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ABSTRACT

A summary is presented of the deliberations of a workshop devoted to the National Research and Education Network (NREN). It also includes policy papers from 18 organizations that broadly represent NREN constituencies in government, education, and industry. The NREN is one of the major components of the High-Performance Computing Act of 1991 (Public Law 102-194). In the Act, Congress posed six questions about NREN policy, and asked for answers by December 1992. The workshop was held to develop informed commentary on the major issues of the congressional questions. Conclusions about the major issues that were widely shared are as follows: (1) the act and the program of the current administration are important first steps in network establishment; (2) the NREN should facilitate development of a national information infrastructure and provide tools for research and demonstrations of technology; (3) NREN should be a national network program supported by the communications infrastructure of the country; and (4) the NREN should be a truly national program with partners in industry, government, and higher education. Specific recommendations are made for policy questions, and other issues are developed. Two charts and four tables illustrate the discussion. Appendix A contains the 18 position papers from industry, universities, and interested bodies. Appendix B lists workshop participants. (SLD)

Proceedings of the NREN Workshop

Monterey, California

September 16-18, 1992

Sponsored by

Computing Research Association
EDUCOM
IEEE U.S. Activities Board

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EXECUTIVE SUMMARY

Introduction

This report contains a summary of the deliberations of a workshop devoted to the National Research and Education Network (NREN), held in Monterey, California on September 16-18, 1992. In addition, it includes policy papers dealing with the NREN from eighteen organizations which broadly represent NREN constituencies in government, education and industry. The text of the papers may be found in Appendix A. The report is intended to provide context and reference material for future deliberations on the NREN by the United States Congress, federal agencies, and other bodies with a policy role in the development of the network.

The NREN is one of the major components of the High-Performance Computing Act of 1991 (PL102-194). Section 102(a) of the Act states, "The Network shall provide for the linkage of research institutions and educational institutions, government and industry in every state."

In the Act, Congress posed six NREN policy questions and asked the Director of the Office of Science and Technology Policy (OSTP) to provide a report on the questions by December 9, 1992. The questions, from Section 102(g), are:

"(1) effective mechanisms for providing operating funds for maintenance and use of the Network, including user fees, industry support and continued Federal investment;

(2) the future operation and evolution of the Network;

(3) how commercial information service providers could be charged for access to the Network and how Network users could be charged for such commercial information services;

(4) the technological feasibility of allowing commercial information service providers to use the Network and other federally funded research networks;

(5) how to protect the copyrights of material distributed over the Network;

(6) appropriate policies to ensure the security of resources available on the Network and to protect the privacy of users of networks."

These policy questions have evoked wide interest among current and potential users of the NREN, as well as among organizations associated with development of the network and with the delivery of services on the network. Assisted by financial support from the Networking Division of the National Science Foundation, the organizers of the workshop undertook to develop an informed commentary on the major issues contained in the Congressional questions.

Participants in the workshop included eighty-one individuals representing organizations in higher education, the library community, K-12, industry, foundations, and network providers. Names and affiliations are shown in Appendix B.

Major Issues

The workshop provided time for lively discussion both in small groups and in plenary sessions. A number of conclusions about major issues were shared widely among the participants:

- The High-Performance Computing Act and the current Administration's High-Performance Computing and Communications program are important first steps toward the realization of a national network. The Congressional intent to "promote the more rapid development of an information infrastructure" should be met through wide participation in the emerging NREN system.
- The NREN should be more than a program supporting high performance computing. It has the potential to:
  - facilitate development of the National Information Infrastructure,
  - provide tools for increasing the effectiveness of research, education and technology transfer at all levels, and
  - demonstrate network applications and technologies which can aid in addressing critical social needs.

• Some members of Congress and others who have been involved with the prior development of research networks appear to assume that the NREN will be a federal network of dedicated physical links. In contrast, the workshop participants see the NREN as a national network program whose advanced transmission requirements will be met by the rapidly evolving commercial communications infrastructure of the country.

• More emphasis should be placed on making the NREN a truly *national* program which includes strategic partners in higher education, state government and industry.

Recommendations on Policy Questions

The specific Congressional questions serve to test the commonality of visions of the network, its services, its governance and funding. The workshop discussion of the questions reflected general agreement that:

• Historical models for the evolution of the NREN such as the highway system, telephone system, national electrical power grid and the agricultural extension system all contain elements which may be useful in developing the NREN. However, workshop participants believe that historical precedent must be balanced with empirical experience gained from actual network implementation. The final shape of the NREN, and its balance of public and private activities, will be unique.

• Federal funds for the existing interim NREN (principally NSFNET) have been significantly leveraged by non-federal funds provided through a variety of means such as user fees, industry support, state and university investment. However, the total funding currently available falls far short of the amount needed to realize the goal stated in the Act of connecting research, education and libraries at all levels in every state.

• NREN governance currently includes Congressional oversight of an Administration program involving multiple agencies as well as coordinating and advisory committees. While this structure may work for the current federal program, it is not likely to be sufficient for the development of the NREN as a national program, since major investors and stakeholders currently participate at most in an advisory capacity.

• As the NREN and other large scale computer networks continue to expand and gain use for a wide range of activities, both institutional and individual, the Congress must be sensitive to possible needs for revision and strengthening of federal statutes, regulations and policies covering security and intellectual property (i.e. copyright) protection.

• Charging for commercially provided services is technologically feasible and can be dealt with during NREN implementation.

Other Issues

Goals and expectations for the NREN system are high, and there is a mismatch between those expectations and the resources of the communities which Congress included in the scope of the network. In its forthcoming review of NREN progress, Congress can significantly contribute to the development of a national consensus on the future of the network. Among the possible steps identified by workshop participants are:

• Establishment of a National Commission charged to develop, in collaboration with all involved constituencies, a detailed plan and program for the NREN;

• Development of a more comprehensive approach to the inclusion of all federal agencies in the NREN, as well as broadening the role of the current agencies;

• Creation of a public sector governing body for the NREN, such as a federally chartered non-profit corporation, which would serve to mobilize and energize the public and private partnerships which are essential to the success of the overall national effort;

• Reaffirming and further defining the role of the federal government in the development of the NREN system;

• Complementing the NREN program with support for Grand Applications, such as medical care, lifelong learning and manufacturing, which would focus development efforts on areas of critical national importance.

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PREFACE

We wish to acknowledge the extraordinary talent, vitality and commitment to the success of the NREN expressed by the participants in this workshop. The meeting brought together individuals from many of the diverse communities working toward the national network and widened our mutual understanding of the strength in this diversity and the potential for contributions to meeting the high expectations that have been established for the NREN.

We also believe that the workshop contributed useful insights on some of the many complex NREN issues which the Congress must address as we move further into the implementation phases.

The workshop participants demonstrated a willingness to work together in spite of a great divergence of backgrounds and we look forward to further interactions.

Support from the Computing Research Association, EDUCOM, the IEEE, and the National Science Foundation (through Grant NCR-9219671) was essential to the success of the workshop and is very much appreciated.

Elizabeth Barnhart carried out the responsibilities of Conference Coordinator with great diligence and unfailing good humor. She and her assistant Ellen McHugh have our collective thanks.

Frederick W. Weingarten, Convenor
Chair, IEEE Subcomittee on High Performance Computing
Executive Director, Computing Research Association

Michael M. Roberts, Co-Convenor
Vice President, Networking, EDUCOM
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October 1992

1. Introduction and Background

The High-Performance Computing Act of 1991 is meant "to provide for a coordinated Federal Program to ensure continued United States leadership in high-performance computing."[1] One of the components of the program is the National Research and Education Network (NREN). The NREN is evolving from the Internet (the international network of networks that has emerged out of the early development of the ARPANET in which a common set of protocols allows networks using those conventions to exchange information).

It is important to note that the NREN is not a single physical network but a web of cooperating networks, formal and informal standards bodies, and high speed transmission facilities. These allow interconnections and provide a backbone across the United States (the NSFNET backbone service), which connects other federal agency networks linked to the missions of the agencies for Energy, NASA and others, as well as to regional networks that provide interconnection among the local networks of educational institutions, libraries, research laboratories, and other public and private sector organizations.

While Congress uses many approaches in national policy development, not all provide an opportunity for diverse constituencies to play a role in its formation. Congress can choose among the following alternatives when policy options are unclear or unresolved. It can:

- establish a commission;
- call for hearings;
- issue committee reports;
- ask for agency reports and recommendations.

After exercising several of these options before passing the High-Performance Computing Act of 1991, Congress asked for agency reports on some of the open issues. One of the agency reports, due from the Office of Science and Technology Policy in December, 1992, is to focus on the six questions on network policy issues in the bill:

> "(1) effective mechanisms for providing operating funds for maintenance and use of the Network, including user fees, industry support and continued Federal investment;
>
> (2) the future operation and evolution of the Network;

[1] Public Law 102-194

(3) how commercial information service providers could be charged for access to the Network and how Network users could be charged for such commercial information services;

(4) the technological feasibility of allowing commercial information service providers to use the Network and other federally funded research networks;

(5) how to protect the copyrights of material distributed over the Network;

(6) appropriate policies to ensure the security of resources available on the Network and to protect the privacy of users of networks."[2]

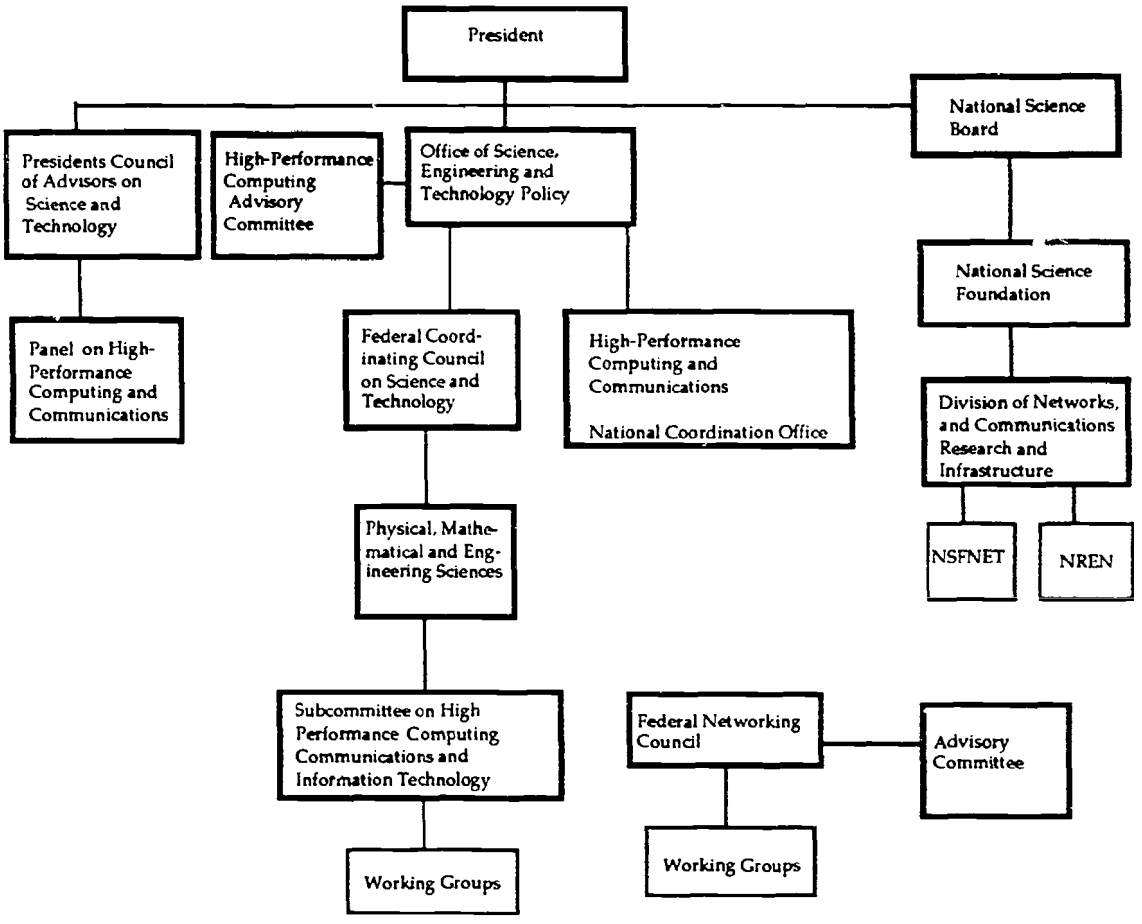
These policy questions are of broad interest because the NREN community includes higher education, K-12, libraries, industry and federal agencies. It seemed appropriate to the organizers that efforts should be made to solicit a discussion of the policy issues that could contribute to their resolution.

The policy workshop was jointly sponsored by the Institute for Electrical Engineering and Electronics - U.S. Activities Board, the Computing Research Association and EDUCOM , and was convened September 16-18, 1992 in Monterey, California. Participants in the workshop included eighty-one individuals with backgrounds in higher education, the library community, K-12, industry (computer companies, telecommunications companies), foundations, network providers and regional networks, government agencies and boards.

Some material in addition to the position papers was distributed to the attendees. A chart of the current federal committee structure relative to networks follows:

[2] Public Law 102-194, Title I High-Performance Computing and the National Research and Education Network, Section 102. National Research and Education Network, (g) Report to Congress

Chart 1 - Organization of Federal NREN-related Committees



The following table of provisions of the High-Performance Computing Act dealing with the network was also distributed:

Chart 2 Provisions of the High-Performance Computing Act Relative to the NREN

President
- Implement a High-Performance Computing Program
- Appoint a High-Performance Computing Advisory Committee

OSTP Director
- Provide for interagency coordination
- Consult with academic,states, industry
- Annual Report on Implementation of the Program
  —Detailed description of goals and priorities
  —Relevant programs and activities for agencies
  —Describe the levels of funding for each agency in the year of the report and the fiscal year proposed including the support for the establishment of the Network
- After a year will provide a report to Congress on the six questions dealing with the Network.
- Assist the President in coordinating agencies to promote the development of information services that could be provided over the Network.
- Annual report on "buy America"

National Research and Education Network
- Agencies shall support the establishment of the gigabit NREN
- The Network will link research institutions and educational institutions, government and industry in every state.
- Agencies and departments will work with private network service providers to ensure researchers, educators and students have appropriate access to the Network.
- The Network will provide access to electronic information resources maintained by libraries, research facilties, publishers and affiliated organizations.
- Network characteristics

—developed and deployed with computer, telecommunications and information industries;
—designed, developed, and operated in collaboration with potential users in government, industry and research institutions and educational institutions;
—designed and operated in a manner that fosters and maintains competition in high-speed networking within the telecommunications industry;
—designed, developed and operated in a manner which develops communication standards and the establishment of privately operated high-speed commercial networks;
—designed and operated to ensure continued application of laws protecting copyright, security
—have accounting mechanisms which allow users or groups of users to be charged for usage of copyrighted materials and/or usage of the Network;
—ensure the interoperability of Federal and non-Federal computer networks;
—developed by purchasing standard commercial transmission and network services where feasible;
—support research and development of networking software and hardware;
—serve as a test bed for improving the national information infrastructure.

National Science Foundation Activities
- Provide computing and networking infrastructure support for all science and engineering disciplines;
- Support basic research and human resource development in all aspects of high-performance computing and high-speed computing networking;
- Primary responsibility for assisting colleges, universities and libraries to connect to the network (where they cannot connect with the assistance of the private sector);
- Serve as the primary source of information about access to an use of the Network;
- Upgrade the NSFnet

DARPA
- Support research and development of advanced fiber optics technology, switches, and protocols to develop the Network

Department of Commerce: National Institute of Standards and Technology
- Measurement research needed and standards and guidelines for the interoperability of high-performance computing systems in networks

2. Workshop Approach

The results expected from the workshop were :

- Clarification of viewpoints from a diverse constituency;
- Development of consensus points on the issues;
- Identification of processes for resolution of differences;
- Presentation of community perspectives to OSTP and Congress.

In order to achieve the results, the workshop followed these steps:

1) Developed a list of invitees familiar with the issues from a diverse community affected by the NREN including higher education, the library community, members of federal committees involved in planning for the NREN, federal agency members, K-12 representatives, industry including computer companies, telecommunications companies and telephone companies, and members of foundations.

2) Created a format for the position papers to be prepared by organizations involved with the NREN to present their views on the questions and issues. Given the short time from the invitation for preparation of position papers to the workshop (less than two months), some of the papers are in a discussion format and do not necessarily represent formally adopted views of the organizations submitting them. Seventeen papers were submitted by the beginning of the workshop (and one following). Prior to the workshop, copies of the papers were sent to each of the participants along with instructions on the planned operation of the workshop. These papers provide an excellent background to both the Congressional questions and also to broad issues associated with the NREN.

3) The eighty-one attendees were organized into six discussion subgroups with leaders and reporters identified. The table below provides a view of the variety of organizations represented at the workshop:

Table 1 - Attendees' Organizations

Background	Number
Higher Education	31
Library	4
K-12	4
Federal Agency	13
Computer Company	5
Telecommunications Company	12
Foundation	2
Information Services	1
Network Service Company	9

4) The workshop agenda provided times for subgroup meetings and plenary sessions to discuss their results.

5) Dr. Eugene Wong, Associate Director, Office of Science and Technology Policy, gave a talk about the High-Performance Computing Program, the challenges of networking and background about the approach to the Congressional questions.

6) All attendees had an opportunity to review drafts of the final report.

In the closing plenary session after two days of work, the participants found themselves in agreement on a number of key issues. However, the limited time available at the workshop did not allow for the crafting and adoption of formal resolutions.

