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NATIONAL CENTER FOR EDUCATION STATISTICS

E.D. TABS February 1996

Advanced Telecommunications in U.S. Public Elementary and Secondary Schools, 1995

FRSS
Fast Response Survey System

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U.S. Department of Education
Office of Educational Research and Improvement NCES 96-854

Introduction

The National Information Infrastructure (NII), set forth by the President, encourages an acceleration of the goal to connect all of the nation's school classrooms, as well as libraries, hospitals, and law enforcement agencies, to the "Information Superhighway."

In response to this federal goal, the U.S. Department of Education commissioned a survey to obtain current data to compare with baseline data obtained in 1994 on the status of advanced telecommunications in public elementary and secondary schools. The survey requested information regarding the types of advanced telecommunications equipment and services that are currently available in public schools and the specific locations of the equipment; current computer networking capabilities in public schools; the number of schools that have plans to connect to wide area networks; the formal role groups have in developing telecommunications plans; and the various barriers that limit schools' acquisition or use of advanced telecommunications.

This report contains tabular summaries based on data collected from the *Survey of Advanced Telecommunications in U.S. Public Schools, K-12* conducted in fall 1995 for the National Center for Education Statistics (NCES). The report is presented as an E.D. TAB, that is, as a collection of tables whose sole purpose is to make data or tables available to the general and research public quickly. E.D. TABS are not intended to present analyses of the data from the survey. The tabular summaries present the actual data collected, and only selected findings are highlighted in this report.

The tables in this report present data for public schools overall and for schools by instructional level (elementary, secondary), size of enrollment (less than 300, 300-999, 1,000 or more), metropolitan status (city, urban fringe, town, rural), geographic region of the country (northeast, southeast, central, west), percent minority enrollment (less than 6 percent, 6 to 20 percent, 21 to 49 percent, 50 percent or more), and the percent of students eligible for the federally funded free or reduced-price lunch program (less than 11 percent, 11 to 30 percent, 31 to 70 percent, 71 percent or more). The statistics in all tables are based on national estimates (see table 1). Any statement of comparison made in this report has been tested for statistical significance through chi-square tests or *t*-tests adjusted for multiple comparisons using the Bonferroni adjustment and are significant at the .05 level or better.

The survey was conducted by Westat, Inc., a research firm in Rockville, Maryland, through the NCES Fast Response Survey System (FRSS). FRSS was designed to provide data quickly on policy-related issues regarding emerging educational developments.

The data from this survey provide valuable information that federal agencies will use to measure progress and determine the tasks and activities required to help our nation's public schools move forward in obtaining and using telecommunications technology. An additional report containing detailed analyses of the findings from the survey is forthcoming, as is a report of the findings for a fall 1995 survey of advanced telecommunications in private schools.

Selected Findings

The *Survey of Advanced Telecommunications in U.S. Public Schools, K-12* requested current information regarding the availability and use of telecommunications and, in particular, access to the Internet, plans to obtain Internet access, use of the Internet, and barriers to the acquisition or use of advanced telecommunications. The data were gathered from a nationally representative sample of 917 public elementary and secondary schools in fall 1995. Some comparisons are made with data collected from a similarly nationally representative sample of schools during fall 1994. For definitions, please see Appendix C: Glossary of Terms.

- Fifty percent of U.S. public schools now have access to the Internet (table 3). This percentage is up from 35 percent just 1 year ago.

- Access to the Internet varies by school characteristics (table 4). Only 31 percent of schools with large proportions of students from poor families (71 percent or higher eligibility for free or reduced-price lunches) have access to the Internet, compared to 62 percent of schools with relatively few students from poor families (less than 11 percent eligibility). Access is also related to school enrollment size--from 39 percent for schools with fewer than 300 students to 69 percent for schools with 1,000 or more students. Secondary schools (65 percent) are more likely than elementary schools (46 percent) to be linked to the Internet.

