reason, States should bear the primary responsibility for generating and disbursing the funds needed for any short-term price support.[54/]

IV. COLLECTION, DISTRIBUTION, AND ADMINISTRATION OF UNIVERSAL SERVICE SUPPORT FUNDS

The Act requires the Commission to establish "specific, predictable, and sufficient" subsidy mechanisms to support widespread availability and affordability of the Federally defined universal service package.[55/] It also authorizes State commissions to adopt mechanisms to finance any additional universal service requirements that "do not rely on or burden Federal universal service support mechanisms."[56/] As indicated in the Notice, establishment of such support mechanisms requires resolution, at least at the Federal level, of three fundamental questions: (1) how and from whom should universal service subsidies be collected; (2) how and to whom those subsidies

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54/ NTIA agrees with those parties that favor a measured elimination of the carrier common line charge (CCLC) as a means of recovering non-traffic sensitive costs (NTS) that have been assigned to the interstate jurisdiction. See, e.g., Comments of BellSouth Corp. at 11-12; Comments of AT&T at 4 n.5; Comments of New York at 4. The Commission should not assume, however, that removal of the CCLC necessitates a corresponding increase in the SLC. Before mandating such an increase, the Commission should ascertain that the NTS costs that would be recovered thereby represent the LEC's actual forward-looking costs of providing interstate access. Comments of New York at 4. The Federal universal service fund could provide monies needed to prevent harm to carriers and subscribers during the phase-out of the CCLC.

55/ Act § 254(d).

56/ Id. § 254(f).

should be distributed; and (3) who should perform those functions.[57/]

A. All Providers of Interstate Telecommunications Services Should Contribute to the Funding of Universal Service

Only carriers that provide interstate telecommunications service must contribute to the funding of universal service.[58/] Many commenters believe that the Commission should require contribution from the broadest range of telecommunications service providers.[59/] Limiting that obligation to a smaller group of carriers could spawn interminable controversies over the definition of a "carrier."

The 1996 Act alleviates these definitional problems by providing some specificity for the term, "telecommunications carrier,"[60/] defined generally as an entity that provides "telecommunications for a fee directly to the public, or to such classes of users as to be effectively available directly to the

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57/ Notice ¶¶ 118-131.

58/ Act § 254(d). Similarly, the Act requires all carriers providing "intrastate telecommunications services [to] contribute, on an equitable and nondiscriminatory basis, in a manner determined by the State" to the preservation of universal service in that State. Id. §254(f).

59/ See, e.g., Comments of Ameritech at 23; Comments of Pacific Telesis Group at 20-21; Comments of US West at 14-15; Comments of MCI at 15-16.

60/ The Act indicates that, in most cases, a telecommunications carrier shall be deemed as a common carrier to the extent that it furnishes telecommunications services. Act § 153(44).

public."[61/] There is, nevertheless, enough ambiguity in the phrase "directly to the public" for enterprising firms to contend they are not "carriers" and, thus, are not obligated to contribute to universal service funding. The Commission should therefore mandate that all firms providing interstate telecommunications services to third parties for a fee should contribute to the advancement and preservation of universal service.[62/]

61/ The Act defines the term "telecommunications carrier" to include most providers of telecommunications services. Id. § 153(44). The language quoted above is contained in the Act's definition of telecommunications service. Id. § 153(47).

62/ The Senate telecommunications reform bill, as introduced, contained language specifically excluding "information services" from the definition of "telecommunications service." S. 652, 104th Cong., 1st Sess. § 3(mm) (Mar. 30, 1995). The Committee Report on the bill indicates that the exclusion was intended "precisely to avoid imposing common carrier obligations on information service providers," such as the obligation to contribute to universal service. S. Rep. No. 104-23, 104th Cong., 1st Sess. 28 (1995). The exclusion was removed from the bill, however, before passage by the full Senate.

The House telecommunications bill also contained language explicitly removing information services from its definition of telecommunications service. H.R. 1555, 104th Cong., 2d Sess. § 501(a)(2) (1995). The House-Senate conference committee on the divergent bills adopted the modified Senate definition. One clear implication of these changes is that information service providers (ISPs) are not necessarily excluded from the category of entities that are obliged to contribute to the Federal universal service fund. Because the Commission has in the past exempted ISPs from contributing to the funding of universal service and because many issues would be raised by changing that decision now, NTIA believes that it would be inappropriate at this time to require ISPs to contribute to the new Federal universal service fund. As the universal service definition evolves and the structure of the industry changes, the Commission may wish to reexamine this matter in the future.