3. Summary of Position Papers

The goal for the position papers was to invite submissions that would identify differences and similarities among community views of the questions. We wanted to identify key assumptions that might be a basis for discussion or the source of differences. The authors of the position papers were provided with a basic structure to bring general consistency into their responses. The format suggested was:

A. Organization

B. Nature, Goals and Constituency of the Organization

C. Organization's view of the eventual nature, services, structure, users, and constituencies of the NREN.

D. Suggestions and rationale for possible historical models that could be applied to NREN development.

E. Comments on Congressional questions and ranking of importance to constituency.

F. Additional policy questions thought important.

Table 2 - Position papers and Organizations

	Organization	Type
1	Advanced Network & Services	Network Services
2	American Library Association	Library
3	Association of American Universities	Higher Education
4	Association of College and Research Libraries	Library
5	Association of Research Libraries	Library
6	AT&T	Telecommunications
7	CAUSE	Higher Education
8	Coalition for Networked Information	Higher Education
9	Computing Research Association	Higher Education
10	Consortium for School Networking	K-12
11	EDUCOM Networking and Telecommunications Task Force	Higher Education
12	Electronic Frontier Foundation	Foundation
13	FARNET	Network Association
14	Library of Congress	Congress
15	IEEE Committee on Communications and Information Policy	Professional Society
16	Information Industry Association	Information Services
17	National Association of State Universities and Land Grant Colleges--Commission on Information Technology	Higher Education
18	Sprint	Telecommunications

The position papers provided an opportunity to identify diverse views that were due to substantially different assumptions about the nature of the NREN. For instance, some of the discussions about the privatization of the network rested on different assumptions about:

1) What is "pre-competitive?" What are the stages of development of the services? Have we reached the stage where many of the services can be handled by the existing telecommunications framework? How will we make those judgments and test the assumptions? What are the risks?

2) Who are the "users?" Are they individuals or institutions? What has been the experience with nurturing new technologies and the impact of charging for their use? Does the federal national supercomputer centers model apply? (Where federal support for supercomputer services is allocated rather than charged to users for resources.) What is a "level playing field" in this context? What does it mean to talk about allocating funds to users? What are the trade offs in allocation of such funds? What are the risks to the users arising from too early charging and uncertainties in funding? What are the risks in continuing to subsidize past the appropriate time?

3) What does the "governance" of the NREN mean? What is today's structure? How is it distributed among the groups involved (higher education, state and local government, federal government, industry, regulatory agencies, etc.)? What are the options for strengthening the role of the communities? What are the risks?

4) What is the process for carefully evaluating existing frameworks for protection of intellectual property?

5) What kinds of federal programs work? Which really stimulate the development and diffusion of new applications and which will just waste funds? How large a risk should be taken? Which approaches provide the greatest leverage of federal funds? Which programs fit the current stage of the NREN? Who will evaluate the results? What communities need special attention and consideration to achieve national goals? What is the role of the NREN in supporting national goals? How do we match expectations with resources?

6) How many tiers are there in the NREN? How important is it to reach a definition? Are the views really contradictory? What are the appropriate models of the NREN as a national program?

7) Who are the major stakeholders? What are their needs? What are the conflicts among the stakeholders? How will they be made?

The following table provides a brief summary of some of the points (which may contradict and/or complement each other) made in the position papers about the Congressional questions:

Table 3 - Position Paper Points

Questions	Some position paper points
(1) effective mechanisms for providing operating funds for maintenance and use of the Network, including user fees, industry support and continued federal investment;	• need for federal support during development of services • need for predictable and affordable costs • a blend of commercial and public facilities will be a component of the environment • backbone should be available for commercial firms and they should pay for a fair share of the use • federal support may go to users (which may be institutions rather than individuals) for use charges • federal funds should be highly leveraged
(2) the future operation and evolution of the Network;	• the NREN is the prototype of the National Information Infrastructure • the NREN is likely to be the prototype of the National Information Infrastructure • the NREN should be seen as a federal program with limited objectives • a model of the National Information Infrastructure needs to be explicitly adopted by Congress where the NREN plays a role in leveraging public sector resources • guiding principles (such as equitable access to information) need to be explicitly formulated and adopted to guide the evolution of the NREN • the NREN is to be a testbed for the National Information Infrastructure and plans must take this into account • federal policies should be adopted that expand the number of users with access to Internet/NREN
(3) how commercial information service providers could be charged for access to the Network and how Network users could be charged for such commercial information services;	• the charges should be considered as stimulants to the development and use of the commercial services • new mechanisms need to be developed to protect the purveyors of service over the network
(4) the technological feasibility of allowing commercial information service providers to use the Network and other federally funded research networks;	• generally this was considered already feasible since the use and charges currently exist

(5) how to protect the copyrights of material distributed over the Network;	• copyright must serve society as well as protect the owner • the application and enforcement of all elements of copyright law should be extended to the network services • new facilities are needed on the NREN for the development and enforcement of agreements with information service providers
(6) appropriate policies to ensure the security of resources available on the Network and to protect the privacy of users of networks.	• the full range of policy strategies (legislation, codes, practices, policy) should be applied to security and privacy issues

Some of the historical models suggested in the position papers for viewing the NREN included:

Table 4 - Historical Models Appropriate for the NREN

Historical Model	Elements
Evolution of Support for Libraries	• Approach to support embedded in many agencies and programs • Commission (U.S. National Commission on Libraries and Information Science) for National policy
Morrill Act	• Establishing infrastructure
Federal Depository Act, Higher Education Act	• Promote equity
Communications Act of 1934, Interstate Highway Act	• Provide benefits to multiple communities; rationalization of telephone system with private, public involvement
Stevenson-Wydler Technology Innovation Act	• To promote innovation
The Development of the National Power Grid	• Complex infrastructure involving private, public, states, federal government in complex governance, standards, etc.
The Distribution System for Natural Gas	• Complex infrastructure involving private, public, states, federal government in complex governance, standards, etc.
Corporation for Public Broadcasting, Public Broadcasting System and the Public Satellite System	• Services distributed through complex web of organizations; governance models

Transportation System (highways, airlines, trains, bus, etc.)	• Mixed mode of services ranging from subsidized public highways to private systems and their interconnection; extends system from the national highways to the home (driveway); multiple governance, policy, regulation and funding structures for each sector
U.S. Postal System	• Founding goals of promoting dissemination of information and facilitating commerce through federal investment
Supercomputing Research Centers	• Established public supported as charging for use of computing was inappropriate model for computers as research instruments
Agricultural Extension Service	• Increase productivity rate (technology transfer)
Tennessee Valley Authority	• Public goals for service in remote areas and economic development through federal leverage and investment yielded private investment and repayment of public loans

The papers are useful in reminding us of the ambiguities and lack of agreement about the definition of the NREN. For instance, the papers by Dr. Weingarten (Computing Research Association)[3] and Dr. Almes (Advanced Network & Services)[4] and Mr. Andreotta (AT&T)[5] provoked lively discussion over the possible models and appropriate number of tiers. Most of the papers provided analysis of each of the Congressional questions while some of the others focused on critical areas of interest to individual communities. The papers, which appear in Appendix A to this report, will be extraordinarily useful in establishing the background for the OSTP report on the Congressional questions.

[3] "Position Statement of NREN Policies", A-9

[4] "White Paper for the NREN Policy Workshop", A-1

[5] "AT&T Statement Regarding NREN Policy", A-43

4. Summary of Workshop Discussions

The following observations were developed from the plenary discussions and the subgroup comments and recommendations.

1) Some of the questions from Congress (as well as from other groups) appear to assume that the NREN is a single physical network. The participants see it as a national network program, a network and a system of extraordinary complexity built on the existing and future infrastructure of physical facilities (cables, switches, services) purchased from commercial providers of such facilities.

2) The NREN is more than a method for communication among computers for high-performance computing. The NREN was viewed as:

- a step toward the development of the National Information Infrastructure;

- a tool for increasing the effectiveness of research, education and technology transfer at all levels;

- the current federal program with its (limited) funding to carry out the Act's objectives; and

- a network system whose components include the current federal program as well as the complementary programs supported through its strategic partners in higher education, state government and industry;

3) The specific Congressional questions dealt both with the NREN program implementation and with the different visions of it, and will require broad investigation and wide community consensus on the nature of the NREN system, its services and its governance. The papers and the workshop discussion of the questions reflected general agreement that:

- Federal funds for the existing interim NREN (principally NSFNET) have been significantly leveraged by non-federal funds provided through a variety of means such as user fees, industry support, state and university investment. However, the total funding currently available falls far short of the amount needed to realize the goal stated in the Act of connecting research and education and libraries at all levels in every state.

- As the NREN and other large scale computer networks continue to expand and gain use for a wide range of activities, both institutional and individual, the Congress must be sensitive to possible needs for revising

and strengthening federal statutes, regulations and policies covering security and intellectual property (i.e. copyright) protection.

• Charging for commercially provided services is technologically feasible and can be dealt with during NREN implementation.

4) There were diverse but slowly converging views of the functioning of the fully deployed network system in terms of its major functional elements or tiered layers.

A possible three-tiered model would consist of:

1) research and development specialized systems and testbeds;

2) a pre-commercial layer advancing the use and development of applications serving the research and educational community with federal funding playing an important role;

3) a universal commercial infrastructure layer potentially providing access to every home and office.

In this view the top tier would support research missions (funded by federal agencies). These would be state-of-the-art ultra-high-speed communication systems (serving supercomputing centers, data from research instruments, etc.) Tier two, the "pure NREN" would serve a wide range of educational needs for researchers, scholars, students and educators in all fields. Funding for this layer would be mixed, with federal, state, local and institutional funds involved. Various mechanisms could serve to channel funds for support for network services.

A possible two-tiered model would consist of:

1) a research layer that supports the development and testing of advanced networking technologies and applications requiring them;

2) a production or commercial layer that supports mature applications which do not require advanced network technologies, and whose users (which may be individuals as well as organizations) buy their services from commercial providers in a competitive network services marketplace.

In this view the research and education community would participate in the development and operation of the research layer, and the research layer would be leveraged via direct federal

investments. The research and education community would purchase services for mature applications from the production/commercial layer, which would not receive direct federal support. However, the federal government could provide mechanisms for services purchased from the production/ commercial layer by federally sponsored users to be charged back directly to the federal government, which could in turn decide how to liquidate those costs.

Both these views agree on the need for the development of the research network and the crucial role of federal funding; they differ on the assessment of the appropriate timing for change to charging for services. A number of the position papers (for instance the American Library Association[6] and the Coalition for Networked Information[7]) note that as important as cost is, another element is predictability, which is important to many institutions with fixed budgets.

5) The Network was seen as a step toward the development of the National Information Infrastructure as the new digital technologies diffuse through the existing facilities of the information distribution systems (telephones, cable, mail and television).

6) The workshop participants discussed the issue of governance represented through the existing oversight of Congress, the Administration, agencies and coordination and advisory committees. While this may be sufficient for the current federal program, it may not be sufficient to facilitate the development of the NREN as a fully national program. Already there is wide participation in the program, with the federal government supporting the backbone and partially funding the regional networks and the universities, states, federal research laboratories and industry supporting the final distribution of information to their own communities. However, the current federal NREN program provides limited participation in its management and governance for the non-federal players. The NREN system should not only include a federal program, but should become a National program including as partners the federal government, state and local government, the educational and library systems and industry.

8) The High-Performance Computing Act and the Administration's High-Performance Computing and Communications program are important first steps toward developing the NREN. The Congressional intent to "promote the more rapid development of an information infrastructure..."[8] should be met

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[6] "Policy Questions for the National Research and Education Network," American Library Association, A-3

[7] "Statement Regarding the Questions to be Addressed by the 1992 OSTP NREN Report and Related Matters", Coalition for Networked Information, A-6

[8] High-Performance Computing Act of 1991, Sec. 3. Purpose, (1) (C)

through wide participation in the emerging NREN system. The Congressional questions serve to test the congruence of visions of the network, its services, its governance and funding.

9) The workshop papers and discussion suggested some models for the evolution of the NREN system ranging from the highway system to the telephone system, from the national power grid to the agricultural extension system. All are suggestive, but none seems to be completely analogous. We are creating a conceptually new type of technology/user organization—which combines users, technology, and providers. The NREN is going through a rapid evolution of great technological and service complexity; simple models do not apply at this stage.

10) Goals and expectations for the NREN system are high and there is a mismatch between those expectations and the resources of the communities which Congress included in the scope of the network. In its forthcoming review of NREN progress, Congress can significantly contribute to the development of a national consensus on the future of the network. Among the possible steps identified by workshop participants are:

- Establishment of a National Commission charged to develop, in collaboration with all involved constituencies, a detailed plan and program for the NREN;
- Development of a more comprehensive approach to the inclusion of all federal agencies in the NREN, as well as broadening the role of the current agencies;
- Creation of a public sector governing body for the NREN, such as a federally chartered non-profit corporation, which would serve to mobilize and energize the public and private partnerships which are essential to the success of the overall national effort;
- Reaffirming and further defining the role of the federal government in the development of the NREN system;
- Complementing the NREN program with support for Grand Applications, such as medical care and manufacturing, which would focus development efforts on areas of critical national importance.

Appendix A

NREN POSITION PAPERS

White Paper for the NREN Policy Workshop
Advanced Network & Services
August 14, 1992

A. Organization

Advanced Network & Services, Inc. (ANS)

B. Nature, Goals, and Constituency of the Organization

ANS is a non-profit corporation, and is applying for 501(c)3 status.

The goals enumerated in our charter include the following:
"...dedicated to the advancement of education and research in the interest of improving the ability of the United States to compete in the global economic environment. The Corporation will concentrate on computer networking and related services, an area clearly recognized as a vital component of United States competitiveness. The Corporation shall help establish a high-speed computer network which will be maintained at the leading edge of technology, and which will eventually feature multi-gigabit per second data transfer rates. The Corporation will also help to expand the access to and interchange of information technology resources among academic, government and industry users. In addition, the Corporation will engage in research and development work, which will support the academic and research communities and contribute to United States preeminence in high speed network technology and related services."

In sum, we aim to contribute to the growth of the Internet in performance and quality, serving an increasingly broad Internet community, while keeping the traditional research/education Internet at the heart of a growing Internet.

C. Our View of the NREN

We view the NREN both as a program and as a network.

When viewed as a program, the NREN is a coordinated federal program to increase the performance, quality, and utility of the Internet in support of American research and education. There are three key goals:

- To advance the leading edge of networking technology and services.
- To increase the ubiquity of network access to the research/education community.
- To accelerate private sector technology development and deployment.

It can thus be seen that the program aims at improving technology, infrastructure, and cultivates an emerging industry.

The NREN can also be viewed as a network, but in this case the interpretation is subtle, for while many networks contribute to this program, there is no single network that could be called *the* NREN. Rather, the Internet, as seen by the research/education community and as influenced and supported by this NREN program, is the primary manifestation of the NREN. The Internet existed before the NREN was proposed, and it will probably exist after the NREN program ceases to exist as a program. Moreover, while the Internet is funded in part by the federal government, it would be a mistake to label the Internet as a 'federal network' due to the diversity of funding of various parts of the Internet.

Thus, in making statements about the NREN, one must make a clear distinction about whether one is speaking of a federal program or a very-partially-federally-funded network. In the following, we will speak of 'the Program' when referring to the NREN as a federal program, and we will see that this is the primary issue. Similarly, we will speak of 'the Network' when speaking of the Internet as enhanced by this federal program.

We are asked to comment on the *eventual nature* of the NREN, the *services* it should offer, its *structure*, the *uses* to which it should be directed, and proposed NREN *constituencies*. We will see that even such simple questions as these can have different meanings depending on whether we focus on the Program or on the Network.

The *nature of the Program* must be that of a pragmatic inter-agency federal program designed to address the NREN goals given above. When one considers that the NREN budget is a small fraction of the total budget being invested in the Internet over the coming years, one realizes that the NREN program is more like the rudder of a ship than like the engine and hull of that ship. The NSFnet Program, for example, has been extraordinarily successful in leveraging investments by universities, state governments, and industry so that federal investments are both amplified (in that they are matched more then tenfold) and directed (in that the leveraged investments are directed to meeting NSFnet goals). The NREN must be similar in these respects.

The *eventual nature of the Network* must include being increasingly advanced in technology and usefulness to the research/education community, and it is the latter notion of being increasingly useful to the research/education community that provides the yardstick for measuring the kind of technology appropriate for the network. For example, the Internet has always been used for fostering collaboration among people and access to remote sources of computation and information. The NREN should serve as a showcase for increasingly effective support for such collaboration and access. In many cases this will mean increasing

performance and ubiquity for the existing Internet. In many other cases, however, this will mean increasing effectiveness of applications using levels of performance and ubiquity already achieved. For example, the current NSFnet is capable of supporting transmissions of several tens of megabits per second from coast to coast, but this capability is not yet fully harnessed in exploiting new kinds of applications that leverage that performance.

The *services of the NREN* only makes sense in the context of the NREN as a Network. Note that the Internet is used primarily for three purposes:

- to support collaboration among people, e.g., through electronic mail and bulletin boards,
- to support access to information sources, e.g., through file transfer, and
- to support access to remote computers and other laboratory facilities, e.g., through remote login.

Broadly speaking, we anticipate that these three purposes will continue to dominate the services needed from the Internet, but we question whether the particular applications used are appropriate for the increasingly broad and demanding user community of the NREN. For example, we anticipate that effective multimedia conferencing techniques including the transmission of shared real-time images and sound will be required to support collaboration among people. Similarly, effective shared remote file systems with advanced security and performance will be required to support access to remote information, and effective remote X-window interfaces will be required to support remote computer access. These services will require significant development of the richness and quality of the application programs used on the network. The traditional email-telnet-ftp triad of applications, developed during the ARPAnet era and so useful since that time, will simply not provide an adequate base for supporting research/education productivity and application and other technologies consistent with the NREN Program goals.

The *structure of the Program* must be highly coordinated and cooperative among federal agencies and highly synergistic with respect to organizations from the private sector and the non-federal public sector. Those agencies charged with leadership within the NREN Program must have vehicles for sharing their goals and plans with others, and they must have vehicles for listening to users and to providers of NREN products and services. Congress can help further by giving these leaders the carrots and sticks needed to accomplish their goals.

The *structure of the Network* seems to be a highly technical question outside the scope of the Workshop. It is clear, however, that the Network will consist of many heterogeneous parts that must interoperate in providing services to users. The NREN will not, for example, be a single homogeneous ATM or Frame Relay network, but will include multiple technologies and various protocol layers. That portion of the Network, for example, that supports TCP/IP at the network layer will make use of traditional ethernets and leased lines as well as the newer frame relay,

SMDS, ATM, and ISDN facilities. The heterogeneity that results must be understood by those managing the NREN program. This is not to say that a broad hodgepodge of competing technologies at the same protocol layer is always to be desired, but rather to say that management of the NREN Program can only be effective if the implications of these competing technologies are understood by all.

