CONNECTING PUBLIC LIBRARIES AND SCHOOLS TO THE INTERNET

A Review of the Literature

Prepared for the
Kansas Task Force on Internet Access

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EXECUTIVE SUMMARY

- As of Fall, 1995, 50 percent of U.S. schools were connected to the Internet, up from 35 percent a year earlier. However, only 9 percent of instructional classrooms are connected.

- Schools are using the Internet for administration, professional development, and instruction. Professional development uses predominate at present. Perhaps more important, the Internet allows students to seek and integrate information that is otherwise unavailable.

- As of 1994, 21 percent of U.S. public libraries had Internet connections. Far fewer had connections that could be used for direct public access. More recent data show that about 28 percent of the public libraries in large urban areas provide public Internet access.

- Libraries most often use the Internet for administration and reference. Libraries also serve as a location where patrons can conduct their own Internet information searches. Sometimes, libraries give patrons email accounts and other communications capacities. Online catalogs can allow patrons to check holdings remotely and avoid fruitless trips.

- Costs and funding are the most serious barriers to Internet connectivity in U.S. schools and libraries. Other major barriers include training and technical support. Difficulties in controlling access to sensitive materials by young people are viewed as a less serious barrier.

- Both costs and benefits for Internet connections are highly dependent on the capacity or "bandwidth" of the connections. Low bandwidth approaches such as dial-in are not very suitable for multiple users, for searching the Internet for source data, or for accessing detailed pictures; they are completely unsuitable for video. High bandwidth approaches generally require construction of a local area network, "LAN," and/or a wide area network, "WAN."

- Dial-in approaches using ordinary telephone lines provide inexpensive start-up costs and simple implementation. Nevertheless, many sources argue that it is better to proceed immediately to create area networks and direct connections though they are technically more complex. They further argue that dial-in approaches are not cost-effective when usage increases beyond a minimum.

- There is every indication that explosive growth in use of the Internet will continue for some years into the future. The numbers of users and of wired computers are growing rapidly; the number of monthly uses per user is growing rapidly; and the amount of bandwidth used per use is growing rapidly. Planning should be based on the assumption of continued rapid growth.

- Internet technology also continues to change rapidly. Planning should be based on up-to-date technology and allow for future change. A key planning decision is the life cycle for replacing equipment.

- Several states, including Nebraska and Missouri, are well ahead of Kansas with respect to planning and implementing statewide Internet connectivity in schools and libraries.

CHAPTER 1. INTRODUCTION

The purpose of this literature review is twofold: provide insight on the current state of Internet connectivity within K-12 schools and libraries in the U.S.; describe the benefits that encourage, and the costs and obstacles that inhibit, K-12 schools and libraries from becoming connected to the Internet. This report is intended to be generally understandable for persons with limited or no Internet experience, though it may be demanding in some places. This review is not intended to make any particular recommendations. The authors have developed certain perspectives in this study, and some are included in this report.

Because the schedule for this study is tight and because available, current literature is not necessarily systematic, much of the information is spotty. We have focused on 12 selected states: Arizona, Arkansas, California, Colorado, Iowa, Kansas, Missouri, Nebraska, North Carolina, Oklahoma, Washington, and West Virginia. These states included several viewed as advanced, and others viewed as developing concurrently with Kansas.

The review begins with introductory technical information and suggests many issues implied for the Task Force on Internet Services. Next, we discuss the technical means of becoming connected and the benefits of Internet connectivity for both schools and libraries; the financial costs of becoming connected; and other non-cost barriers to becoming connected. We then point out some recent data on national patterns of usage.

While reading this report, it should be kept in mind that patterns of usage have been changing very rapidly. The level of overall connectivity has been skyrocketing in schools, libraries, homes, and businesses, and continues to do so, so that data tends to be out of date by the time it is reported.

Finally, we review documents for a selected sample of states on their plans to become connected and the stages of implementation of those plans. This review is preliminary and will be supplemented with a survey of the selected states. We conclude with a discussion of some general policy issues concerning Kansas.

CHAPTER 2. TECHNICAL ISSUES AND GLOSSARY

This chapter is intended as a primer on some general technical ideas and issues, i.e., issues that are fundamental for deciding what general goals the Kansas Task Force on Internet Access might want to adopt. It does not go into these questions beyond the minimum needed to understand the basic issues and the other chapters of this report, and it does not make any recommendations. Therefore knowledgeable readers may want to skim this chapter, focusing on the "critical issues." In most cases the information is common knowledge, and no specific sources will be cited. This chapter does not include any very substantial findings about current commercial offerings, state of the art, or best practice; those issues will be the subject of a separate report.

The chapter is organized into sections based on a sequence of concepts. Where applicable, "critical issues" for the Task Force are listed at the end of a section.

User Interface.

"User interface" is jargon for "the equipment seem, heard, and touched, and how it responds when a person 'talks' to the Internet." The discussion in this report assumes that the Internet user will sit at a desk, face a monitor or screen, and enter commands and information into a computer by typing on a keyboard and/or moving a mouse or trackball. The computer will be connected to a printer (which may be in a different room in the building). Sometimes the user will have speakers that allow audio output (this will become standard soon). In most cases there will be no microphone or other audio input device. In most cases, there also will be no video input device (e.g., no TV camera or VCR camera). The desk, chair, and equipment seen by the user are called collectively a "workstation."

Video Communications.

Many states have plans for the Internet that are integrated with plans for televideo, distance-education and distance-conferencing. These video-related issues are largely, though not entirely, outside the scope of this study. Right now the main relationship between the two kinds of issues deals with the wires that move the signals. That is, any wires that move video signals are also capable of moving Internet signals. Moreover, there will often be cost savings from putting both kinds of signals onto the same wires.

In the future, we expect that the Internet itself will rely more heavily on animation and other video-type transmissions. As a result, there will be a tendency for the Internet to take over functions that separate video circuits previously handled. *Vice versa*, video circuits such as CATV will be used to wire the Internet. At some point, video system planning will probably become indistinguishable from Internet system planning. However, these issues will be reserved for future studies.

Critical Issue #1: To what extent should present-day Internet planning be integrated with educational telecommunications planning?

Types of Internet Activities.

There are a number of different ways in which people can actually use the Internet. Some of the most important are these:

Email. Electronic-mail, or email, is currently the single most important activity on the Internet. It refers to sending and receiving messages over the Internet (or over a local network). Email has numerous advantages over ordinary postal service or interdepartmental mail:

- Email is much faster (when it is working);
- It is easier to send (you don't have to fuss with paper, or even move from your desk; you can do it right out of your word processor with just a few keystrokes);
- By dialing in with a modem, you can receive it from many different locations - if you have the right setup;
- It is much cheaper than ordinary mail;
- It is extremely easy to send copies to multiple persons;
- It is extremely easy to forward what you have received;
- What you receive is already in computer-readable form, so it is easy to cut out quotations or make other manipulations, and easy to keep in electronic files.

Email is the only computer application that really does save paper - but you can easily print out a paper copy if you wish.

Mailing Lists and Electronic Conferences. A group of people can maintain an ongoing discussion on given topic using systems that sends copies of each contribution to every person enrolled in the mailing list. The list can be moderated by an editor or else allow free access to any participant. Members can easily subscribe or unsubscribe from the mailing list. This device is especially valuable for teachers and researchers who want to keep in touch with current work in a certain area.

Bulletin Boards, Databases, and World Wide Web Sites. A very large number of groups and agencies maintain some kind of information posted at a public location or "site" accessible from the Internet. A "bulletin board" is a set of text, graphics, or other data that can be read and copied from a remote terminal. A "database" is a collection of data that can easily be searched and from which some parts can easily be extracted. The World Wide Web is a specific type of advanced technology that is rapidly becoming standard for managing bulletin boards. It makes it very simple for users at remote locations to retrieve information, even if they have very low computing and Internet skills. It also supports simple ways to move from one site to another and even from one type of transmission to another ("hypertext").

The posting of public information on the Internet in various forms is the second most important activity carried out on the Internet. It can be extraordinarily useful. For example, the most important database in any library is its catalog; putting the catalog "online" and making it available to patrons through the Internet can provide an extremely useful service. People with Internet connections could check whether the library has certain books or books on a certain topic, without entering the library.

With more advanced systems, patrons can see if a certain book is checked out, or even reserve a book, before coming into the library.

Newsgroups. A newsgroup is another way to run an ongoing conference. Instead of emailing all contributions to all list members, the individual contributions are posted on a bulletin board for a set time. Then anyone anywhere with access to the Internet can scan the bulletin board and post a response. Several thousand newsgroups already exist; they can be located through indexes of newsgroups.

Chat Rooms. A chat room is an email conference that happens in real time. In other words, participants only receive messages from persons who are currently signed on and sending messages. Existing chat rooms are usually recreational and are not used much for educational or scholarly purposes. That could change, of course, in the future.

Searching and "Surfing." There are already more than 21 million Web pages on the Internet. (Individual sites may have more than one "page." A page is a location that has a separate Internet address so you can reach it directly.) It is physically impossible for a single individual to examine or "visit" even a tiny fraction of those pages; moreover, the vast majority of Web sites contain specialized, arcane, or idiosyncratic information that most people would view as junk. Yet, if only one-tenth of 1% of all sites have any value for a given user, that would still be too many sites to examine individually. Various software is available at certain specialized sites to help users find what they want from these different sites. For example, some software will search every word in the text at every site it can find, and look for combinations of words that the user has requested. It then gives the user a list of all sites that have that combination of words. Other sites are devoted to reviews of individual sites, organized or indexed by type of site. Another way to find sites is to follow links (i.e., cross-references) from site to site.

Video Conferencing. Individuals can use the Internet to transmit a video signal.

Remote Computing. The Internet can allow persons to sign-on to a computer or use specialized software at another location anywhere on the planet.

Site Blocking. There is software which makes it possible to prevent access to certain specified sites from a given terminal. The point is to prevent children and students from having access to materials viewed as sensitive. There are also commercial services that keep track of sites that contain sexually explicit material.

Forms of Internet Transmission.

A transmission on the Internet can take several different forms, which entail varying degrees of technical complexity. Some of these forms include:

Text. This is most common form of transmission, consisting simply of a sequence of letters and words. If the message is not too long, this kind of transmission is very fast, because the signal does

not have to explain what each individual letter will look like on the screen (your local computer already knows that).

Graphics, i.e., pictures of varying quality and detail. This is the second most common form of Internet transmission. When you sign onto a Web site, the site will often send you a fancy picture, as well as text. The picture goes much slower than the text. Unless you have a fast line (i.e., "a high bandwidth" - see below), you will eventually get frustrated waiting for pictures to "download," or be received.

Audio. Sending sounds over the Internet is uncommon now, but it is about to become very common. For example, the radio station KJHK at KU is now broadcasting "in real time" (simultaneously) on the Internet.

Animation. Animation consists of a rapid sequence of graphic images that appear to move on the screen. The pictures have to be sent very fast to be perceived as continuous motion. This technique is not important right now, but soon it may be.