- Seventy-four percent of the schools that do not currently have access to the Internet plan to obtain access in the future (table 13).

- 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, and 54 percent indicated too few telecommunications access points in the building as a major barrier (table 14).

- Although half of the nation's public schools already have access to the Internet somewhere in the building and three-fourths of those without access have plans to connect, only 9 percent of all instructional rooms (classrooms, labs, and library media centers) are currently on the Internet (tables 4 and 13). This is a three-fold increase compared with fall 1994, when only 3 percent of all instructional rooms had access to the Internet.

- Public schools report an average of 72 computers including those used for both administrative and instructional purposes (table 5). However, only 14 percent of all computers in public schools across the country have Internet access. Schools with Internet access report an average of 12 computers connected to the Internet (table 7).

- Eighty-five percent of public schools have access to some kind of computer network; 77 percent have computers connected to a local area network and 61 percent have computers with wide area network access (tables 2 and 3).

- In addition to the 50 percent of schools that are on the Internet, 11 percent have access to some other wide area network that does not connect to the Internet, and 23 percent have only a local area network (table 3).

- Public schools now are as likely to have a computer with a modem as they are to have cable television (76 percent for each; table 2). Seventy-one percent have access to broadcast television in their schools. Fewer schools have closed-circuit television (28 percent), one-way video with two-way audio or computer link (13 percent), and two-way video and audio (7 percent).

- In schools with wide area network access, it is generally found in library media centers (68 percent) and to a lesser extent in computer labs (41 percent; table 2). Only 35 percent of public schools with wide area network access report having this capability in a classroom.

- The types of telecommunications most often located in classrooms are broadcast and cable television (71 and 76 percent, respectively; table 2). Although 91 percent of schools with closed-circuit television report having it in the classroom, only 28 percent of schools have this capability.

- Schools indicate that the school district (63 percent) and teachers and other staff (38 percent) are the two groups most likely to play a large formal role in developing the school's telecommunications program (table 12). While only 7 percent indicate that parents play a large role, 31 percent cite parents as playing a moderately active role. This is up from 1994, when only 4 percent of public schools indicated that parents played a large role, with 17 percent reporting they played a moderate role (reference table 12b1).

For the 50 percent of public schools having Internet access in 1995:

- Seven percent of schools on the Internet do not have access in any instructional rooms (including computer labs, library or media centers, and classrooms), 47 percent have 1 instructional room on the Internet, 24 percent have 2-3 rooms, 4 percent report 4 rooms, and 19 percent of schools can connect to the Internet in 5 or more instructional rooms in the school (table 6).

- In fall 1994, 97 percent of schools with wide area networks (49 percent of all schools) could connect to these networks by modem; only 3 to 4 percent used higher speed connections such as T1 (3 percent), 56Kb (4 percent), or SLIP/PPP (3 percent; table 3 and reference table 10b1). By fall 1995, fewer schools with Internet access were relying on modems and the use of faster transmission connections had increased markedly. In fall 1995, 61 percent of schools were connected to wide area networks. Most schools still can connect by modem (81 percent), but 23 percent now report having a SLIP or PPP connection, 10 percent connect by a 56Kb, with 7 percent for T1, and 3 percent for ISDN (table 10).

- Of the schools with Internet access, 93 percent have e-mail, 83 percent can access resource location services, 80 percent have World Wide Web access, and 73 percent can access news groups (table 8). While e-mail is the most widely available Internet service in schools, a higher proportion of schools with other Internet services make these other services 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

news group services in 51 percent of the schools with news group access. Only 41 percent of schools with e-mail provide access for students.

- Twenty-eight percent of those schools with Internet access report that teachers use the wide area networks to a moderate or large extent, with 21 percent for students and 18 percent for administrators (table 9).

- High school students are more likely to use wide area networks than elementary students; 30 percent of high schools report a moderate to large extent of wide area network use by students, as compared with 17 percent of elementary schools (table 9).

