhere

leased line costs

installation charges

remote provider costs

installation charges

Operating costs

On site costs

personnel costs

*supervision and replanning

maintenance and operation

*ongoing training (costs for trainers, trainees, materials, travel, and venue)

*staffing: planning lessons, searching the net, helping patrons

user support

equipment costs

replacement parts

supplies: paper, toner

Costs elsewhere

leased line costs

leases for WAN connections

lease for connection to Internet access provider

remote provider costs

access provider fees

Note: personnel costs marked * are partly "implicit", meaning that these activities may substitute for other activities already budgeted for. For example, teacher training may replace ordinary in-service training already budgeted. Note also that much of the hardware costs could also be viewed as "implicit"; in particular, substantial quantities of computers and area networks are likely to be purchased even in the absence of Internet connections.

Source: Burrell, Livingston, and Oslund, 1996, p.26

CHAPTER 2. ASSUMPTIONS OF THE COST MODEL

The cost model includes not only the cost of bringing a connected wire from the Internet to a school district or library, but also the computers, staff and training necessary to use that connection. Much of this infrastructure is already in place. Therefore, not all of the costs listed in the model involve new funding. Statewide costs depend on several variables: the level of service; the technology and staffing used to provide that service; the prices of inputs; and the number of persons served.

Levels of Service.

This paper makes very specific assumptions about the level of service that will be provided to schools and libraries in Kansas. These assumptions are partly justified in other reports [Kansas Task Force on Internet Access, 1996; Burrell, Livingston, and Oslund, 1996; Burrell, Meents, Worthen, Oslund, 1996; Carlin, Glass, and Krider, 1996]. The level of service has three main hardware components: the speed, or bandwidth, of a connection (in bits per second); the number of computers or workstations provided per user; and the replacement period for equipment and software. We assume that there will be adequate staffing to support a given level of service effectively.

Assumed levels of service are based on requirements and usage patterns that are projected for the year 2000 under the assumption that all school buildings and libraries will be connected directly to the Internet. District Internet connections at 56 kbps will probably be inadequate to carry the communication traffic that is expected. Therefore, it is assumed that most districts will be connected at 384 kbps, while the largest districts will be connected at T1.

However, the model assumes that local area networks will operate at 56 kbps. It should be noted that 56 kbps connections will be inadequate for many potential administrative uses for within district connections. Some districts may be willing to fund higher frame relay speeds on telephone line, or else provide alternative connections such as laying or leasing their own optical fibers. These extra costs are not included in the cost model presented here.

In the main cost model, it is assumed that there will be one computer per each 30 students. However, because computers tend to comprise both the largest single cost item, and also the most important limitation on the level of service, variant models will be shown that assume one computer per six students and one computer per student. All models assume one computer per each teacher or library staff person and one computer per 2000 library population served. The replacement period for all equipment is assumed to be 5 years.

The minimum level of service model, with 30 students per computer, would mean that if every computer was scheduled for use for every minute of every school day, each student would get one hour per week of computer time, with only part of that time spent on the Internet. (In actual practice, they would get even less because of inactive periods). The second level of service, with 6 students per computer, would allow one hour per day of computer time. The third level of service, with one computer per pupil, would allow full time access to a computer for each student as needed. (The majority of the computer usage would probably not be directly Internet-related.) Some school districts in Kansas are already very near to having the maximum level of one computer per student.

However, most of these computers are not yet connected to the Internet. Other schools are below the minimum level of one per 30 students, especially if obsolete computers are not counted [Kansas State Board of Education, 1995].

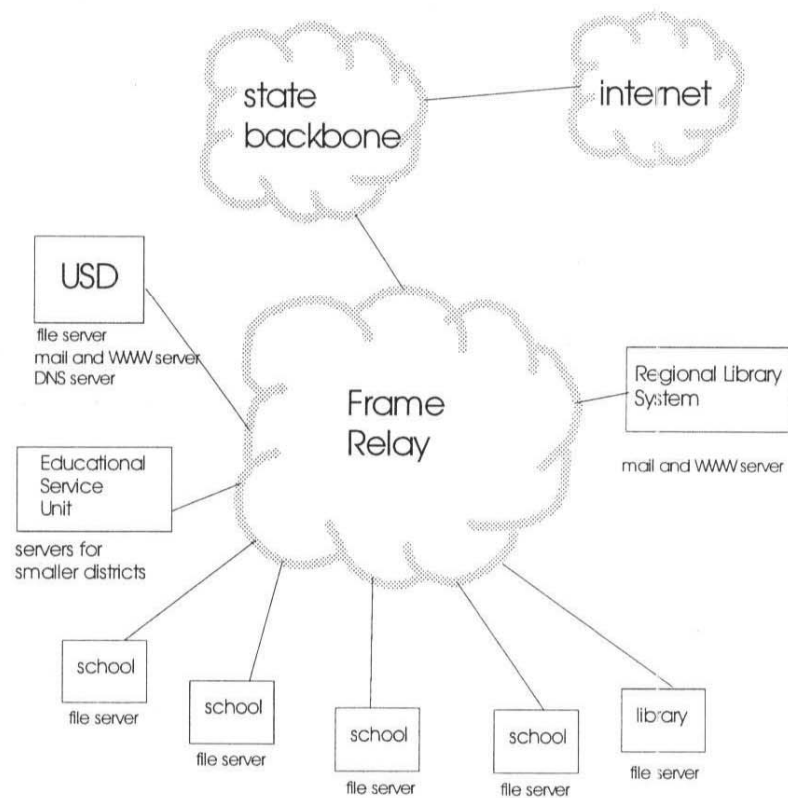
Technology and Architecture.

There are currently several alternative technologies for connecting schools and libraries to the Internet, and the number of alternatives is expected to grow. This model assumes a uniform network topology implemented using “frame relay” connections. (Frame relay technology is a telecommunications standard which allows signals between multiple origins and multiple destinations to be combined or “multiplexed” onto a single transmission line). Figure 1 shows that topology. Each school and library building connects via frame relay. Servers for World Wide Web pages and e-mail are located at the school district and regional library system level. Domain Name Services (DNS) are handled at the school district level. Smaller school districts may incorporate server-based services at the educational service units.

Each building is assumed to have a local file server. It would be possible to share these servers among several buildings but not at the network speeds anticipated to be initially installed. For example, launching a typical word processing program across a shared 56 kbps line could take several minutes, an unacceptable delay. As the network evolves and speeds increase there may well be centralization of some of the servers in this model.

Finally, the model includes the cost of providing servers at the Regional Library System level to provide resources unique to libraries. The model has libraries and schools cooperating in connectivity by having the backbone

Figure 1
Network topology used in this model



connections in the school districts, but it does not assume that e-mail and World Wide Web (WWW) services will be or should be shared.

Personnel Requirements.

Costs per teacher include training and development costs. Teachers will need to learn to use Internet related tools -- how to use the computer, how to use browser software, how to find things on the Internet, and so on. They will also need to learn how to integrate Internet related computing into their curriculum. The costs of teachers' training time is included in the model but may not mean an increase in district budgets. This cost may, instead, mean that teachers have less time to train in other areas.