Limited-Motion Video (i.e., using software called CU-seeMe). This primitive technology allows face to face video conferencing with jerky motion that appears unnatural. This technology never really caught on and probably never will.

Full-Motion Video. This refers to video that is sufficiently fast so as not to be distracting, and has about the same meaning as "video."

Bandwidth.

"Bandwidth" is jargon for "how much stuff you can send, and how fast you can send it." In other words, it refers to the speed of transmission on a given circuit. "Stuff" means information, and is measured in bits. A "bit" is a signal that represents the smallest possible unit of information. Bandwidth is usually measured as the number of bits per second, "bps," that can be sent over a circuit. Bandwidth is also sometimes described by using the names of specific technologies or capabilities. Some of these include T0, T1, and T3. The Bell companies have similar techniques called ISDN, S0, S1, and S3. In general, greater bandwidth means better service. It also usually means higher cost per work station, but lower cost per bit actually transmitted.

Bandwidth is a quantitative attribute, but it has qualitative implications. As bandwidth increases past certain thresholds, entirely new uses and new forms of transmission become possible. At the same time, different (and initially more expensive) technology is necessary to support it. There are four important thresholds, which are as follows.

28.8 Kbps, or 28,800 bits per second. Below, and including, this threshold, the circuit can use ordinary telephone lines, which means you don't necessarily have to make any special arrangements with the telephone company. However, this bandwidth is generally limited to sending text and small graphics. When searching the Internet -, e.g., moving from one Web site to another - the delays are

annoying. The time it takes to change sites at this speed can impose a serious barrier against extensive searching on the Internet. Only a single user can ordinarily use a circuit operating at this speed.

56 Kbps. (Corresponds to T0 or S0. ISDN is roughly comparable.) This level of speed is adequate for Internet searching and for limited downloading of pictures. It will support limited-motion video. It will also support multiple users and work stations reaching the Internet through a single circuit (i.e., "multiplexing," discussed further below), but there will be noticeable delays from time to time when one user has to wait for another user to finish downloading something.

T1 or S1 (roughly 1.5 Mbps, or 1,500,000 bit per second). This level of service should be more than adequate for Internet access in any Kansas library or USD under existing patterns of demand. (See below for a discussion of future patterns of demand). In particular, graphics and sound can be downloaded quickly, and rapid searching can be supported for multiple users on the same circuit. This level of service is also used by the statewide "backbones" of KANREN and DISC (see below).

At the same time, a T1 channel would be almost entirely used up by one video channel, for example by one class being taught via tele-education. Therefore, if tele-education circuits and Internet circuits are integrated in the future, then T1 circuits will no longer be adequate for individual USDs.

T3 or S3 (roughly 45 Mbps, or 45,000,000 bits per second). This capacity is far beyond the current needs of any single library or USD, but could be needed by a major research university or a statewide "backbone." Currently there are no T3 lines in use by any Kansas governmental or educational agencies. The University of Kansas is thinking of upgrading to a T3 connection to the Internet. The immediate use would be to allow KU researchers to use supercomputers in other states.

Critical Issue #2: should there be minimum standards or goals for bandwidth at each USD and each library? What standards?

Dial-in Versus Dedicated Lines.

The simplest way to connect to the Internet is to connect your computer to your outgoing telephone line, dial the local or long distance number of an access provider, and begin an Internet session. That is also the cheapest in terms of initial costs. Most new personal computers come with all the necessary hardware and software already installed. (The hardware mainly consists of an internal "modem" and a telephone plug. A modem is a device that allows digital signals to be sent over ordinary audio telephone lines.)

This approach comes with a long list of disadvantages, however, when compared with the alternative of renting a transmission line which is fully dedicated and permanently connected to the Internet. Disadvantages include the following:

Bandwidth. A dial-in bandwidth is limited to less than 28 Kbps. Hence, all uses that are more intensive than simple exchanges of text files or small graphics become problematical.

Contention for Access. When you dial in, you may not find an extra port available at your access provider. At that point, the system becomes useless to you. Most dial-in systems have faced this problem from time to time as usage increased. The system is not a reliable one unless there is a large amount of capacity at the other end. Capacity is expensive, however, and the access provider has a financial incentive to keep capacity somewhat restricted. The result is contention for resources during peak usage.

High Cost for Multiple Users. When multiple users are connected by individual modems, costs increase in proportion to the number of users. In particular, multiplexing cannot be used. For large systems, approaches based on multiplexing yields better service at a lower cost.

Many Telephone Lines. You need an outside telephone line in each room with an Internet connection. The majority of U.S. and Kansas classrooms do not presently have outside lines. (In Kansas, as in most states, they charge school lines at business rates rather than at lower household rates.)

Interference with Telephone Use. When you are using the Internet, no one can use the telephone on that line.

Critical Issue #3: should there be minimum standards or goals that discourage dial-in service? Should dial-in service be viewed as an acceptable transitional technology for new Internet clients?

Multiplexing, and Assembling the Jigsaw Puzzle.

The Internet is built upon the idea of multiplexing, which means joining multiple transmission streams into a single stream. As suggested above, a single connection into the Internet can support multiple users at multiple workstations. For that to happen, there has to be some way to combine all of their transmissions into a single stream of transmissions. This is accomplished by means of a local network. Indeed, the entire Internet has been designed as a collection of little networks, attached into larger networks, and so on.

Of course, as the multiple streams get joined, the single stream that results gets bigger and bigger, and needs an ever-greater bandwidth. But there are important "economies of scale," or cost savings per user, when the number of users increases. Most people using the Internet spend their time thinking, typing, or reading. Actual transmissions occur only briefly as very intense bursts of bits (when you hit the "return" key). Thus, many people using a single high speed line do not interfere with each other. (Economies of scale are missing for dial-in connections.)

In a typical building, there will be a local network, known as a "LAN." In a typical USD there will be a higher level network, sometimes called a "WAN." Someone has to design how these networks fit together and to assemble and maintain the various networks.

Critical Issue #4: Is the Kansas Internet problem simply a problem of getting a single Internet connection into one location in each school district or library? Should it also be defined as a problem of encouraging and supporting the creation of area networks?

Local Area Network, "LAN" - Building Level.

A LAN is, roughly, a set of wires that connects computers, usually inside a single building, possibly to a master computer, software that allows the computers to talk to each other, and to an outside connection. LANs come in two main technical flavors. An older technology known as "AppleTalk" is built into Macintosh computers. This technology is cheap and very easy to use, but it is also very limited. In particular, it almost exclusively runs on Apple computers. A newer technology known as "Ethernet" has become standard. Ethernet has ten to thirty times more bandwidth than AppleTalk, and is inherently more compatible with the Internet.

Setting up LAN entails a significant initial cost. Maintaining the LAN and training personnel to use is also important, and it will entail significant ongoing costs as well.

Critical Issues #5: should there be minimum standards or goals that encourage creating a LAN in each school and/or library? Should there be standards for the number of workstations connected to the Internet, per building, per pupil or teacher, per laboratory, per library patron or staff? Should there be standards for the particular networking technology?

Wide Area Network, "WAN" - USD or Community Level.

A USD may elect to have a higher level network that connects its various school buildings. Local libraries might also be connected to this network, or alternatively, they might be connected with other libraries in their region. A wide-area network allows an entire system to be served by a single connection to the Internet. This network could also perform other functions: provide email addresses for individual teachers and librarians, provide central memory for maintaining each person's computer files; provide modem ports so that teachers and librarians could dial-in to the network from their own homes; and maintain a school or library-wide bulletin board system or Web site. (Most of these functions could also be performed by the individual building LANs, at the cost of some duplication.)

A major ongoing cost of the WAN is to rent the dedicated lines that connect the various buildings. Buildings that are close together can be connected cheaply by wires owned by the USD or library system. There are also ongoing costs for maintaining the system.

Critical Issues #6: Should there be standards or goals for establishing USD and community-wide networks? Should there be standards or goals about what services are provided by the network? In particular, should there be standards or goals about providing email addresses for each teacher, each librarian, each student, or each library patron?

Connecting to the Internet.

The school building or library or USD will need hardware, software, and leased lines for connecting the local network to an Internet access provider. This connection generally occurs in two or more steps: First, the local network is connected to a statewide or subregional network. Second, the subregional network is connected to a regional network that has access to the Internet's main

trunk or "backbone." Two Kansas government agencies, KANREN and DISC, are already in the business of providing a statewide backbone that is connected to the Internet.

Critical Issue #7: Should there be a single designated statewide provider of access to the Internet for USDs and/or libraries?

Reliability Issues.

It takes a certain level of skill and staffing to keep a network running. If the network is down persistently, people cannot or will not use it. If the network is to become a working tool rather than a toy, it must be reliable. If teachers are to use it, it will need to be available in off-hours as well as during the day.

Critical Issue #8: Should there be goals or standards with respect to operating hours, percent of down time, and response time in cases of problems? How can these standards be implemented?

Service Providers.

State and local government personnel can fulfill most needs of the network. Alternatively, private organizations could provide them. Some possibilities for private service contracts include the following:

- Connecting a USD or library to a statewide backbone.
- Supporting a statewide backbone and connecting it to the Internet.
- Providing a building network (LAN).
- Providing a USD network (WAN).
- Providing leased lines as part of any of the above activities.

In each case, it is important to distinguish between installing the hardware and software, and maintaining and running the system. Both functions are needed.

There could be substantial cost-savings if these services were procured by a single, centralized contract, rather than individual contracts. At the same time, there is a potential problem of "cherry picking." It is cheaper to provide services in more densely populated areas. Rural areas tend to be more expensive. If a state contract charges a flat rate, urban districts may have an incentive to "opt out." If they do, average costs will increase.

Critical Issues #9: Should the State of Kansas undertake the task of negotiating statewide contracts with service providers to support Internet services? What services should the contracts cover? Should Kansas promise, or at least attempt, to meet alternative prices or bids obtained by individual USDs and libraries? Should Kansas prevent USDs and libraries from accepting alternative bids in cases where the Kansas-wide provider can meet the alternative bid? Should Kansas charge flat rates, or rates that vary with location?

Future Demands for Bandwidth and New Technology.

The load of traffic carried on the Internet has grown almost exponentially, not only on the system as a whole, but also on most individual links. Usage grows for many interrelated reasons:

- More and more people are learning to use it.
- More and more locations are connected.
- More and more Web sites and other functions are available for each user to use.
- New ways to use the Internet are invented.
- Schools and workforces keep upgrading their skill levels.
- The cost (per bit transmitted) of using the Internet is dropping.
- People are using the Internet for longer and longer periods.
- People are using applications that require increasingly more bandwidth; people graduate from text to graphics to remote computing. In the future, they are likely to start using animation and video.

We can predict that usage will continue to grow almost exponentially in most USDs and libraries for several years. It follows that USDs and libraries will need more and more bandwidth. We can reasonably predict that in three to five years, all of the larger USDs will need T1 service. We can also predict that the technology for using the Internet will keep changing. These changes will be in the direction of using more bandwidth.