NTIA also concurs with the many commenters who argue that contributions should be generated by a percentage surcharge on the interstate revenues of all providers with an obligation to contribute.[63/] A surcharge would be easier to implement than other approaches from the standpoint of both calculation and collection. Moreover, such an approach would not discriminate between carriers based on technologies and, if the Commission defines the universe of required contributors as broadly as suggested above, it would be competitively neutral as well. To avoid "double-counting" of certain revenues, however, contributions should be based on a firm's retail revenues, less payments for telecommunications services received from other

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63/ E.g., Comments of US West at 16-18; Comments of AT&T at 7-9; Comments on MFS at 16; Comments of Indiana Regulatory Commission at 5. NTIA believes that it may be appropriate to apply the chosen surcharge to all of an interstate service provider's revenues, whether interstate, intrastate, or international, although the Act is unclear on this point. It plainly does not bar the Commission from reaching all of an interstate carrier's revenues, however, in view of the long-standing bifurcation of regulatory jurisdiction over intrastate and interstate services, if the Commission considers basing contributions to the Federal universal service fund on both types of revenues, it should consult closely with State regulatory commissions before acting.

NTIA recognizes that States could encounter problems if, in return for preserving their jurisdiction over intrastate services, they assume a larger share of the responsibility for funding universal service support. If, for example, two neighboring States adopt substantially different contribution requirements to promote their universal service goals, service providers may migrate towards the State with the lower requirement. That may, in turn, undermine the other State's economic development objectives.

companies who also pay monies into the Federal universal service fund.[64/]

B. Subsidies Should Be Distributed in a Way That Promotes Competition Among Telecommunications Service Providers

The Act specifies that only ETCs may receive support payments from the Federally created universal service fund.[65/] This requirement must be implemented carefully so as not to impede the growth of local competition. As the Commission is aware, "[a]ssistance programs that provide subsidies to incumbent service providers while denying assistance to new entrants may impede the development of competition."[66/] Put another way, if subsidies are limited to a small number of providers in an area, that may deter entry from lower cost, more efficient competitors unless the entrants' costs are below the subsidized price.

64/ See Comments of MCI at 15-16; Comments of NCTA at 24-25. Thus, before calculating its required contribution, an interstate telecommunications reseller would reduce its retail revenues by an amount equal to the payments made to secure its underlying facilities.

65/ Act § 254(e). If States adopt universal service requirements in excess of the Federally defined basic universal service package and develop independent support mechanisms to fund those additional requirements, they may distribute those subsidies in any fashion and to any entity they choose. Id. § 254(f).

66/ Universal Service Task Force, Federal Communications Commission, Preparation for Addressing Universal Service Issues: A Review of Current Interstate Support Mechanisms 30 (Feb. 23, 1996). See also Comments of MCI at 8-9.

To further the Act's overarching objective of promoting local service competition (which, as noted above, will advance universal service goals), the Commission and the States should interpret the Act to maximize the number of firms that can qualify as ETCs and, therefore, become eligible to receive universal service support.[67/] This would require action in two principal areas: First, the Act appears to require ETCs to offer all of the services in the Federally defined basic universal service package.[68/] This counsels in favor of a package like that proposed in the Notice and supported by virtually all commenters, with measured expansion in the future as new services and functionalities become necessary to give households full and fair access to the Information Superhighway. That approach would afford new entrants a fair opportunity to provide qualifying services, yet give residential subscribers a flexible, fully functional pipeline to the Information Superhighway.

Second, ETCs must also provide those services throughout a "service area" designated by the Commission, in the case of rural

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67/ In unserved areas, NTIA agrees with commenters who argue that an ETC should be selected via competitive bidding among prospective applicants. See Comments of MCI at 18-19. See also Comments of GTE Service Corp. at 8-12. Indeed, we are intrigued by the notion of using auctions to select ETCs even in currently-served areas. Competitive bidding could provide a more accurate measure of the costs of serving a particular area than even a proxy cost model.