Librarians, like teachers, will need to learn to use Internet-related tools—how to use the computer, how to use browser software. They will also need to develop expertise on what resources are available on the Internet and how to find them.

Computers and network equipment require support staff for a number of reasons. Broken equipment needs to be repaired, and software (including computer viruses) evolves continuously. Machines used by multiple students may also require occasional software fixes to remedy the results of youthful curiosity. The model assumes that each 500 computers will require one support person. Similarly, the networks in each building will require support for the hardware itself and the software on the network servers. The model assumes an additional support person for each 25 buildings.

There also will be networking support costs at the district level. E-mail and World Wide Web pages will require some sort of server. E-mail accounts will also have to be maintained. Internet addresses will have to be assigned and Domain Name Services will need to be supported. The model includes a half-time position for each district for networking support. For smaller districts it may be desirable to aggregate these positions at the Service Center level. The largest districts will probably need more than a half-time person.

We do not believe that these assumptions about support costs are extravagant but they do represent a substantial expenditure. Skimping on support can result in substantial waste as expensive equipment sits unused while waiting for repair.

As computing and networking technologies evolve there will continue to be a need for planning. The model includes costs for planning at both the district and building level.

A Decomposition of Cost.

The goal here is to divide total cost into its components. Costs are divided into “fixed” costs and “variable” costs. Statewide costs refer roughly to what it would take to operate a system with a minimal number of districts; therefore any additional costs at the state level are included in the district-level costs. The district costs refer to what it takes to operate a district network with a minimal number of buildings; therefore any additional costs at the district level are included in the

building costs. Similarly, any additional costs at the building level are included in the costs per staff person or client.

Technically, the basic cost model is:

$$\begin{aligned} \text{TOTAL COST} = & \\ & + (\text{statewide network cost}) \\ & + (\text{statewide library system cost}) \\ & + (\text{cost to serve one district}) \times (\text{number of school districts}) \\ & + (\text{cost to serve one building}) \times (\text{number of buildings}) \\ & + (\text{cost to serve one student}) \times (\text{number of students}) \\ & + (\text{cost to serve one teacher}) \times (\text{number of teachers}) \\ & + (\text{cost to serve one library patron}) \times (\text{number of library patrons}) \\ & + (\text{cost to serve one library staff person}) \times (\text{number of library staff}). \end{aligned}$$

While this detailed analysis of fixed and variable costs may seem a bit fussy, it is needed in order to support an analysis of inequality across districts. In particular, a district with a small number of students has a relatively high cost per student, because the fixed district costs and building costs are spread across a small number of students. For further details, see Burrell, 1996.

Within each cost item, some or all of the types of costs listed in Table 1.1 can be included. Conversely, all of the cost items have to be included somewhere.

- Costs at the state level include provision of state-wide data bases.
- Costs at the district level involve things like a shared e-mail server for the whole district, support staff for that server, and a connection from the district to the state backbone. State level backbone costs and connections from the state system to the Internet are included in the district component, because these costs are expected to grow roughly in proportion to the number of districts being served.
- Costs at the building level include a file server and a connection to the district. Within the building, wiring and the attendant network interface devices are computed on a per-computer basis and appear elsewhere in the model.
- Per student costs involve the cost of providing computers for students to use the Internet and the within-building network wiring for those computers.
- Per teacher costs include the cost of providing a computer for each teacher, the within-building network wiring for the computer, and training and development costs.
- Library costs have four components in the model - per building, per patron, per librarian, and per library system. The costs per building are assumed to be the same as for a school building so they do not appear separately. Per patron costs, like per student costs, have to do with the cost of providing workstations.

- Costs per librarian include the cost of providing a computer for each full time librarian, within building network wiring for the computer, and training.
- Finally, the model includes the cost of providing servers at the Regional Library System level to provide resources unique to libraries.

Pricing Assumptions.

Estimates for the costs of connections were made using currently available prices, with a few exceptions. Line charges for Internet connections seem to be higher in Kansas than in Iowa and Missouri. This model assumes that economies of scale when implementing connections to more than 1,600 buildings would bring prices down closer to those in neighboring states. For the same reason this model also uses the current KANREN rates for the smallest sized schools for all connections.

The cost for local line speeds is estimated. Currently, an average cost in Kansas for a 56 kbps line is estimated to be \$250 per month. However, MORENET in Missouri gets its 56 kbps lines for \$150 per month, or less. An assumption is made that with the purchase of over 1,500 lines a price closer to that available in Missouri can be obtained.

MORENET annual charge (partly subsidized):

56 kbps line only	\$1,800
T1 line only	\$6,300

State level backbone costs and connections from the state system to the Internet are evaluated at the current KANREN rates for 384 kbps. Larger school districts may generate enough traffic to the Internet that they will want T1 connections.

KANREN annual connection charge:

56 kbps to Internet	\$7,380
384 kbps to Internet	\$14,700
T1 to Internet	\$22,080

CHAPTER 3. RESULTS

The basic model of Internet-related costs has been implemented in the form of a LOTUS spreadsheet. The spreadsheet can easily be used to simulate effects of changes, not only in the level of service being provided, but also in the prices paid for inputs and in the load of consumers that are being served.

Significant results of the model are presented in Tables 3.1, 3.2, and 3.3 as spreadsheets having particular assumptions about the number of connected computers per student and line speeds. The first section of each spreadsheet contains a table of parameters for the model. In some cases there are also additional numbers listed which are functions of the parameters. These numbers appear in a table labeled "Derived from Assumptions". They are used as named constants in the spreadsheet to make proofreading the formulas easier. For example, "**computers per hardware support person**" appears as a parameter while "*hardware support persons per computer*" appears in italics since it is computed from the parameter.

Results for the model under the three variant assumptions are summarized in Table 3.4. The only parameter that varies between models is the number of students per computer. (Total costs are much more sensitive to that parameter than to any other parameter related to the level of service.) However, according to the model, as the number of computers increases, there are corresponding increases in cost for wiring and technical support. Costs at the state-wide level, district level, building level, and teacher level are the same in all three variant models. Library-related costs are also the same in all three variant models.

Within each table, separate sections show the detailed costs at each level (the levels are: state-wide, district, building, student, teacher, library patron, library staff, regional library system). The initial section summarizes the main parameters used in the model. The final section summarizes the cost totals by function and by administrative system.

Table 3.4 summarizes the results of the three variant models.