Critical Issues #10: Should there be minimum standards or goals related to upward-compatibility of equipment with respect to bandwidth? Should there be ongoing statewide planning which attempts to anticipate and prepare for new Internet technology? Should there be standards for amortizing and upgrading equipment, say, for example every three to five years?

CHAPTER 3. APPLICATIONS AND BENEFITS

All the benefits of the Internet depend on its ability to organize information, locate, send, and receive many forms of information quickly. These benefits depend on having software that is easy to use and on applying it to some useful purpose.

Software Techniques to Support Various Forms of Organization and Transmission.

As described in Chapter 2, a connection to the Internet offers electronic access to many forms of information, including document (text and graphical) "browsers" that let you read things from remote sites on your screen; general communication systems to send and receive copies of electronic files; electronic mail; newsgroups; and hypertext retrieval systems, such as World Wide Web crawlers. Some particular software techniques for using these services are summarized below.

Table 3.1
Guide to Selected Internet Techniques

Service	Description
Document browsers (Universal Resource Locators, URLs)	A **Gopher** travels through menu-based layers of database using keywords or phrases. **VERONICA** helps find the correct Gopher based on the topic. **WAIS** searches the full document looking for keywords or phrases.
General communications systems	File Transfer Protocol (ftp) fetches programs and vast documents from remote computers. **Archie** is the mechanism used to navigate around ftp hosts. **Telnet** allows users to logon to other computers to utilize that system's available computing resources.
Electronic mail (email) systems	Each computer has an address and each user of a computer has an identification name in front of that computer's address where the mail is delivered. Many different software systems are generally compatible.
Usenet	A set of machines that allow users to exchange articles tagged with one or more universally-recognized labels, which are called **newsgroups**. Newsgroups are separated into topics which facilitate discussion, encourage inquiries, provide assistance or guidance, lend additional reference or resource people, share discoveries, etc.
Hypertext retrieval systems	These link documents and other objects such as sounds and pictures by words and phrases. The World Wide Web is currently the ultimate in hypertext retrieval systems. **Netscape** and **Mosaic** are specific programs that allow the user to access the Web.

[Pool, Blanchard, and Hale, 1995]

Educational Applications.

These transmission methods have many different uses which benefit different aspects of education:

- *Administrative*: There is a great need for the ability to transfer administrative information between schools and districts. The U.S. student population is very mobile. It is estimated that in California, for example, as much as 20 percent of the student population changes schools

annually [California Department of Education, *et al.*, 1992]. According to the study, the current method for exchanging student records and reporting to state and federal agencies costs California $50 million each year. The average time spent transferring a record using the current system is 24 days. The Internet makes it possible to establish standards for the exchange of this information over a common network. Using Electronic Document Interexchange (EDI), one could transfer student records across the Internet to other schools, as well as universities and community colleges. [Parker, 1994]. Transfer time could be cut from weeks to seconds and estimated cost-savings are considerable. According to the California study, the cost will drop from the current average $15 per transferred record to $4 [Parker, 1994, p. 3].

- *Professional Development*: Teachers benefit when the Internet is available as a resource. For example, specialized instructors, such as Journalism or Physics teachers, are often the sole instructors in their field in their schools, or even districts. With the Internet, teachers can share ideas with and ask questions of others in their discipline. All teachers can download useful information, guides, and images for use in the classroom, such as on-line Associated Press, Reuters news feeds, the daily CNN Newsroom curriculum guide, and NASA space images. Teachers can coordinate projects with classrooms in other countries, and engage in dialogues with field experts [Parker, 1994].

- *Instructional Benefits/Benefits for Students*: Benefits of Internet connectivity to K-12 students are as diverse as the number of applications it provides. With Internet connections it is possible for a class in rural Nebraska, far from a large urban museum, to "see" the New York Metropolitan Museum of Art, or other images that would not previously be possible. "The Internet holds the promise of enhancing classroom instruction through the electronic acquisition of resources and reference material" [McMillan Magnet School, 1995]. For example, students can study about the moon and then look at actual NASA pictures of the moon.

- Empirical analysis appears to support the positive nature of interactive learning. "Simply put, students of all ages learn better when they are actively engaged in a process, whether that process comes in the form of a sophisticated multimedia package or a low-tech classroom debate on current events [Carvin, 1995]." With appropriate guidance, the Internet can be an effective alternative to promote interactive learning.

For example, fifth graders at Mendocino Grammar School in California have a project in their American History class using the Internet, in which they are expected to:

1. Read from a variety of sources, fiction and nonfiction about the life of a colonial child in America.
2. Gather and share information from their reading in groups of four, develop notes, and share what they have learned with the rest of the class.
3. Compose, revise, edit, and illustrate a letter written to them by an imaginary child of about their age living in the year 1750. The letter will contain references to customs, beliefs, and other information derived from the students' research. Students will work in groups on peer revising and editing.

4. Publish their two letters on the school's Web server after formatting them in HTML. (HTML is a standardized access language).
5. Generate questions with the teacher to be developed into a form for obtaining feedback from the site's users. (The form will be at the end of each student's report).
6. The student and teacher will analyze their feedback [Mendocino Grammar School, 1995].

• *Community Outreach*: There are advantages to providing community access to school district resources, besides the administrative and educational benefits achieved with Internet. Some schools and network projects encourage parents to become involved through dial-in accounts to school systems. Homework assignment archives, schedules, calendars, lunch menus, etc., are examples of things that they can make publicly available. Additionally, teachers are more accessible via electronic mail for parent-teacher communications [Parker, 1994].

Educational Access Patterns.

The benefits of Internet usage for students are best achieved with as much hands-on access as possible. However, surveys indicate that teachers are the main users of Internet services in K-12 schools, although the disparity between teacher and student usage has decreased significantly since 1994.

Table 3.2
Percent of Public Schools with Internet Connections
Having Particular Capabilities, by Type of User: 1995

Internet Capabilities	Percent Available	Members of school community		
		Administrative Staff	Teachers	Students
Email	93	91	85	41
Newsgroups	73	82	92	51
Resource location services (Gopher, Archie, etc.)	83	83	92	62
Graphical User Interface to the Web (Netscape, Mosaic, etc.)	80	82	92	70

[Heaviside, Malitz, and Carpenter, 1995]

A Vision for Libraries in the Information Age.

Public libraries have traditionally served as a repository of information for citizens. In the Information Age, libraries will play an increasingly important role because a changing economy requires that workers continuously learn new skills. Connecting libraries to the NII (National Information Infrastructure) is critical to ensure that all Americans can obtain information and services and

benefit from life-long learning opportunities, regardless of economic circumstances and geography [Gonzalez, 1995, p. 1].

This quotation is from *Connecting the Nation*, a vision and status report on the Clinton administration's priorities for the information infrastructure. The report clearly emphasizes the role of libraries in providing public access to electronic information to people of all economic levels. In fact, the role of public libraries is often described as providing an "information safety net" so that no segment of the population will be left behind as the widespread use of electronic information changes the way people work. In the sections that follow, we consider some of the ways in which the Internet is currently being used to achieve access to information in public libraries.

Applications for Libraries.

The Internet has the potential to change the way libraries operate. This is emphasized in a recent article:

> In order to survive, the library must make a fundamental change in the way access is provided to the user. The new model must focus on networked access, differentiated levels of services, and direct delivery. The library must be a partner in building a local infrastructure for information [Veasey and Ashton, 1995, p. 46].

The types of change brought about by the Internet and the information revolution more generally can be organized into three categories. First, libraries may experience changes in the way they perform traditional service functions, such as communications and reference. Second, libraries may experience changes in the type and amount of information that patrons request, as rapid access to a broad scope of information sources becomes feasible. Third, libraries may play a new role as direct providers of Internet access points, with patrons initiating information searches. Table 3.3 catalogs potential Internet uses.

Table 3.3
Potential Uses of the Internet in Public Libraries

Function.	Description/Implementation.
Traditional functions performed in new ways.	The Internet and electronic communications create the potential for more efficient service.
Communications.	The Internet supports email communications among library staff, use of listserve lists and newsgroups.
Administration.	The Internet enhances the use of on-line card catalogs, on-line check-out systems, interlibrary loan requests.
Reference.	The Internet allows Internet reference searches using commercial search engines, access to specialized CD ROM databases, use of newsgroups to address difficult reference questions.
Access to new information, improved access to previously existing information.	The Internet extensively broadens the scope of information available to patrons. Information on many topics is now available as it emerges. In other cases, information that might in the past have taken many weeks and many special requests to procure is now available to the user immediately.
Government documents.	Federal government information, and information from many states is available electronically. For example, users can immediately access the most up-to-date Census estimates for their city and county.
Research documents.	Research libraries have formed a consortium [Machovec, 1995] to make research and historical documents available in electronic form to scholars everywhere.
Other documents.	Increasingly, corporations and other organizations are publishing information in the Web.
Improved searching.	Commercial Web searchers such as Alta Vista, Lycos, and Web Crawler can, in a matter of seconds, search millions of documents for key words and phrases. This allows patrons to, in a sense, be their own reference librarians.
New information structures.	Many efforts have been made to organize information on the Internet. Librarians may, for example, maintain lists of important Web sites and share these with patrons. More ambitiously, organizations such as the Internet Public Library structure information in a way familiar to library users. For example, a patron may visit an electronic "children's room" where resources of interest to young people are located and cross-referenced.
Full Internet access point for patrons.	Patrons can use the library as an access point where they gain the ability to both send and receive information. Here patrons would be able to send and receive Email, retrieve information from Web sites, and publish their own information on Web sites.

[IPPBR]

Examples of Internet Implementation in Libraries.

Many library systems are incorporating Internet access. As of 1994, 21% of libraries were connected to the Internet [McClure, Bertot, and Zweizig, 1994], and that percentage has surely grown dramatically. We illustrate the use of the Internet in libraries with three examples from three cities: Denver, San Francisco, and Blacksburg, Virginia.

- Denver now has a system that is referred to as the "Big New Library." Their library system connects the main library with twenty-two branches through a medium-speed wide area network or WAN. A high-speed link connects the Denver library system with the Internet from the main library. Denver claims to be the first library system in the nation to offer patrons a full range of PC-based services at all of its branches.

  The goal of the Denver system is to provide patrons with direct Internet access and access to other electronic information sources. In addition, the system connects previous "pockets of computerization" such as automated card catalogs, CD-ROM databases, and circulation systems. Users of the system logon to the Internet and other information systems by clicking on appropriate icons. Currently, the system offers:

  1. A reference area with access to databases in more than 20 subject areas;
  2. A search engine organized by topic area such as business, job, and career information;
  3. Specific links to children's resources including the Kids Catalog, programmed at Denver and used nationwide;
  4. Periodical searches of 200 periodicals by subject, title, and author;
  5. CD-ROM technology running educational programs; and
  6. Access to Denver's photo digitization project. Denver's unique collection of early photos of the American West is being made available on-line and nationwide [Veasey and Ashton, 1995].