- Schools manage their networks in a variety of ways. The largest percentage are managed by a part-time administrator (45 percent; table 11). Twenty-four percent indicate that someone from the district staff administers their network and 20 percent report that no single individual is responsible. Only 12 percent of schools report that their network is administered by a full-time administrator.

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Before the
Federal Communications Commission
Washington, DC 20554

In the Matter of	)	
Federal-State Joint Board on Universal Service	)	CC Docket No. 96-45

DECLARATION OF CRAIG LYNDES
IN SUPPORT OF COMMENTS OF
NATIONAL SCHOOLS BOARDS ASSOCIATION, ET AL.

I, Craig Lyndes, a secondary school computer coordinator, declare as follows:

1. I submit this Declaration in support of the Comments filed by the National School Boards Association, et al. I am fully competent to testify to the facts set forth herein, and if called as witness, would testify to them.
2. I have helped Champlain Valley Union High School ("CVUHS") set up a Local Area Network (LAN) connected to a Wide-Area Network (WAN) or the Internet. CVUHS has 950 students. In 1995/6 we paid $19,000 to have a 256K leased line to CVUHS. This included Internet services to the school. This connection is being shared by the 4 feeder schools (Hinesburg Elementary, Charlotte Central, Shelburne Community and Williston Central) through our 56K Wide Area Network. In 1995/6 the use of services by students, teachers, and administration caused this bandwidth to be

inadequate. That is, the service became too slow if students tried to gain access to the World Wide Web and evolving video and audio services available on the Internet. As our need for bandwidth to the Internet increases we are also seeing a need for increased bandwidth between the schools in our district. Internet access is just one facet of the telecommunications being used in the district, with intranet communications between the schools being a very valuable and exciting new resource. Telecommunications services are playing an increasingly important role in all aspects of school life.

3. It is my opinion that a school should have a bandwidth and resources necessary to play a primary telecommunications role for the whole educational community. Parents and families would benefit from not only Internet access, but access to the school library, CD-ROMs owned by the school and communications with teachers if they could connect to the school using telecommunications. When we look at providing access to our school to all of our student's families we need a high bandwidth pipe to the Internet, and extensive telecommunications resources, whether POTS or ISDN or cable modems, to the homes of our students.

4. We have found that demand for bandwidth increases as students and teachers become accustomed to the technology. First-time schools may do fine with 56K, but we are in our third year with a leased line connection and would like a T1

next year. In a few years I could see needing 10 megs and in 5 years 155 megs. So over time, I see our needs for bandwidth steadily increasing.

5. To give some sense of the issues involved in setting up a school network, attached is a true and accurate excerpt from a manual I developed.

Verification

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief, and that this declaration was executed on April 10, at Hindsburg, Vermont.

Craig Lyndes

Craig Lyndes

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ATTACHMENT TO DECLARATION OF CRAIG LYNDES

This attachment is an excerpt from:

SSIP: A New Internet Protocol for K-12 Schools A Guide for K-12 Schools Wishing to get on the Internet and Use Information Technology

* Simple School Internet Protocol

Copyright 1995, Craig Lyndes
URL (location on the World Wide Wed):
http://www.cvu.cssd.k12.vt.us/k12tech/k12tech.htm

The following is the technical chapter's table of contents and a sections from a chapter (the fourth of four main sections in the manual) called "Technical considerations when setting up information technology in a school."

[Those who use the World Wide Web to get to this resource would see an Image here. The Web address is above.]

Technical Considerations when setting up Information Technology in a school.