Table 3.1 Model Results for the Assumption of 30 Students per Computer

3.1.1 General Data and Assumptions

GRAND TOTAL FOR ALL COSTS

\$82,061,335

technical staff, annual salary including fringe	\$32,000
amortization period (years)	5
local 56 kbps frame relay line rent, annual	\$2,000
connect to statewide backbone and Internet, annual	\$14,700
cost of computer and software over lifespan	\$2,500
wiring LAN port (with concentrators and NIC)	\$600
students per computer	30
teachers per computer	1
librarians per computer	1
population per public library computer	2,000
teachers	29,814
students (projected from KSA*)	480,000
student-teacher ratio (KSA)	16.1
librarians (see sidebar)	850
library patrons (see sidebar)	2,500,000
school buildings	1,490
school districts	304
full time libraries	194
regional library systems	7
support staff per Regional Library System	2
network support persons per district	0.50
buildings per network support person	25
computers per hardware support person	500
teacher-days per training person	2,400
librarian-days per training person	2,400
travel cost+equip./trainer year	\$4,084
materials cost/trainee day	\$5.00
days training per teacher	1
days training per librarian	1
development days per teacher	4
development days per librarian	5
teaching days per year	180
librarian days per year	240

KANREN annual connection	
56 kbps to Internet	\$7,380
384 kbps to Internet	\$14,700
T1 to Internet	\$22,080

MORENET annual cost	
56 kbps line only	\$1,800
T1 line only	\$6,300

Libraries	
open 20 hrs/week	174
branches	20
total	194
librarians	850
[Bird and Ealy, 1994]	

supports server, e-mail, DNS, WWW pages, user accounts

supports building LAN, file server

fixes & upgrades computers, installs and upgrades software

daily 40 miles @ .29/ mile +1300 per year equip

100 pages @ .05/page

in-service training days

learning about Internet software

working computing into the curriculum

learning about Internet resources

*KSA - Kansas Statistical Abstract, 1993-94

Table 3.1 Model Results for the Assumption of 30 Students per Computer

Derived from Assumptions:

<i>maximum computer hours per week per student</i>	<i>1.0</i>
<i>computers per student</i>	<i>0.033</i>
<i>computers per teacher</i>	<i>1</i>
<i>computers per librarian</i>	<i>1</i>
<i>computers/population served</i>	<i>0.0005</i>
<i>mean computers per school</i>	<i>31</i>
<i>mean computers per library</i>	<i>10.82</i>
<i>mean computers per building</i>	<i>28.45</i>
<i>total number of buildings</i>	<i>1,684</i>
<i>network support persons per building</i>	<i>0.040</i>
<i>annual network support cost per building</i>	<i>\$1,280</i>
<i>hardware support persons per computer</i>	<i>0.002</i>
<i>annual hardware support cost per computer</i>	<i>\$64</i>
<i>teachers per training person</i>	<i>2,400</i>
<i>librarians per training person</i>	<i>2,400</i>
<i>total computers</i>	<i>47,914</i>

3.1.2 State Level Costs

Types of Costs at the State Level

multiple T1 lines or T3 line to Internet	included in price of connection to district	
backbone circuits	"	
router(s) for the statewide backbone	"	
staff support for the statewide backbone	"	
databases (online periodicals, research materials, encyclopedias, etc.)		\$500,000

Statewide Annual Costs **\$500,000**

Note: Connections to the school districts are computed at the current KANREN rate for 384 kbps. This includes the cost of a state-level managed backbone network. Actual costs for a 300 node WAN at 384 kbps are likely to be lower. On the other hand, higher speeds for district connections are likely to be needed.

Table 3.1 Model Results for the Assumption of 30 Students per Computer

3.1.3 District Level Fixed Costs

Types of Costs at School District Level	Single District FTE Employees	Single District Costs	Statewide Annualized Costs for 304 Districts
capital costs:			
hardware planning	0.125 FTE	\$4,000	\$243,200
curriculum planning	0.500 FTE	\$16,000	\$972,800
Communications hardware(CSU/DSU)	included in installation fee below		\$0
router	included in installation fee below		\$0
network server and software		\$7,500	\$456,000
post office/home page server		\$6,000	\$364,800
Internet connection installation fee		\$5,500	\$334,400
NOTE: the network described here uses frame relay connections from the districts to a state backbone and from each building in a district to a district router. All routers would support T1 speeds although initial line speeds would likely be lower. This configuration avoids expensive equipment replacement for upgrading to higher speeds. Figure 1 is a diagram of the configuration.			
total capital costs		\$39,000	
annualized capital costs			\$7,800
recurring annual costs:			
support personnel	0.500 FTE	\$16,000	\$4,864,000
Internet and local frame relay		\$14,700	\$4,468,800
total recurring costs			\$30,700
total annualized costs			\$38,500
Statewide costs:			
number of districts			304
Total Costs at District Central Sites			\$11,704,000

Table 3.1 Model Results for the Assumption of 30 Students per Computer

3.1.4 Building Level Fixed Costs (Schools and Libraries)

Types of Costs at the School Building Level	FTE Employees per Building	Individual Building Costs	Statewide Annualized Costs for 1,684 Buildings
capital costs			
WAN connectors (CSU/DSU)		\$400	\$134,720
hardware planning	0.042 FTE	\$1,333 (2 weeks every 5 years)	\$449,067
T1 capable router		\$3,000	\$1,010,400
network server and software		\$5,500	\$1,852,400
WAN connection installation fee		\$500	\$168,400
total capital costs		\$10,733	
annualized capital costs			\$2,147 \$3,614,987 Note: sum of above
recurring annual costs			
network support person	0.04 FTE	\$1,280	\$2,155,520
56 kbps line		\$2,000	\$3,368,000
<p>NOTE: the cost for local line speeds is estimated. Currently an average cost in Kansas for a 56 kbps line is estimated to be \$250 per month. MORENET gets 56 kbps lines for \$150 per month or less. A similar price is available in Iowa. An assumption is made that with the purchase of over 1,500 lines a price closer to that available in neighboring states may be available.</p> <p>It should also be noted that 56 kbps connections will be inadequate for many potential administrative uses for within district connections. Some districts may be willing to fund alternative connections such as laying or leasing their own optical fibers.</p>			
total recurring costs			\$3,280
total annualized costs			\$5,427
number of school buildings			1,684
Total Cost for 1,684 Buildings			\$9,138,507

Table 3.1 Model Results for the Assumption of 30 Students per Computer

3.1.5 Per Student Marginal Costs

Types of Costs Related to Number of Students	Computers per Student	Costs per Computer	Costs per Student	Statewide Annualized Costs (for 480,000 students)
capital costs/ workstation computer with software	0.033	\$2,500	\$83.33	\$8,000,000
LAN port & NIC	0.033	\$600	\$20.00	\$1,920,000
annualized capital costs/student			\$20.67	
hardware support recurring costs/student	0.033	\$64	\$2.13	\$1,024,000
total annualized costs/student			\$22.80	
statewide costs				
number of students			480,000	
Total Cost for 480,000 Students				\$10,944,000