- The San Francisco Public Library, SFPL, has set the goal to become an electronic hub for the entire region. A new main library building is now under construction and is scheduled for opening in Fall, 1996. It will include more than 600 multimedia workstations. The library is seen by the San Francisco community as the key institution for building communications bridges. SFPL's goal is to have an electronic connection in every home, school, and office in San Francisco by the Year 2000. SFPL intends to be the gateway between the community and the Internet. With this new technology comes a new role for librarians. Staff will "shift from being retrievers to (being) facilitators [Dowlin and Wingerson, 1995, p. 54]."

- Many smaller libraries are involved in providing Internet access for patrons. The best example is probably the Montgomery-Floyd Library System in Blacksburg, Virginia. The town of Blacksburg made a community-wide effort to connect homes, schools, and the library to the Internet. The library serves as a general access point for county residents to obtain free email accounts. Patrons can access a full range of Internet resources, and send, and download information [*About the Blacksburg Electronic Village*, 1996].

CHAPTER 4. COSTS

This section reviews selected literature on the costs of building and maintaining an Internet connection. Cost data are somewhat difficult to find in public literature, as most programs are in the developmental stage. Compounding this, those who provide Internet service for a fee are often reluctant to discuss costs. Another problem with cost data is that information is likely to be soon out of date, due to rapid changes in technology and in market conditions. However, some data concerning the costs of Internet connectivity are available, and there is a recent design guide for local library systems [McClure, Bertot, and Beachboard, 1995]. We hope that more detailed cost data reports will be developed, from interviews with vendors. However, both because of industry competitiveness and because proposed Kansas Internet system's specifications are necessarily vague, information from vendors is also likely to be limited in the absence of a formal request for proposals (RFPs).

Types of Costs.

The costs of creating and maintaining an Internet connection can be broken down into capital (start-up) outlay and operating costs. We can look at services performed at the site versus services performed elsewhere. On-site service can be further broken out into services of personnel services and equipment. Service elsewhere can be broken into leased lines, to connect the site to another location, and remote connection services, which add personnel, leased line, and connection costs. A complete plan would look something like Table 4.1.

Design Models.

The costs of connectivity depend on the design that is adopted. We have raised most of the design issues in Chapter 2, but summarizing them may be helpful. These issues include the following:

- Dial-in versus dedicated connection with an area network.
- Bandwidth of Internet connection.
- Vendors for leased lines and Internet access point.
- Creation and relationships of LANs and WANs, both hardware and software, and geographic area served.
- Number of and locations of workstations.
- Particular services (email, World Wide Web pages, newsgroups).
- "Wetware" - Steps to handle management, operations, training, and support.
- Amortization and replacement schedule for equipment.

For a more detailed cost and design model for libraries, see McClure, Bertot, and Beachboard [1995].

Table 4.1
The Structure of Internet Access Costs

Capital Costs
   On-site Costs
      personnel costs
         planning
         installation
         initial training (costs for trainers, trainees, materials, travel, and venue)
      equipment costs
         workstation: computers, software, chairs, desks, printers, modems
         LAN: wires, internal connectors, network server (i.e., a computer to manage it), software, routers, connection box for a higher level network
         WAN: wires, internal connectors, network server, email server, server for other utilities (memory, Web site), software, routers, connection boxes for higher and lower level networks, modem ports
   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)
         user support
      equipment costs
         replacement parts
         supplies: paper, toner
   Costs Elsewhere
      leased line costs
         leases for WAN connections
         lease for connection to an Internet access provider
      remote provider costs
         access provider fees

[IPPBR]

Cost-Effectiveness and Design Issues.

There is a great deal of literature that describes and recommends particular configurations and designs. Much less literature is available to discuss design from a comparative and cost-effectiveness point of view. One exception is the issue of dial-in versus direct connection, previously discussed.

Dial-in approaches are inexpensive and relatively simple to implement. They are an easy, transitional mode of hooking up to the Internet. However, many authorities argue that it is better to proceed immediately to establishing an area network and direct connections.

Langan *et al.*, 1995, p. 21, for example state:

> Nebraska has been a leader in emphasizing "direct connect" technology in its statewide connectivity plans and activities. Many states have built their network based upon modem connections, often including "800" support lines. Some of these states are now having considerable difficulty in making such networks cost-effective, and in making the necessary transition to a direct connection environment.

For a concrete description of the difficulties of using modem access, see Mossberg, 1996.

Amortization.

To compare total costs for different approaches, we would need to put capital costs on a comparable basis with annual costs. This depends upon how long the equipment will be used.[1] Unfortunately, we located no data on working lifetimes for networking equipment. However, some data is available on lifetimes of computing equipment, which is one type of Internet equipment. Both federal income taxes and commercial leasing schedules assume a lifetime of around three years for computing equipment. Three years also corresponds to the typical period between new models of IBM-compatible personal computers.[2]

Old equipment can be discarded for a variety of different reasons that can lead to different working lifetimes of equipment. For example:

- New equipment may provide such superior service that the value of the benefits alone justifies its purchase.
- The value of the benefits of new equipment, in addition the differential cost of repairing and maintaining old equipment, exceeds the cost of the purchase of new equipment.
- Repair and maintenance of outmoded equipment is no longer possible.

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[1] To a lesser extent, it also depends on the assumed discount rate or rate of interest. That factor is relatively unimportant in the case of computer equipment, because historically it has a short life time - as noted below it becomes obsolete and is replaced with great rapidity.

[2] On the other hand, regulated telephone company equipment has traditionally been written off over several decades, though the practice is changing. Moreover, new generations of telephone technology have appeared at intervals of 20 years or more, certainly much longer than is typical of computing equipment. Optical fiber technology might become technologically out-of-date in just a few years, because of improvements in the "repeaters" that amplify signals, not in the fiber itself, however, the new technology represents immense upward leaps in bandwidth and cost-savings. New equipment now being put into place is expected to function for up to 40 years [Shelley, 1994]. Obsolescence of telephone equipment is not directly relevant to amortization of USD-owned or library-owned equipment, because telephone lines are leased, not purchased.

The higher-numbered reasons on this list lead to longer working lifetimes for equipment. Schools and libraries tend to place a low value on superior service, and tend to operate at the end of this list. That is, due to funding constraints, many public schools and libraries may continue to use computers long after they would be considered obsolete in business or government. That implies that students are often learning from, and staff and patrons are often working with, equipment that is out-of-date and hard to use.

Rates of obsolescence in Kansas schools can be inferred from the State Board of Education's 1995 Computer Technology Survey. We will focus on IBM-compatible personal computers, because they were reported in the survey with more gradations of technology than were Apple computers or laptops.

Table 4.2
Obsolescence of IBM-Compatible Computers in Kansas Schools

PC generation	Approximate age of technology (years)	Number in classrooms	Number in laboratories	Total number
286	11	1163	1444	2607
386	8	3002	2367	5369
486	5	5083	3566	8649
Pentium	2	450	457	907
Average (weighted by total number)	6.7	- -	- -	- -

[Kansas Board of Education, 1995; IPPBR]

Kansas schools are using IBM-compatible PCs that are six to seven years old on average. This is about two generations behind the newest technology. This result is subject however to biases from a number of sources, so it is only a rough guide.[3] Note that the average age of technology should be

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[3] Factors that may lead to overstatement of the average age of technology include: some older computers that were reported in the survey, may not be working, or if working, may not receive very much actual use; Apple technology, which was excluded from the table, may be more advanced. Factors that may lead to understatement of the average age of technology include: schools tended to migrate from Apple to IBM over time, so counts for the older technology are understated; the total demand for computers was increasing over time; no question was asked about first generation (8088) IBM machines, so they were omitted; earlier pre-IBM and pre-Apple machines were not surveyed.

around a half of the working life of the equipment; so this result implies a working life cycle of around 13 years. No comparable data are available for libraries.

To a substantial extent, the period of amortization is a policy question, not an empirical question. If Kansas is willing to spend the money necessary to keep its schools and libraries at the forefront of technology, then it will have to replace much of its Internet equipment on a cycle not much longer than three years. Expenses will be related to the length of this cycle. A six-year replacement cycle, for example, would lead to average equipment being three years behind the cutting edge. However, equipment costs would be about half as great as for a three-year cycle. Judging from the USD results above, replacement cycles will be much longer than either figure, unless substantial outside funding is provided by the state.

As cycle time increases, capital costs become a smaller portion of total costs. Maintenance costs increase with the age of the equipment. Therefore, beyond a certain point there is little or no proportionate cost-saving from lengthening the replacement cycle.

Equipment Procurement Costs.

This section describes data on costs for various items procured from vendors. There are several areas where cost data is obtained. One is the direct connection to a remote access provider. These data are presented in Table 4.3:

Table 4.3
Costs of Connecting to a Server

Source	Method	Costs	
		Initial Costs	Variable Costs
Topp 1995	modem	$100	varies w/ server
	direct connection (LAN)	$3500/school building	$100-$200 monthly line fee
Tohme 1995	32k access	- -	$30/month

[Topp, 1995, Tohme, 1995]

Data were obtained on the cost of the wiring within the school itself, as presented in Table 4.4 below:

Table 4.4
Costs of Wiring

Source	Total Cost	Cost per Classroom	Cost per District
Feder 1995	$150,000	$500	- -
Sayre and Rorvig 1995	- -	$150/month	$400/month

[Feder, 1995, Sayre and Rorvig, 1995]

Data were found that outline equipment costs for an entire LAN, including access to a leased line; see Table 4.5. (The hardware items listed depend on a particular design. Of course, these costs omit design, installation and maintenance costs.)

Table 4.5
Network Hardware Costs for Urbana Schools

Item	Quantity	Unit Price	Total
Synoptics 2813-04 16 port Managed Hub	1	$1750.00	$1750.00
Synoptics 2803 16 port hub	1	$765.00	$765.00
48 port patch panel	1	$245.00	$245.00
3' modular patch cord 14561	32	$4.85	$155.20
FacePlate (anixter 14824 Ortronics)	32	$2.25	$72.00
Single 10BT jack	32	$5.95	$190.40
Homaco Swing Gate Equipment Rack	1	$105.35	$105.35
Belden lev 5 4 pair 10bastT Plenum Wire 1	3	$250.00	$750.00
Box for wall mounting	32	$6.45	$206.40
Wire Mould (2 ft sections - average)	128	$3.00	$384.00
Up-front ISDN cost (1 time)	1	$2400.00	$2400.00
Total			$7023.00

[Urbana School System, 1995]

Two conclusions can be drawn from these limited data:

- Startup costs for connectivity depend on the type of connection. Costs range from very low (a single modem connection to a remote service provider) to relatively high costs (establishing of a local area network and the creation of dedicated lines devoted to Internet access).

- Costs are significant, with equipment startups costs per classroom of up to $500 for wiring alone, $3,500 per building, and an additional $150-$200 per month line fee for a connection to a remote access provider.

Estimated Costs for a Complete Library System.

McClure, Bertot, and Beachboard 1995 provide designs and comprehensive estimates of costs for complete library systems, including personnel costs, access fees, and provisions of various services that go beyond mere access to the Internet. A brief summary of costs follows.

