March 26, 1996

Office of the Secretary
Federal Communications Commission
1919 M Street, NW
Washington, DC 20554

Dear Sir,

I am filing the attached research paper in my role as faculty member and academic researcher at the Public Utility Research Center, College of Business Administration, University of Florida. This is an informational document for In the Matter of Federal-State Joint Board on Universal Service, CC Docket No. 96-45, Notice of Proposed Rulemaking and Order Establishing Joint Board.

The enclosed paper is an executive summary of Schools in Cyberspace: The Cost of Providing Broadband Services to Public Schools, with the complete paper attached as an appendix providing factual material.

The views expressed in this paper are those of the Telecommunications Industries Analysis Project. The information in this paper is intended to provide general public information and does not constitute or foretell the official position of any of the parties who contributed to this paper. The opinions expressed in this paper do not necessarily reflect the views of any agency or company.

In accord with FCC guidelines, I am submitting ten copies of the document (including five for Commissioners’ personal use). I have also sent a copy to the Commission’s copy contractor.

Sincerely,

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Comment on

*In the Matter of Federal-State Joint Board on Universal Service, FCC Docket No. 96-45, Notice of Proposed Rulemaking and Order Establishing Joint Board*

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Schools in Cyberspace: The Cost of Providing Broadband Services to Public Schools

Executive Summary

July 1, 1995, Reformatted for FCC Filing, March 25, 1996

Presentation at the July 1995 NARUC Meeting, San Francisco, CA

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Schools in Cyberspace: The Cost of Providing Broadband Services to Public Schools

Carol Weinhaus, Teresa Pitts, Linda Garbanati, et al.
July 1, 1995.

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The Telecommunications Industries Analysis Project is associated with the Public Utility Research Center at the University of Florida College of Business Administration.

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Schools in Cyberspace:
The Cost of Providing Broadband Services
to Public Schools

Executive Summary

Objective

This paper gives policy makers information on the cost of providing public schools with broadband access to traditional telephone networks and emerging new networks (such as video networks and the Internet) via the local exchange carriers (LECs). The costs in this paper are for one type of broadband technology.\(^1\) The results in this paper supplement existing studies.\(^2\) Although this paper assumes that the broadband infrastructure is provided by LECs, in practice educators may choose other network suppliers.

Broadband Modeling Results

The additional LEC network investment for providing schools with broadband services is very low compared to school investment and equipment costs. This is also true for providing wideband services. Most of the cost of providing new technologies is driven by two factors:

- Deploying technologies too fast.
- Providing schools with computing equipment, wiring, and training.

\(^1\)Technology that supports data rates of 45 Mbps (Megabits per second) or greater is called broadband. The broadband platform can support both MPEG-II and 45 Mbps or greater.

Definitions of Deployment Schedules and Scenarios Modeled

Two deployment schedules for public schools are compared – a 20-year nationwide broadband deployment and a 5-year accelerated deployment for broadband access and school equipment. Both schedules assume a nationwide, ubiquitous deployment of a broadband infrastructure in the LEC telecommunications networks over a twenty year period. To provide valid comparisons between the two deployment schedules, the modeling cost results are based on comparisons of twenty year periods for all three access-to-technology scenarios: teacher only (only one computer per classroom), team of students (seven computers per classroom), and universal (every student and teacher has a computer). The data are for public schools only, kindergarten through twelfth grade.

Range of Broadband Costs

The range of total costs for the 20-year broadband deployment is $14.7 billion for the teacher-only access scenario to $118.3 billion for the universal access scenario. The range for the 5-year accelerated deployment for these two scenarios is $28.6 billion to $204.4 billion.

- LEC Network Investment Costs are Dwarfed by School Costs

LEC network investment costs are dwarfed by the school costs, especially as the number of computers per classroom approaches the number of students per classroom. In the case of universal deployment of computers (a computer on
every desktop), even the expense associated with software upgrades and
Internet access charges rapidly exceeds the LEC network investment costs
(Figures 1 and 2). LEC network investment costs are $10.2 billion for the 5-year
accelerated deployment and $2.2 billion for the 20-year deployment.
Depending on the scenario, these costs range from 1.9% to 35.6% of total costs.
This pattern of relatively high investment by schools, low investment by LECs is
especially evident in the most extensive scenario (universal access). While not
as extreme, this same pattern also holds true for the simplest scenario (teacher-
only access) which provides only one computer per classroom.

- **Accelerating Deployment Increases LEC Network Investment Costs**

If broadband deployment to public schools is accelerated to five years
instead of integrated as part of a 20-year nationwide deployment, LEC network
investment costs are approximately five times as much ($10.2 billion compared
to $2.2 billion). Acceleration of deployment to the schools produces
significantly higher costs. This is due to the fact that more equipment is
purchased in the early stages when prices are higher and to the fact that there
will be little sharing of common facilities and civil works with other customers.
The 20-year schedule shows the cost advantages for sharing network investment
over all available services. In this case, investment is stimulated by wider
market demand and an integrated cost-effective modernization of facilities.
LEC network investment costs are indifferent to the number of PCs per classroom.

Data rates supported by broadband equipment and fiber-optic cable are so great that these costs are insensitive to the variation in the demand for data services due to the number of PCs.

Incremental Investment per Student per Year may be High or Low

The incremental investment per student per year (Figures 3 and 4) indicates that the universal access scenario costs approximately twice as much as the team of students scenario and approximately seven times as much as the teacher-only access scenario. Incremental investments remain relatively constant over time for these two less extensive deployments.