Table 3.1 Model Results for the Assumption of 30 Students per Computer

3.1.6 Per Teacher Marginal Costs

Types of Costs Related to Number of Teachers	Resources per Teacher	Costs per Computer	Costs per Teacher	Statewide Annual Costs (for 29,814 teachers)
capital costs/teacher	Computers per Teacher			
computer with software	1	\$2,500	\$2,500	\$14,906,832
LAN port & NIC	1	\$600	\$600	\$3,577,640
annualized capital costs				\$620.00
recurring costs/teacher	Computers per Teacher			
hardware support	1	\$64	\$64	\$1,908,075
trainer travel and materials		\$7	\$7	\$199,801
	FTE Training Employees per Teacher			
trainers	0.00042		\$13	
teacher training	0.00556		\$178	
development efforts	0.02222		\$711	
recurring training costs				\$902.00
total annualized costs				\$1,522.22
NOTE: teacher training and development efforts are already budgeted, but there are costs in that they compete with other kinds of training.				
statewide costs				
number of teachers				29,814
Total Costs for 29,814 Teachers				\$47,490,899

Table 3.1 Model Results for the Assumption of 30 Students per Computer

3.1.7 Marginal Costs Per Library Patron

Types of Costs Related to Public Library Patrons	Resources per Patron	Costs per Computer	Costs per Library Patron	Statewide Annual Costs
equipment costs				
capital costs/workstation				
computer with software	0.0005	\$2,500	\$1.25	\$625,000
LAN port & NIC	0.0005	\$600	\$0.30	\$150,000
annualized capital costs/patron			\$0.31	
recurring annual costs				
	Computers per Patron			
hardware support	0.0005	\$64	\$0.032	\$80,000
total recurring costs			\$0.032	
total annualized costs			\$0.34	
statewide costs				
number of patrons			2,500,000	
Total Cost for 2,500,000 Library Patrons				\$855,000

3.1.8 Marginal Costs Per Public Librarian

Types of Costs Related to Public Librarians	Resources per Librarian	Costs per Computer	Costs per Librarian	Statewide Annual Costs (850 librarians)
capital costs/librarian				
computer with software	1	\$2,500	\$2,500	\$425,000
LAN port & NIC	1	\$600	\$600	\$102,000
annualized capital costs				\$620
recurring costs/librarian				
	Computers per Librarian			
hardware support	1	\$64	\$64	\$54,400
trainer travel and materials		\$7		\$5,696
librarian training and staffing				
	FTE			
trainers	0.00042	\$13		
librarian training	0.00417	\$133		
librarian staffing	0.02083	\$667		
recurring training costs				\$813
total annualized costs				\$1,433
statewide costs				
number of librarians			850	
Total Costs for 850 Librarians				\$1,278,430

Table 3.1 Model Results for the Assumption of 30 Students per Computer

3.1.9 Marginal Costs Per Regional Library System

Types of Costs for Regional Systems	FTE Employees	Regional Library System Costs	Statewide Annual Costs
hardware planning	0.125	\$4,000	\$5,600
network server and software		\$7,500	\$10,500
post office/home page server		\$6,000	\$8,400
total capital costs		\$17,500	
annualized capital costs			\$3,500
recurring annual costs			
support personnel (FTE)	0.500	\$16,000	\$112,000
56 kbps line		\$2,000	\$14,000
total recurring costs			\$18,000
total annualized costs			\$21,500
number of regional systems			7
Total Costs for Regional Library Systems			\$150,500

Table 3.1 Model Results for the Assumption of 30 Students per Computer

3.1.10 Summary for 30 Students per Computer

Statewide Annual Cost Summary		
30 students per computer		
computers - workstations		\$23,956,832
computers - servers		\$2,692,100
staff		\$39,458,545
new	\$11,868,661	
current	\$27,589,884	
networking - within district		\$10,445,160
networking - to Internet		\$4,803,200
travel and materials		\$205,498
database		\$500,000
Total		\$82,061,335

total for schools	\$78,724,632
schools expenditure per pupil	\$164
total for libraries	\$3,336,703
NOTE: backbone costs for libraries are included in the schools figure	

per district costs

connection to Internet	\$38,500
computers, local network, staff	\$220,463

Table 3.2 Model Results for the Assumption of 6 Students per Computer

3.2.1 General Data and Assumptions	
GRAND TOTAL	\$125,837,335
technical staff, annual salary including fringe	\$32,000
amortization period (years)	5
local 56 kbps frame relay line rent, annual	\$2,000
connect to statewide backbone and Internet, annual	\$14,700
cost of computer and software over lifespan	\$2,500
wiring LAN port (with concentrators and NIC)	\$600
students per computer	6
teachers per computer	1
librarians per computer	1
population per public library computer	2,000
teachers	29,814
students (projected from KSA*)	480,000
student-teacher ratio (KSA)	16.1
librarians (see sidebar)	850
library patrons (see sidebar)	2,500,000
school buildings	1,490
school districts	304
full time libraries	194
regional library systems	7
support staff per Regional Library System	2
network support persons per district	0.50
buildings per network support person	25
computers per hardware support person	500
teacher-days per training person	2,400
librarian-days per training person	2,400
travel cost+equip./trainer year	\$4,084
materials cost/trainee day	\$5.00
days training per teacher	1
days training per librarian	1
development days per teacher	4
development days per librarian	5
teaching days per year	180
librarian days per year	240

KANREN annual connection	
56 kbps to Internet	\$7,380
384 kbps to Internet	\$14,700
T1 to Internet	\$22,080

MORENET annual cost	
56 kbps line only	\$1,800
T1 line only	\$6,300

Libraries	
open 20 hrs/week	174
branches	20
total	194
librarians	850
[Bird and Ealy, 1994]	

network support persons per district	0.50	supports server, e-mail, DNS, WWW pages, user accounts
buildings per network support person	25	supports building LAN, file server
computers per hardware support person	500	fixes & upgrades computers, installs and upgrades software
travel cost+equip./trainer year	\$4,084	daily 40 miles @ .29/ mile +1300 per year equip
materials cost/trainee day	\$5.00	100 pages @ .05/page
days training per teacher	1	in-service training days
days training per librarian	1	learning about Internet software
development days per teacher	4	working computing into the curriculum
development days per librarian	5	learning about Internet resources

*KSA - Kansas Statistical Abstract, 1993-94

Table 3.2 Model Results for the Assumption of 6 Students per Computer

Derived from Assumptions:

<i>maximum computer hours per week per student</i>	5.0
<i>computers per student</i>	0.167
<i>computer per teacher</i>	1
<i>computers per librarian</i>	1
<i>computers/population served</i>	0.0005
<i>mean computers per school</i>	74
<i>mean computers per library</i>	10.82
<i>mean computers per building</i>	66.46
<i>total number of buildings</i>	1,684
<i>network support persons per building</i>	0.040
<i>annual network support cost per building</i>	\$1,280
<i>hardware support persons per computer</i>	0.002
<i>annual hardware support cost per computer</i>	\$64
<i>teachers per training person</i>	2,400
<i>librarians per training person</i>	2,400
<i>total computers</i>	111,914

3.2.2 State Level Costs

Types of Costs at the State Level

multiple T1 lines or T3 line to Internet backbone circuits	included in price of connection to district	
router(s) for the statewide backbone	"	
staff support for the statewide backbone	"	
databases (online periodicals, research materials, encyclopedias, etc.)		\$500,000
Statewide Annual Costs		\$500,000

Note: Connections to the school districts are computed at the current KANREN rate for 384 kbps. This includes the cost of a state-level managed backbone network. Actual costs for a 300 node WAN at 384 kbps are likely to be lower. On the other hand, higher speeds for district connections are likely to be needed.