68/ Act § 214(e)(1)(A).

localities, and State commissions in other instances.[69] The Commission currently defines a carrier's service area to include "all the territory within a single state within which that carrier operates."[70] Requiring an entrant to serve immediately the same area as the incumbent in order to qualify for subsidies needed to place the new firm on an equal competitive footing with its subsidized rival may erect a barrier that many entrants cannot overcome. Consequently, the designation of smaller service areas would make more sense. Among other things, smaller areas would help demarcate true high cost areas and separate them from areas that should not receive high-cost support. Regulators could consider a number of possible alternatives (e.g., counties, wire center boundaries, or census blocks) but, in any event, service areas should not be coextensive with either State boundaries or territories served by incumbent carriers.

Once regulators determine which providers should qualify as ETCs, those entities should receive support monies based on the number of subscribers served. The model would be the Commission's Lifeline program, under which carriers provide service to eligible low-income households at a discounted rate, then recover that discount by drawing money from the universal service fund. Under this approach, for example, ETCs serving a high cost area would provide service to residential subscribers

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69/ Id. §§ 214(e)(1)(A), (e)(5).

70/ Notice ¶ 45.

at the nationwide average rate for the Federally defined basic service package. The ETCs would then recover from the new universal service fund, for each subscriber served, an amount equal to the difference between the nationwide rate and the benchmark cost for serving that area. Allowing subsidies to "follow the customer" in this fashion would promote head-to-head competition among ETCs, encourage additional carriers to request ETC status, and better ensure that support funds are used to serve universal service customers and not to subsidize an ETC's other service offerings.[71/]

C. Administration of the Universal Service Fund

The Notice also solicits comment on how the universal service fund should be administered.[72/] Under one approach, "individual State commissions or groups of State commissions would be responsible for administering the fund's collection and distribution, operating under plans approved by the Commission."[73/] Similarly, some commenters suggest that the Commission disburse "block grants" to State commissions for redistribution by them to ETCs within their jurisdictions.[74/] NTIA believes that entrusting the fund to more than one

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71/ See Act § 254(k); Notice ¶ 41. See also Comments of AT&T at 9-10.

72/ Notice ¶¶ 127-131.

73/ Id. ¶ 130.

74/ See, e.g., Comments of MCI at 12.

administrator would be complicated and cumbersome and would likely increase administrative costs.

NTIA's preferred approach would be to designate a single independent administrator, much as the National Exchange Carrier Association (NECA) handles collection and distribution of Federal universal service support today. NTIA recommends that the administrator should be selected via competitive bidding among the group of qualified applicants.[75/] NECA could be a contestant in that auction, so long as it makes changes in its membership to insure its neutrality and independence.[76/]

V. CONNECTING SCHOOLS, LIBRARIES, AND HEALTH CARE PROVIDERS

A. Special Services for Schools, Libraries, and Hospitals

Passage of the Act ensures for the first time the inclusion of schools, libraries, and health care providers as a focus of universal service policy.[77/] Similarly, the Administration has made connecting schools and libraries to the National Information Infrastructure (NII) one of its higher priorities. President Clinton and Vice President Gore have forcefully advanced two

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75/ See, e.g., Comments of Frontier Corp. at 9-10; Comments of ALTS at 18-19.

76/ See Comments of Idaho Public Utilities Commission at 17-18.

77/ Act § 254(b)(6). Section 254(b)(6) of the Act establishes as one of the principles necessary for the preservation and advancement of universal service that "[e]lementary and secondary schools and classrooms, health care providers, and libraries should have access to advanced telecommunications services . . ." Id.

imperatives: (1) our children must have access to the world through information systems and (2) our children must become computer literate so that they can compete and succeed in the working world of the next century. For these and other economic and social reasons, both President Clinton and Vice President Gore have encouraged the formation of public-private partnerships to accomplish one specific purpose: to connect every classroom, library, hospital, and clinic to the NII by the year 2000.[78/]

In addition to the nationally defined universal service package, the Joint Board may recommend that the Commission adopt so-called "special services" for public and nonprofit schools, libraries, and health care providers. Special services consist of those services that the Commission determines "are essential to education, public health, or public safety."[79/]

B. The Pricing of "Special Services"

Senators Snowe (R. ME), Rockefeller (D. W.VA), Exon (D. NE), and Kerrey (D. NE) co-sponsored an amendment to the Act that extends to schools and libraries discounts on the rates they are

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78/ See, e.g., President William J. Clinton, State of the Union Address, (1994, 1996); Vice President Albert Gore, Jr., Remarks before the Academy of Television Arts and Sciences in Los Angeles, CA (Jan. 11, 1994). In addition, the Administration, through its recently announced "Technology Literacy Challenge" and NTIA's Telecommunications and Information Infrastructure Assistance Program (TIIAP), seeks to supplement the connection campaign by addressing remaining needs, including financing hardware, software, training, and other technical assistance.