- A purely text-based system for a single library with one computer with 8 terminals and dial-in access to the Internet through 3 modems:
  Initial Costs: $13,400
  Annual Costs: $29,250

- A multimedia system for a single library with 11 workstations and T1 access to the Internet:
  Initial Costs: $124,555
  Annual Costs: $94,830

- A multimedia system for a main library and 4 branches, with 38 workstations and T1 access to the Internet:
  Initial Costs: $310,285
  Annual Costs: $258,210

State Government Agency Charges.

We have also obtained limited data on charges that state government agencies make for particular Internet-related services. These charges include varying packages of equipment, leased lines, Internet access charges, and personnel costs. These services are all subsidized in part by federal grants and/or state appropriations.

Iowa.

EDNET provides direct connection access to the Internet for public schools and libraries. Fees depend on currently existing connections and on other infrastructure in place in that area's educational service unit (AEA), or, in some cases, the regional library. Additional fees must be paid

to the AEA. Total charges to both the AEA and EDNET for a single connection for a USD or library usually look like this [EDNET, 1995]:

		Directly To a backbone	Through an AEA or regional library
First Year	56 Kbps	$6468	- -
	T1	$8508	$3208
Second Year	56 Kbps	$4428	
	T1	$5868	$3168

Additional installation fees would also be charged by the telephone company in some cases. Other additional cost items include providing a WAN and/or LANs, email servers, computers, and support. Some of this service may be provided by the AEA.

Missouri.

MOREnet will provide a dedicated 56 Kbps line to each USD in Missouri by summer of 1997. The connection hardware, but not the WAN and LAN are included. It also provides technical documentation and support functions, including training for USD coordinators.

Setup Fee: $4,000. (State subsidies are estimated as an additional $4,000).
Training Fee: $350 for replacement USD Coordinator (if old coordinator is still employed).
Annual Fee: $500, up to 49 FT employees.
$1,000, 50 to 99 FT employees.
$1,500, 100 to 499 FT employees.
$2,000, 500 FT employees and over
(estimated as $7,000 to $12,000 in the absence of a subsidy).

Additional cost items for the USD would include providing two district coordinators, paying their travel expenses for training, providing a WAN and LANs (or else a local dial-in modem pool), and providing computers. State grants are available to offset part of these fees and costs. An older dial-in service for USDs is being phased out. It has the following cost structure:

Setup Fee: none.
Annual Fee: $250 to $1,000, depending on number of full-time employees.
The fee covers 10 to 40 separate dial-in accounts.

The appropriation by the Missouri Legislature for MOREnet is approximately $750,000 per year for training and connections. This does not include the MOREnet backbone. In addition, Missouri has around $10,000,000 in annual appropriations for various educational grant programs for USDs related to technology and video education. (Sources for MOREnet information are Cole, 1995, and Wening, 1995).

A pilot project of MOREnet and the Missouri State Library, *Project REAL (Researching Electronic Access for Libraries),* [*MU Campus Computing,* 1994], will provide dedicated Internet lines to 20 public libraries, and dial-in access for all other public libraries in Missouri. Project REAL will have the following cost structure:

Fees: none.
Additional cost items would include providing computers and possibly a LAN.

Wisconsin.

BadgerDial supplies software, manuals, and dial-in access to the Internet for public schools, libraries, and government agencies. There is a 24-hour toll-free help line. There appears to be support for email addresses. There are about 300 clients at present.

Setup Fee (account plus software and manuals): $50.
Monthly Account Fee: $10.
Connect Fee (including long-distance charges): $4.80 per hour

The source for this data is the Wisconsin Department of Public Instruction, 1996. Additional cost items for the user would include a computer and local telephone service.

CHAPTER 5. BARRIERS TO ADOPTION.

There are a multitude of obstacles, besides financial ones, to full Internet connectivity for schools and libraries. Financial obstacles are the most apparent [Heaviside, Malitz, and Carpenter, 1995, McClure, Bertot, and Zweizig, 1994]. Moreover, many obstacles that seem non-financial have underlying financial origins. Data available at this time are national rather than Kansas specific, but Kansas data will be available after the completion of several surveys now in progress.

Obstacles Perceived by Local School Authorities.

Barriers to Internet connectivity perceived by public school principals are reported in Table 5.1, which is based on the U.S. Dept. of Education's national survey, based on data collected in 1995. Presumably, a similar pattern of barriers exists in Kansas.

Table 5.1
Percent of All Public Schools Indicating Barriers to the Acquisition
or Use of Advanced Telecommunications: 1995

Barrier	Minor or no barrier	Moderate barrier	Major barrier
Lack of or poor equipment	39	23	38
Inadequate hardware upkeep and repair	60	20	20
Too few telecommunication access points in building	31	18	51
Problems with telecommunications service provider	79	12	9
Lack of instructional software	59	27	14
Software too complicated to use	83	13	4
Lack of time in school schedule	37	26	37
Telecommunications links not easily accessible	48	23	29
Telecommunications equipment not easily accessible	45	25	31
Lack of technical support or advice	49	29	22
Lack of administrative support or initiative	76	16	8
Lack of or inadequately trained staff	37	35	28
Lack of teacher interest	69	25	5
Lack of teacher awareness regarding ways to integrate into curriculum	33	37	30
Lack of student interest	95	4	1
Lack of parent or community interest	83	12	4
Not enough help for supervising student computer use	45	31	23
Concern about student access to inappropriate materials	55	26	19
Funds not specifically allocated for telecommunications	33	18	49
Variability of telecommunications rates from service providers	68	18	14
Use of advanced telecommunications does not fit with the educational policy of this school	96	4	<.5

[Heaviside, Malitz, and Carpenter, 1995]

Although the survey distinguished all the barriers listed above from financial barriers, many of the barriers on this list could easily be overcome with the use of sufficient resources. Thus one assumes that lack of or poor equipment, a lack of access points within schools, and a lack of accessibility to equipment could easily be overcome with money. Problems of technical support and advice and teacher time can also be overcome with money, but they also require organizational change so as to incorporate needed additional personnel. Problems of teacher awareness and training are largely organizational (e.g., substituting Internet training for other in-service training). Problems of student access to sensitive materials are both organizational (i.e., policies and procedures) and political (i.e., relationship to the larger community).

Other sources point out the importance of a subset of the problems listed in the table. For example, a West Virginia survey comments that teachers are typically eager to engage in the telecommunications effort, especially for the benefit of their students. At the same time, teachers stress the importance of providing training and technical assistance [Howley and Howley, 1994].

A widely discussed obstacle concerns the possibility of minors gaining access to "sensitive" materials. This could deter some states or schools from pursuing an Internet program. As Andrew Blau [1993, p. 497-498] recently noted:

> A key concern is that students may be exposed to material that parents or teachers find inappropriate for children. In other electronic media, such as broadcast television, cable TV, and audiotext, legal restrictions have been imposed to protect children from "harmful" or "indecent" material, and liability has been assigned. No such framework exists for the Internet. Moreover, the strengths of the Internet - its decentralized, unhierarchical, and essentially uncontrolled flow of traffic - offer distinct challenges to those who would seek to control it in the interest of protecting children. Finally, the tools available in other media - safe harbors, lockboxes, or subscription schemes - do not seem to carry over easily into this environment.

Now, of course, with the recently passed Communications Decency Act (CDA), legal mechanisms are being developed to address this issue. (However, the CDA is under legal challenge as being overly broad and interfering with constitutional rights of adults). Also, software such as "site blockers" are being developed which help restrict access to sensitive materials. Still, this is an obstacle which should be considered.

Obstacles Perceived by Statewide Educational Internet Planners.

Survey data also exists for many states that shows what barriers impede the implementation of their plans for full connection. (The survey was directed to plans related to public schools, but some of the state plans refer to libraries as well as schools).

Table 5.2a
Perceptions of Potential Barriers by Statewide Educational Internet Planners
(Scale: 1=is a problem to 5=not a problem)

State	Legislative and Regulatory Actions	Technical Infrastructure and Support	Professional Development and Training	Funding: Initial and Long-Term
Arizona	3	2	2	1
Arkansas	3	2	1	1
California	1	1	1	1
Colorado	1	3	2	1
Iowa	4	5	3	2
Kansas	2	1	3	1
Missouri	2	2	3	4
Nebraska	5	3	5	4
North Carolina	1	2	3	2
Oklahoma	2	3	4	4
Washington	3	4	1	2
West Virginia	5	1	5	1
Average	2.7	2.4	2.8	2.0

[The State Networking Project, 1996]

Table 5.2b
Perceptions of Potential Barriers by Statewide Educational Internet Planners
(Scale: 1=is a problem to 5=not a problem)

State	Ethical and Liability Issues	Infusion into Goals 2000 and Educational Development	Developing Private Sector and Community Partners	Educational Systems and Policy Barriers	Other
Arizona	3	4	4	4	-
Arkansas	3	3	2	3	-
California	3	2	3	1	-
Colorado	4	2	3	2	1**
Iowa	3	3	4	1	-
Kansas	4	3	3	3	-
Missouri	3	4	3	3	-
Nebraska	2	2	3	3	2***
North Carolina	4	3	3	2	-
Oklahoma	2	3	2	3	-
Washington	4	5	5	3	-
West Virginia	4	5	5	5	-
Average	3.3	3.3	3.3	3.8	

**Lack of phone lines in school
***Technical complexity of the task. Political structure (climate) to allow for cooperation.

[The State Networking Project, 1996]

The most important obstacles perceived may be the limitation in outside funding, rather than problems in internal educational policy and organizational relationships. Additionally all of these states noted that the rural nature of many districts made funding, finding resources, and wiring difficult.

Barriers in Rural Areas.

The barriers to providing Internet connectivity in rural areas are obvious ones. In rural areas, there is less access to computers and there are fewer resources for learning technology [Thurston and Stone, 1990]. Low enrollments and the large geographical areas covered by most rural schools have created challenges to provide rural youth with educational opportunities equal to those enjoyed by students living in urban or metropolitan areas and attending large school systems. Rural schools enroll between 17-33 % of all school-aged children and comprise between 28-67 % of all schools [Barker and Hall, 1993]. Rural libraries face similar barriers.

Most barriers come down to cost. The average costs required to wire the rural schools and libraries is simply greater than in urban areas. In isolated rural areas, telephone lines can be more than twice as expensive as in urban areas. In these areas, installation of one additional telephone line can cost as much as $20,000 [Stout, 1995]. Further, phone companies do not want to provide service to areas that are not profitable. A possible solution to this cost problem is to subsidize rural costs by averaging together urban and rural line costs.

However, rural areas may also face larger non-cost barriers than urban areas. There may be less awareness of technology, more techno phobia, and more need for training. "The issue is not really information haves and have nots, but information cans and cannots [E. Michael Staman, quoted in Byers, 1996, p.2].