Table 3.2 Model Results for the Assumption of 6 Students per Computer

3.2.3 District Level Fixed Costs

Types of Costs at School District Level	Single District FTE Employees	Single District Costs	Statewide Annualized Costs for 304 Districts
capital costs:			
hardware planning	0.125 FTE	\$4,000	\$243,200
curriculum planning	0.500 FTE	\$16,000	\$972,800
Communications hardware(CSU/DSU)	included in installation fee below		\$0
router	included in installation fee below		\$0
network server and software		\$7,500	\$456,000
post office/home page server		\$6,000	\$364,800
Internet connection installation fee		\$5,500	\$334,400
NOTE: the network described here uses frame relay connections from the districts to a state backbone and from each building in a district to a district router. All routers would support T1 speeds although initial line speeds would likely be lower. This configuration avoids expensive equipment replacement for upgrading to higher speeds. Figure 1 is a diagram of the configuration.			
total capital costs		\$39,000	
annualized capital costs			\$7,800
recurring annual costs:			
support personnel	0.500 FTE	\$16,000	\$4,864,000
Internet and local frame relay		\$14,700	\$4,468,800
total recurring costs			\$30,700
total annualized costs			\$38,500
Statewide costs:			
number of districts			304
Total Costs at District Central Sites			\$11,704,000

Table 3.2 Model Results for the Assumption of 6 Students per Computer

3.2.4 Building Level Fixed Costs (Schools and Libraries)			
Types of Costs at the School Building Level	FTE Employees per Building	Individual Building Costs	Statewide Annualized Costs for 1,684 Buildings
capital costs			
WAN connectors (CSU/DSU)		\$400	\$134,720
hardware planning	0.042 FTE	\$1,333 (2 weeks every 5 years)	\$449,067
T1 capable router		\$3,000	\$1,010,400
network server and software		\$5,500	\$1,852,400
WAN connection installation fee		\$500	\$168,400
total capital costs		\$10,733	
annualized capital costs			\$2,147 \$3,614,987 Note: sum of above
recurring annual costs			
network support person	0.04 FTE	\$1,280	\$2,155,520
56 kbps line		\$2,000	\$3,368,000
NOTE: the cost for local line speeds is estimated. Currently an average cost in Kansas for a 56 kbps line is estimated to be \$250 per month. MORENET gets 56 kbps lines for \$150 per month or less. A similar price is available in Iowa. An assumption is made that with the purchase of over 1,500 lines a price closer to that available in neighboring states may be available.			
It should also be noted that 56 kbps connections will be inadequate for many potential administrative uses for within district connections. Some districts may be willing to fund alternative connections such as laying or leasing their own optical fibers.			
total recurring costs			\$3,280
total annualized costs			\$5,427
number of school buildings			1,684
Total Cost for 1,684 Buildings			\$9,138,507

Table 3.2 Model Results for the Assumption of 6 Students per Computer

3.2.5 Per Student Marginal Costs

Types of Costs Related to Number of Students	Computers per Student	Costs per Computer	Costs per Student	Statewide Annualized Costs (for 480,000 students)
capital costs/ workstation computer with software	0.167	\$2,500	\$416.67	\$40,000,000
LAN port & NIC	0.167	\$600	\$100.00	\$9,600,000
annualized capital costs/student			\$103.33	
hardware support	0.167	\$64	\$10.67	\$5,120,000
recurring costs/student			\$10.67	
total annualized costs/student			\$114.00	
statewide costs				
number of students			480,000	
Total Costs for 480,000 Students				\$54,720,000

Table 3.2 Model Results for the Assumption of 6 Students per Computer

3.2.6 Per Teacher Marginal Costs

Types of Costs Related to Number of Teachers	Resources per Teacher	Costs per Computer	Costs per Teacher	Statewide Annual Costs (for 29,814 teachers)
capital costs/teacher	Computers per Teacher			
computer with software	1	\$2,500	\$2,500	\$14,906,832
LAN port & NIC	1	\$600	\$600	\$3,577,640
annualized capital costs				\$620.00
recurring costs/teacher	Computers per Teacher			
hardware support	1	\$64	\$64	\$1,908,075
trainer travel and materials		\$7	\$7	\$199,801
	FTE Training Employees per Teacher			
trainers	0.00042		\$13	
teacher training	0.00556		\$178	
development efforts	0.02222		\$711	
recurring training costs				\$902.00
total annualized costs				\$1,522.22
NOTE: teacher training and development efforts are already budgeted, but there are costs in that they compete with other kinds of training.				
statewide costs				
number of teachers				29,814
Total Costs for 29,814 Teachers				\$47,490,899

Table 3.2 Model Results for the Assumption of 6 Students per Computer

3.2.7 Marginal Costs Per Library Patron

Types of Costs Related to Public Library Patrons	Resources per Patron	Costs per Computer	Costs per Library Patron	Statewide Annual Costs
equipment costs				
capital costs/workstation				
computer with software	0.0005	\$2,500	\$1.25	\$625,000
LAN port & NIC	0.0005	\$600	\$0.30	\$150,000
annualized capital costs/patron			\$0.31	
recurring annual costs				
	Computers per Patron			
hardware support	0.0005	\$64	\$0.032	\$80,000
total recurring costs			\$0.032	
total annualized costs			\$0.34	
statewide costs				
number of patrons			2,500,000	
Total Cost for 2,500,000 Library Patrons				\$855,000

3.2.8 Marginal Costs Per Public Librarian

Types of Costs Related to Public Librarians	Resources per Librarian	Costs per Computer	Costs per Librarian	Statewide Annual Costs (350 librarians)
capital costs/librarian				
computer with software	1	\$2,500	\$2,500	\$425,000
LAN port & NIC	1	\$600	\$600	\$102,000
annualized capital costs			\$620	
recurring costs/librarian				
	Computers per Librarian			
hardware support	1	\$64	\$64	\$54,400
trainer travel and materials		\$7		\$5,696
librarian training and staffing				
	FTE			
trainers	0.00042	\$13		
librarian training	0.00417	\$133		
librarian staffing	0.02083	\$667		
recurring training costs			\$813	\$691,333
total annualized costs			\$1,433	
statewide costs				
number of librarians			850	
Total Costs for 850 Librarians				\$1,278,430

Table 3.2 Model Results for the Assumption of 6 Students per Computer

3.2.9 Marginal Costs Per Regional Library System			
Types of Costs for Regional Systems	FTE Employees	Regional Library System Costs	Statewide Annual Costs
hardware planning	0.125	\$4,000	\$5,600
network server and software		\$7,500	\$10,500
post office/home page server		\$6,000	\$8,400
total capital costs		\$17,500	
annualized capital costs			\$3,500
recurring annual costs			
support personnel (FTE)	0.500	\$16,000	\$112,000
56 kbps line		\$2,000	\$14,000
total recurring costs			\$18,000
total annualized costs			\$21,500
number of regional systems			7
Total Costs for Regional Library Systems			\$150,500