79/ Act § 254(c)(1)(A).

charged by telecommunications carriers for the provision of special services.[80] This amendment provides an important mechanism that will facilitate accomplishment of the Administration's ambitious vision to achieve universal connection of these public institutions by the turn of the century.[81] As passed, the Snowe-Rockefeller amendment contemplates offering discounts for interconnecting school classrooms and libraries to the NII, not for other services such as obtaining and deploying hardware, software, training, and technical support.[82]

Providing universal service support for schools, libraries, and health care providers is novel for this country. America has never before attempted to define special services,[83] to set national standards for enhancing access to advanced

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80/ See id. § 254(h)(1)(B).

81/ The Act requires telecommunications carriers to provide special services for schools and libraries "at rates less than the amounts charged for similar services to other parties." Id. Although the Act also requires telecommunications carriers to offer "special services" to rural health care providers, the Act does not similarly require discounts for such services. It mandates, instead, that rates charged to rural health care providers must be "reasonably comparable to rates charged for similar services in urban areas in that State." Id. § 254(h)(1)(A).

82/ The provision relating to special services for health care providers includes instruction on how to use such services. See id. § 254 (h)(1)(A).

83/ See id. § 254(c)(3) (permits Commission to designate additional services for qualifying schools, libraries, and health care providers that are eligible for universal service support).

telecommunications services to those institutions,[84] or to define the circumstances under which carriers may be required to connect those institutions to their networks.[85] These tasks could be facilitated by compiling evaluations of potential costs, possible pitfalls, and educators' best views on curriculum requirements so that the ultimate decisions by the Commission and its state counterparts have a sound policy basis.

In the attached exhibit, NTIA has -- as a starting point for discussion -- based on existing studies and experience gained from NTIA's Telecommunications and Information Infrastructure Assistance Program (TIIAP), attempted to develop approximations of the costs involved in connecting schools and libraries to the NII.[86] Based on this analysis, it appears that the implementation of a preferential rate scheme would, overall, represent a relatively modest proportion of the total costs of bringing schools and libraries into the Information Age. For

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84/ See id. § 254(h)(2)(A) (requires Commission to establish competitively neutral rules to enhance access to advanced telecommunications and information services for qualifying schools, libraries, and health care providers).

85/ See id. § 254(h)(2)(B) (requires Commission to establish competitively neutral rules to define circumstances pursuant to which carrier may be required to connect its network to qualifying schools, libraries, and health care providers).

86/ See attached Exhibit, Estimated Cost Profiles for Connecting Schools and Libraries to Advanced Networks (June 1996). The absence of data from NTIA regarding the costs involved in connecting health care providers to the NII should not suggest that NTIA is not equally concerned about health care-provider connection issues.

example, NTIA's study suggests that the connections costs for which discounts would apply may range from $800 million to $1.5 billion.

NTIA urges the Joint Board and the Commission to bear in mind that the equitable allocation of resources has great urgency for schools and libraries. The disparities in educational opportunities available to students in well-funded educational districts compared to those in poorer districts have been adequately documented.[87/] Access to information systems could mitigate the effects of these disparities. In considering the discounts that will be offered, the Commission and the Joint Board should give particular attention to the discounts' impact on schools and libraries located in poorer districts. Because of funding shortfalls in poorer districts, educational institutions located there may not be able to afford access to advanced services -- even with the help of discounts. Accordingly, the proposal suggested by the American Library Association (ALA) and the National School Boards Association, et. al. (NASB) of a two-tiered discount scheme appears promising and deserving of close study.

87/ See, e.g., B. Means and K. Olson, Restructuring Schools With Technology: Challenges and Strategies (Menlo Park, CA: SRI International, Nov. 1995). Additional discounts might be considered for higher cost as well as lower-income districts. See Comments of ALA at 5, App. B; Comments of NSBA et al. at 23.