* The Network
    - o Wire and Termination
    - o Hubs
    - o Backbones, Switches and Network Topology
    - o Back Bones
    - o Fiber vs. Copper
    - o High Speed Backbones
    - o Ethernet Collision Detection
    - o Collapsed Backbones
    - o High Speed Backbones
    - o Packets
    - o Protocols
    - o Routers
    - o Wide Area Networks
    - o Dial Up Routers
* The Internet
    - o TCP/IP Addresses
    - o Subnet Masks
    - o Domain Name Servers
    - o Gateways or Routers
    - o Installing Client Software
    - o Protocol Stacks and what they mean to you.
    - o Novell
    - o ODIPKT
    - o Appletalk

- o Applications
- o Internet Services

* Security

Getting Started

So, you've got some educational goals that you want to accomplish, you have cajoled, finagled and persuaded enough people to get a budget, now what? If you haven't been able to out source all of the details it is time to roll up your sleeves and tackle the technical aspects of using technology in a school.

What follows is based upon my experience. I have tried to share my mistakes and successes when I can. I will mention good technologies that I have not set up myself when I am aware of them. The areas where I go into detail are the areas that I am personally familiar with. Take what is useful to you and feel free to disagree!

First, plug in! Subscribe to Byte and Wired. Read Infoworld, Communication Week, Network World and MacWeek every week. (OK, so I only read two monthlies and skim 3 weeklies, still, it is important to keep up-to-date!) Get an Internet e-mail account and subscribe to lists that are visited by fellow professionals. For every major software or hardware platform there is a group of fellow sufferers out there willing to support you in exchange for hearing about your successes and failures.

It is necessary to have a crystal ball if you are going to survive in this profession. The decision you make will either add to your success or haunt you in the future. Getting plugged in is the only way to make informed decisions about hardware, software and long range technology directions.

I fin[d] it fun and exciting to be a part of this dynamic industry. The challenges and constant change keep work form getting dull. The people I've met along the way, both in Educational Technology and in the Computer Industry, are an interesting group of pioneers.

The Network

Ethernet is my suggested choice for schools today (March 1995). At less than $50.00 per computer ($100.00 for Macintosh) it is much less expensive than token ring. The hubs are also less expensive than token ring Media Access Units (MAU's). My experience is that Thin Ethernet, although the least expensive, is not an optimal technology for a school. Because Thin Ethernet does not use hubs, but is a daisy chain, a single failure, either from a bad connector or a bored student, will take your whole network down. 10 Base-T Ethernet is a star configuration, where each computer has a dedicated wire

from a hub. This configuration is not vulnerable to a single workstation failing and taking out the whole system. (although there are plenty of other things that can kill any network) The hubs can be relatively inexpensive, an unmanaged 12 port 10 Base-T hub is less than $300.00.

Wire and Termination

10 Base-T uses a type of phone wire to connect the computers to the hub. This wire has 4 "pairs" of wires totaling 8 wires. These pairs are twisted together, the twists are very important as they give the wire the ability to carry the data without interference. This wire is graded by how much data can be passed through the wire with an acceptable amount of loss and interference. Category 3 wire is OK for today's Ethernet which runs at a speed of 10 million bits per second (10 Mbps). Currently there are several competing standards that will multiply that speed by 10. These 100 Mbps network technologies need Category 5 wire. Wiring a building is very labor intensive, and therefore very expensive. For that reason it makes sense to install Category 5 wire which will be useful for a few years in the future.

The wire that is installed in a building usually goes from a hub to a wall outlet where the computer will be located. 10 Base-T Ethernet uses an 8 wire phone connector to connect the computer to the wall jack. This 8 wire phone jack is called an RJ45 connector. These jacks are also rated by how fast the data can pass through them. If you are putting in Category 5 wire it is important to get Category 5 wall jacks. The wires are connected to the wall jacks with a telephone repairman's tool called a punch down tool.

There are several types of punch down connections, Type 66 is primarily used for voice phones, Type 110 is very common for data wiring and there are several proprietary punch down connections made by individual manufacturers. For some strange reason these tools are relatively expensive; $30.00 - $60.00. They are very simple to use and quickly pay for themselves when compared to having a commercial vendor install the wire.