The *uses of the Network* have already been discussed under *services*. The points made about the importance of new applications in support of the traditional broad categories of collaboration among people and access to remote information and computation resources are particularly important. As these services are provided with the performance and ubiquity necessary, we will move to an era in which geographical barriers are remove as limitations to such collaboration and access. The NREN must foster collaboration among people as effective as if they were physically local, and it must foster access to information, computational, and laboratory resources as if those resources were local.

The *constituencies of the Program* include the following:

- Users of the Network, particularly those striving to use the NREN in new ways,
- Application developers, particularly those striving to make the Network radically more useful to users,
- Technology developers, particularly those striving to make available technologies judged key for new uses and applications, and
- Internet services providers, particularly those striving to address NREN program objectives.

In all these cases we focus on those who take risks to address the programmatic concerns of the NREN rather than on those simply operating as users, developers, or providers of the established Internet. The 7th-grade teacher using the Internet to open new vistas to students could be one example, as could the physicist using advanced visualization techniques in interpreting the output of numerical simulations -- both are investing time and other resources in using a network in which such uses are not easy. Similar examples could be provided for developers and providers.

D. Possible Historical Models

As in the previous section, much depends on whether we are speaking of the NREN as a Program or as a Network.

Taken as a Program, there is a great need to ensure that the actions taken by the federal agencies serve the needs of the constituents of the Program and of the goals of the HPCC program and legislation. There is the constant danger of inter-agency rivalries or mismatches of perception between conscientious agency

administrators and Program constituents. The framers of the NREN were careful to include advisory committees in their planning -- thus, for example, there is a Federal Networking Council (FNC) made up of agency representatives and an FNC Advisory Committee made up of key constituents. The FNC Advisory Committee, however, has much less power than would the TVA or Corp. for Public Broadcasting boards. Everyone should understand that the individual federal agencies themselves have the primary power to make decisions about the direction of the NREN Program portions under their control. The danger of inter-agency disagreements is much greater than is the danger of disagreements between the agencies collectively on the one hand and the constituents on the other.

Taken as a Network, we should reflect on the fact that the NREN Network comprises several different portions of the Internet. Moreover, the Program typically provides only partial funding for those portions. Thus, there are really two issues raised in models of governance of the Network.

- First, the general problem of how the Internet should be governed. This is an important issue that encompasses such issues as routing coordination, cross-payments, and interconnectivity agreements among competing Internet service providers. While it is not within the scope of the NREN Program to solve this problem, all should understand that the solution of this problem would be of enormous help to all NREN constituents.
- Second, the particular problem of how those portions of the Internet (partially) funded by the NREN Program should be governed to ensure that Program objectives are met and that government resources are not misused. This problem *is* within the scope of the Program, and its solution is generally taken to be the responsibility of the respective agencies.

These two subproblems might be characterized as the formation of groundrules for an emerging industry on the one hand and the oversight of agency programs on the other.

If a governance structure capable of solving the more general Internet governance problem were found, then that structure might also be very useful in helping solve the more particular NREN Network governance problem. While many of us hope that the Internet Society might grow to become such a structure, it is probably too early say. In the meantime, the balanced collection of views of such older organizations as EDUCOM, FARnet, the Computer Systems Policy Project, the Coalition for Networked Information, the American Research Libraries, and the Computer Research Association should be actively sought and listened to.

E. Comments on Congressional Questions

E.1. Effective mechanisms for providing operating funds for the maintenance and use of the Network, including user fees, industry support and continued federal investment

Recall that, when we speak of the Network, we are speaking of portions of the Internet that are partially federally funded. It is crucial that the federal agencies use their dollars--in a coordinated way--to steer the Internet in ways consistent with the Program and with the interests of the research/education constituents.

The Congress should provide incentives for the agencies to work together to promote private sector competition in meeting Program objectives. Federal dollars should not be used to distort market forces, but should empower various constituents taking risks in support of Program objectives.

E.2. The future operation and evolution of the network

The Internet will have many components, each with their own operational and evolutionary requirements. Important here are the needs of that part of the Internet supported by the NREN Program and supporting the objectives of the NREN Program.

These needs will vary with the particular portion of the Internet under consideration. The needs of a portion supporting K-12 networking for teaching might well differ from the needs of a portion supporting high-speed visualization. In most cases, the economies of using network service providers with users other than NREN-funded users will be significant.

E.3. How commercial information services providers could be charged for access to the Network and how Network users could be charged for such commercial information services

Note that this is happening now. Information service providers currently connect to the Internet and charge their users for information service provision. The information service providers and their users connect to the Internet and pay (directly or indirectly) for their use of the Internet (including access from user to information service provider). Further, the various Internet service providers have bilateral agreements with each other for exchanging traffic. This arrangement results in better economies of scale for the Internet and better and less expensive access by users to information; it is in place to varying degrees and with varying details in many portions of the Internet, and is controlled by market forces.

Note also that the information service provider and the user might be on different portions of the Internet. One area in need of more development relates to this point: we currently lack customary provisions for cross-payments among Internet service providers in cases where the user is on one Internet component and the information service provider is on another. We need more experience in this area.

E.4. The technological feasibility of allowing commercial information service providers to use the Network and other federally funded research networks

As noted above, this is not only technologically feasible, but within current practice. Needless to say, it is necessary that this not be done in a way that misuses Program funds for commercial purposes. At the same time, it is necessary that this not be done in a way that place the government in competition with private sector Internet service providers.

The key to accomplishing this is to achieve clarity on the role of the research/education acceptable use policies (AUPs) placed on federally funded Network components. In essence, these AUPs allow use of Network services provided by federal funds for purposes consistent with Program objectives and not for purposes (such as commercial purposes) outside of Program objectives. At the same time, it is evident that NREN Network services can most cost-effectively be provided by Internet service providers that also carry non-NREN traffic. These two requirements -- the requirement to use federal Network *services* only for purposes within the AUP and the requirement to implement these services on *networks* that combine AUP traffic with other traffic -- are in tension, but they are not contradictory.

Both requirements can be met if the AUP is understood to be an accounting mechanism for ensuring that NREN money is only used for Program purposes. The alternate view, that the AUP be used as a restrictions on what users can do with the Internet, limits the usefulness of the Network to users and limits the cost-effectiveness of the Network.

Given this understanding, we would prefer that the AUP be vigorously enforced.

E.5. How to protect the copyrights of material distributed over the Network

This is an important topic, worthy of Program funding. If solutions come from the software marketplace, then early use of those solutions should be funded. If no solutions come, then research and development should be funded.

E.6. Appropriate policies to ensure the security of resources available on the Network and to protect the privacy of users of networks

This is another important topic, but here the picture with respect to available solutions is somewhat brighter. ANS and some of its competitors offer several new security offerings, and there are several instances of security-conscious sites attaching to the Internet only because of the availability of these offerings. Program funds should be available both for research into security issues *and* for early use of these offerings by security-conscious sites whose attachment to the Network is important to Program objectives.

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POLICY QUESTIONS FOR THE NATIONAL RESEARCH AND EDUCATION NETWORK

Paper Prepared for the
NREN Policy Workshop

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Monterey, California

A. Organization. American Library Association

B. Nature, goals and constituency of the organization.

ALA is a nonprofit educational organization of more than 55,000 librarians from public, school, academic, state, and specialized libraries and library cooperatives and network organizations, library and information science educators, library trustees, and other friends of libraries. ALA's mission is to provide leadership for the development, promotion, and improvement of library and information services and the profession of librarianship in order to enhance learning and ensure access to information for all. ALA's current priority areas are access to information; legislation/funding; intellectual freedom; public awareness; personnel resources; and library services, development, and technology.

C. ALA's view of the eventual nature, services, structure, uses and constituencies of the NREN.

ALA sees the National Research and Education Network as a system of interconnected networks rather than a single entity. The evolving NREN system will include full implementation of those points which ALA strongly (and successfully) pressed for in the HPCA establishing the NREN:

- inclusion of all types and sizes of libraries as network access points;
- inclusion of all types and sizes of libraries as network information providers;
- high-capacity NREN connections throughout all states and territories;
- recognition of education in its broadest sense as a reason for development of the NREN;
- a voice for libraries in the development of network policy and technical standards;
- use of the network for government information dissemination; and
- inclusion of library and information science in the education and training component.

More broadly, ALA sees a network with the following characteristics:

- a wide diversity of users and uses (R&E, very broadly defined),
- equity of access,
- affordable and predictable costs for access,
- interoperability and ease of use,
- scalability and extensibility,
- multimedia capability,
- federal incentives to encourage broad access, and
- a meaningful voice for involved constituencies.

D. Suggestions and rationale for possible historical models that could be applied to NREN development.

The NREN is an infrastructure element deserving of national policy attention and continued federal support, particularly to ensure equity of access. A network system such as the NREN can incorporate a variety of support mechanisms, some public and some private. No one historical model, including the examples provided in the outline suggested for these papers, the Public Broadcasting System or the Tennessee Valley Authority, will be fully applicable. Elements of several may be useful.

The need for a continuing federal role in support of NREN has an instructive parallel in the federal support of libraries, and the two federal roles need more explicit connections. The federal role in support of libraries is small, but it is embedded in numerous federal agencies and programs, including but not limited to the Library Services and Construction Act, the Higher Education Act, the Medical Library Assistance Act, the library postal rate, the Library of Congress, the National Agricultural Library, the National Library of Medicine, the Depository Library Act, and the National Commission on Libraries and Information Science.

Without exception, each of these vehicles through which the federal government addresses libraries involves a stimulus to the sharing of resources

across boundaries as a way to make the most productive use of and foster the widest access to the collective national investment in libraries and information resources. Further, the enabling statute for the U.S. National Commission on Libraries and Information Science affirms as national policy that the federal government will cooperate with state and local government and public and private agencies in assuring optimum provision of library and information services.

E. Comments on congressional questions and ranking of importance.

The High-Performance Computing Act of 1991 (PL 102-194) required a report to Congress in December of 1992 that addressed six questions. These questions are addressed below in order of importance.

1. Effective mechanisms for providing operating funds for the maintenance and use of the Network, including user fees, industry support, and continued Federal investment.

Critical assumptions include: The NREN is still developmental. The NREN is evolving and will go through several more stages before maturing. The NREN is not a single entity, but a complex web of cooperating networks. Throughout its development and deployment the NREN will continue to need a mix of funding sources.

Stakeholders affected include a diversity of users as well as providers of network capacity, information services, and ease-of-use tools. Stakeholders include academic and research, public, school, specialized, and state libraries.

Continued federal support is essential. Federal agency involvement should be widened to include the national libraries (LC, NAL, NLM), the Department of Education, and the National Commission on Libraries and Information Science.

Access to the NREN must be equitable and affordable. Pricing of access should be fixed rather than variable. Not-for-profit and publicly funded entities such as libraries supporting research, education, and lifelong learning require predictable and affordable costs. A full range of choices for access and for levels of services is needed.

The legislative history of the Act speaks to this point: "In formulating possible charging policies, consideration should be given to the importance of maintaining access to NREN for research and education purposes by users who may not be recipients of Federal research grants or contracts. Therefore, provision for low-cost, predictable network access should be included in the future evolution of NREN to ensure that, for example, schools and libraries are not excluded." (H. Rept. 102-66, Pt. 1)

2. **The future operation and evolution of the Network.**

The NREN is broadly defined in the Act to serve a diversity of users and uses. Libraries are among the stakeholders specified in the Act: "The Network is to provide users with appropriate access to...libraries. The Network shall provide access, to the extent practicable, to electronic information resources maintained by libraries..." (PL 102-194)

On this point, the House report states: "...the skills of librarians in organizing and finding information will be important for ensuring that students, small businesses, independent researchers and others are able to access resources on NREN. The Committee strongly encourages the agencies participating in the HPC Program to include libraries in plans for information dissemination on NREN, particularly as access points to NREN and in demonstration projects for providing information resources." (H. Rept. 102-66, Pt. 1)

Concerning the future operation of the NREN, ALA recommends these actions:

- Inclusion of libraries in Act must be translated into library involvement in the operation of the network.

- Increase the emphasis on practical network applications, such as literacy, lifelong learning, provision of government information, and information to contribute to social and community problem solving and economic development.

- Foster ease of use with more federal support for projects that make the network more user friendly, improve organization of electronic information resources, systematize archival responsibilities for electronic information resources, and foster development of needed standards.

- Incorporate instruction and knowledge about electronic information technologies into the curriculum for the preparation of teachers, librarians (where it already exists but needs assistance) and professors. Support a test program shared between graduate programs in teaching and librarianship.

- Increase library representation on advisory structures. The advisory structure for the network includes the "library communities," interpreted in the legislative history to "include university, state, regional or local libraries..." (H. Rept. 102-66, Pt. 1). The addition of several representatives from the various types of libraries to a new or existing advisory committee would strengthen NREN by incorporating the experience of librarians in the design and use of databases, incorporating the experience of librarians on fundamental issues of user confidentiality, access, and preservation, and incorporating the experience of the

variety of users librarians serve.

Concerning the future evolution of the NREN, ALA has identified several major issues. The NREN's high capacity is needed by libraries to handle the increased sharing among libraries and between libraries and their users of full text, nontextual and multimedia library and archival resources.

Standards are needed for interoperability, high-resolution graphics, and the balancing of leading-edge technology development with increased network reliability.

Low costs are needed by libraries, especially those not affiliated with parent institutions, and small and/or rural libraries. Rural or remote locations should not mean higher access costs. The legislative history on this point notes: "the Committee wants to ensure that rural colleges, researchers, and students have equal access to high-performance computer networks and to this Act's programs." GAO is "to conduct a study on the accessibility of high-performance computer networks at colleges, schools and libraries in rural areas." (H. Rept. 102-66, Pt. 2)

Preferential telecommunications rates for library and educational use have precedents in the current preferential postal rates and in the Networks for Knowledge provisions under a previous Higher Education Act title VIII.

Educational uses of the NREN need much more specific attention at the federal level:

National Science Foundation. NSF has a responsibility under the Act in "assisting...libraries to connect to the Network." The NSF-seeded regional networks should be required to provide reasonable-cost access to all entities mentioned in the Act.

The recently-introduced Information Infrastructure and Technology Act (S. 2937 & HR 5759) would authorize NSF to support pilot projects connecting K-12 schools to the network.

Department of Education. ED should exert leadership comparable to that of NSF. The Senate science committee (S. Rept. 102-57) encouraged ED, "through its library programs, to initiate and fund projects that promote linkages between existing library and information science networks and the NREN." The House education committee (H. Rept. 102-66, Pt. 2) added amendments to the Act to "further enhance the ability of educators and librarians to participate in the benefits which will be provided" through the NREN.

ED's SMARTLINE should use the network, as proposed in the pending

Educational Research, Development, and Dissemination Excellence Act (HR 4014).

ED-administered programs should promote network access and use. The recent reauthorization of the Higher Education Act (PL 102-325) does this in its HEA library programs. The upcoming renewal of the Elementary and Secondary Education Act should also include network access.

ED's Library Services and Construction Act, up for renewal in 1994, should include network access in its titles allocated through state library administrative agencies. State library agencies and library networks can contribute to the brokering, training, and technological support needed by many libraries, especially small libraries and those in rural or isolated locations.

The NREN should be fully utilized for the dissemination of government information. The HPCA is to "provide for improved dissemination of Federal agency data and electronic information."

Federal government information would be available over the network through two pending bills (HR 2772 and S. 2813, the GPO WINDO/Gateway to Government Act) which would use an electronic Government Printing Office sales program and GPO's Depository Library Program.

State and local government information is a natural for network dissemination. More than 400 libraries in North Carolina are involved in an Internet-connected state network developed with LSCA funds; library databases, state jobs listings, data center statistics, state RFPs and regulations, etc. are newly available to rural area citizens and businesses through local networked public libraries.

3. Appropriate policies to ensure the security of resources available on the Network and to protect the privacy of users of networks.

No less need for constitutional protection exists in the electronic networked environment than in any other. A full range of responses is required -- not just legislative, but human judgment and common sense.

Security measures are needed to protect integrity of databases, confidentiality of communications, privacy of users (without extra cost), and anonymity. Technical means to achieve such protection, such as encryption and electronic signatures, should be encouraged. A mechanism should be established to ensure the observance of such protection.

4. How to protect the copyrights of material distributed over the Network.

The existing balance between the rights of authors and users, including fair use, must be carried forward into the electronic networked environment. The basis of copyright, as stated in the U.S. Constitution, is to "promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries." The fair use doctrine codified in section 107 of the current Copyright Law provides limitations on exclusive rights to encourage criticism, news reporting, teaching, scholarship, and research.

Users and proprietors would benefit from innovative efforts, but both want to minimize risk. Protection of copyrights called for in the HPCA must be balanced with treatment of fair use. The legislative history of HPCA reiterates this concern. S. Rept. 102-57 states that mechanisms for charging for the use of copyrighted material available over the NREN "should not be implemented without due consideration of both the rights of authors and the rights of users of copyrighted material, and specifically, of the fair use of copyrighted works for teaching, scholarship, or research."

Non-legislative measures should be encouraged, such as cooperatively developed guidelines, dialogue among all interested parties, continuing education, and a focus on spurring creativity.

Certain challenges require special attention in the electronic networked environment, such as collective and derivative works, multimedia information resources, and the fluid nature of the medium of expression.

5. How commercial information service providers could be charged for access to the Network, and how Network users could be charged for such commercial information services.

In the long run, this question is better addressed to the eventual universal broadband network reaching every home and workplace. In the short run, traffic allowed on the federal backbone to support research and education should be interpreted as flexibly as possible. The House-passed HR 5344 would help by amending the NSF authorizing statute to provide additional flexibility in this regard.

A major issue is how to pay for the network capacity commercial traffic will require; whether it is appropriate for such traffic to be federally subsidized. Commercial services should pay their own way. Users will expect to pay for the content of commercial information services provided over the network. To the extent that differential pricing is imposed, revenues should be reinvested in the network.

6. The technological feasibility of allowing commercial information service providers to use the Network and other federally funded research networks.

It is certainly technologically feasible.