VI. CONCLUSION

For the foregoing reasons, NTIA respectfully requests that the Commission adopt the recommendations contained herein.

Respectfully submitted,

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EXHIBIT

ESTIMATED COST PROFILES FOR CONNECTING SCHOOLS AND LIBRARIES TO ADVANCED NETWORKS

I. Introduction

Based on a review of some available studies and data from several grants awarded under NTIA's Telecommunications and Information Infrastructure Assistance Program (TIIAP),[1/] this exhibit presents estimated cost profiles for connecting schools and libraries to the National Information Infrastructure (NII). The connection needed to link schools and libraries to the NII -- which is subject to the universal service discount under the Snowe-Rockefeller amendment to the 1996 Telecommunications Act (Act)[2/] -- represents only a part of the expenditure that will be incurred by any school or library seeking to use services offered over the NII. The preferential rate scheme under the Act will cover some or all of these connection costs for schools and libraries. Because most available data includes costs beyond those for connection, we have attempted to use broader cost data encompassing other aspects as well (e.g., obtaining and deploying hardware, software, training, and technical support) to put connection costs in context.

There is a great need to explore the potential costs of hooking up the schools and libraries, despite the difficulty of providing precise estimates at this time. Accordingly, we have relied on some data that is now available in order to commence a dialogue on this issue. As explained below, variations in the networks and needs of the schools or libraries could affect the connection costs. For that reason, we present a number of different scenarios to illustrate the possible range of costs.

For example, the total cost of providing access to the NII for schools and libraries depends on those entities' specific requirements with respect to

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1/ TIIAP refers to the Telecommunications and Information Infrastructure Assistance Program, which provides matching grants to non-profit organizations for the purpose of improving the quality of, and the public's access to, education, health care, government services, and economic development. Since 1994, TIIAP has awarded 209 grants in 47 states, the District of Columbia, and several territories.

2/ See Telecommunications Act of 1996, Pub. L. No. 104-104, § 254(h)(B)(1), 110 Stat. 56 (1996). This analysis excludes rural health care providers, which are assured by the Act of receiving telecommunications rates that are "reasonably comparable" to urban counterparts also located in their states.

investment in capital and human resources, as well as recurring expenses (such as subscription to telecommunications or information services). Technology choices can also significantly affect the magnitude of the outlays: a T-1 connection will cost more than a regular voice-grade line but will also deliver higher-speed transmission (1.5 Mbps versus 34 Kbps or slower). Full-motion video may necessitate an even faster, broader, and more expensive 45 Mbps DS3 link. Decisions as to the number of instructional rooms connected and student-to-computer ratios will also have an impact on connection costs. These various outlays will include both initial deployment, or "up-front," costs and those that will be ongoing. Moreover, development of alternatives for connecting the schools and libraries -- such as the potential for wireless connections -- may also change the cost landscape.

Decisions on other factors will also affect overall costs. The cost of hardware will vary widely depending on the specific system selected. For example, a Macintosh computer costs more than an Apple II personal computer (PC), a Pentium microprocessor costs more than a 386, and a laser printer costs more than an inkjet or dot matrix printer. Educational software will be needed, as well as training and technical support. Furthermore, the level of overall expenditures will be a function of the deployment schedule: a five-year roll-out would be much more expensive than a 20-year timetable.[3/] Due to the myriad choices confronting school administrators about Information Age capabilities and budget allocations, any cost profile must be developed on the basis of different options. Accordingly, the cost profiles presented are only broad estimates that provide a starting point for further discussion of the most expedient means to bring the Information Age to schools and libraries.

The following analysis begins with an examination in Section II of recent studies on the total costs of achieving and maintaining access to the NII for the nation's public schools and libraries. Information about the connection component

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3/ For example, using model projections, a 1995 study by the University of Florida's Telecommunications Industries Analysis Project concluded that total costs for a 20-year broadband deployment program would range from $14.7 billion for connecting only teachers to $118.3 billion for hooking up all students and teachers in public schools. If a five-year accelerated deployment schedule were pursued, then the range would be $28.6 billion to $204.4 billion. See Carol Weinhaus et al., Schools in Cyberspace: The Cost of Providing Broadband Services to Public Schools, Executive Summary 5-6 (July 1, 1995) (Presentation at the July 1995 NARUC Meeting, San Francisco, CA). The Project's study focused on hardware, software, training, wiring, and Internet access costs incurred by schools or LECs. Tariffed rates for telephone services or enhanced broadband services were excluded, as were ongoing expenses for maintenance and operations. Id. at 21.

that could be eligible for discounted services under the Snowe-Rockefeller amendment to the Act is broken out where possible. In Section III we examine some "real-world" examples of schools in regional, inner city, or rural areas that received TIIAP grants for NII connections. Section IV presents some general implications from the cost data. Finally, Section V discusses more specific implications that pertain to the discounts to be accorded the schools and libraries under the Snowe-Rockefeller amendment to the Act.