The problem of training teachers in rural areas who have not been exposed to Internet technology is being faced by several sites in the Northwest. The five sites participating in the Rural Telecommunications Initiative will open new avenues of information and communication for rural teachers through the Internet. Nearly 6,000 teachers are expected to take part in the program over three years. The project will evaluate the effectiveness in easing teachers' isolation, improving math and science teaching, and developing useful resources. All five projects will begin by training teachers to use the Internet, for communications and to access information [Yap, 1995].

Obstacles Perceived by Public Libraries

The best source of information on factors affecting Internet use in public libraries is a 1994 survey conducted by the National Commission on Libraries and Information Science [McClure, Bertot, and Zweizig, 1994]. Although somewhat dated, the survey offers insight into factors impeding Internet use. Not surprisingly, cost of connections was found to be the number one barrier. The availability of staff time to learn about the Internet, and the availability of training were also listed as important barriers. Respondents from rural libraries more often listed each factor as being a barrier than their counterparts in urban libraries (Table 5.3).

Table 5.3
Factors Affecting Public Library Involvement with the Internet

Scale: 1 = very important 5 = very unimportant	Overall	Urban Libraries	Rural Libraries
Costs of connections	1.95	2.36	1.32
Staff time to develop expertise	1.96	1.92	1.49
Availability of training	2.05	2.07	1.52
Staff skills	2.06	2.02	1.55
Costs of software	2.28	2.80	1.61
Costs of hardware	2.29	2.60	1.66
Level of community interest	2.60	2.59	1.74
Interest of governing body	2.60	2.81	1.74
In-house technical expertise	2.29	2.38	1.76
Staff awareness of the Internet	2.43	2.35	1.90

Overall response includes all respondents. Urban includes respondents from communities of 250,000 or more. Rural included respondents from communities of 25,000 or less.

[McClure, Bertot, and Zweizig, 1994]

For libraries that already have Internet connections, another survey [Basu, 1995] provides interesting insights into Internet use. Librarians reported that the most important barrier to their use of the Internet was a lack of time to learn about its capabilities. Most librarians reported five or fewer hours of training, and 30 percent had no training whatsoever. Taken together, the two surveys clearly imply that any successful Internet implementation must include a strong component of staff training.

CHAPTER 6. NATIONAL PATTERNS OF USAGE

This chapter reviews some recent national data on methods and rates of use of the Internet in schools and libraries.

Utilization in Public Schools.

A survey, entitled "Advanced Telecommunications in U.S. Public Elementary and Secondary Schools, 1995" [Heaviside, Farris, Malitz, and Carpenter, 1996] provides a great deal of information on Internet access. The data were gathered from a nationally representative sample of 1,380 public elementary and secondary schools in Fall, 1995. Some of the findings of this survey are the following [Heaviside, Farris, Malitz, and Carpenter, 1996]:

- Fifty percent of U.S. public schools now have access to the Internet. This percentage is up from 35 percent just one year ago.

- Seventy-four percent of the schools that do not currently have access to the Internet plan to obtain access in the future.

- Funding and inadequate telecommunications access points in the building were the most frequently cited barriers to acquiring or using advanced telecommunications in public schools. Fifty-five percent of schools indicated that funds not specifically allocated for telecommunications was a major barrier. However, this is down from 69 percent one year ago. Fifty-four percent indicated too few telecommunications access points in the building as a major barrier.

- Although half the nation's public schools already have access to the Internet somewhere in the building, and three-fourths of those without access plan to connect, only 9 percent of all instructional rooms (classrooms, labs, and library media centers) are currently on the Internet. This is a threefold increase compared with Fall, 1994, when only 3 percent of all instructional rooms had access to the Internet

- Eighty-five percent of public schools have access to some kind of area computer network. Seventy-seven percent have computers connected to a local area network (LAN) and 61 percent have computers with a wide area network (WAN) access.[4]

- Besides the 50 percent of schools that are on the Internet, 11 percent have access to a WAN that does not connect to the Internet, and 23 percent have a LAN but no WAN.

- By Fall, 1995, 20 percent of schools will have access to the Internet or other WANs connected at a speed of 56 Kbps or higher. The use of faster transmission connections increased markedly

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[4] These kinds of networks are much smaller than the Internet, but provide the usual basis for connecting to the Internet; they are further defined in Chapter 2.

from fall 1994, when only 49 percent of schools were connected to a WAN and only 7 percent of these were connected at high speeds. (The various transmission speeds are explained further in Chapter 2).

- Of the schools with Internet access, 93 percent have email, 83 percent can access bulletin boards and resource location services, 80 percent have World Wide Web access, and 73 percent can access newsgroups. (These types of services are described in Chapter 2). While email is the most widely available Internet service in schools, it is less likely than other services to be available to students. Seventy percent of schools with World Wide Web access make it available to students, 62 percent of schools with resource location services make it available to students, and students can avail themselves of newsgroup services in 51 percent of the schools with newsgroup access. Only forty-one percent of schools with email provide access for students.

Some of the more interesting and important data gathered are presented in the following tables. These results suggest the issues we expect to confront when looking at specific state plans and policies.

Table 6.1
Percentage of Public Schools Having Access to the Internet
And the Percentage of All Instructional Rooms Across the Country
With an Internet Connection, by School Characteristics: 1994 and 1995

School Characteristics	Percentage of schools having access to the Internet		Percentage of all instructional rooms across the country with Internet access	
	1994	1995	1994	1995
All public schools	35	50	3	9
Instructional level				
Elementary	30	46	3	10
Secondary	49	65	4	8
Size of Enrollment				
Less than 300	30	39	3	11
300 to 999	35	52	3	10
1000 or more	58	69	3	4
Metropolitan status				
City	40	47	4	8
Urban fringe	38	59	4	8
Town	29	47	3	10
Rural	35	48	3	10
Geographic region				
Northeast	34	59	3	7
Southeast	29	44	2	6
Central	34	52	3	11
West	42	48	5	10

[Heaviside, Farris, Malitz, and Carpenter, 1996]

Table 6.2
Percentage of Public Schools Having Access to the Internet by the Number of Instructional Rooms with Internet Access, by School Characteristics: 1995

School characteristics	Number of instructional rooms with access				
	0 rooms	1 room	2-3 rooms	4 rooms	5 or more rooms
All public schools	7	47	24	4	19
Instructional level					
Elementary	7	51	20	4	19
Secondary	6	39	33	5	17
Size of Enrollment					
Less than 300	10	42	28	4	17
300 to 999	6	50	22	4	19
1000 or more	5	40	30	5	20
Metropolitan status					
City	7	42	22	6	23
Urban fringe	6	50	24	2	19
Town	8	47	21	4	20
Rural	7	47	28	5	13
Geographic region					
Northeast	3	54	25	1	17
Southeast	2	58	22	6	12
Central	10	41	24	3	22
West	9	41	24	6	20

[Heaviside, Farris, Malitz, and Carpenter, 1996]

Table 6.3
Percentage of Public Schools Having Access to any Wide Area Network,
By Type of Connection and School Characteristics: 1995

School characteristics	Type of Connection				
	Modem	SLIP/PPP	56 Kbps	T1	ISDN
All public schools	81	23	10	7	3
Instructional level					
Elementary	82	21	9	6	2
Secondary	77	28	13	8	3
Size of Enrollment					
Less than 300	85	18	9	1	4
300 to 999	81	23	11	7	2
1000 or more	76	30	10	12	3
Metropolitan status					
City	83	20	9	10	5
Urban fringe	80	23	9	7	2
Town	82	24	13	6	0
Rural	80	23	10	5	4
Geographic region					
Northeast	87	22	11	5	2
Southeast	86	16	6	8	6
Central	78	32	10	7	1
West	76	17	14	7	3

[Heaviside, Farris, Malitz, and Carpenter, 1996]

Utilization in libraries.

Two national surveys provide information on Internet connectivity in public libraries. The first survey [McClure, Bertot, and Zweizig, 1994], is out of date, but presents interesting urban/rural and regional patterns of Internet connectivity which are still likely to persist. In particular, the authors found that libraries in large urban areas were much more likely to be connected than libraries in small communities, and that libraries in the Midwest were less likely to be connected than libraries in other regions. Tables 6.4 and 6.5 summarize their findings.

Table 6.4
Public Libraries Connected to the Internet by Region

Region	Percent of Libraries Connected
Midwest	15.4
Northeast	25.9
South	18.6
West	28.2
Total Libraries Connected	20.9

[McClure, Bertot, and Zweizig, 1994]

Table 6.5
Public Libraries Connected to the Internet by Population of Service Area

Population	Percent Connected
1 million +	77.0
500,000-1,000,000	64.0
250,000-499,999	76.0
100,000-249,999	54.4
50,000-99,999	43.7
25,000-49,999	27.6
10,000-24,999	23.2
5,000-9,999	12.9
Less than 5,000	13.3
Total Libraries Connected	20.9

[McClure, Bertot, and Zweizig, 1994]

A second survey addresses the specific issue of public Internet access [Needham, 1995, p. 24]. The article reports on 369 metropolitan libraries. The study found that 23 percent of these libraries allow direct Internet access by patrons, and another 5 percent allow access with staff assistance. While we are clearly making progress toward connectivity goals, public Internet access is still lacking in more than 70 percent of the nation's largest library systems--it is even more likely to be lacking in smaller communities.

CHAPTER 7. OTHER STATE PLANS AND STAGES OF IMPLEMENTATION

Elements of a Statewide Plan.

It is apparent from the previous sections that there are several aspects to the problem of providing statewide connectivity. In general terms, a plan should provide for:

- Determination of scope: the plan might cover schools, libraries, colleges and universities, state agencies, local government units, community groups, and/or households.
- Determination of statewide Internet access providers, generally including a statewide backbone.
- Determination of technical recommendations or standards for local networks and connections.
- Determination of cost and fee structures.
- Provision of additional statewide funding.
- Provision for training, technical support, and utilization of resources.
- Provision for ongoing planning and coordination.
- Provision for ongoing evaluation.

A substantial amount of information is available on statewide plans that include public schools. Not all existing statewide plans have addressed all aspects listed above, but most plans have addressed most aspects. Many of these plans also include public libraries; but we have less systematic information on statewide public library plans.

Educational Networking Plans: Summary for Selected States.

A survey of all fifty states by the Office of Technology Assessment, 1995, p. 114, found that thirty-nine states now have some kind of support system for K-12 telecomputing, and nine of the remaining eleven states were in the planning stages. There is substantial variation across states, but most of the states still rely heavily on modems.

The State Networking Project 1996 is a nationwide collaborative effort. It is funded by a grant to the University of Texas at Austin's computation center and the Texas Education Network by the National Science Foundation, the U.S. Department of Commerce, and the U.S. Department of Education. The goal is long-range planning for the integration of an information infrastructure to support the needs of the K-12 educational community. It seeks implementation strategies to assure the education community attains national and global information infrastructure goals, and it assists in achieving state and national goals for technology in classrooms by the year 2000. This project has also conducted a review of statewide plans for K-12 connections for all states. Approximately thirty-five states were found to have some sort of plan in progress or under formulation. Many of the state-level plans involve libraries as well as schools, though that is not the main thrust of the project.