E. Additional questions or policy areas.

Public libraries, as ubiquitous and politically neutral agencies, as significant community information resources and physical places, and as electronic extensions of those resources and places, could play a key role in making the NREN a major force in solving grass-roots problems and a powerful tool on behalf of the public's right to know. Although not excluded from the HPCA and the NREN, neither are public libraries specifically mentioned. This has led to barriers, both real and perceived, to effective use of the Internet/NREN by public libraries on behalf of their communities.

F. Bibliography. Attached.

G. Additional background material.

Attached is ALA testimony at NCLIS open forum on library and information services' roles in the NREN, July 20, 1992.

This paper was prepared by Carol C. Henderson, Deputy Director of the ALA Washington Office, in preparation for the NREN Policy Workshop. It is not an official statement of ALA policy. However, it is based on ALA's policy statements on the NREN, and on ALA's testimony, presented by Elaine Albright on June 20, 1992, at the NCLIS Open Forum on Library and Information Service Roles in the NREN. These sources were supplemented by reaction to the Albright testimony requested from the ALA Committee on Legislation and from ALA Legislation Assembly members and units.

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A. ***Organization:*** Association of American Universities (AAU)

B. ***Nature, Goals and Constituency of the Organization:*** AAU is an organization of 56 U.S. and two Canadian research universities; member institutions are represented within AAU by the presidents or chancellors of those institutions (membership list attached). AAU focuses on national policies affecting the capacity of research universities to maintain strong programs of research and graduate and professional education.

C. ***Organization's view of eventual nature, services, structure, uses, and constituencies of the NREN:*** AAU has not yet developed a formal position on NREN. However, the association's commitment to academic research and advanced education tie it directly to the functions of the NREN. In addition, AAU is implementing a research library project in cooperation with the Association of Research Libraries, which will address three issues: (1) Acquisition and Distribution of Foreign Language and Area Studies Materials, (2) Intellectual Property Rights in an Electronic Environment, and (3) A National Strategy for Managing Scientific and Technological Information. These three topics will be addressed by task forces of university administrators, librarians, and faculty; and will be overseen by a steering committee of AAU presidents and chancellors. The members of the steering committee are listed on the attached project description. Task force #3 will focus directly on issues involved in the development and implementation of NREN, but the other task forces will address issues central to NREN as well.

D. ***Suggestions and rationale for possible historical models that could be applied to NREN development:*** Models can provide useful guidance in developing the NREN, as long as their properties are applied flexibly and do not become constraining. Models can be helpful in directing the development of the network in circumstances where solutions to problems encountered by the models can either serve as or point the way to appropriate solutions to network problems. But models also can serve as valuable rhetorical and persuasive mechanisms for explaining the system and its possibilities to audiences unfamiliar with its concepts.

E. ***Comments on Congressional questions and ranking of importance to your constituency; and***

F. ***Additional policy questions you think are important:*** In addition to developing answers to questions contained in the legislation, attention should be given to what questions should shape the discussion of the formation of the network. The legislative questions are among them, but a number of more fundamental questions need to be answered in building a coherent constituency for the NREN and forging agreement within that constituency on priorities for development of the network.

Because the potential of a national high performance computer network system is so great, there is a natural tendency to identify the full range of its long-term capacities as equally weighted immediate objectives. Constituent groups have differing vested interests in the research and educational functions that will be supported by the system. These groups must strive for some general agreement on an orderly evolutionary process for the development of the system. Groups must be willing to make short-term compromises for long-term benefits and commit to a pragmatic process for developing priorities that can generate the necessary support among government, corporate, and academic sectors. The Monterey NREN policy workshop can provide a valuable contribution to this priority-setting process.

AAU Presidents and Chancellors

Brandeis University	President Samuel O. Thier
Brown University	President Vartan Gregorian
California Institute of Technology	President Thomas E. Everhart
Carnegie Mellon University	President Robert Mehrabian
The Catholic University of America	Brother Patrick Ellis, S.C.
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The University of Wisconsin	Acting President Katharine C. Lyall
Vanderbilt University	Chancellor Joe B. Wyatt
Washington University	Chancellor William H. Danforth
Yale University	Acting President Howard R. Lamar

August 1992

AAU Research Library Project

The Association of American Universities is creating task forces to address three research library issues in which AAU can play a helpful role. The basic objective of the task forces will be to engage the range of university expertise that will assure that the perspective of research universities plays a defining role in the evolution of national information policies and practices that affect university education, research, and scholarship.

The three task forces are:

1. Acquisition and Distribution of Foreign Language and Area Studies Materials

2. Intellectual Property Rights in an Electronic Environment

3. A National Strategy for Managing Scientific and Technological Information

The task forces will be established by AAU in cooperation with the Association of Research Libraries (ARL), and will report to an AAU Research Libraries Steering Committee. The members of the Steering Committee are:

President Hanna H. Gray, University of Chicago, *Chair*
Chancellor Richard C. Atkinson, University of California, San Diego
President Myles Brand, University of Oregon
President John Lombardi, University of Florida
President Martin Massengale, University of Nebraska
President Charles M. Vest, Massachusetts Institute of Technology

Staffing arrangements will coordinate the work of the task forces with the activities of related groups such as the ARL/EDUCOM/CAUSE Coalition for Networked Information and the Computing Research Association. A description of the composition and objectives of the task forces follows.

1. Acquisition and Distribution of Foreign Language and Area Studies Materials

This task force will be made up of librarians, area studies center directors and scholars, and government relations officers. It will be asked to develop a four-part strategy for increasing acquisitions of foreign materials and expanding access to them:

- Working in conjunction with area studies groups, develop some measure of needs and priorities for foreign materials by world area.
- Establish specific national acquisition targets, based on area-specific needs and priorities and on additional information provided from current studies (see below).
- Develop models for collection and distribution of foreign materials.
- Develop a plan of action for securing the requisite funding.

Background: Many libraries are facing sharp reductions in their acquisitions of foreign materials due primarily to three developments: (1) the dollar has dropped more than 40% on world currency markets over the last three years; (2) the rising cost of all materials has forced libraries to reduce expenditures on foreign books and materials, and (3) political developments abroad have played havoc with collection strategies—for example, the loss of state subsidies in Eastern Europe has meant that journals formerly obtained through exchange agreements must now be purchased at Western European prices.

The combination of rising serial prices and the increasing need to maintain collections that reflect the rapid and profound political, social, and economic changes throughout the world calls for new cooperative ventures to strengthen our foreign language and area studies centers and expand the access of scholars to them.

ARL is conducting a study funded by the Mellon Foundation to assess what appears to be an inverse relationship between decline in U.S. acquisitions of foreign materials and the explosion in global knowledge. This study should help provide a rational basis for setting acquisition targets as part of a comprehensive national collection and dissemination plan covering the 10 world areas.

Title VI of the Higher Education Act provides a locus for federal funding. Title VI's foreign periodical acquisitions program was first funded in FY 1992 at $500,000. The program is likely to have its authorization ceiling substantially increased and its scope expanded from foreign periodicals to foreign research materials during this year's HEA reauthorization.

Development of procedures for the collection and distribution of foreign periodicals could provide models for more general resource sharing plans.

2. Intellectual Property Rights in an Electronic Environment

A task force of librarians and university administrators knowledgeable about copyright, patent, and other university information policies will be charged with developing proposals for university policies governing intellectual property ownership and rights in an electronic environment. The task force will examine from a university perspective the emerging possibilities for the creation and dissemination of electronically based information, and develop proposals under which universities could provide their faculties and students with new options for collecting and disseminating the products of research and scholarship in electronic environments. Such options could both expand access to university-generated information and reduce the cost of that access.

Background: The rights to intellectual property created by university faculty are frequently given to commercial publishers who then sell it back to universities. An increasing proportion of this information, particularly in scientific and technological fields, is being concentrated among a small number of publishers, most of them overseas, who are increasing the price of this information at rates that exceed any reasonable combination of cost and profit, aided by an environment lacking effective market constraints.

In addition, fair use provisions provided for higher education in the 1976 copyright law are being eroded by a number of factors, including university responses to litigation by publishers. Legal advice designed to reduce exposure of individual institutions has the aggregate effect of limiting faculty and student access to scholarly information.

The development of electronic environments for the collection and distribution of information may provide universities with an opportunity to develop alternatives to the current, commercially dominated system of information creation, distribution, and use. Faculty are exploring the feasibility of forming electronic text centers which would digitize available scholarly information and make it available to scholars over computer networks. Commercial interests militate against the development of these information resources by restricting what information can be included and at what cost.

An analysis of intellectual property rights in an electronic environment may identify opportunities available through a collective response by universities that will not otherwise be realized.

3. A National Strategy for Managing Scientific and Technological Information

This task force will consist of university administrators, librarians, and scientists that collectively bring expertise in scientific communication, library and information management, and telecommunications networks. It will examine new options for the collection and dissemination of scientific and technical information, giving particular attention to the concept of a distributed national science and technology library, a system of regional libraries responsible for the collection and dissemination of scientific and technological journals and related forms of communication.

Background: The rapid development of communication and computing technology is changing the way scientific information is created, disseminated, and used. Nonetheless, the preponderance of scientific information is provided through serial publications that are rapidly growing in number and price and are increasingly concentrated among a small number of commercial publishers.

The economic pressures on a captive university market, combined with new technological possibilities for handling information, can provide the motivation and the means to develop a system of regional libraries that would provide a nationally organized structure for managing scientific and technological information. Among other functions, such a system could collect and store serial publications which could be distributed electronically to local users. Canada has created the Canada Institute for Scientific and Technical Information which supports the highest level of interlibrary lending in North America. A similar system, regionally distributed to develop broad political acceptance and to accommodate the greater dimensions of the U.S. scientific and technological information enterprise, could provide a structure that would reduce collection requirements—and therefore costs—for individual universities while sustaining and even expanding access by students and faculty to scientific and technological information.

The computing networks currently being developed by the federal government and the private sector will provide the electronic communication system for handling national science and technology information flow. It is important for universities to participate in the development of such a system so that it reflects both the research and educational needs of those institutions.

AMERICAN LIBRARY ASSOCIATION
ASSOCIATION OF COLLEGE AND RESEARCH LIBRARIES

ACADEMIC LIBRARIES AND NREN

Statement by
Patricia A. Wand
Member, Government Relations Committee
Association of College and Research Libraries
American Library Association
Draft presented July 20, 1992
Final statement submitted August 31, 1992

I speak on behalf of the Association of College and Research Libraries (ACRL), the largest division of the American Library Association with over 10,000 members. Academic libraries support education and research activities of large, small and medium-sized institutions.

I recently drove north on the Oregon Coast, crossing five spectacular bridges that were constructed in the 1930's as part of a federally-assisted project. The Works Progress Administration enabled Oregon to complete U.S. Highway 101, thereby linking its coastal towns and its north and south borders. The construction of bridges replaced ferry service on major Oregon rivers and estuaries, opening the coast to industry and tourism.

The foresight demonstrated in the 1930's by federal projects that helped underwrite the cost of bridges and highways stimulated the further development of the automobile, trucking, petroleum, and tourist industries, to name a few.

In the 1990's we look forward to the design and development of the National Education and Research Network (NREN), the information superhighway of the 21st century. NREN is vital to the economic development and the security of the United States. As envisioned, NREN will provide for storing and high speed transferring of data in text, voice, and graphic format.

Certain aspects of the proposed National Research and Education Network (NREN) are essential to provide for the educational needs and research activities of academic institutions. **Essential characteristics must be specified from the beginning of NREN development in order to assure their inclusion as this multi-phased superhighway becomes a reality.**

KEY PLAYERS IN NREN

Key players in NREN fall into three groups: **owners, transmitters,** and **receivers.** Information owners include the creators of databases, owners of databases, and the information professionals responsible for organizing data. Transmitters of information are the hardware providers and owners, software developers and vendors, the telecommunication providers. Receivers of information include both end-users and information professionals who assist them.

Academic libraries will play major roles as both OWNERS and RECEIVERS of information.

As OWNERS of information, academic libraries create and purchase information. They create large databases that are catalogs of library holdings. Organizing and classifying information are special areas of expertise for librarians. Academic libraries also purchase databases that they make available to their users.

As RECEIVERS of information, librarians are the specialists who interface with the end-user. Academic librarians understand the information needs of learners, educators, and researchers. Librarians access off-site databases on behalf of library users. Librarians teach users how to locate and interpret information.

STRUCTURAL CAPABILITIES

NREN must be available to users in homes, offices, schools, libraries, research laboratories, government assembly rooms. In short, it must provide for links to workplaces, study spaces, and leisure activities across the country.

The structure must provide for communication:

Scholar - to - scholar
Scholars must be able to work together in pursuing common research interests. They need to interact with information files defined as "works-in-progress."

Scholar - to - user
Research being undertaken or already completed must be available to users with appropriate safeguards to protect its integrity. The information needs to be presented in such a way that users can access and interpret it.

Instructor - to - student
Distance learning is an established mode of education across the U.S. NREN will assure interactive communications between instructors and learners when information is in any format: text, image or voice.

User - to - government information
All government generated information, much of which is

currently disseminated through the U.S. Document Depository Program, should be available through NREN. The Superintendent of Documents should regard NREN as another major vehicle for disbursement of government generated information. State and local government information must also be available on the NREN.

User - to - library/database
Individuals from homes, offices, schools must have access to library catalogs and databases. Dial-up capability is fundamental to NREN.

User - to - international databases
Interaction through NREN to international education, research, and information communities is a critical component. Libraries have always exchanged information and communicated with countries even when their respective governments have severed diplomatic ties or were at war.

GOVERNING BOARD

NREN must be publicly funded and regulated. Its governing board must be bi-partisan and independent.

Because this infrastructure is so vital to the flow of information in the country, NREN must be overseen with minimal political interference. Oversight responsibility must be assigned to an entity that is committed to distributing information in all subjects and to all sectors of the country. Because of the diverse nature of the "stake holders" it is essential that the NREN governing board maintains an independent stature and serves as an integrator agency.

The following federal government agencies have already expressed interest in NREN development and have a vested interest in its full implementation:

Department of Agriculture
    National Agricultural Library
Department of Commerce
Department of Defense
Department of Education
Department of Energy
Department of Health and Human Services
    National Institutes of Health
    National Library of Medicine
Department of Interior
    U.S. Geological survey
Library of Congress
National Commission on Libraries and Information Science
National Aeronautics and Space Agency

National Science Foundation
Office of Science and Technology
Office of Management and Budget
Superintendent of Documents

Because of its jurisdiction over education and libraries in the U.S., the Department of Education must be very involved in NREN development and maintenance. In spite of the critical role that NREN will have in the security of the country, the Department of Defense must not have control or undue influence on NREN.

Numerous groups within the private sector also are committed to a fully developed NREN. Those include both for-profit and not-for-profit organizations:

Educational institutions, pre-K through higher education
Libraries
Non-profit organizations
Publishers
Telecommunications industry
Software designers
Hardware vendors
Independent researchers

Should certain aspects of NREN become privatized, there must be guarantees that such privatization would not make NREN unaffordable to large segments of the population. Privatization, without effective regulation, may also reduce the possibility of providing access to uncensored information.

REGULATIONS AND GUIDING PRINCIPLES:

Academic libraries, as well as other types of libraries and educational institutions, must have a strong voice in developing the operating procedures and policies governing use of NREN. Substantive input must be sought from a wide variety of user communities, including the public, non-profit and commercial sectors.

Accordingly, use of NREN must include:

Equitable access to information by users in all economic strata

It is essential to this democracy that access to information not be restricted by ability to pay. Libraries have traditionally provided information to users without regard to their economic status. As more information is available in electronic as opposed to print format, steps must be taken to assure its accessibility. Access to NREN by an individual should

not be limited by the ability of the individual to pay for services.

Predictable and affordable pricing structure

In order to keep costs as low as possible and predictable for budgeting purposes, fixed pricing is the preferred method for the near future. Paying a predictable amount is more feasible for non-profit and for smaller enterprises than pricing by quantity or time of use.

Protection of intellectual property rights

Scholars must be insured they can share work in progress without having it pirated.

Confidentiality of user activity

Personal and institutional use may not be monitored by the government nor by commerce. Government surveillance would jeopardize academic freedom. Commercial interests could use monitoring for marketing and development purposes. Electronic eavesdropping must be prohibited.

Safeguards against governmental restrictions on use between political entities

Communication on NREN must be open to all without regard to their political convictions.

Provision to archive master copies of information files

To preserve the cultural heritage of the nation, works declared complete by their authors, composers, directors, producers, etc. must be archived in at least three separate locations. It is possible that the existing model used by ERIC clearinghouses could be adapted for archiving files in NREN.

Assignment of identification descriptor to every information file

Each unique file must be retrievable, as is every unique item in a collection or library. So that users can both find and cite documents from the network, an identification descriptor similar to a MARC record must be designed and used.

Capable of high speed data and graphics transmission

Even from the beginning, technology must provide for high speed data transmission and protection against viruses. Standards must be developed for the transmission of graphics.

SOURCES OF FUNDING FOR DEVELOPMENT AND OPERATION:

Development and maintenance of NREN will be the shared

responsibility of the federal government, educational institutions, libraries, and the commercial sector. Likewise, financial support must come from all groups with the federal government providing the largest portion of support.

The **federal government** must make a continual commitment to maintain and enhance NREN. This support must accommodate rapid and continual increase of user traffic and embrace new technology. It must provide for the installation of adequate technology to handle increased traffic and provide switching capabilities.

The increase in government support for NREN must not be at the expense of its current support for libraries, education, and researchers.

The **commercial sector** will support the development of NREN through research and development investments. Commercial support for the maintenance of NREN will be in the form of fees paid for access.

Provision must be made for commercial enterprises to use NREN to increase revenue but users should not be unwillingly subjected to advertising. One source of revenue, for example, would be an option for credit card use by those who wish to pay a vendor for quick, as opposed to routine, document delivery. Libraries should receive preferential rates for such quick transmission, even by commercial vendors, for interlibrary loan purposes.

Rates should be established in such a way that libraries and educational institutions can offer their users access to NREN at no fee to the user. Fees charged to the for-profit sector can be used to help subsidize educational use. Pricing provisions in NREN must support the library tradition of providing access to information without regard to the user's ability to pay.