Table 3.2 Model Results for the Assumption of 6 Students per Computer

3.2.10 Summary for 6 Students per Computer

Statewide Annual Cost Summary		
6 students per computer		
computers - workstations		\$55,956,832
computers - servers		\$2,692,100
staff		\$43,554,545
new	\$15,964,661	
current	\$27,589,884	
networking - within district		\$18,125,160
networking - to Internet		\$4,803,200
travel and materials		\$205,498
database		\$500,000
Total		\$125,837,335

total for schools	\$122,500,632
schools expenditure per pupil	\$255
total for libraries	\$3,336,703
NOTE: backbone costs for libraries are included in the schools figure	

per district costs

connection to Internet	\$38,500
computers, local network, staff	\$223,926

Table 3.3 Model Results for the Assumption of 1 Student per Computer

3.3.1 General Data and Assumptions

GRAND TOTAL \$339,437,335

technical staff, annual salary including fringe	\$32,000	
amortization period (years)	5	
local 56 kbps frame relay line rent, annual	\$2,000	
connect to statewide backbone and Internet, annual	\$14,700	
cost of computer and software over lifespan	\$2,500	
wiring LAN port (with concentrators and NIC)	\$600	
students per computer	1	
teachers per computer	1	
librarians per computer	1	
population per public library computer	2,000	
teachers	29,814	
students (projected from KSA*)	480,000	
student-teacher ratio (KSA)	16.1	
librarians (see sidebar)	850	
library patrons (see sidebar)	2,500,000	
school buildings	1,490	
school districts	304	
full time libraries	194	
regional library systems	7	
support staff per Regional Library System	2	
network support persons per district	0.50	<i>supports server, e-mail, DNS, WWW pages, user accounts</i>
buildings per network support person	25	<i>supports building LAN, file server</i>
computers per hardware support person	500	<i>fixes & upgrades computers, installs and upgrades software</i>
teacher-days per training person	2,400	
librarian-days per training person	2,400	
travel cost+equip./trainer year	\$4,084	<i>daily 40 miles @ .29/ mile +1300 per year equip</i>
materials cost/trainee day	\$5.00	<i>100 pages @ .05/page</i>
days training per teacher	1	<i>in-service training days</i>
days training per librarian	1	<i>learning about Internet software</i>
development days per teacher	4	<i>working computing into the curriculum</i>
development days per librarian	5	<i>learning about Internet resources</i>
teaching days per year	180	
librarian days per year	240	

KANREN annual connection	
56 kbps to Internet	\$7,380
384 kbps to Internet	\$14,700
T1 to Internet	\$22,080

MORENET annual cost	
56 kbps line only	\$1,800
T1 line only	\$6,300

Libraries	
open 20 hrs/week	174
branches	20
total	194
librarians	850
[Bird and Ealy, 1994]	

*KSA - Kansas Statistical Abstract, 1993-94

Table 3.3 Model Results for the Assumption of 1 Student per Computer

Derived from Assumptions:

<i>maximum computer hours per week per student</i>	<i>30.0</i>
<i>computers per student</i>	<i>1</i>
<i>computer per teacher</i>	<i>1</i>
<i>computers per librarian</i>	<i>1</i>
<i>computers/population served</i>	<i>0.0005</i>
<i>mean computers per school</i>	<i>342</i>
<i>mean computers per library</i>	<i>10.82</i>
<i>mean computers per building</i>	<i>303.99</i>
<i>total number of buildings</i>	<i>1,684</i>
<i>network support persons per building</i>	<i>0.040</i>
<i>annual network support cost per building</i>	<i>\$1,280</i>
<i>hardware support persons per computer</i>	<i>0.002</i>
<i>annual hardware support cost per computer</i>	<i>\$64</i>
<i>teachers per training person</i>	<i>2,400</i>
<i>librarians per training person</i>	<i>2,400</i>
<i>total computers</i>	<i>511,914</i>

3.3.2 State Level Costs

Types of Costs at the State Level

multiple T1 lines or T3 line to Internet	included in price of connection to district	
backbone circuits	"	
router(s) for the statewide backbone	"	
staff support for the statewide backbone	"	
databases (online periodicals, research materials, encyclopedias, etc.)		\$500,000
Statewide Annual Costs		\$500,000

Note: Connections to the school districts are computed at the current KANREN rate for 384 kbps. This includes the cost of a state-level managed backbone network. Actual costs for a 300 node WAN at 384 kbps are likely to be lower. On the other hand, higher speeds for district connections are likely to be needed.

Table 3.3 Model Results for the Assumption of 1 Student per Computer

3.3.3 District Level Fixed Costs

Types of Costs at School District Level	Single District FTE Employees	Single District Costs	Statewide Annualized Costs for 304 Districts
capital costs:			
hardware planning	0.125 FTE	\$4,000	\$243,200
curriculum planning	0.500 FTE	\$16,000	\$972,800
Communications hardware(CSU/DSU)	included in installation fee below		\$0
router	included in installation fee below		\$0
network server and software		\$7,500	\$456,000
post office/home page server		\$6,000	\$364,800
Internet connection installation fee		\$5,500	\$334,400
NOTE: the network described here uses frame relay connections from the districts to a state backbone and from each building in a district to a district router. All routers would support T1 speeds although initial line speeds would likely be lower. This configuration avoids expensive equipment replacement for upgrading to higher speeds. Figure 1 is a diagram of the configuration.			
total capital costs		\$39,000	
annualized capital costs			\$7,800
recurring annual costs:			
support personnel	0.500 FTE	\$16,000	\$4,864,000
Internet and local frame relay		\$14,700	\$4,468,800
total recurring costs			\$30,700
total annualized costs			\$38,500
Statewide costs:			
number of districts			304
Total Costs at District Central Sites			\$11,704,000

Table 3.3 Model Results for the Assumption of 1 Student per Computer

3.3.4 Building Level Fixed Costs (Schools and Libraries)

Types of Costs at the School Building Level	FTE Employees per Building	Individual Building Costs	Statewide Annualized Costs for 1,684 Buildings
capital costs			
WAN connectors (CSU/DSU)		\$400	\$134,720
hardware planning	0.042 FTE	\$1,333 (2 weeks every 5 years)	\$449,067
T1 capable router		\$3,000	\$1,010,400
network server and software		\$5,500	\$1,852,400
WAN connection installation fee		\$500	\$168,400
total capital costs		\$10,733	
annualized capital costs			\$2,147 \$3,614,987 Note: sum of above
recurring annual costs			
network support person	0.04 FTE	\$1,280	\$2,155,520
56 kbps line		\$2,000	\$3,368,000
<p>NOTE: the cost for local line speeds is estimated. Currently an average cost in Kansas for a 56 kbps line is estimated to be \$250 per month. MORENET gets 56 kbps lines for \$150 per month or less. A similar price is available in Iowa. An assumption is made that with the purchase of over 1,500 lines a price closer to that available in neighboring states may be available.</p> <p>It should also be noted that 56 kbps connections will be inadequate for many potential administrative uses for within district connections. Some districts may be willing to fund alternative connections such as laying or leasing their own optical fibers.</p>			
total recurring costs			\$3,280
total annualized costs			\$5,427
number of school buildings			1,684
Total Cost for 1,684 Buildings			\$9,138,507