We will review some results of the Networking Project Survey for a selected sample of twelve states. These states provide a wide range of demographics. States of widely varying student population size, teacher population size, and number of school districts are included in the sample. The states and their demographic data are presented in Table 7.1 below. The table also shows each state's progress in setting up the plan.

Table 7.1
State School Plans and Demographics: 1995

State	# Districts	# K-12 Teachers	# Students	Current Status of Plan
Arizona	226	37,879	709,261	Operational
Arkansas	311	30,000	450,000	Partially Operational**
California	1,060	223,932	5,267,277	Partially operational through development of regional networking infrastructure
Colorado	176	33,419	612,635	Operational, Planned and Proposed***
Iowa	390 public, 203 non-public	31,833 public, 2,345 non-public	494,539 public, 44,752 non-public	Not uniform across state
Kansas	304	30,282	457,744	Partially Operational
Missouri	38	53,000	840,409	Planned
Nebraska	958	21,160	315,781	Partially Operational
North Carolina	119	68,566	1,387,763	Partially Operational
Oklahoma	554	40,000	605,000	Operational****
Washington	296	45,000	920,000	Operational
West Virginia	55	20,900	313,977	Operational*****

**144 districts (46%) and 315 school sites (30%) have direct connections as of 7/3/95.
***Operational-for library information network; planned-a pilot BBS on Denver FreeNet; Proposed-for instructional and administrative applications.
****ONENET is operational since July 1, 1993. It provides the WAN for the state.
*****being updated to allow Internet access

[The State Networking Project, 1996]

Perceived barriers to implementation were also surveyed. (See Chapter 5 for some of the data). By averaging the data on these barriers, one can come up with a rating of the overall level of obstacles per state. (See Table 7.1). This measure supplements Column 5 of Table 7.1. This new measure assumes, of course, that each obstacle is equally important, and that states downgrade obstacles they have already overcome. These assumptions may or may not be the case. The purpose of this measure is to provide some estimate of the state's progress in overcoming barriers. The higher the number, the less the obstacles are perceived to be a problem. The states are listed in order of their perceived progress in overcoming barriers.

Table 7.2.
State Obstacles to Connectivity

State	Obstacle Rating (1=severe problems, 5=few problems)
West Virginia	3.9
Washington	3.4
Nebraska	3.2
Iowa	3.1
Missouri	3.0
Arizona	2.9
Oklahoma	2.9
North Carolina	2.5
Colorado	2.4
Arkansas	2.3
Kansas	2.2
California	1.6

[IPPBR (calculated from Table 5.2)]

These states have all made strides toward Internet connectivity for their K-12 schools. We will now review the individual state plans in further detail.

Educational Networking Plans: Individual States.

Arizona.

Arizona has produced a plan that carefully outlines their technical plans for connectivity. The plan also outlines goals, under the mantle of the Arizona Education and Information Telecommunications Cooperative (AEITC), which unites the public universities, community colleges, the K-12 system and the state Department of Administration.

The AEITC has clearly defined their goals as being the following [Evergreen Communications, 1993]:

- Provide a forum for highlighting key telecommunications public policy issues and represent education's perspective to regulatory, legislative, and executive branches of government.

- Create a forum for dialogue concerning the requirements of the education community, technologies appropriate to respond to these requirements, economic and technical issues, techniques for applying technologies, and other matters of common concern.

- Assist with the planning and development of coordinated policies by state educational institutions, boards accrediting agencies, state agencies and the state executive and legislative branches to affirmatively guide the use of telecommunications for educational purposes.

- Provide assistance with the development and utilization of telecommunications delivery systems to improve the quality of opportunity and access to public educational services to unserved and minimally served citizens of the state.

- Encourage individual educational entities to develop and staff internal telecommunications planning, development, and utilization units which can assist administrators, faculty and students in the integration of appropriate technologies.

- Encourage the planning and development of instructional courses and related services which benefit from the application of telecommunications technologies.

- Facilitate appropriate, common technical and operating standards for telecommunications technologies and service levels to facilitate inter-connectability of institutions.

- Facilitate partnerships with the private sector to promote the delivery of education and training through technology.

- Explore the opportunity of developing a division of the AEITC to operate as a nonprofit organization.

To meet these goals, the AEITC has established the following objectives:

- Establish a liaison with representatives of the State Corporation Commission, the State Legislature, and the Arizona Governor's Office to promote and represent the issues with which the AEITC is involved. The AEITC will provide comment to all initiatives and represent unserved and minimally served interests in all areas of education, delivery, and access, as appropriate.

- Maintain an annual schedule of statewide dialogue for each segment of public education represented in the AEITC - K-12, community colleges and universities, so as to share information in areas of common concern. Additionally, an annual conference will be held to accommodate the sharing of information between the segments and to external entities concerned with the progress of AEITC and its constituencies.

- Act as a clearinghouse for all institutions, boards and agencies involved with issues which directly, or indirectly, affect the use of technology for instructional purposes. An active roster of such groups will be maintained by the AEITC from both a state and national perspective. It

is the responsibility of the AEITC to maintain a relationship with these groups to publicly comment on all actions taken which affect education. A monthly update will be made available to the active roster of pending issues, initiatives positions and results.

- The AEITC will encourage and serve as a resource to assist each segment of public education within Arizona to prioritize the cooperative's needs, capabilities, expenditures, and planning as it relates to providing equal educational access to all citizens of the state. Emphasis will be placed on supporting minimally served and unserved citizens of Arizona.

- Assist each segment of public education with proposals for continued development of telecommunications-related staff and facilities, whether they be internal or pooled resources based on economic availability of resources. Particular attention will be paid to the K-12 segment by playing an active role with the Department of Education in statewide planning efforts.

- Provide administrative and technical resources towards the development of instructional course work to be provided through nontraditional means, e.g., interactive video and correspondence tapes. AEITC will act as a clearinghouse to maintain a database and disseminate information regarding activities such as the provision of training for faculty development and information on curriculum development. A report of these activities will be presented at the annual AEITC conference.

- The AEITC will act as an agent for facilitating the interconnectivity of all member institutions. The AEITC also will represent their interests to external organizations, make public updates on interconnectivity, and work with interested parties to utilize connections to support educational instruction and administration.

- The AEITC members will act as spokespersons to the private sector to represent its mission and goals within the community. The AEITC will also foster and promote public/private sector partnerships through partnership agreements. A semiannual presentation will be made by the AEITC Operating Committee and Board of Directors to all partnership entities on the progress of these interests.

- The AEITC will continue to investigate the opportunities behind establishing separate entities of the AEITC to be operated by a nonprofit organization. They will submit a business and marketing plan to the AEITC Operating Committee for consideration and vote.
[Evergreen Communications, 1993]

Arkansas.

Arkansas has formed a Goals 2000 Planning Committee, which is responsible for planning Internet connectivity programs. One-hundred-forty-four districts (46%) and 315 school sites (30%) had direct connections as of July 1995. The Arkansas Public School Computer Network and the Department of Computer Services has been working with Southwestern Bell on infrastructure development as part of a Public Service Commission over earnings stipulation. The settlement

requires more backbone fibre between Bell central offices in communities (95% will be interconnected) and an ATM trial involving the statewide network, several school districts, universities, and medical facilities [The State Networking Project, 1996].

California.

A new statewide plan is under development titled the California Technology Assistance Project (CTAP). Funding will be made available through a statewide coalition to regions. This project will address school technology-related needs:

* Staff Development.
* Information and learning resources.
* Technical assistance, including hardware acquisition.
* Telecommunications infrastructure.
* Coordination and funding.

The telecommunications infrastructure is under development through a project called Educational Communications and Information Services (ECIS). The intent is to ensure equitable access to educational information resources from every school and classroom in California. This will be accomplished by building regional network infrastructure in at least ten county service regions of the state. County Offices of Education will offer Internet connections and services to districts with regional hub sites providing the high bandwidth Internet link. ECIS will be managed by a statewide coalition of regional partners, with oversight by the California Department of Education. The regional partners will be comprised of district and county representatives, including superintendents, principals, teachers, and education and information technology personnel [The State Networking Project, 1996].

Colorado.

Several state agencies including the Colorado Telecommunications Advisory Commission (TAC) are independently, but cooperatively, developing 'statewide telecommunications plans." The Governor has directed the Lieutenant Governor to head a telecommunications initiative. Additionally, the Governor's Office, along with numerous industry and government partners, has applied for a TIIAP planning grant [The State Networking Project, 1996].

Iowa.

To date, K-12 computer networking efforts have not been uniform across the state. Decisions have been driven by local priorities with some schools receiving consultative support from their Area Education Agency. An initiative to support an upgrade of technology in schools was proposed in the 1995 session of the Iowa Legislature. It did not pass. However, bipartisan support for the initiative has been growing and passage during the 1996 legislative session looks promising. The Iowa Legislature did appropriate $1.2 million for FY '96 to support educational activities of Iowa's fifteen Regional Telecommunications Councils. Part of those funds will go to provide support to computer

networking efforts. The Iowa Department of Education will also be supporting computer networking efforts through its newly formed Office of Technology.

The Iowa Communications Network (ICN), a statewide 3000 mile fiber optic network (DS3), provides voice, data, and video services to educational institutions, public libraries, the Iowa National Guard, state and federal agencies, judicial agencies, and hospitals and clinics. ICN provides services to schools and libraries through a service called EDNET.

Two of the major recommendations from the 1994 report of the Iowa Department of Education Technology Commission, "Technology for Education in Iowa," are for "effective interconnections with and integration of telecommunications networks linking Iowa's community colleges with Iowa's schools," and "the consolidation of responsibilities for developing and managing the Iowa Communications Network in ways that ensures equity and access for all institutions in the Iowa education community [The State Networking Project, 1996]."

Missouri.

Missouri is undertaking connectivity initiatives under the aegis of the Department of Elementary and Secondary Education (DESE) Technology Network Research Project and the Missouri Research and Education Network (MOREnet). Under the DESE project, the state agreed to provide services associated with:

- Access to state, national and international networking capabilities and non-metered data services.

- Operation and maintenance of data and equipment making up the nodes of the pilot computer network.

- Training for school personnel and community members in using the computer network, to include the following:

    1. Train and trainer modules.
    2. End-user training modules.
    3. User-guides.

- Access to information services from DESE.

- Assistance with local building connectivity (associated with MOREnet).

- Access to instructional/curriculum materials, to include:

    1. Full text and other database resource materials.
    2. Industrial technology.
    3. Science and mathematics.

4. Missouri History.
5. Index of regional and national library resources.

- Administrative uses, to include:

  1. Email.
  2. Electronic conferencing.
  3. Data transmission to and from DESE.
  4. An online discussion list.

MOREnet, meanwhile, has seen steady growth in participation on the Internet, working from institutions of higher education across the state. DESE participated in the pilot project described above with MOREnet to work with school districts throughout the state to enable teachers to access the Internet. As a result of this project, DESE has decided to expand this service and make connections available to all 536 school districts in the state. MOREnet will provide these services over the course of three years, with 150 schools receiving leased-line connections in the first year, 250 more schools in the second year and the remaining schools in the final year. Those schools not receiving direct connections immediately will be served through toll-free dial-in access until the direct connections reach their district [MOREnet, 1994, Cole, 1995].