Support of NREN by **academic libraries** will be in the form of creating and maintaining catalogs and other databases, in developing front-end software and screens that assist users in locating information in NREN, and in guiding users in selecting the most helpful data from an abundance of sources.

We wish to thank the National Commission on Libraries and Information Science for providing the opportunity for interested parties to participate in the further development of Internet toward a comprehensive NREN. We offer here general guidelines for an NREN configuration that will meet the needs of large and small academic libraries and their students, faculty and users.

Patricia A. Wand
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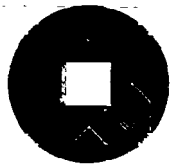

ASSOCIATION OF RESEARCH LIBRARIES

August 1992

Key Issues to Consider in NREN Policy Formulation

A. Association of Research Libraries

B. 1. The Association of Research Libraries is a not-for-profit organization representing 120 research libraries in the United States and Canada. Its mission is to identify and influence forces affecting the future of research libraries in the process of scholarly communication. ARL programs and services promote equitable access to, and effective use of recorded knowledge in support of teaching, research, scholarship, and community service. These programs include annual statistical publications, federal relations and information policy, and enhancing access to scholarly information resources through telecommunications, collection development, preservation, and bibliographic control.

2. The Association articulates cooperative action, influences information policy development, and supports innovation and improvement in research library programs. In March 1990, ARL, CAUSE, and EDUCOM established the Coalition for Networked Information.

C. View of eventual nature, services, the structure, the uses and constituencies of the NREN.

1. NREN as a network, a system of networks, or a program will, with federal assistance, support and foster communication and interaction between the research and education communities.

2. The eventual nature of NREN and services available via NREN are dependent upon the definition of research and education. The definition of the research and education community in High-Performance Computing Act of 1991 is broadly-based to encompass constituencies such as libraries and K-12.

3. A key to the success of NREN will be the means by which multiple constituencies with diverse information needs, applications requirements, and skills are included in the network environment, exposed to the benefits and opportunities that flow from network access, and thus influence the future direction of the system. To be responsive to these constituencies and changing needs, the following characteristics or elements should be incorporated in the network structure. NREN should be innovative, be flexible, be scalable, include multi-media, be extensible, be affordable, and promote the assurance of longevity.

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4. The diversity of users (librarians, K-12, researchers, scholars, scientists, business, etc.) will continue to expand and these users will become more dependent upon networks as a means to conduct their work. For example:

•The High-Performance Computing Act of 1991 recognizes the central role of libraries in society as providers of information resources and as points of access to information for many constituencies. Research libraries have taken a leadership role in advancing network-based initiatives to advance access to information resources in support of research and education.

•Recent ARL statistics reflect that ARL libraries are moving from the "just in case" model of on-site resources to the "just in time" model of resource-sharing.

•Movement away from the traditional supply model to a demand or access model for providing information to users is occurring at a faster pace with the use of networks by libraries and with the increasing capacity of existing networks that meet library needs.

•Network applications today focus on access to resources such as books, journals, and online files; in the near future, the focus will be on access to and use of research materials and collections generally unaccessible but of extreme research value including photographs, satellite and related spatial data, archival data, videos and movies, sound recordings, slides of paintings and other artifacts, and more.

5. The advent of NREN and the dual role of libraries as envisioned in the Act will result in a fundamental shift in how libraries operate and support their multiple user communities.

•The promise of NREN for libraries and our users, is in part, the opportunity to rethink current practice to address current needs better and/or seize future opportunities.

•NREN is the vehicle through which research libraries will realize the virtual library. Research libraries are already engaged in fundamental elements of this virtual library including document delivery, electronic journals, full text databases, end-user searching, training, network access, OPAC enhancements, cooperative

development of databases and hardware, and policies, services, and strategies that promote access to information in lieu of ownership.

•Libraries typically serve a wide range of constituencies with an equally broad range of information needs and data gathering skills.

6. To reflect this broad range of users and to be responsive to their needs, the development of NREN will require a continuing federal role and;

•Mechanisms to ensure equitable access to the network and its resources.
•Pathways to accommodate differing skill levels and an infrastructure that includes support services, training materials, workshops, help lines, development of documentation, and more.
•The development of statements/positions regarding appropriate use of the network e.g. freedom of expression is guaranteed in a networked environment.
•Interoperability within the network system to ensure ease of use and ease of access for users. This will require standards development to permit such ease of use and access.
•Regular evaluations regarding network affordability to existing and new constituencies, e.g. do costs of access become barriers of access for different communities of users?
•Clear delineation of responsibilities between networks, and between networks and users vis a vis services and archival responsibilities.

7. NREN should be a key element of -- and actively promoted as -- the public information infrastructure for government of all levels -- state, local, and federal.

D. Possible applicability of historical models to the development of the NREN.

There is a value in trying to identify historical models or elements of historical models that may be applicable to the development of new infrastructures such as NREN. It may be useful to identify elements (including those that worked as well as failed or were not successful) from other models that:

•establish infrastructure, e.g. the Morrill Act
•promote equity, e.g The Federal Depository Library Act of 1962, the Higher Education Act

•provide benefits to multiple communities, e.g. the Communications Act of 1934, Interstate Highway Act

•promote innovation, e.g. Stevenson-Wydler Technology Innovation Act of 1980

•enhance productivity, e.g. tax laws

•stimulate markets, e.g. CRADAs

E. The six questions are presented in rank order of importance .

Effective mechanisms for providing operating funds for the maintenance and use of the Network, including user fees, industry support, and continued federal investment.

1. The successful evolution and deployment of the network or system to diverse communities is dependent upon continuing the partnership of federal, state and local governments, university, library, education-related communities, and the private sector. This partnership has proven to be an effective mechanism for stimulating growth of the Network, developing new services, and sparking creativity. There are several elements of this relationship including cooperative ventures in R&D, support for and assistance of new users and communities, cooperation and shared support for the long-term goals of network, and partnership in funding network development and access.

2. Maintaining low and predictable costs for access to the Network will be a key element in libraries continuing to utilize networks and to bring in new users and new communities into the network environment.

3. The successful deployment of the network will also depend upon maintaining a governmental role, and in particular a federal role to ensure equity of access to the network. The federal presence is important in a number of arenas including:

• a federal role ensures that new communities will have access to the network;

• the seeding or stimulating of other activities throughout the government (all levels);

•providing connections between network activities and a variety of related federal programs that could benefit from network opportunities. Several related laws, bills, and activities underway include:

--H.R. 2772 and S. 2813 seek to provide a single point of online public access to a wide range of federal databases containing public information. The goal of the legislation is to provide comparable access to federal information in electronic format as is currently

available in print. An additional benefit of these proposals is that agencies will have new avenues to disseminate information products and services in support of agency missions. NREN is mentioned as a dissemination channel in S. 2813.

–The American Technology Preeminence Act that calls for the National Technical Information Service to establish the feasibility of creating and operating an Online Information Product Catalog or FEDLINE.

–S. 1940, the Electronic Freedom of Information Improvement Act, updates FOIA in an electronic environment and H.R. 3459, the Improvement of Information Access Act promotes enhanced access to and accountability of agency dissemination efforts.

–Two federal activities are the proposed revision of Circular A-130, "Management of Federal Information Resources," from the Office of Management and Budget and the work of the Federal Geographic Data Committee that coordinates federal spatial data policy.

–An education-related initiative, Sources of Materials and Research about Teaching and Learning for Improving Nationwide Education or SMARTLINE, is a proposed one-stop shopping network for information concerning teaching and learning for teachers, administrators, parents, and community leaders. The Department of Education envisions that SMARTLINE will be accessible via NREN and via libraries. SMARTLINE is included in H.R. 4014, a bill that will reauthorize the Office of Educational Research and Improvement.

–The Information Infrastructure and Technology Act, (S. 2937) seeks to support NREN applications for digital libraries and authorizes pilot projects to link schools and the Internet/NREN.

The future operation and evolution of the Network.

1. There is a fundamental need for a continued federal presence in the evolution of the network. NREN will be an integral and central element of the U. S. information infrastructure and this centrality demands a continuing federal role to ensure equity of access to networks and to ensure

that access to networks is broadly-based so that varied communities can reap benefits of the Network.

2. The increasing dependency of multiple communities, including libraries, on networks requires that the Network, system of networks, or program have the following characteristics; be accessible at a low cost; be user friendly; have the capacity and capabilities to achieve effective and meaningful access to needed resources. The program should also include (at a minimum) the following service infrastructure:

- educational assistance and training in utilizing the network;
- outreach services to identify new communities of users and their distinct information needs;
- programs and services that will assist users in utilizing the network;
- coordination between network providers and service organizations for an integrated approach to user services and access.

3. How access to the NREN is priced will have a direct relationship/bearing on the ability of new users and communities to engage in network activities. When and how network services are offered to new users will influence the direction of the network, the nature and type of services available, and will determine who benefits.

4. With the number of activities and affected communities, there must be effective oversight and coordination of these activities. The current advisory structure as stipulated by the High-Performance Computing Act of 1991 no longer reflects nor is adequate in representing the broad range of users and constituencies. The advisory structure could be strengthened and representation expanded.

Appropriate policies to ensure the security of resources available on the network and to protect the privacy of users of networks.

1. There is a need to promote policies of privacy, confidentiality, equitable access to information, and freedom of expression. These are valuable policies that must be woven into network practices.

2. These are familiar issues that require careful consideration in a networked environment as they have in other environments. There is already an appreciation of and sensitivity that

issues relating to access, privacy, freedom of expression, and security can co-exist and be maintained.

3. There are numerous policies and laws that provide guidance including the library bill of rights, privacy law such as FOIA, the Privacy Act, and Federal Depository Library Act of 1962.

How to protect the copyrights of materials distributed over the Network.

1. The question as presently worded requires more balance to better reflect the rights of both the creators and the users. The Copyright Act strikes such a balance and in particular, section 107 stipulates fair use provisions that should be considered in a networked environment.

2. There is a clear understanding among users and publishers that there should continue to be protection of copyrighted materials in a networked environment.

3. There is also an appreciation that the advent of Internet/NREN signals that new formulas, arrangements, and relationships will emerge and should be allowed to flourish. ARL supports the development of a robust market for networked information.

4. It is too early to consider or to impose restrictive agreements that limit access, limit creativity, or undermine fair use provisions as these could be detrimental to long-standing policies that promote public access.

How commercial information service providers could be charged for access to the Network, and how Network users could be charged for such commercial information services.

1. It is important to distinguish between the technological means by which users can be charged for access to commercial services versus the policies concerning public versus private use of a public resource.

2. In the conduct of research, users of networks benefit from access to commercial information resources. Research libraries routinely utilize commercial information services.

3. It seems appropriate that commercial users should assume some costs of access while utilizing a publicly subsidized facility. Such costs of access could be considered with a sensitivity to the risks that information providers may experience or encounter given the fragility of the

environment. Information providers should also appreciate the new networking initiatives supported and encouraged by libraries and the education communities that seek to enhance access to resources in a cost effective manner.

The technological feasibility of allowing commercial information service providers to use the Network and other federally funded research networks.

The establishment of the Commercial Internet Exchange (CIX) in 1991 is a recent example of how the industry is responding to the evolving network structure. It is likely that the establishment of CIX is but one such response to allowing commercial providers to utilize federally funded networks. Such a response may also be viewed as a signal that additional efforts (federal) are not required and that in fact the "system" is working.

F. Additional questions or policy areas to consider .

1. The speed with which new communities are engaging in networked-based activities and the growth of networks to accommodate such use, requires that questions such as those posed in the High-Performance Computing Act of 1991 be identified, discussed, and evaluated. It will be useful to regularly take stock of how the "network program" is evolving and to rethink existing approaches based on need, use, and opportunity. Who should take the lead in initiating this review? Congress, agencies, advisory groups?

2. As NREN evolves, there will be a tension between meeting existing user needs while developing and extending the capabilities and capacities of the system. It will be important to strive for the longer-term vision that will provide known and yet unknown benefits and opportunities to the Nation. The managers/developers of NREN should be permitted sufficient flexibility to experiment so that the system can flourish and expand. Who will strike that balance while continuing to press ahead-- Congress, OSTP, advisory groups?

3. What forums will be discussing, reviewing, evaluating the evolution of the NREN program and its relationship to the information infrastructure and other related telecommunications policies?

4 . NREN should be promoted as a channel for federal, state, and local agencies to disseminate information resources to the public. What agency should take the lead?

5. The six questions included in the High-Performance Computing Act of 1991 could also benefit from additional review. First, equal weight should be given to the rights of users as of creators in question 5. Second, the operation and evolution of the Network is dependent upon the definition of research and education. And finally, the value and use of the Network will increase and expand with a far-reaching definition of research and education.

G. Statement of Duane E. Webster, Executive Director, Association of Research Libraries, before the NCLIS Open Forum on Library and Information Service Roles in the NREN

ARL Fact Sheet

ASSOCIATION OF RESEARCH LIBRARIES

ARL FACT SHEET

Mission: The mission of ARL is to identify and influence forces affecting the future of research libraries in the process of scholarly communication. ARL comprises the libraries that serve major North American research institutions and operates as a forum for the exchange of ideas and an agent for collective action. ARL programs and services promote equitable access to, and effective use of recorded knowledge in support of teaching, research, scholarship, and community service. The Association articulates the concerns of research libraries and their institutions, forges coalitions for cooperative action, influences information policy development, and supports innovation and improvement in research library programs.

Membership: 120 research libraries in the United States and Canada; founded 1932.
President: Arthur Curley, Librarian, Boston Public Library (1992).
Staff: Duane E. Webster, Executive Director; 11 professional and 10 support staff.

ARL PROGRAMS AND CAPABILITIES:

- Statistics: The collection and distribution of quantifiable information describing research libraries. Annual publications include *ARL Statistics* and *ARL Annual Salary Survey*. Other projects are *Preservation Statistics*, and the datafile *Research Library Statistics 1907/08 through 1987/88*.

- Communications: Publishing, media relations, meetings and outreach to ARL members, the library profession, policy-makers and the higher education community. *ARL: A Bimonthly Newsletter of Research Library Issues and Actions* and other publications are available.

- Federal Relations and Information Policy: Activities to monitor legislative and governmental matters of concern to research libraries, analyze and respond to federal information policies, and develop ARL positions on these issues as they affect diverse constituencies within ARL.

- Technology and Access: Pursues the objective of enhancing access to scholarly information resources through telecommunications, collection development, preservation, and bibliographic control. Recent programs include the North American Collections Inventory Project (NCIP) and the National Register of Microform Masters (NRMM) Retrospective Conversion Project.

- Office of Management Services: OMS conducts research and provides consulting, information and training in the management of human and material resources in libraries. Major programs include the Academic Library Program and the Systems and Procedures Exchange Center (SPEC).

- Office of Scientific and Academic Publishing: Launched following the *Report of the ARL Serials Prices Project*, OSAP is designed to identify and influence the forces affecting the production, dissemination, and use of scholarly and scientific information.

- Office of Research and Development: Articulates the ARL research agenda through the development and administration of grant-supported projects in all of the above program areas. Coordinates the Visiting Program Officer program.

- Coalition for Networked Information (CNI): Formed by ARL, CAUSE, and EDUCOM in March 1990 to "advance scholarship and intellectual productivity" by promoting the provision of information resources on existing and future telecommunications networks, and the linkage of research libraries to these networks and to their respective constituencies.

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MEMBERSHIP OF THE ASSOCIATION OF RESEARCH LIBRARIES

National Libraries:

Canada Institute for Scientific and Technical Information
Library of Congress
National Agricultural Library
National Library of Canada
National Library of Medicine

Special Libraries:

Center for Research Libraries
Linda Hall Library
Newberry Library
Smithsonian Institution Libraries

Public Libraries:

Boston Public Library
New York Public Library
New York State Library

University Libraries:

Alabama
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Arizona
Arizona State
Auburn
Boston
Brigham Young
British Columbia
Brown
Calif., Berkeley
Calif., Davis
Calif., Irvine
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Oklahoma
Oklahoma State
Oregon
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Washington
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Waterloo
Wayne State
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Wisconsin
Yale
York

rev. May 1992

AT&T
STATEMENT REGARDING NREN POLICY

SUBMITTED TO
THE WORKSHOP CONVENED BY

The IEEE - USA Committee on Communications and Information Policy
The Computing Research Association, and
The EDUCOM Networking and Telecommunications Task Force

Held on
September 16-18, 1992
in Monterey, California

Ralph J. Andreotta
AT&T
Government Affairs

NREN Definition and Background

The National Research and Education Network (NREN) is a key component of the High Performance Computing and Communications Initiative (HPCCI) of the U.S. Government, signed into law in December, 1991. The NREN is currently a concept with annual Government funding ($122.5 Million in 1993) and detailed plans for its implementation are still under development. The NREN concept arose out of a vision of connecting together supercomputing centers and research universities to create a national networking resource for university and government researchers. Such a resource was deemed necessary to effectively address the Grand Challenges (examples of Grand Challenges are the prediction of weather, climate and global change; determination of molecular, atomic, and nuclear structure; and understanding the structure of biological macromolecules).

The present-day Internet has been widely viewed as the technical basis for the evolution to the NREN. However the current administrative practices of the Internet, and efforts to leverage it for commercial purposes, raise several concerns regarding Government's appropriate role relative to private industry in network development and deployment for broad public use. The Internet is comprised of a number of national, regional, state, and local networks interconnected by the "NSFnet" backbone. The NSFnet backbone is funded by the National Science Foundation (NSF). It is currently run by Advanced Network and Services, Inc. (ANS), a corporation whose principal managers/directors are IBM, MCI and MERIT. ANS runs NSFnet under a cooperative agreement between MERIT and NSF. ANS receives direct funding from NSF. The NSFnet backbone was recently upgraded to "T3" (45 Mbps) speeds from its original T1 (1.5 Mbps) speeds.

The NSF recently issued a draft solicitation and obtained public comments on its plan to "rebid" the NSFnet. The NSF rebid plan envisions (a) a high speed backbone network operating at hundreds of megabits per second, with its provider receiving Government subsidies from the NSF, and (b) a set of network access points where other (unsubsidized) networks can interconnect to each other and to the subsidized backbone. A final NSF solicitation is expected in Fall, 1992.