[I skip to the section on networks]

So what happens when dial up is too slow or too expensive? Then you need to contact the phone company and say you are interested in talking with someone about data lines. After you are shuttled around for a week or two you will eventually get someone that can tell you what is available in your area and what it will cost. Be persistent, this wasn't meant to be easy. Always remember you are dealing with a monopoly. If you want your WAN you have to play the game their way because it is the only game in town.

If you are like me you will be shocked at the expense. Our 56K leased line cost $500.00 up front to be installed and runs us over $3,000.00 a year. This is to carry our network signal 12 miles to Burlington.

Here is some of the lingo that you will need to talk to the phone company. The least expensive type of connections are called leased data lines. These are usually at 19.2 kbps and 56 kbps. It is possible to get slightly higher speeds out of these links by using compression at either end, but that is your job. The phone company is only supplying you with the wires. If you should need more bandwidth than 56K you will need to go to what is called a T1 line. T1 lines go up to 1.5 Mbps, but if you are lucky you can buy fractions of a T1 line, called Fractional T1 (we're not so lucky, we have to buy the whole T1 from the phone company or nothing). If your phone company has decided to offer it, you might be able to get ISDN or Switched 56K service. These are switched services, like a regular phone line, that carry data only when you need it and can send it to whomever you need it to. Regrettably Vermont has very few of these modern data services at this time.

When you go to these higher speed, leased data lines you will no longer be able to use a modem. For leased data lines and T1 lines you will use a device called a CSU/DSU that does the same thing as a modem. You will still need a router, but many dial up routers will handle the higher speed serial line protocols used with leased lines.

The Internet

The Internet is a world-wide WAN. To get your network connected to the Internet you will need to have in place some sort of WAN connection to someone who is already on the Internet and who is in the position to let your network participate in this WAN. At this point there are only two companies in Vermont that bring the Internet into the state. One is called Nearnet and the other is Sprint. Both of these companies are leasing T1 lines from the phone company to their next closest Point Of Presence (POP), Boston and Albany respectively. Currently both of these companies have their POP in Chittenden County. Nearnet is located at the University of Vermont in Burlington and Sprint is located in Essex Junction. If you purchase your Internet connection from either of these providers you will have to lease, from the phone company, some sort of connection from your school to one or the other of these locations.

There are several entrepreneurs that are buying Internet connections from Nearnet or Sprint and bringing the connection to an area that is currently not being served, then reselling the bandwidth. If and when someone does this in your area you will

only have to lease a line to this closer POP. Of course the business that is bringing the Internet into your area will be making a profit, but because they are spreading the cost of the connection to Burlington or Essex among all of their customers the total cost to you should be less than doing it all by yourself.

Something to keep in mind is that there is a lot more to an Internet connection than a phone wire to an Internet Point Of Presence. Let's start with the important stuff, some background information on TCP/IP and how to hook up the users' computers.

[The section on the Internet continues, but I will stop here. These excerpts should help readers of this declaration understand some of what goes into connecting a K-12 school to the Internet.]

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US OFFICE PRODUCTS

APPENDIX F

COST CONCERNS IN CALIFORNIA

The following excerpts from statements submitted by various California school districts illustrate the importance of affordability:

Fresno Unified School District:

Recently a state block grant (AB 825) has provided about $50 per student for technology. While this has been helpful, it will in no way get us to an acceptable standard and does not provide for operating costs. The successful passage of a bond election will provide for the capital expense of local area networks and a wide area network, but this will take five years and, again, does not provide for operating nor hardware costs. Schools will also need the support of a state broadband link, which does not currently exist. To operate our LANs and WAN we will need relief for access and line charges. Our goal is to also have an interactive multi-media station for each teacher linked via the LAN and WAN.

For EMAIL, bulletin board and voice mail capabilities, we not only need those devices and software to enable 3300 classrooms to have access but again will need reduced operating rates. It will cost FUSD $500,000 per year for basic, flat rate line charges for telephone service in each classroom in addition to the unit charges and phone devices.