Nebraska.

A consortium of nineteen Educational Service Units (ESUs), each serving various Nebraska schools districts, recently installed fifteen mainframe computer systems as a first step in building a statewide education network that links teachers and students to the Internet. These units are required by statute to provide access and training related to the Internet. This ESU consortium, along with the University of Nebraska at Omaha produced a progress report outlining their current status and future goals. The report notes several aspects of current connectivity, as described below:

Table 7.3
Progress in Nebraska: 1995

Estimates, as of June 1, 1995 (Year 1:1994, Year 2:1995)	Year 1	Year 2
Number of statewide Internet users supported by the ESUs	10,200	16,468
Number of "direct connected" schools	186	238
Number of planned additional "direct connects" in the next year	170	219
Number of individuals going through at least initial ESU training on the Internet	5,800	9,537

[Langan *et al.*, 1995]

North Carolina.

Planning for Internet connectivity in K-12 schools is incorporated into state at large plans under the North Carolina Information Highway (NCIH). A 1994 session of the General Assembly appropriated nine positions to work with schools out of the Regional Service Centers. State funding provides for $42 million for school technology, and $7 million for NCIH. Programs have been established by major telecommunications providers, including Southern Bell, GTE, and Carolina Telephone, providing a fiber backbone for the NCIH [The State Networking Project, 1996].

Oklahoma.

ONENET, which provides a Wide Area Network (WAN) for the state, has been operational since July 1, 1993. The K-12 education plan for telecommunications, which is currently being developed, is incorporated into the Oklahoma State Telecommunications and Data Processing Committee State Plan, Tele-medicine Plan, NII, and the State Chamber of Commerce State Plan. State funding and Federal grants are being utilized [The State Networking Project, 1996].

Washington.

Funding is provided primarily by local school districts, with marginal state support. The state plan for networking is developed and operational, but the state has 28 different telephone companies, which make networking difficult [The State Networking Project, 1996].
West Virginia.

State networking efforts are operational, but are being updated to allow Internet access. Bell Atlantic has started a World School Project that provides 56 Kbps frame relay services to all schools in their service area which is about 85 percent of the state. This project will provide the schools with a router, software packages and installation. Funding is provided by local districts and the state, along with some federal programs and grants [The State Networking Project, 1996].

CHAPTER 8. CONCLUSION

This literature report will be supplemented by original surveys now in progress. The main purpose of this report is to raise issues, rather than settle them. Many of the issues are summarized in Chapter 2. Nevertheless, some preliminary conclusions do emerge.

It is clear from Chapter 7 that several states are well ahead of Kansas with respect to planning and implementing statewide Internet connectivity in schools and libraries. A more complete comparison will be possible after results are available from mail surveys and case studies of selected states.

Internet activity is already occurring in the schools and libraries of Kansas independently of any statewide plans. We are not yet able to make firm comparisons between Kansas and the rest of the nation. This will be possible when the Kansas surveys are completed. Preliminary information implies that Kansas utilization patterns lag well behind the nation as a whole, as described in Chapter 6.

What to make of the apparent fact that Kansas is lagging behind other states depends, of course, on the importance one places on Internet connectivity. Chapter 3 on the benefits of connectivity suggests three alternative types of positions that might be defended:

- The Internet may still be too young and largely a fad, a device that is fun to use but which at present makes little fundamental change in anything that is important for schools or libraries.[5] The Internet may provide new techniques, but all of the types of services it provides can arguably be accomplished through other means. Thus, email can be replaced with telephone calls, voice mail and the postal service; information searching can accomplished through databases on CD-ROMs; online catalogs are useful even when not connected to the Internet. Also, techniques for using the Internet as a teaching tool are still in their infancy. Moreover, Internet technology is changing rapidly, and equipment purchased now may quickly become obsolete. If this is the case, then Kansas could save money with little loss of benefits by waiting until the Internet becomes more highly developed and access becomes cheaper. In that case, no statewide plan would appear to be needed at this time.

- The Internet may be significant purely because it provides efficient new methods for accomplishing old tasks. For example, in terms of marginal or incremental cost, communication by email is certainly much less expensive than communication by post. In particular, once you have a dedicated network up and running, the cost of sending one more message is practically zero (except for the time it takes to write it and to read it). Moreover, the majority of the costs of Internet connectivity consist in the cost of the local computers and area networks. These

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[5] The authors of this review find it hard to present this negative position adequately, because they themselves rely very heavily on the Internet and are thoroughly convinced of its value. For example, much of the material in this report was located on the Internet, and would have been absolutely impossible to find in a timely manner using any other method of search. Still, what is useful for University level researchers could, at least conceivably, be less useful for libraries and public schools.

items may be already purchased by Kansas USDs at high utilization rates, for reasons independent of the Internet. If this were the case, then it would be prudent to adopt Internet technology at a moderate rate, making case-by-case decisions on whether the anticipated cost savings justify the start-up costs. In this picture, a completely decentralized Internet policy could be best. In other words, there is no reason to adopt a statewide plan, unless the plan can be shown to lead to substantial cost savings in helping the school districts and libraries do what they would have done anyway.

- The Internet may be of great significance, for several interrelated reasons:

  1. It may provide qualitatively new services to students, teachers, library patrons, and library staff. Services such as discussion groups and online catalogs are viewed as desirable by all clients that make use of them.

  2. It may enhance learning and make libraries more useful. Use of the Internet may be intrinsically motivating for students and library patrons. Students and patrons may locate desired information that they could not obtain otherwise.

  3. It may be important to the competitive position of states and localities with respect to economic development. Employers may want to hire employees who already know how to use the Internet effectively. Entrepreneurs may want to live in communities where their children attend schools that are ahead of the technological curve. Small business people may need to consult the Internet at their local library.

  4. Wiring the schools and libraries may encourage the wiring of government agencies, community groups, and households. Each old connection on the network becomes more valuable with the addition of each connection on the network, because there are more places and applications connected to it -- just as a telephone is useful if, and only if, most other people also have telephones. Each new connection on the network encourages additional actors to join the network. Libraries in particular provide valuable public access points that give everyone a way to reach the network.

If the above conditions hold, then it may be reasonable for Kansas to adopt a plan designed to equal or surpass the national level of Internet utilization.

The decision to adopt the plan depends, of course, on the projected cost of the plan as well as on the value that policy-makers place on these benefits from the plan. Another report, [Burress and Hoyle, 1996], supplies initial gross estimates of the costs involved. However, creating a fully detailed, technical Internet plan and providing refined cost estimates will require ongoing work after the work of this Task Force is completed. What the Task Force might reasonably hope to accomplish in its brief lifetime is to recommend general principles and guidelines for that plan, set up a steering committee and a working group, and propose a timetable to ensure that the work continues.

APPENDIX. CHILDREN'S RESOURCES ON THE WORLD WIDE WEB: AN INCOMPLETE LIST

Compiled by Patti Mersmann
Kansas State Library
February 1996

KLNB Blue Skyways
   hhtp://skyways.lib.ks.us/kansas/

Ameritech Schoolhouse
   hhtp://www.ameritech.com/products/education/schoolhouse/index.html

Children's Services
   hhtp://www.state.lib.ut.us/children.htm

Children's Services Internet ABCs
   hhtp://www.state.lib.ut.us/chil-abc.htm

Children's Literature Web Guide
   http://www.ucalgary.ca/~dkbrown/index.html

Children's Literature Web Guide - Related Internet Sites
   http://www.ucalgary.ca/~dkbrown/othsites.html

Children's Literature Home Page
   http://www.parentsplace.com/readroom/childnew/index.htm

Yahoo - Arts:Literature:Children
   http://www.yahoo.com/Arts/Literature/Children/

Children's Writing Resource Center
   http://www.mindspring.com/~cbi/

SJCPL Children's Services
   http://sjcpl.lib.in.us/homepage/ChildSrv/Childrens.html

Hillside Elementary School
   http://hillside.coled.umn.edu/

(Bob Allison's Home Page) Uncle Bob's Kids' Page
   http://gagme.wwa.com/~boba/kidsi.html

Web 66
http://web66.coled.umn.edu/

IPL Youth Division
http://ipl.sils.umich.edu/youth/HomePage2.html

IPL Youth Division's Dr. Internet
http://ipl.sils.umich.edu/youth/DrInternet/DrInternet.html

KIDDING Around
http://alexia.lis.uiuc.edu/~watts/kiddin.html

Kids' Web
http://www.primenet.com/~sburr/index.html

Children's Pages at WombatNet
http://www.batnet.com/wombat/children.html

KidPub WWW Publishing
http://www.en-garde.com/kidpub/

Trade Wave Galaxy
http://galaxy.einet.net/

Interactive Web Fun (Leisure and Recreation)
http://galaxy.cinet.net/galaxy/Leisure-and-Recreation/Interactive-Web-Fun.html

Just For Kids (Leisure and Recreation)
http://galaxy.cinet.net/galaxy/Leisure-and-Recreation/Just-For-Kids.html

Wildlife Migrations
http://www.ties.k12.mn.us/~jnorth/migrations.html

The Franklin Institute Science Museum
http://sln.fi.edu/tfi/welcome.html

Reed Interactive's Online Projects
http://www.ozemail.com.au:80/~reed/global/mythstor.html

The NASA Homepage
http://www.gsfc.nasa.gov/

Smithsonian Gem and Mineral Collection
http://galaxy.einet.net/images/gems/gems-icons.html

Welcome to UCMP!
http://ucmp1.berkeley.edu/welcome.html

LIBRARIAN'S GUIDE
http://k12.oit.umass.edu/libguide.html

The Science House
http://www2.ncsu.edu/ncsu/pams/science_house/

The Virtual Reference Desk
http://thorplus.lib.purdue.edu/reference/index.html

City, Net World Map
http://wings.buffalo.edu/world/vt2/

Virtual Tourist World Map
http://www.vtourist.com/vt/

What's New at the Smithsonian: Overview
http://www.si.edu/whatsnew/start.htm

The Asylum's Lite-Brite
http://asylum.cid.com/lb/

HyperDOC:The Visible Human Project
http://www.nlm.nih.gov/extramural_research.dir/visible_human.html

Hotlist: Museums
http://sln.fi.edu/tfi/hotlists/museums.htm

3DriDDle-HomePage
http://cvs.anu.edu.au/andy/rid/riddle.html

Yahoo - Recreation:Games:Internet Games:Interactive Web Games
http://www.yahoo.com/Recreation/Games/Internet_Games/Interactive_Web_Games/

About USA TODAY
http://www.usatoday.com/

Mr. Edible Starchy Tuber Head Home Page (Mr. Potato Head game)
http://winnie.acsu.buffalo.edu/potato/

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http://www.exploratorium.edu/

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