Table 3.3 Model Results for the Assumption of 1 Student per Computer

3.3.5 Per Student Marginal Costs

Types of Costs Related to Number of Students	Computers per Student	Costs per Computer	Costs per Student	Statewide Annualized Costs (for 480,000 students)
capital costs/ workstation computer with software	1.0	\$2,500	\$416.67	\$240,000,000
LAN port & NIC	1.0	\$600	\$100.00	\$57,600,000
annualized capital costs/student			\$620.00	
hardware support	1.0	\$64	\$64.00	\$30,720,000
recurring costs/student			\$64.00	
total annualized costs/student			\$684.00	
statewide costs				
number of students			480,000	
Total Costs for 480,000 Students				\$328,320,000

Table 3.3 Model Results for the Assumption of 1 Student per Computer

3.3.6 Per Teacher Marginal Costs

Types of Costs Related to Number of Teachers	Resources per Teacher	Costs per Computer	Costs per Teacher	Statewide Annual Costs (for 29,814 teachers)
capital costs/teacher	Computers per Teacher			
computer with software	1	\$2,500	\$2,500	\$14,906,832
LAN port & NIC	1	\$600	\$600	\$3,577,640
annualized capital costs			\$620.00	
recurring costs/teacher	Computers per Teacher			
hardware support	1	\$64	\$64	\$1,908,075
trainer travel and materials		\$7	\$7	\$199,801
	FTE Training Employees per Teacher			
trainers	0.00042		\$13	
teacher training	0.00556		\$178	
development efforts	0.02222		\$711	
recurring training costs			\$902.00	\$26,898,551
total annualized costs			\$1,522.22	
NOTE: teacher training and development efforts are already budgeted, but there are costs in that they compete with other kinds of training.				
statewide costs				
number of teachers			29,814	
Total Costs for 29,814 Teachers				\$47,490,899

Table 3.3 Model Results for the Assumption of 1 Student per Computer

3.3.7 Marginal Costs Per Library Patron

Types of Costs Related to Public Library Patrons	Resources per Patron	Costs per Computer	Costs per Library Patron	Statewide Annual Costs
equipment costs				
capital costs/workstation				
computer with software	0.0005	\$2,500	\$1.25	\$625,000
LAN port & NIC	0.0005	\$600	\$0.30	\$150,000
annualized capital costs/patron			\$0.31	
recurring annual costs	Computers per Patron			
hardware support	0.0005	\$64	\$0.032	\$80,000
total recurring costs			\$0.032	
total annualized costs			\$0.34	
statewide costs				
number of patrons			2,500,000	
Total Cost for 2,500,000 Library Patrons				\$855,000

3.3.8 Marginal Costs Per Public Librarian

Types of Costs Related to Public Librarians	Resources per Librarian	Costs per Computer	Costs per Librarian	Statewide Annual Costs (850 librarians)
capital costs/librarian				
computer with software	1	\$2,500	\$2,500	\$425,000
LAN port & NIC	1	\$600	\$600	\$102,000
annualized capital costs				\$620
recurring costs/librarian	Computers per Librarian			
hardware support	1	\$64	\$64	\$54,400
trainer travel and materials		\$7		\$5,696
librarian training and staffing	FTE			
trainers	0.00042	\$13		
librarian training	0.00417	\$133		
librarian staffing	0.02083	\$667		
recurring training costs				\$813
total annualized costs				\$1,433
statewide costs				
number of librarians				850
Total Costs for 850 Librarians				\$1,278,430

Table 3.3 Model Results for the Assumption of 1 Student per Computer

3.3.9 Marginal Costs Per Regional Library System

Types of Costs for Regional Systems	FTE Employees	Regional Library System Costs	Statewide Annual Costs
hardware planning	0.125	\$4,000	\$5,600
network server and software		\$7,500	\$10,500
post office/home page server		\$6,000	\$8,400
total capital costs		\$17,500	
annualized capital costs			\$3,500
recurring annual costs			
support personnel (FTE)	0.500	\$16,000	\$112,000
56 kbps line		\$2,000	\$14,000
total recurring costs			\$18,000
total annualized costs			\$21,500
number of regional systems			7
Total Costs for Regional Library Systems			\$150,500

Table 3.3 Model Results for the Assumption of 1 Student per Computer

3.3.10 Summary for 1 Students per Computer

Statewide Annual Cost Summary		
1 students per computer		
computers - workstations		\$255,956,832
computers - servers		\$2,692,100
staff		\$69,154,545
new	\$41,564,661	
current	\$27,589,884	
networking - within district		\$66,125,160
networking - to Internet		\$4,803,200
travel and materials		\$205,498
database		\$500,000
Total		\$399,837,335

total for schools	\$396,100,632
schools expenditure per pupil	\$825
total for libraries	\$3,336,703
NOTE: backbone costs for libraries are included in the schools figure	

per district costs

connection to Internet	\$38,500
computers, local network, staff	\$1,264,463

**Table 3.4 Total Costs by Category for Models with
Alternative Assumptions on the Number of Students per Computer**

Statewide Annual Cost Summary	students per computer		
	1	6	30
computers - workstations	\$255,956,832	\$55,956,832	\$23,956,832
computers - servers	\$2,692,100	\$2,692,100	\$2,692,100
staff	\$69,154,545	\$44,554,545	\$39,458,545
new	\$41,564,661	\$15,964,661	\$11,868,661
current	\$27,589,884	\$27,589,884	\$27,589,884
networking - within district	\$66,125,160	\$18,125,160	\$10,445,160
networking - to Internet	\$4,803,200	\$4,803,200	\$4,803,200
travel and materials	\$205,498	\$205,498	\$205,498
database	\$500,000	\$500,000	\$500,000
TOTAL	\$399,437,335	\$125,837,335	\$82,061,335

total for schools	\$396,100,632	\$122,500,632	\$78,724,632
schools expenditure per pupil	\$825	\$255	\$164
total for libraries	\$3,336,703	\$3,336,703	\$3,336,703
NOTE: backbone costs for libraries are included in the schools figure			

average per district costs

connection to Internet	\$38,500	\$38,500	\$38,500
computers, local network, staff	\$1,264,463	\$364,463	\$220,463

CHAPTER 4. CONCLUSIONS

It would cost an estimated \$83 million per year to provide a minimum level of direct Internet connections to all Kansas schools and libraries, assuming there is only 1 computer connected to the Internet per each 30 students. Much of this cost is implicitly contained within existing school and library budgets. These costs are based on many other modeled assumptions, and actual experience would be different in many details and probably would change over time.