In parallel with the above developments, discussion surrounding the uses of the NREN has broadened considerably from its original intent of supporting supercomputing applications addressing the Grand Challenges. K-12 schools, health care providers/insurers, commercial institutions, etc., are being proposed as candidates to connect to the NREN. Significantly, a new bill for applications research proposes Federal funding to benefit education, health care,

proposes Federal funding to benefit education, health care, library access, and manufacturing. As contrasted with the Grand Challenges, these applications areas are often referred to as the "Grand Applications".

NREN Evolution and the NCII

At this point, it becomes imperative to distinguish between the NREN and what will be referred to here as the existing and evolving National Communications and Information Infrastructure (NCII). The NCII is much broader in scope than the NREN; NREN is a subset of the NCII (and presumably a "leading edge" to facilitate the evolution of the NCII). As the Internet is viewed as "today's NREN" so should the existing commercially provided communications/ computer and information networks be viewed at "today's NCII". For example, in the LAN, MAN and WAN areas, today's NCII communications technologies have evolved to serve a broad and diverse array of customer/user connectivity requirements. Because of application differences in terms of required bandwidth, latency, burstiness, holding time, meshedness, and service integration, a variety of network solutions have emerged to effectively and efficiently serve end-customer needs. These include end-to-end dedicated solutions, as well as circuit-switched and packet-switched solutions with dedicated and dial-up access. In addition, customer solutions are configured as private (customer-owned switching/routing equipment), public (shared carrier/VAN-provided services), virtual private (public network with appearance and protection of a private network), or as hybrids. In the MAN/WAN packet area alone, X.25, TCP/IP, Frame Relay, SMDS, and ATM technologies are considered as viable candidates to a network decision maker. The NCII has evolved based on free market forces in a competitive environment driven by ways to best meet customer needs.

As one projects to the future, this networking infrastructure must be improved and enhanced. The future vision of the NCII is one of a universally accessible, widely distributed network of multiple private and public interconnected networks that will permit access to a variety of public and private databases and transmission of voice, text, images, video, and virtually any other format for depicting information, to anyone at any time in any place. The NCII will be made up of user information appliances (computers, personal assistants, telephones, FAX machines, video terminals, etc.), Local Area Networks (LANs), and network interface devices; local networks and access networks as well as numerous regional and national networks embodying various technologies, with speeds from hundreds of bits per second to kilobits, megabits and gigabits per second; and vendor/user systems and databases. The NCII will serve the diverse needs of the country, ranging from

the supercomputer and research center needs of up to gigabit speeds, to business user needs ranging from multiple megabits down to kilobit speeds, and to users in homes and schools, whose needs will typically be in the kilobit range and occasionally reaching megabits. The most effective way for the NCII to be structured is as a web of interconnected and interoperable commercial networks that allow new technologies to be implemented and market forces to respond to user needs.

The NCII will be broadly and easily accessible through a variety of services/technologies from virtually every home, hospital, school, library, business, and government office in the nation, and via wireless technologies to most other locations in the country. The NCII, as it has and will continue to evolve, will support users who have very different needs and skill levels.

Making it Happen

The free market evolution of the NCII can be stimulated, expedited, and steered in a direction best serving the national interests. This should be the role of Government; indeed it is the real contribution the NREN can make. The NREN can serve as a pre-production testbed for new technology and new applications, for computer and network interworking, and for testing of easy-to-use customer interfaces based on human factors engineering. As with any testbed, once commercial technology and applications meet or exceed those resident in the testbed, it becomes appropriate to devise new tests to leapfrog current technology once more.

The Government should focus its activity on the key social/economic issues facing America today and the associated application needs and number of impacted users (which may range from tens of supercomputer centers to millions of K-12 students). The applications and number of impacted users will drive connectivity requirements and the required product/service infrastructure. For example, in the area of health care, two illustrative medical applications are health care database look-up and remote real-time consultation on medical images (X-Ray, MRI, CSCAN). The former requires equipping most doctor's offices (150,000 in number) with PC/modem 9.6 Kbps access; the latter requires a lesser set of offices (maybe 50,000) with additional specialized ISDN equipment enabling 128 Kbps and/or 1.5 Mbps access. Again, the individual applications drive the connectivity and product/service requirements and most importantly the resulting economics. In each social/economic area key applications must be identified, selected, and prioritized, understanding the NCII infrastructure and economic implications of such choices.

Once such an applications-based plan is formulated, the infrastructure requirements can be compared to the existing/evolving commercial NCII. Where gaps exist and/or impediments to commercial solutions exist, the Government can examine steps to stimulate action or remove impediments. In this model, the NREN should serve as the testbed where new working technologies and demonstration projects/applications can be viewed and validated by government, industry, and the affected constituencies, stimulating rapid adoption and transition to the commercial sector. With such a structured, orderly, and segmented approach, the Grand Challenges and Grand Applications proposed for the NREN can be managed in an effective and efficient fashion.

Public Policy Principles

The evolution of the NREN and its on-going transition to the NCII should be governed by the following principles:

- The Government should direct any funding towards the development of critical *pre-competitive* technologies and applications, with the active collaboration of multiple industry players. Focus should be on technologies many years away from marketplace offerings; they should not purport to provide *operational networks or systems* for a wide base of users. In order to best use its resources, the Government should develop a set of guidelines for determining when a given technology or application is pre-competitive (thus qualifying for Government support) and when it has matured sufficiently to be provided by commercial vendors: these guidelines and subsequent pre-competitive technology project proposals should be subject to open public debate before they are adopted. When subsidizing pre-competitive technologies, the Government should spell out a plan for how it will phase out its role as the technologies evolve and become commercialized.

- Government has a key role to play in the rapid development of standards and interworking agreements to interconnect multiple (potentially competing) networks. Besides supporting standards-setting through bodies such as CCITT (where U.S. companies are represented through the U.S. State Department), the Government should also encourage the formation of industry forums (such as the Frame Relay Implementation Forum) for rapid standards-setting.

- The Government should also encourage the development of user interface standards for access to systems, databases, and networks, with ease-of-use for a broad base of users as a principal consideration.

- If the Government decides to target a specific user segment (such as researchers) for NCII-related subsidies, the subsidies should be provided directly to the users rather than to providers. Any other mechanism lends itself to significant marketplace distortion, and dilutes the benefits to the target community.

The initial intent of Government sponsorship of the NREN was to focus on development of *precompetitive* networking technologies to aid corporate/government researchers and university researchers. However, many factors in the NREN evolution are pointing to significant expansions and departures from this intent. Certain visions of the NREN require it to be "all things to all people," without regard to priority or economic tradeoffs. Other visions could result in a skewed marketplace for communications/ information services, where innovation by commercial service providers is choked off due to their inability to compete with Government-picked "winners." Another possibility is that the Government would stay inextricably involved in operating public communications networks. This concept would be at odds with true competition in communications services markets, which generally results in greater innovation and ultimately benefits all users.

The aforementioned principles will ensure the ultimate objective of creating a "level playing field" NCII where multiple commercial providers of internetworking services compete directly for end-users' business; and where these competing networks are interconnected to enable end users to obtain access to information and to communicate with one another regardless of the specific network to which they are connected.

NREN Policy Paper
CAUSE

A. CAUSE as an organization

A.1. CAUSE is a 501(c)3 non-profit organization serving as the association for managers and users of information technology in higher education.

B. CAUSE's nature, goals, and constituency

B.1. CAUSE members include more than 1,000 college and university campuses and fifty corporate members, with more than 2,800 individuals participating as member representatives.

B.2 CAUSE member representatives typically have responsibilities including management of information technology, computing services, administrative computing, academic computing, telecommunications and networking, and/or management information systems.

B.3. CAUSE's mission is to enhance the administration and delivery of higher education through effective management and use of information technology.

B.4. CAUSE's strategic priorities are:

B.4.1. to provide indispensable support to information technology managers in their work and help them better understand the nature of the higher education "business" they serve

B.4.2. to educate and inform senior institutional executives about the value of their investment in information technology

B.4.3. to help others within higher education institutions benefit from the enabling force of information technology for transformation

B.4.4. to educate, influence, and collaborate with those outside higher education, including those in the corporate and government sectors

B.5. CAUSE accomplishes its goals and objectives through professional development programs (seminars, workshops, management institutes), an annual national conference, extensive publications, information exchange services, and active liaisons with organizations that share our goals and objectives.

C. CAUSE's view of the eventual nature, services, the structure, the uses, and the constituencies of the NREN

C.1. CAUSE believes that networking in general and the National Research and Education Network in particular will be key elements in helping institutions get the most from their investment in information technology and in enabling transformation in higher education.

C.2. CAUSE has supported (and continues to support) the creation and evolution of the NREN through participation on EDUCOM's Networking and Telecommunications Task Force and through the founding, with EDUCOM and the Association of Research Libraries, of the Coalition for Networked Information, to promote the creation of and access to information resources in networked environments in order to enrich scholarship and to enhance intellectual productivity.

C.3. CAUSE's perspectives on NREN policy are shared through the Coalition for Networked Information and EDUCOM's Networking and Telecommunications Task Force.

C.4. CAUSE believes in the eventual existence of an NREN that serves the needs of researchers and educators for high-performance computing, communication with colleagues, and electronic access to the world's knowledge base of multi-media digital libraries.

C.5. CAUSE believes that functions of researchers and educators are enhanced and supported by effective and efficient management and administration of education institutions; therefore CAUSE supports the evolution of an NREN structure that allows and facilitates direct use by administrators and managers as well as researchers and educators.

D. Suggestions and rationale for possible historical models that could be applied to NREN development:

D.1. no suggestions offered

E. Comments on Congressional questions and ranking of importance to CAUSE constituency:

E.1. effective mechanisms for providing operating funds for the maintenance and use of the Network, including user fees, industry support, and continued federal investment

E.1.1. CAUSE supports the continuation of the successful public/private partnership that has achieved significant results in the proliferation of Network use and availability of resources on the Network and has significantly leveraged the federal investment by encouraging investment by institutions, states, and commercial organizations.

E.1.2. CAUSE supports the continued federal investment, highly leveraged by investments of institutions, states, and commercial organizations, in national Network infrastructure and in testbeds to bring to fruition the technologies needed to increase Network transmission speed enhancements. Opportunities for collaboration between colleges and universities and commercial organizations should be included among the testbeds.

E.1.3. It is important to CAUSE that federal policy for the Network not disenfranchise small colleges, community colleges, and other institutions with limited resources. CAUSE strongly encourages and supports the continuation and increase of federal investment in assistance to small colleges, community colleges, and other institutions with limited resources in connecting to the Network.

E.2. the future operation and evolution of the network

E.2.1. CAUSE believes that determinations about the future operation and evolution of the Network should involve all those affected, including federal agencies, institutions, state and regional networks, and others.

E.3. how commercial information service providers could be charged for access to the Network, and how Network users could be charged for commercial information services

E.3.1. CAUSE believes the Network should support a full range of charge mechanisms, including but not limited to a charge per use and a fixed charge for limited and/or unlimited use by individuals or groups of individuals within a specified time period.

E.4. the technological feasibility of allowing commercial information service providers to use the Network and other federally funded research networks

E.4.1. CAUSE believes that the functions of researchers, educators, and administrators will be enhanced and supported by the ability to communicate via the Network with colleagues in commercial organizations.

E.4.2. CAUSE believes allowing commercial information service providers to use the Network is necessary to ensuring the broadest possible array of information resources available to researchers, educators, and administrators using the Network.

E.4.3. CAUSE believes that use of the Network by commercial service providers and other commercial organizations must be provided in such a way that researchers, educators, and administrators do not experience increased cost or decreased service because of commercial usage.

E.4.4. CAUSE believes that allowing the participation of commercial information service providers in the Network offers an opportunity to leverage their resources in the development and operation of the Network.

E.4.5. CAUSE believes that use of the Network by commercial information service providers should be technologically feasible.

E.5. how to protect the copyrights of material distributed over the Network

E.5.1. CAUSE supports resolution of the issue of copyright protection in such as way as to promote the unimpeded creation and dissemination of knowledge and at the same time reward the contributors of value to these processes.

E.5.2. CAUSE supports continuation of activities within the Coalition for Networked Information, with Task Force members representing key stakeholders (education institutions, libraries, commercial and non-commercial publishers, and corporate organizations), to develop solutions to the issue of copyright protection for material distributed over the Network.

E.6. appropriate policies to ensure the security of resources available on the Network and to protect the privacy of users of networks

E.6.1. CAUSE supports the formulation of policies to allow varying and selectable levels of security and privacy with minimal additional complexity, loss of flexibility, and cost.

The NREN: Opportunities for College and University Administration

by Richard P. West

***Richard P. West** is Associate Vice President–Information Systems and Administrative Services for the nine-campus University of California system, with overall information and telecommunications responsibility for academic and administrative purposes for the UC system. Since 1990 he has chaired the Steering Committee of the Coalition for Networked Information.*

While the High Performance Computing Act of 1991 was developed and supported in the context of teaching, learning, and research, the National Research and Education Network (NREN) will present administrative computing and communications organizations with unprecedented opportunities to benefit from the anticipated new levels of network capacity, connectivity, and reliability.

On December 9, 1992, President George Bush signed into law the High Performance Computing Act of 1991 (the Act). Passage of PL 102-194 was hailed by colleges and universities nationwide and culminated years of determined lobbying efforts by higher education interests. While full funding and governance and management issues will require ongoing vigilance and action, PL 102-194 recognizes and authorizes the research and development of the National Research and Education Network (NREN) as one of four programmatic objectives of U.S. high performance computing.

The funding for FY 93 NREN and related activities, totaling $122.5 million in the President's budget,[1] will be invested towards enhancing the existing national backbone and towards the long-term goal of developing a national data communications infrastructure supporting gigabit speeds. While this legislation was developed and supported in the context of teaching, learning, and research—the typical domain of academic computing organizations—the NREN will present administrative computing and communications organizations with unprecedented opportunities to benefit from the anticipated new levels of network capacity, connectivity, and reliability.

NREN status and current issues

The program elements of the Act relating to the NREN will be coordinated by the Federal Networking Council (FNC) which consists of federal agency representatives. Higher education's interests, and those of other constituencies, will be facilitated by the Federal Network Advisory Committee which was established to promote collaboration among those interested in the NREN.

The Supplement to the President's FY 1993 budget describes two components of the federal NREN activity. First, investments will continue to be made in existing operating federal networks such as the NSFNET, DOE's Energy Sciences Network, NASA's Science Internet, and other networks supporting education and research. This existing infrastructure, referred to as the *Interagency Interim NREN*, will be expanded and enhanced to meet the eventual goal of a gigabit NREN. Second, funds will be invested to develop the technology base needed to achieve "at a minimum gigabit speeds and advanced capabilities in the NREN."[2]

While we are gratified at the success of higher education's efforts to bring NREN funding and development to the forefront of the nation's research and education agenda, we cannot rest on our laurels. At this writing, a number of issues will continue to command our attention as the national networking program moves ahead.

First, it is not yet clear how much the federal funding commitment to the NREN will be. While the Act defines the program and authorizes federal expenditures, actual funding depends on the federal budget process and its constraints and competing priorities. Also, even if appropriations total the levels anticipated in the Act, the mechanisms for allocating these appropriations between (1) upgrading existing network operations, and (2) pursuing advanced network research and design, have not been specified. These tradeoffs and priorities will have to be balanced among the federal mission agencies through the FNC, but ongoing vigilance by and input from higher education will be required.

[1] Committee on Physical, Mathematical, and Engineering Sciences, "Grand Challenges 1993: High Performance Computing and Communications," *Supplement to the President's 1993 Budget* (Washington, D.C.: 1992), p. 28.

[2] Ibid., p. 20.

"... pertinent to any proposed administrative use of the national network is the issue of acceptable commercial use of the NREN."

Second, and pertinent to any proposed administrative use of the national network, is the issue of acceptable commercial use of the NREN. Currently, NSF policy restricts traffic on the NSFNET to bona fide research and educational purposes. Clearly, the advancement of administrative use of the national network will require access, by college and university trading partners, to the NREN.

A new era in higher education

As budgets shrink, demographics change, and demands for accountability rise, American higher education in general will be faced with major changes in the decade of the 1990s. As colleges and universities organize to address these changes and challenges, the administration—as always—will be expected to shoulder a disproportionately larger share of the burden. The good news is that the trends in technology, particularly in networking, present us with new opportunities to "do more, with less."

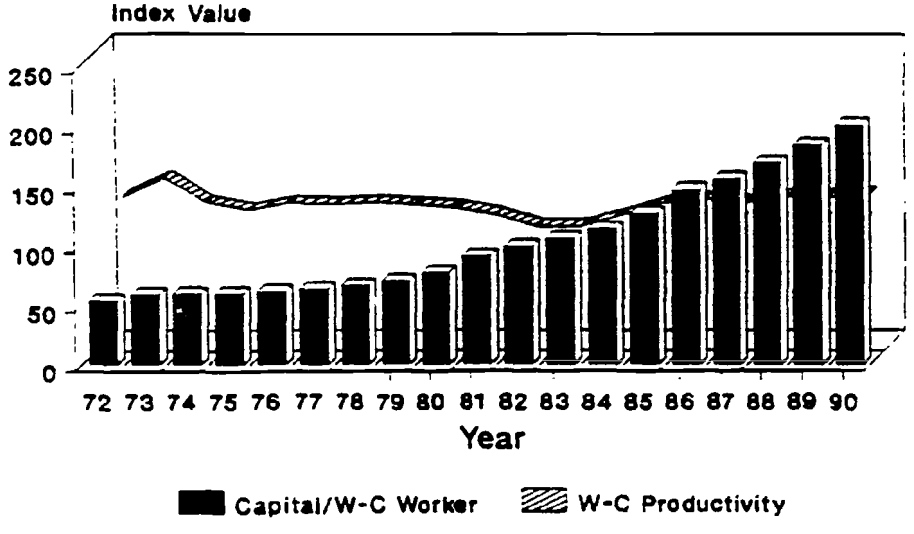
- The shift from paper-based and batch-oriented campus operating environments to network-based and cooperative-processing-oriented environments will make it possible to leverage the historical investments we have made in administrative computing.
- Through improvements in campus data communications networks, many colleges and universities are witnessing the leverage of staff time—as networks enhance employees' ability to communicate easily via electronic mail, and as interactive and interconnected administrative systems reduce the redundant creation and management of institutional data.
- As our networks grow more robust and our architectures mature to take full advantage of the client-server model of computing, we will witness greater opportunities for leverage; that is, leverage of the campus installed base of computers, printers, storage devices, fax machines, and others.
- The bandwidth and connectivity promised by the NREN create yet another opportunity for economic leverage: the leverage of information (read: someone else's time!) and of technological capabilities and resources nationwide.