In order to meet the spirit of the Telecommunications Act of 1996, it is imperative that public schools have the necessary hardware, software, staff development and reasonable operating fees to do so. these are add-on instructional expenses in most cases.

Oakland Unified School District:

To understand the impact of telecommunications regulations on school districts such as Oakland you need to understand two things. First, there is a minimum level of technology required just to keep our communications infrastructure current with the private sector. Second, our technology resources are not adequate for us to keep current because they are being squandered on telecommunications costs which are excessive and unnecessary. Only through progressive regulation and market-driven competition will these excessive, unnecessary costs be eliminated from Oakland School's communications budget. Once this happens, funds will become available for important technology upgrades from routine funding sources.

However, what continues to hamper the district's efforts to keep abreast of technology development are the unnecessary and excessive costs to which school district's are subjected. To fully support the above communications upgrades, Oakland Schools require a district-wide private communications infrastructure. However, the costs to acquire the fully robust network is in the millions. The school district covers five different operating company central offices. To connect all the school sites together, the local operating company charges for "interoffice facilities" which tie the different telephone company central offices together and creates one communications system for the district. However, because of a technology called Signaling System 7, the operating company does not need separate "interoffice facility" trunks to provide this service. Yet, the operating company charges the district for these "phony" facilities.

Finally, the provision of the district's internet service has become a problem. The district's current Internet Service Provider (ISP) has presented a multi-year contract without rates. We are forced to investigate an alternate ISP. However, if the district does not keep the same ISP, it will be forced to change ISP addresses and numbers. With the change, all the internet routers in the district must be reconfigured. It costs between $100 and $200 for each router reconfiguration. Because of the infancy of the internet industry and the ongoing shakeouts of ISPs, over the next several years the district may be forced to change its ISP numbers several times and incur ongoing router reconfiguration costs.

Sacramento City Unified School District:

The District is in support of the efforts being made by ELS in attempting to obtain FCC approval for lower rates for schools and libraries. Our District is currently implementing a wide are network using a combination of ISDN, frame relay and point-to-point connections. Although this endeavor is costly from a resources basis, fully one third of the entire project cost will be expended each year on line charges alone. Relief in this area is of major interest to us, and could assist greatly in expanding the use of technology in the future.