Most of these costs are “variable” costs, i.e. costs which depend on the numbers of users being served. According to the model:

- The cost to connect one additional district to the Internet backbone is roughly \$39,000 per year.
- The cost of computers, local networking, and related staff for a typical district is roughly \$220,000 per year.
- The cost of networking for one additional building is roughly \$5,400 per year.
- The cost to serve one additional student is roughly \$23 per year (excluding additional staff costs).
- The cost to serve one additional teacher is roughly \$1,500 per year.
- The cost to serve one additional librarian is roughly \$1,400 per year.
- The cost to serve one additional potential library patron in the general population is roughly \$.34 per year.

The breakout of annual costs by function is roughly:

- \$24 million for computers at clients’ workstations
- \$3 million for computers for local databases, applications, e-mail addresses, and bulletin boards
- \$10 million for area networking
- \$5 million for statewide networking, databases, and Internet access fees
- \$40 million for personnel costs.

Much of this annual cost is already included in existing budgets. In particular up to \$28 million in teacher and librarian time would be shifted to Internet-oriented activities from non-Internet-related activities. Some \$5 million to \$10 million is already being spent on computers. Several million dollars are already being spent for area networking and Internet access.

At higher levels of service, costs would increase to \$126 million with 6 students per computer; and to \$400 million with 1 student per computer. For high levels of service, most of the cost is for computers and workstations.

APPENDIX. STATEMENT FROM KANREN

KANREN

The Kansas Research and Education Network

Date: February 23, 1996
Subject: Internet Proposal for K12 School Districts
To: Internet Services Task Force
From: Jerry Crow

I am pleased that a top level group has been formed to address the issue of bringing the Internet to the K12 environment in Kansas. KANREN has been engaged in that enterprise since its inception almost three years ago. Today we continue our pursuit of the goal of bringing the Internet to every school district in the state by presenting the attached proposal to this committee.

KANREN believes

- that the ultimate goal should be to provide Internet access to every K12 district in the state that desires such access
- that top-down funding and planning is the only viable means of achieving this goal in a timely, productive and organized fashion
- that KANREN is the best choice to provide, administer and maintain Internet access for the K12 school districts in Kansas

To that end, we propose to provide Internet access to 100 selected K12 districts by the end of the 1996-1997 school year, according to the attached plan.

Thank you,

Gerald P. Crow
Director
The Kansas Research and Education Network
crow@ukans.edu

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THE INTERNET AND K12 SCHOOLS

A Proposal to the
Kansas State Board of Education
and
The Internet Services Task Force
from
The Kansas Research and Education Network

Background

KANREN, The Kansas Research and Education Network, was seeded by a National Science Foundation grant awarded in 1993. Initially deployed in 1994, the KANREN consortium now consists of some 50 members. KANREN membership includes all six Regents institutions, 16 of the 19 community colleges, 18 of the 20 accredited private colleges/universities, seven K12 school districts, 5 of the 16 area vocational-technical schools, and several other organizations.

Administrative and technical support for KANREN is provided by a full-time staff of two, with assistance from the University of Kansas, Kansas State University and Wichita State University. Accounting and financial administration for KANREN is executed by the University of Kansas Center for Research, Inc. , a 501(c3) non-profit corporation. KANREN administrative authority is vested in an eleven member Executive Committee elected from the membership. The Director of KANREN reports to the chair of this Executive Committee. The Director manages day-to-day operation of the network and future planning. The Executive Committee charts policy and long range direction. The Executive Committee includes two individuals from the K12 school member sites and an individual from the staff of the Kansas State Library.

KANREN is chartered to provide wide-area network connectivity among its members and Internet access to its members. As KANREN has evolved, however, its primary function has become the provision of Internet access to its various members. In short, the mission of KANREN is to provide Internet access to its members at the lowest possible cost consistent with reliable, quality service. KANREN has traditionally focused on the education arena.

KANREN membership includes access to professional quality training. A comprehensive series of seminars is conducted by KANREN staff on a continuing basis at the University of Kansas. This training is provided free for up to four staff members from each member site and is available at nominal rates for other attendees.

Examples of this synergy include the leadership role taken by Olathe School District USD 233 in deploying software designed to manage and control K12 student access to Internet resources; and,

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the assistance provided by Bethel College to several other private colleges in the Wichita region in installing and maintaining electronic mail services.

The KANREN Executive Committee has defined a two component annual membership fee for connected members. The fee consists of a portion allocated to the costs of the actual network connection and a portion allocated to the costs of technical support, KANREN staff, etc. The former element is based solely upon the speed (or bandwidth) of the network connection. The latter element is graduated according to the annual operating budget of the member institution. This structure creates an environment in which: (a) the cost of any given connection is uniform across the entire state of Kansas, thus benefiting rural locations; and, (b) larger institutions contribute slightly more funds to the infrastructure costs of KANREN. For the purposes of establishing support fees according to institution size, KANREN has defined the following groups:

Group A: annual budget in excess of \$100 million

Group B: annual budget between \$30 million and \$100 million

Group C: annual budget less than \$30 million

KANREN also offers an affiliate membership. This membership class permits an organization that has joined KANREN as a connected member to add a separate, additional KANREN connection to any geographically distinct, physical facility within the state of Kansas that is part of that organization for just the connection portion of the standard membership fee. The affiliate membership was created primarily to assist K12 school districts in bringing geographically dispersed facilities on line at a reasonable cost.

KANREN does not, at present, provide dial access to the Internet. A number of our member sites, however, do provide such access. KANREN staff has provided technical support and guidance to several of these sites as they deployed dial access for the first time. Dial access permits students, faculty and staff to access the Internet when not at school.

The KANREN connected membership installation fee includes the equipment necessary to attach the member site's local LAN to the KANREN backbone. This equipment remains the property of the consortium and is maintained, monitored and serviced by KANREN.

KANREN itself gains access to the Internet under contract to Global Internet Services (formerly MIDNet). There are currently three exit points to the Internet, one in each Local Access and Transport Area (LATA) within the state. The need for a fourth connection has been demonstrated and bids to supply that connections are now being evaluated. Each exit point is T1 bandwidth (1.544 Mbps). The topology of KANREN is such that each member institution is just one circuit connection

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(or "hop") away from an Internet exit point.

KANREN was created to serve the education arena, libraries, and other selected non-profit or governmental organizations. KANREN use policy specifically prohibits the transport of traffic to or from profit-making enterprises. KANREN does not compete in the commercial marketplace. KANREN does, however, believe that it is the provider of choice for educational institutions.

KANREN staff provides assistance for new members in dealing with the myriad tasks needed to complete a connection to the Internet.. KANREN global policy, however, currently excludes direct participation in local member site infrastructure planning or support, chiefly because KANREN staff resources are simply not sufficient to support this task. KANREN has had a number of requests to provide such support and this policy could be possibly be amended with sufficient staffing.