As technological progress is made, colleges and universities that have made strategic investments in their intra-campus network infrastructures will witness the emergence of new opportunities for sharing resources among themselves and their business partners. Significantly, the ultimate beneficiaries of such resource sharing will be students and faculty who will be faced with fleeter-of-foot and better-integrated administrative environments.

Before proceeding, I offer a word of caution. To date, the data nationwide suggest that the massive American investments in computing and communications over the past two decades have had very little positive effect on white-collar productivity (see Figure 1). Productivity in higher education administration has a similarly equivocal track record for the period, witnessed by the

Figure 1

Service Sector's Technology Paradox: IT and White-Collar Productivity



Source: Morgan Stanley estimates based on U.S. Department of Commerce and U.S. Bureau of Labor data.

failure of the college and university tuition price index to remain at, or below, the American consumer price index (CPI).

The reasons for the muted impact of information technology (IT) on white-collar productivity are unclear. One reason, I suggest, is that the history of IT for the past two decades reflects a focus centered more on technology, than on information. While bigger and faster computers, software, and networks are important, the questions of how—or even whether—we should use and manage information technology must remain at the forefront of our thoughts, discussions, and plans if we are to really reap the benefits anticipated by the NREN. A robust and richly interconnected national network for higher education only creates the opportunities for leveraging resources in the manner described. How we exploit this opportunity will depend on our willingness and ability to alter those attitudes and values that form barriers to inter-institutional cooperation and resource sharing.

The NREN and higher education administration

The administrative opportunities presented by the national commitment to the NREN are considerable and cannot be described here in exhaustive detail. On the level of infrastructure, the NREN—through improved connectivity—will enhance the use of electronic mail. E-mail has emerged as a key network capability and function and has direct administrative benefits by enhancing the quality and ease of communications between and within organizations.

Universal administrative connectivity to campus networks and the NREN will enable broader spans of managerial control by reducing the number of other—more time consuming—exchanges between managers and staff. The enhanced ability of our employees to consult with their professional peers across the country will help develop these staff into the sophisticated problem solvers we will need to face the 1990s.

In some cases, the need for certain meetings and for travel may be obviated through enhanced network accessibility and directory services. Telecommuting, which offers to mitigate certain pressures for campus work space, parking, and other resources, will also be fostered by the NREN.

A high capacity network such as the NREN will also add to the campus alternatives vis-à-vis disaster preparedness. During the California earthquake of 1989, campuses of the University of California affected by the quake were able to communicate across data communication networks at a time when telephone service had been interrupted.

Additionally, expanded network capacity, connectivity, and reliability (as well as value-added services) will open possibilities for us to share unused computing or storage capacity or to share specialized production facilities such as printing, binding, and reprographics. Such capacity could even create opportunities for live backup sites for our key application systems.

More interestingly, perhaps, new network capacity and function will create new opportunities for electronic data interchange (EDI). These opportunities are enormous and create the possibility of transforming the very nature of how colleges and universities are administered. For example, the purchasing process is a particularly onerous and costly one at most colleges and universities owing to the strict accountabilities imposed by trustees, regulators, auditors, and others. This process is complicated further by the need for a large cast of facilitators and controllers who mediate campus purchasing activity. This cast can typically include:

- a "customer"
- a departmental purchasing facilitator
- a departmental accounting person
- a department chair (to sign)
- a dean (to sign)
- a campus buyer
- an equipment or property manager
- a receiver
- a delivery person
- a campus general accounting person
- a campus accounts payable person
- a vendor.

This is quite a cast! Typically, a college or university purchase is initiated on a purchase requisition that is sprinkled with signatures authorizing the requestor to purchase the goods specified. A central campus official conducts product and vendor research and verifies fund sources or grant terms and issues a purchase order to the selected vendor. This process, as well as those activities associated with receiving, delivering, and paying for goods purchased, is mediated by forms which move slowly across the desks of this large cast of characters.

As the national information network emerges, colleges and universities will be able to contract for goods with suppliers who offer "just-in-time" delivery capabilities through sophisticated inventory control and manufacturing practices. Purchase orders, under such agreements, can be made, authenticated, filled, invoiced, accepted, and paid across the NREN. Such a scenario could

(continued on page 19)

"... new opportunities for electronic data interchange (EDI ... are enormous and create the possibility of transforming the very nature of how colleges and universities are administered."

The card looks very similar to a credit card sized calculator. Authentication is selected as an option from our main menu. The authentication sequence adds about 20 seconds and four steps to the log-on process:

(1) after the user is prompted for a log-on ID, she/he is given a "challenge," which is a seven-digit number;

(2) the user keys the challenge into the authenticator card which then displays a "response," also a seven-digit number;

(3) the user enters the response on the terminal or workstation keyboard and a restricted submenu of only database subsystems is displayed; and

(4) the customer selects the appropriate subsystem and continues with the log-on process.

The device is easy to use and has required very little training. The only real problem experienced so far has been some initial quality control problems with the cards. Around 10 percent of cards were either "dead on arrival" or failed in the first few weeks. When the failure occurred after a card was in the field, the customer was understandably frustrated. Fortunately, this problem occurred during the pilot and was addressed with the vendor; they subsequently switched to a different card supplier which improved the situation.

Authentication slows down the log-on process, is an additional expense, and requires keeping track of the cards. However, very few complaints have been registered about the enforced use of authentication. I believe this is due to the active involvement of our customer community in understanding the problem and in choosing a solution.

Authentication alone will not be an adequate solution for installations whose general security requirements are more stringent than ours. However, we believe this approach addresses most of the problem at a reasonable cost without introducing onerous restrictions on our customers. All in all, we feel authentication is a good choice for ASU.

Acknowledgements

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NREN...

(continued from page 5)

improve processing speed and accuracy tremendously, while: (1) maximizing campus negotiating leverage; (2) reducing staff effort; (3) reducing campus storehouse inventories; and (4) freeing professional purchasing staff to concentrate their efforts on complex and high-dollar transactions. That's "doing more, for less" through the NREN!

The NREN will enable similar administrative improvements across the board. In the student services area, many onerous administrative transactions that degrade students' impressions of the campus will be improved through expanded network access and services. Eventually, students will be able to make application for admission and financial aid through high schools with NREN access. Transcripts, too, will be exchanged and authenticated over the NREN, as will letters of support. Online access to class registration and scheduling systems will also simplify student life while reducing demands on administrative staff. Class grades and college transcripts will be reported, posted, and distributed—possibly certified—over networks, including the NREN.

The opportunities abound. Links with chemical manufacturers' databases will help central campus administrators ensure employee access to health and safety information. Links with banks will help expedite campus payrolls and other funds transfers. The administrative possibilities presented by the emergence of the NREN are limited only by our resolve to invest in the needed technologies and by our imagination and creativity. The creation of a robust physical network will make possible the creation of inter-organizational business networks of unprecedented character and scope, changing dramatically—and for the better—the administrative character of American higher education.

"The creation of a robust physical network will make possible the creation of inter-organizational business networks of unprecedented character and scope ...."

G. Additional background material

G.1. West, Richard P., "The NREN: Opportunities for College and University Administration," *CAUSE/EFFECT*, Summer 1992, Boulder, Colo, pp. 3-5, 19.

This policy paper was prepared by Jane Norman Ryland, CAUSE president, in consultation with the CAUSE Board of Directors. CAUSE appreciates the opportunity to present this material for consideration.

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Statement Regarding

the Questions Pertaining to the

National Research and Education Network

to be Addressed by the

1992 Report to the US Congress

by the

Office of Science and Technology Policy

of the

US Office of the President

Prepared by the

Coalition for Networked Information

1527 New Hampshire Avenue NW

Washington, District of Columbia 20036

October 5, 1992

COALITION FOR NETWORKED INFORMATION

Statement Regarding the Questions Pertaining to the
National Research and Education Network
to be Addressed by the 1992 Report to the US Congress
by the Office of Science and Technology Policy
of the US Office of the President

INTRODUCTION

1. This statement addresses the six questions pertaining to the development and operation of the National Research and Education Network (NREN) that were referred to the Office of Science and Technology Policy (OSTP), US Office of the President, by the High-Performance Computing and Communications Act of 1991 (PL102-194) for answering in a report to the US Congress within one year of the passage of PL102-194.

2. This statement provides a snapshot of Coalition thinking on these questions and related matters, a snapshot that was first taken at a invitational meeting on July 28 and 29, 1992 and which was subsequently refined at a second invitational meeting on August 23 and 24, 1992. An updated version of this statement will be produced in light of discussions at the Coalition's Fall 1992 Task Force Meeting on November 19 and 20, 1992.

3. This statement also constitutes the Coalition's contribution to two related deliberative process:

   - that begun by the US National Commission on Libraries and Information Science with an open forum on July 20 and 21, 1992; and,

   - that begun by the IEEE-USA Committee on Communications and Information Policy, the Computing Research Association, and the EDUCOM Networking and Telecommunications Task Force with an invitational workshop on September 16, 17, and 18, 1992.

4. This statement follows the format specified by the IEEE-USA Committee on Communications and Information Policy, the Computing Research Association, and the EDUCOM Networking and Telecommunications Task Force for contributions to their invitational workshop on September 16, 17, and 18, 1992.

5. Additional information about this statement can be obtained from:

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NATURE, GOALS, AND CONSTITUTENCY OF ORGANIZATION

The Coalition for Networked Information was founded in March 1990 to help realize the promise of high performance networks and computers for the advancement of scholarship and the enrichment of intellectual productivity. The Coalition is a partnership of the Association of Research Libraries (ARL), CAUSE, and

EDUCOM. ARL is dedicated to equitable access to, and effective use of, recorded knowledge in support of teaching, research, scholarship, and community service, and CAUSE and EDUCOM are dedicated to different aspects of the introduction, use, and management of information technology and related resources in research and education in general and higher education in particular.

The Coalition pursues its mission with the assistance of a task force that provides a common vehicle by which a growing number of institutions and organizations (173 at this writing, see attached *Task Force Membership List*) are exploring a shared vision of how information management must change in the 1990s to meet the social and economic opportunities and challenges of the 21st century. Members of the Coalition Task Force include, among others, higher education institutions, publishers, network service providers, computer hardware, software, and systems companies, library networks and organizations, and public and state libraries, a truly diverse collaboration of stake-holders in information resource management.

VIEW OF EVENTUAL NATURE, SERVICES, STRUCTURE, USES, AND CONSTITUENCIES OF THE NREN

1. **The NREN will evolve as a networked information initiative.**

   - The NREN will be used both as a communications medium (transporting packets constituting electronic messages and files) and as a computational matrix (transporting packets constituting remote, interactive computer sessions).

   - The communications medium represented by the NREN will generate a networked information environment in which users of the NREN will create and utilize networked information resources and services in pursuit of their research and education objectives.

2. **The NREN will evolve as a system.**

   - The NREN will develop as a complex, interoperating system of networking links, hardware, software, standards, information resources and services, and access and support services.

   - A change to one component of the NREN system will propagate to the other components of the system in ways that will need to be thoroughly analyzed and announced in advance of that change.

   - The NREN system will not be planned or operated as the responsibility of any single individual, agency, institution, or organization.

     - Rather, the NREN system will be planned and operated on the basis of the decisions and actions of all of the individuals, agencies, institutions, and organizations that have a stake in its components.

3. **The NREN will create understandable and desirable options.**

   - Access to the NREN will be provided by a wide variety of alternative, interoperating connectivity providers which will differentiate themselves according to a number of cost, capacity, and service criteria.

   - NREN information resources and services will substitute for and modernize a wide array of existing, predominantly print-based, information resources and services.

     - They will also assume highly innovative, even transformational, forms that were not possible, some nor even imaginable, using print-based technologies.

   - How NREN information resources and services are produced and priced, if they are priced at all, will be an element of healthy competition among providers of those resources and services.

4. **The NREN will serve a diverse population.**

   - The NREN will play a major role in improving the quality and productivity of research and education enterprises at all levels and in all areas of the Unites States.

   - The NREN will serve individuals engaged in research and education activities who are affiliated with higher education institutions, but it will also serve individuals engaged in research and education activities who are not affiliated with higher education institution.

     - Such individuals will be provided with access to the NREN by the commercial entities at which they are employed, by the public libraries in their communities, by the primary, secondary, and adult research and education establishments with which they are affiliated, and by other, similar means.

   - The broadest and most flexible criteria will be adopted for what constitutes "research" and "education," qualifying all activities that are reasonably said to contribute to knowledge production, distribution, and utilization in the United States.

   - Equitable and affordable access to be NREN will be possible throughout the entire research and education enterprise in the United States.

5. **NREN users, resources , and services will be secure.**

   - The constitutional rights of NREN users, particularly the rights of free speech and privacy, will be protected.

   - The assets and interests of providers of NREN information resources and services will be protected.

   - The rights of NREN users and the assets and interests of providers of NREN information resources and services will harmonized in a way that ensures that both ease of access and integrity and security of resources and services are achieved.

- Principles, standards, and norms of / for responsible and commodious NREN user behavior will emerge.

6. **The NREN will operate at high levels of performance, availability, reliability, and servicability.**

   - The NREN will achieve levels of performance that meet the requirements of ever more demanding research and education applications of networking.

   - The NREN will achieve levels of availability, reliability, and servicability that meet the requirements of the business plans of a steadily expanding community of information resource and service providers.

   - The performance of the NREN will be improved in ways that do not compromise its availability, reliability, and servicability.

   - The levels of performance, availability, reliability, and servicability achieved be the NREN will always be above those achieved by the Public Telecommunications Network.

     - In this respect, the NREN will function as a testbed for networking technologies and networked information resources and services destined for eventual incorporation into the Public Telecommunications Network.

7. **The NREN will be governed in a democratic manner.**

   - The NREN will be governed in a way that leverages the research and education networking and networked information efforts throughout the Federal Government.

   - The NREN will be governed in a way that integrates the research and education networking and networked information efforts of state and local governments.

   - The NREN will be governed in a way that serves and directly represents the research and education networking and networked information efforts of non-governmental institutions and organizations.

POSSIBLE HISTORICAL MODELS THAT COULD BE APPLIED TO NREN DEVELOPMENT

1. **Caution should be used in the search for and application of possible historical "models" because:**

   - there is a tendency to be overly selective and opportunistic in the identification and application of such models; and,

   - there is a very real possibility that the development of the NREN will require new approaches that are uniquely appropriate to its arguably distinctive mission, character, and setting.

2. **The public policy lessons, as contrasted with the social and economic lessons, offered by the authorization, funding, construction, operation, and maintenance of the national highway system should be fully exploited, with particular attention to:**

   - how the national highway system is actually used;
   - how national highway system costs are shared across levels of government and between governmental and non-governmental entities (including individual citizens);
   - how national highway system standards are written, promulgated, and enforced; and,
   - how inter-state and local regulatory and enforcement authorities conceive of and pursue their respective responsibilities and jurisdictions.

3. **Other historical cases that offer lessons for the development of the NREN are:**

   - the development of the national power grid;
   - the development of the national natural gas distribution system;
   - the establishment of the Corporation for Public Broadcasting, and the development of the Public Broadcasting System and the Public Satellite System; and,
   - the rationalization of the national telephone system as represented by the Communications Act of 1934.

COMMENTS ON CONGRESSIONAL QUESTIONS IN RANK ORDER OF IMPORTANCE

Rank	Question #	Question Wording / Comments on Question
1.	1.	**Effective mechanisms for providing operating funds for maintenance and use of the Network, including user fees, industry support, and continued Federal investment.**

- Government should be a major investor in the NREN because it can be demonstrated that the NREN increases the returns on government investments in research and education.
- All agencies of the Federal Government should be required to use the NREN as their research and education networking infrastructure and as their networked information environment.
- State and local governments, industry, research and education institutions of all types, and a wide variety of other non-governmental institutions and organizations should be provided with incentives to use the NREN as their

research and education networking infrastructure and as their networked information environment.

- Access to the NREN should be priced in ways that:
  - encourage experimentation and use, as volume (fixed) rather than flow (variable) pricing strategies have to-date in the Interim Interagency NREN and in other subnets of the Internet;
  - are affordable and predictable;
  - are responsive to the special challenges of geographic isolation; and,
  - ensure access by all research and education communities through cooperative measures devised by governments in partnership with industry, research and education institutions of all types, and a wide variety of other non-governmental institutions and organizations.

Rank	Question #	Question Wording / Comments on Question
2.	2.	**The future operation and evolution of the Network.**

- The availability, reliability, and servicability of the NREN should support both the production / mission-oriented and discretionary / task-oriented activities and requirements of research and education communities.
- The performance of the NREN should enable interactive multimedia and other high-performance, non-print information resources and services.
- The NREN should encompass all types of research and education communities and all elements of the research and education enterprise.
- The proper role, if any, of "acceptable use" policies in the operation and evolution of the NREN should be carefully framed and addressed with particular attention to:
  - concerns that information transportation and storage systems that are sensitive to content frequently fall prey to administrative misuse and abuse; and,
  - advertising and related commercial revenues have been shown to be effective means for defraying the costs arising from the wide distribution of research and education information.

Rank	Question #	Question Wording / Comments on Question
3.	6.	**Appropriate policies to ensure the security of resources available on the Network and to protect the privacy of users of networks.**

- Policy formulation, enforcement, and evaluation in these areas, particularly in the early stages of NREN development, should emphasize:
  - discovery, review, and synthesis of experiences and findings; and,
  - a process that harmonizes local norms and controls with national principles and guidelines.
- The full range of policy strategies (legislation, codes, policies, practices, etc.) should be examined and employed.
  - Full benefit should be derived from the broad array of existing policies and laws (Freedom of Information Act, the Buckley amendment, the Library Bill of Rights, privacy law, computer security law, etc.).
- Privacy and confidentiality should be ensured and allowed in a manner that:
  - frames and addresses the felt need for some sort of anonymous access;
  - calls upon individuals to be accountable for their actions;
  - protects the security of the NREN and the integrity of its information resources and services; and,
  - indemnifies against the liabilities faced by institutions and organizations that mediate access to the NREN and its information resources and services.
- NREN security and privacy efforts should be informed by widespread concerns about the advisability of:
  - pending export restrictions on encryption techniques and technologies;
  - pending proposals to provide police and other national security authorities with special telecommunications access privileges and methods; and,
  - the relatively undeveloped state of US data protection legislation as compared with that of the European Community and other areas of the world with which the US interacts via the global Internet.