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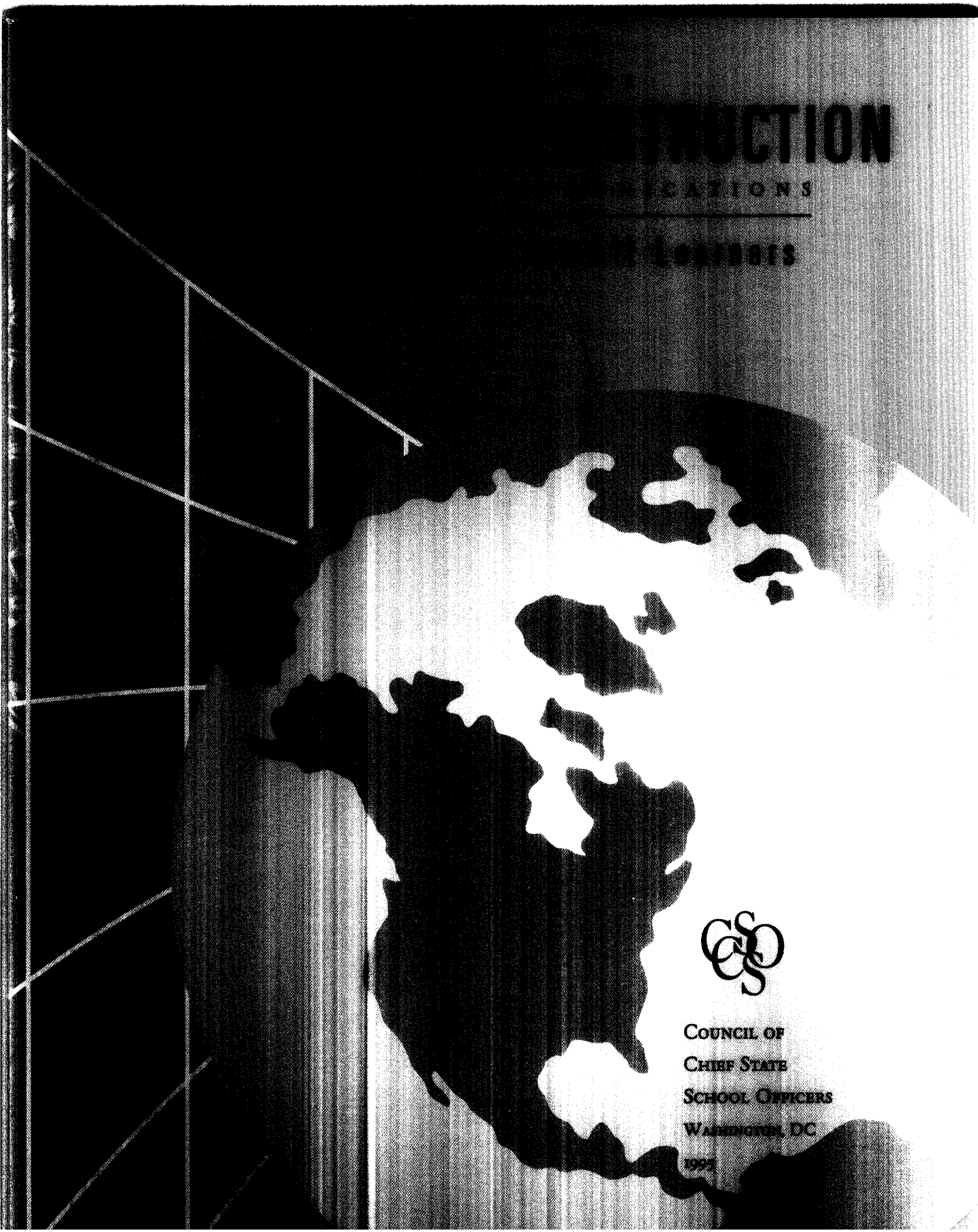

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Council of
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Washington, DC
1995

UNITED STATES

EDUCATION AND INSTRUCTION

THROUGH TELECOMMUNICATIONS

Distance Learning for All Learners

COUNCIL OF
CHIEF STATE
SCHOOL OFFICERS
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1995

UNITED STATES

EDUCATION AND INSTRUCTION

THROUGH TELECOMMUNICATIONS

Report prepared under cooperative agreement for The National Telecommunications and Information Administration (NTIA) of the United States Department of Commerce by the Council of Chief State School Officers

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The Council of Chief State School Officers is a nationwide, nonprofit organization of the 57 public officials who head departments of elementary and secondary education in every state, the District of Columbia, the Department of Defense Dependents Schools, and the five extra-state jurisdictions of American Samoa, Guam, Northern Mariana Islands, Puerto Rico, and the Virgin Islands. Through its structure of committees and task forces, the Council responds to a broad range of concerns about education and provides leadership on major education issues.

CCSSO is committed to supporting the effective use of technology to improve learning, provide new opportunities for collaboration and professional development among educators, and extend opportunities for lifelong learning to all Americans. The Learning Technologies program assists states through a network of state technology representatives (STRs), individuals appointed by the chief state school officers. The Council hosts forums on major issues concerning new developments and applications of technology. It also monitors federal regulatory activity affecting telecommunications and education.

ISBN 1-884037-07-0
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CCSSO would like to thank the following NTIA staff members for their assistance and cooperation:
Dennis Connors, Director, Public Telecommunications Facilities Program
Richard Harland, Senior Project Officer
Robert Sestili, Senior Communications Advisor