In terms of the incremental investment per student per year, the decision to accelerate broadband deployment beyond the nationwide deployment produces an effect that isn't erased with time. This difference is most evident in the comparison of 5-year and 20-year deployments of the universal access scenario (Figure 5). By the sixth year, the investments diverge dramatically. To a lesser degree, this same pattern appears in the teacher-only access and in the team-of-students access scenarios.

In 1992 public school expenditures per student were approximately $5,200. A comparison of this number with the results from the model (Figures 3 and 4), indicate potential for increased expenditures. However, it is difficult to
determine the impact of new technology on existing expenditures. For the
universal access scenario, incremental investments per student may double current
expenditures, while for the teacher-only access scenario, incremental investments
may increase by ten percent.

Public Debate over Expenditures for Schools

The deployment of broadband technology to schools is only one area in a larger
debate over public expenditures for schools. One view is that the federal
government should play a leading role in getting broadband services to schools.
Another view prefers local control. Yet other views combine these extremes and
see a need for a federal framework within which local officials decide how
information technologies can be used to prepare U.S. students for a competitive,
global economy. Regardless of the view that is taken, educators and policy makers
need information on technology costs to help them to make informed decisions.
* In the 5-year accelerated deployment, replacement costs for school investment in computers, etc., is minimal in relationship to the initial investment and, therefore, is not immediately visible in years 6 through 20. Modeling the costs out to 20 years allows comparisons with the 20-year deployment.

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Figure 2: Comparison of School Costs with LEC Network Costs: 20-Year Broadband Deployment, Universal Access

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Figure 3: Incremental Investment per Student per Year for Three Access Scenarios:
5-Year Accelerated Broadband Deployment

*Modeling the costs out to 20 years allows comparison between the 5-year accelerated and the 20-year deployment schedules.

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Figure 4: Incremental Investment per Student per Year for Three Access Scenarios: 20-Year Broadband Deployment

- Universal Access: $2,774
- Team-of-Students Access: $899
- Teacher-Only Access: $344

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Figure 5: Incremental Investment per Student per Year for Universal Access:
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*Modeling the costs out to 20 years allows comparison between the 5-year accelerated and the 20-year deployment schedules.

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List of Acronyms

FCC           Federal Communications Commission
LAN           Local Area Network
LEC           Local Exchange Carrier
Mbps          Megabits per Second
NII           National Information Infrastructure
PBX           Private Branch Exchange
PC            Personal Computer
PSN           Public Switched Network
U.S.          United States
I. Introduction

Introduction

Currently, there are debates over the provision of advanced telecommunications services (i.e., data transfer, access to the Internet, and access to state networks and libraries) to students and teachers in primary and secondary (kindergarten through twelfth grade) public schools. The FCC, the Administration, Congress, state governments, and local municipalities have all expressed interest in finding ways to provide the education community with access to new technologies and to the interconnected web of public and private networks.

Deploying broadband services is one way to give schools access to new technologies and networks. One issue associated with this deployment is cost: is the cost significant and are broadband services worth the investment?

This paper demonstrates that the additional local exchange carrier (LEC) network investment for providing schools with broadband services is very low compared to school investment and equipment costs. This is also true for providing wideband services. This paper also shows that most of the cost of providing new technologies is driven by two factors:

- Deploying technologies too fast.
- Providing schools with computing equipment, wiring, and training.

The objective of this paper is to present policy makers with information on the cost of providing public schools with broadband access to the Public Switched Network (PSN) via the LECs. The results in this paper supplement existing studies. Specifically, this paper provides costs for one type of broadband technology and gives ranges of costs for capabilities derived from access to broadband services for educational purposes. Although this paper assumes that the broadband infrastructure is provided by LECs, in practice educators may choose other network suppliers.


3The traditional Public Switched Network is a single nationwide network connecting each telephone on the network to every other telephone on the network. (Definition adapted from AT&T Bell Laboratories, Engineering and Operations in the Bell System: Second Edition, Reorganized and Rewritten Telecommunications in the Bell System in 1982-1983, R.F. Rey (Technical Editor), Murray Hill, NJ, 1983, page 3.) For purposes of this paper, the PSN will include both the traditional telephone networks and emerging broadband networks, such as video networks and the Internet.

4Technology that supports data rates of 45 Mbps (Megabits per second) or greater is called broadband. The broadband platform can support both MPEG-II and 45Mbps or greater.
I. Introduction, cont.

The rest of this paper covers the following items:

- **Section II, Broadband Model Results:** Presents results for two broadband deployment schedules. In one, schools receive broadband technologies as part of a 20-year nationwide deployment. In the other, broadband network deployment follows a 5-year accelerated schedule for the schools. Three scenarios for classroom costs, including the costs of computers and other equipment, are modeled for both deployment schedules.

- **Section III, Wideband and Broadband Deployment Definitions and Assumptions:** Provides definitions and assumptions for wideband and broadband deployments. The broadband data in this paper supplements previous research on the deployment of wideband technologies to public schools.

- **Section IV, Public Debate over Expenditures for Schools:** Discusses different policy views associated with expenditures for education. While it is necessary to understand the costs underlying the various choices for providing communications services to the schools, it is important to view these decisions within the larger context of the debate over expenditures for education in general.

- **Section V, Appendix A, LEC and School Cost Charts:** Contains additional charts for LEC network investment and school costs. Allows comparisons among deployment schedules and scenarios.

- **Section VI, Appendix B, Incremental Investment per Student per Year Charts:** Contains additional charts for comparisons of the incremental investment per year. Allows comparisons among deployment schedules and scenarios.

- **Section VII, Appendix C, Background Data:** Provides background data for the charts.