II. Recent Studies on Costs of NII Connection

A. Public Schools

A comparison of two recent major studies yields some broad estimates of the costs of access to the NII for the nation's public schools. Again, we recognize that under the Snowe-Rockefeller amendment, discounts that may be covered by the universal service fund apply only to interconnection costs when telecommunications carriers provide certain services to the schools. It should be noted that where the data covers total costs, we have attempted to break out connection costs for purposes of discussion and debate on the costs of ultimately linking each classroom to the NII.

Rothstein Study. Building on his 1994 working paper for the Department of Education (ED), as well as a subsequent collaboration with Lee McKnight, Russell Rothstein developed five cost models of K-12 school networking.[4/] Each of the models in his 1996 study encompasses five schools that are connected to a school

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4/ Under the auspices of the Department's Office of Educational Technology, Russell I. Rothstein authored the study, Connecting K-12 Schools to the NII: A Preliminary Assessment of Technology Models and Their Associated Costs, August 4, 1994. Analyst John C. Beachboard notes that the recurring charge estimate is "substantially" understated because it omits equipment maintenance charges. See Comments of Syracuse University School of Information Studies at 11, n. 39, NTIA Inquiry on Universal Service and Open Access (December 19, 1994). The following year, Rothstein and McKnight revised the study. See Technology and Cost Models of K-12 Schools on the National Information Infrastructure, Massachusetts Institute of Technology, February 10, 1995. Rothstein further developed the analysis in his Master's Thesis at MIT. See Networking K-12 Schools: Architecture Models and Evaluation of Costs and Benefits, submitted to the Sloan School of Management and the Technology & Policy Program (May 10, 1996) [hereinafter MIT Thesis].

district office, which is, in turn, linked to the Internet. The different models are briefly described below:

Model 1 features a single PC dialup connection to the school district office, hooked up to the Internet via a 56 Kbps line, with very limited training (two-to-four teachers) and limited support at the district office. For all public schools, Rothstein estimated one-time total costs of the full connection, hardware, training, and other costs would be $70 to $370 million, with ongoing costs of $110 to $430 million.[5/]

Model 2 consists of a local area network (LAN) with a shared modem that supports only a few users at a time, with 56 Kbps Internet service at the district level, where five-to-twenty staff are trained per school, and one-to-two support staff provided per district. Total one-time costs for all schools were estimated at $2.01 to $6.08 billion, and on-going disbursements would be $1.18 to $2.68 billion.

Model 3, which builds on Model 2, includes a LAN that uses a router and assumes one PC per classroom in three-quarters or more of the rooms, with a 56 Kbps school hookup to the hub and to the Internet service at the district office. The construct assumes training of ten-to-twenty staff per school and one-to-two support staff provided per district. Total one-time costs for all schools would range from $4.13 to $10.49 billion, and ongoing expenditures would be $1.22 to $3.38 billion. Rothstein concluded that each of these first three models would fall short of meeting the vision of the NII initiative.[6/] He indicated, however, that the remaining two models would be more consistent with the goal of providing access for every school classroom.

5/ Id. at 35-38.

6/ Id. at 35, 39-42, Table 3. Rothstein bases this conclusion on the Federal Information Infrastructure Task Force's (IITF) assessment that the NII:

> promises every...school...in the nation access anywhere to voice, data, full-motion video, and multimedia applications. Through the NII, students of all ages will use multimedia electronic libraries and museums containing text, images, video, music, simulations, and instructional software.

See MIT Thesis, supra note 4 at 44, fn. 14, citing IITF, NIST Special Pub. 857, Putting the Information Infrastructure to Work (Washington, D.C.: U.S. Government Printing Office 1994). Rothstein indicated that these three models would not provide access to such services, whereas Models 4 and 5 could.

Model 4, Rothstein's second most sophisticated model, is the one he regards as meeting the NII "baseline." He assumes that a PC is supplied for every eight students (three per classroom that averages 25 students), and that LANs, local file servers, and a 56 Kbps connection to the district office are installed. The level of training (40-50 staff per school) and support provided (two-to-three staff per district) exceeds the three models above but is less than in Model 5. One-time total charges for all schools under this scenario would be approximately $9.19 to $22.05 billion, and recurring charges would be an estimated $1.74 to $4.6 billion annually.[7/]

Model 5 is Rothstein's most advanced scenario under which it is assumed that a PC is provided to every student, plus installation of LANs, local file servers and high-speed wideband (1.5 Mbps) connectivity for all public schools, and training for all teachers. For a system characterized by access to the full range of text, audio, graphical, and video applications available over the Internet and a well-staffed support team, he calculated that one-time (hardware, retrofitting, and initial training) charges would range from $49.25 to $112.67 billion, while annual recurring (connections, Internet service, support, training) charges would approximate $3.57 to $10.03 billion over a five-year timeframe.[8/]

For at least Rothstein's NII models, the sum of PC purchases, initial training, and retrofitting would together comprise the largest one-time cost for launching a school's network, and support of the network represents the largest ongoing annual costs.[9/] Support and training could account for a substantial proportion (e.g., 46 percent, or almost half, in Rothstein's NII baseline Model 4) of the total costs of networking schools. Telecommunications lines and services would be a significantly smaller cost element (e.g., 11 percent in Model 4) for both start-up and ongoing connection costs.[10/]

7/ MIT Thesis, supra note 4 at Table 4, see generally Chpt. Two.

8/ Id. Table 5. The costs for educational software and applications were not included due to the need for further research. In the models, it was assumed that schools would be able to obtain free versions of educational software.

9/ Id. at 16-17.

10/ Id. at 43-46, Figure 7. The percentage is based on an average of low and high cost estimates, excluding PC purchases over the first five years of deployment. Rothstein argues that because the "value of PCs goes well beyond their use as networking devices... the costs should be allocated across other parts of the technology budget." Id. at 45.

McKinsey Study. A study completed by McKinsey & Company during mid-1995 on behalf of the U.S. Advisory Council on the National Information Infrastructure estimated the costs of accessing the NII by network element and also by deployment option. McKinsey determined that the largest up-front cost would involve the purchase and installation of hardware, while teacher training and support would account for most of the ongoing deployment cost. Connection costs would be a relatively small proportion (four to 15 percent) of either initial or recurring expenditures, regardless of the deployment plan.[11/] McKinsey presented four deployment "models," each of which would include a district server and local area network; one or more school servers, printers, and scanners; software, professional development, and support.[12/] The results of the four models are described briefly below:

The Lab Model resulted in estimates for initial deployment ranging from $11 billion for a 25-computer lab using an Ethernet LAN and ten telephone lines. Annual operations and maintenance expenditures were estimated at $4 billion per year.

The Lab Plus Model added a computer and modem for the teacher to the Lab model, resulting in estimated costs of $22 billion in up-front expenditures. Annual operations and maintenance were estimated at $7 billion per year.

The Partial Classroom Model would provide one-half of all classrooms with one computer per five students, an Ethernet LAN across and within all classrooms, and a T-1 connection at a cost of $29 billion. Annual operations and maintenance expenditures were estimated at $8 billion over a five-year period.

The Classroom Model resulted in estimates of $47 billion to connect every public school classroom to the NII during a ten-year interval, assuming five students per computer, with a T-1 communications channel that transmits data, video, and voice at 1.5 Mbps. Annual operations and maintenance expenditures

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11/ U.S. Advisory Council on the National Information Infrastructure, KickStart Initiative: Connecting America's Communities to the Information Superhighway, 90-91 (Jan. 1996).

12/ McKinsey notes that the ED/MIT studies "informed [their] approach early on" but the Rothstein/McKnight analysis factored in less training and support, much longer hardware replacement cycles, and no packaged software or upgrades, and did not allow for either declining hardware prices over time or differing rural/urban connection requirements. McKinsey & Company, Connecting K-12 Schools to the Information Superhighway 63-64 (1995) [hereinafter McKinsey Study].