Rank Question # Question Wording / Comments on Question

4. 5. **How to protect the copyright of materials distributed over the Network.**

- Policy formulation, enforcement, and evaluation in this area, particularly in the early stages of NREN development, should be framed and addressed in a way that recognizes:
  - copyright must serve the interests of the knowledge production, distribution, and utilization processes in society;
  - the variety of rewards that result from the knowledge production, distribution, and utilization process, of which financial remuneration is but one;
  - the range of measures that promote the integrity of the knowledge production, distribution, and utilization process, of which legislation such as copyright law is but one; and,
  - apply and enforce all provisions of all extant copyright law (including provisions pertaining to "fair use").
- New thinking about intellectual property and copyright will be stimulated by the emergence of new forms of networked information resources and services.
  - This new thinking should be coordinated and integrated at the national level by a broadly representative fact-finding and recommendation-making body.
    - This body should be modelled on the National Commission on New Technological Uses of Copyrighted Works (CONTU) that played this role in the mid-1970s.

Rank Question # Question Wording / Comments on Question

5. 3. **How commercial information services providers could be charged for access to the Network, and how Network users could be charged for commercial information services.**

- Methods for charging commercial information service providers for access to the NREN should be devised in ways that:
  - recognize the importance of these commercial providers and users to the long-term value and viability of the NREN;
  - encourage experimentation and risk-taking by such providers so that they might quickly assess the costs and benefits of the NREN relative to those of other information access and delivery media;

- provide incentives for the quantification of the cost, value, price, and mechanism variables, and their interactions, that define the economics of networked information resources and services; and,

- offer such providers affordable and predictable cost centers and levels over the sorts of multi-year periods that are essential to long-term business planning.

- Charges assessed of commercial information service providers for access to the NREN should to every extent possible be used to:

  - enable affordable and equitable access to that the NREN throughout the research and education enterprise; and,

  - stimulate improvements in NREN performance, availability, reliability, and servicability.

- Market forces should determine the pricing strategies of and prices set by commercial providers of NREN information services and resources.

Rank	Question #	Question Wording / Comments on Question
6.	4.	**The technological feasibility of allowing commercial information service providers to use the Network and other federally funded research networks.**

- Technological means that allow commercial information service providers to use the NREN should be devised in ways that:

  - recognize the importance of such providers to the long-term value and viability of the NREN;

  - promote a rapidly expanding and healthy population of such providers on the NREN; and,

  - encourage public / private and non-commercial / commercial partnerships in the design, implementation, operation, and enhancement of the NREN.

- Technological means that allow commercial information service providers to use the NREN should not devised in ways that:

  - increase the complexity of the NREN to the point that its administration by operators, users, and providers becomes burdensome;

  - increase the frequency and difficulty of NREN failures, major or minor;

  - increase the costs centers and levels experienced by non-commercial information service providers; or,

- increase the fragmentation of user, resource, and service populations and access pathways.

ADDITIONAL IMPORTANT QUESTIONS OR POLICY AREAS

1. **How will the population served by the NREN be diversified?**

   - The population served by the NREN must be as diverse as the population involved in the total research and education enterprise throughout the United States.

   - This degree of diversity will not be achieved without a concerted, coordinated, national strategy and plan to bring new constituencies onto the NREN.

     - Particular attention should be paid to prospective users involved in research and education activities at the primary, secondary, and adult (life-long) levels.

2. **How will the role of libraries, schools, and other social and public agencies be framed and addressed?**

   - Libraries, schools, and other social and public agencies are essential for ensuring the wide and sustained dissemination of the public goods and personal benefits that will flow to research and education communities as a result of the development of the NREN.

   - A concerted, coordinated, national strategy and plan is needed to provide access to the NREN via libraries, schools, and other social and public agencies.

3. **How will the potential of the NREN to improve access to and delivery of public information be realized?**

   - PL102-194 calls upon the NREN to be used as the primary network infrastructure and networked information environment of the Federal government for access to and delivery of Federal information.

   - A concerted, coordinated, national strategy and plan is needed for realizing this use of the NREN and for integrating the flow of networked Federal information with networked public information arising from the activities of state and local government.

4. **How will experience with the NREN be brought to bear on Public Telecommunications Network?**

   - The NREN will function as a testbed for networking technologies and networked information resources and services destined for eventual incorporation i to the Public Telecommunications Network.

   - A concerted, coordinated, national strategy and plan is needed for capturing and applying the lessons of the NREN to the sorts of technologies, resources, services, and policies that will soon comprise the ubiquitous, fully digital "national information infrastructure" that the Public Telecommunications Network is rapidly becoming.

5. **How will progress on the NREN be evaluated on an ongoing basis?**

   - The 1992 OSTP NREN report should be the first step in an annual, if not more frequent, process of policy formulation and review.

   - A concerted, coordinated, national strategy and plan is needed to recognize, frame, and address questions and concerns pertaining to the NREN as they arise from the participants and stakeholders in its operation and evolution.

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PROGRAM STRATEGY

Mission

- The mission of the Coalition for Networked Information is to promote the creation of and access to information resources in networked environments in order to enrich scholarship and to enhance intellectual productivity.
- The Coalition pursues its mission by seeking to realize the information distribution and access potential of existing and proposed high performance computers and networks that support the research and education activities of a wide variety of institutions and organizations.
- The Coalition accomplishes this realization by undertaking activities, on its own and in partnership with others, that formulate, promulgate, evaluate, and promote policies and protocols that enable powerful, flexible, and universal access to networked information resources.
- The Coalition directs the combined intellectual, technological, professional, and financial resources of its members according to a shared vision of how the nature of information management is changing and will continue to change through the end of the 20th Century and into the beginning of the 21st.

Goals and Objectives

- To inspire, by promulgating vision statements that (a) project the future characteristics and capabilities of high performance computers and advanced networks, and (b) analyze those characteristics and capabilities in terms of their likely impacts, both positive and negative, on research and education communication.
- To inform, by identifying, endorsing, supporting, and coordinating projects that (a) are collaborative, (b) seek to advance the understanding of or the state-of-the-art relative to the vision statements, (c) recognize the need for open architectures and standards, and (d) fully disclose their objectives, methods, and findings.
- To influence, by advocating principles, guidelines, and positions that address the behavioral, social, cultural, and economic processes and structures that both enable and constrain the use of high performance computers and advanced networks as infrastructures for research and educational communication.
- To integrate, by providing opportunities for senior administrators of libraries and senior administrators of information technologies in higher education institutions to work with comparable administrators from other institutions and organizations in a common enterprise directed toward a shared future.

ARL / CAUSE / EDUCOM
Coalition for Networked Information

PROGRAM STRATEGY

Thematic Strategy

- ***Incentives and disincentives in research and education communication***

  The Coalition strives to elucidate the complex system of incentives and disincentives that both enables and constrains existing research and education communication processes. It also strives to analyze this system and to investigate alternative systems that foster the creation of and access to networked information resources.

- ***Architectures of and infrastructures for networked information services***

  The Coalition strives to conceptualize architectures and infrastructures that model and support cost-effective interoperation of distributed digital libraries which house rich collections of research and education information. It also strives to facilitate the realization of these architectures and the implementation of these infrastructures.

- ***Information exchange among projects seeking to advance the state of the art***

  The Coalition strives to organize information about experiments and demonstration projects that progress the state of the art in the application of advanced networks and high performance computers to research and education communication processes. It focuses on efforts undertaken by its members but also monitors efforts undertaken by other institutions and organizations.

- ***Environments for testing and evaluating service and product innovations***

  The Coalition strives to orchestrate the identification and management of suitable testing and evaluation environments for service and product innovations that are ready to be subjected to the rigors of field conditions. It also strives to establish effective working relationships with change agents and risk takers who research, develop, and promote such service and product innovations.

- ***Codes, policies, and practices that clarify rights and duties***

  The Coalition strives to represent the interests of authors, readers, and intermediaries who seek full and equitable participation in research and education communication processes that depend upon networked information. It also strives to promote norms of responsible and ethical behavior that ensure the greatest possible social utility of networked information.

- ***Professional and user education for effective access to and management of networked information***

  The Coalition strives to identify, categorize, and develop the broad range of new skills that are essential to effective access to and management of networked information. It also strives to design and promote training opportunities that are appropriate to user as well as professional communities at its member institutions and organizations.

PROGRAM STRATEGY

Organizational Strategy

- The Association of Research Libraries (ARL), CAUSE, and EDUCOM comprise the Coalition which functions as an activity of ARL that takes direction from CAUSE and EDUCOM through their chief executives.
- The Coalition carries out its work through a Task Force of institutions and organizations that pay its assessed dues, actively engage in its program of work, and are governed by its leadership.
- The Coalition Task Force is composed of the senior administrator of libraries and the senior administrator of information technologies of higher education member institutions and comparable leaders and officers from other member institutions and organizations.
- The positions assumed and activities undertaken by the Coalition and its Task Force are coordinated by a nine person Steering Committee appointed by the chief executives of ARL, CAUSE, and EDUCOM with each executive naming three members.
- The Steering Committee charges and forms Working Groups to focus the attention of the Task Force in general areas or on specific tasks in which collaborative thought, planning, and action are necessary to pursue the mission of the Coalition or to achieve one or more of its goals and objectives.
- The Task Force meets for two days and an evening each March in order to establish the general terms of reference for its program and budget and for two days and an evening each November to advance progress on specific tasks and to update information on specific projects.

Investment Strategy

- A secretariat directs the affairs of the Coalition by (a) articulating and advocating its mission, goals and objectives, (b) orchestrating its planning and consensus building, and (c) managing and representing its program and assets.
- A networked information server enables the Coalition to pursue its mission and to manage its program in a manner that is consistent with the vision that inspires its members and to provide access to the products and services that result from its activities. The Coalition relies upon the publications of ARL, CAUSE, and EDUCOM, among others, to disseminate information about its plans and activities in printed form.
- Facility, meal, and refreshment expenses that result from meetings of the Coalition Steering Committee, Task Force, and Working Groups, as well as from other Coalition meetings and activities, are recovered from member dues and sponsor contributions rather than from registration fees. Travel and housing expenses that result from such meetings are generally covered by the member institution or organization with which a given individual is associated.
- Travel and housing expenses of experts and other parties invited to Coalition meetings and activities, in those cases in which such support is necessary to secure the participation of a key individual, are also recovered from member dues and sponsor contributions. Honoraria are sometimes provided to those invited experts and other parties who are not associated with a member institution or organization and who make significant contributions of time and effort.

THE FOUR STAGES RESEARCH AND EDUCATION

By Stephen C. Hall

THE PROPONENTS OF THE NREN NEED TO DEFINE THE NETWORK AND ITS SERVICES, SPECIFY ITS AIMS, AND PLAN FOR ALL ASPECTS OF ITS DEVELOPMENT AND DEPLOYMENT

As director of the Office for Information Technology at Harvard University, Stephen C. Hall is responsible for the university's central I/T services. Previously, he was responsible for running the Lexington office consulting operations for Nolan, Norton and Company. Hall began his professional career in information technology at IBM Corporation, where he held various consulting, marketing and engineering positions. He graduated from Tufts University in 1966 with a Bachelor of Science degree in mathematics.

Within a year after Alexander Graham Bell patented the telephone in 1876, the Harvard Telegraphy Society offered new telephone service to students for $10 a year. Their advertisement in the *Harvard Crimson* said that anyone who wished to remain "an old fogey" could keep his telegraph key, which had been supplied by the society. The Harvard Telegraphy Society is now the Harvard Computer Society. The Office for Information Technology, a part of Harvard's administration, manages student telephone service, which now includes many advanced features that would astound those earlier student entrepreneurs.

It was not until a hundred years after Bell's invention that we could boast of having a nationwide and even worldwide telephone (dial anyone anywhere) network. It took a hundred years for telephone technology to be made available at every home and on every desk. Only recently, with the lower price of voice mail and fax equipment, has the network become generally used for voice interactive traffic and facsimile images. While the vision for an integrated voice, image, and data network is intriguing, the path for developing more robust data networking is not so obvious.

In the nearly fifty years since the first computer was used for research at Harvard University, computer networks and electronic mail have become popular in colleges and universities. Networking began when the U.S. government started the ARPANET for research in the late 1960s. During the 1970s, BITNET—now CREN—was formed. ARPANET has evolved into DRI (Defense Research Internet). The national backbones of other federal agencies, NSFNET, CSnet, NSI, and CREN are now interconnected and called

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work resources. Today the NREN backbones include DRI, NASA Science Network, Energy Sciences Internet, and NSF Network. These networks serve the long-distance and high-bandwidth needs of the individual.

The scope of NREN services includes the production, development, planning, architecture, and standards for developing and deploying the network. It also includes certain services necessary to ensure that the individual can use the network, including directories, user assistance, and network operations and control services. For ease in planning for network growth and managing its structure and services, NREN should not include everything originally included in the High-Performance Computing Act (e.g., supercomputer services or shared software libraries). Although such services are very critical higher education needs, the communities of interest become smaller in each case and should not be linked to the NREN for the sake of strategy, funding, or governance.

NREN's Mission

The mission of an information infrastructure is simply to allow people to use their information technologies to communicate. Since the advent of the computer, all media taking digital form and digital information are now becoming the common language for people worldwide. Software must be much better developed to allow easy transformation or interchange of information from one medium to another, and it must go even further to translate from one language to another. These developments will come in time, however. The notion of the "collaboratory" suggested by William Wulf of the NSF envisions communication among people working in all fields and disciplines. It also suggests the necessity of an open architecture available to all academic fields. The collaboratory will mean more rapid development in fields that thus far have not had the benefit of information technology services. In the near future, while we will not achieve the "Star Trek" promise of "Beam me up, Scotty," we will be able to change information from one form to another and beam it from one side of the world to the other nearly instantaneously. Scholars working on the same subject matter and materials will use the network and collaboratory to compress time and space differences.

The Stages Model

After the invention of a technology, many years may pass before a market develops for it, and the rate of absorption or adoption of that technology and its related services depends on many different factors. The acceptance of a

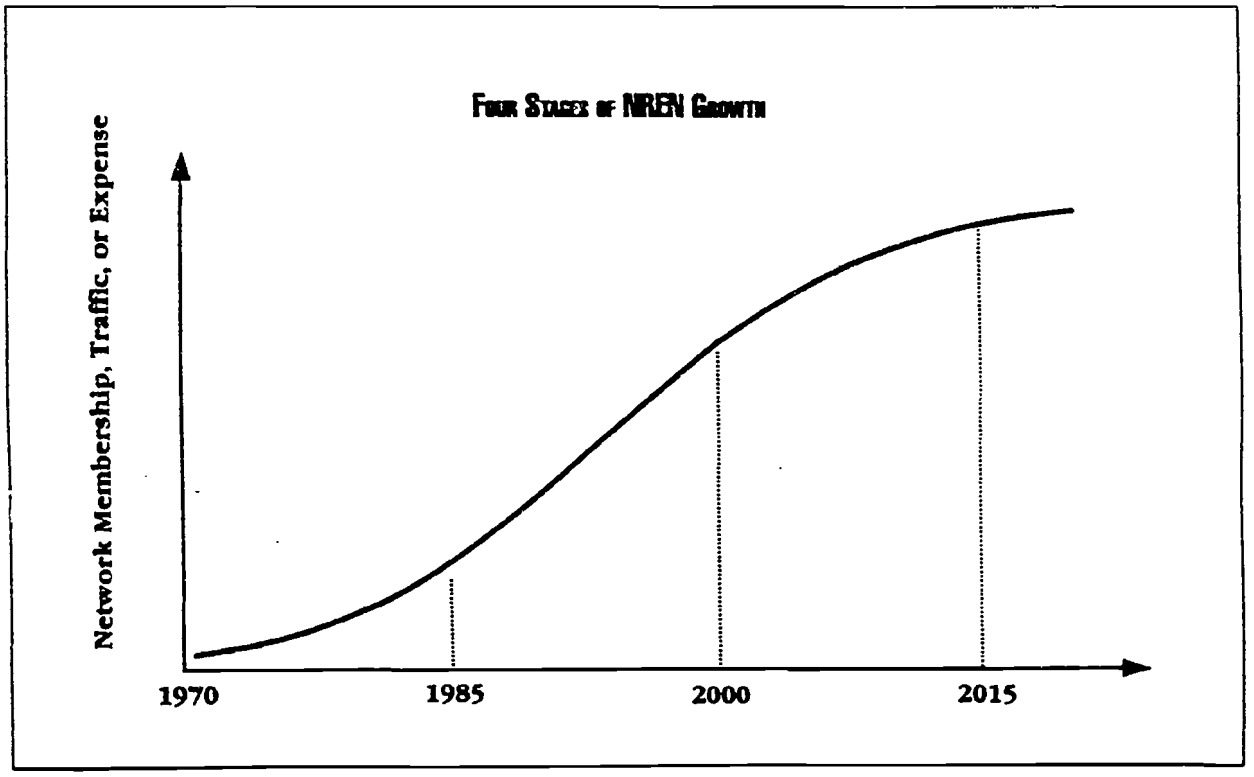

FIGURE 1 *Based on Nolan's and Gibson's "Four Stages of EDP Growth":* Harvard Business Review, *1974, Jan.-Feb., p. 76.*

THE DEFINITION OF THE NREN MUST EVENTUALLY EXPAND TO INCLUDE INTERACTION WITH COMMERCIAL, FOR-PROFIT NETWORKS AND NETWORK RESOURCES

new technology follows an S-shaped learning curve. Although data networking is well enough established that we see it as a part of the common fabric or information infrastructure, it is still in its early stages.

Richard L. Nolan and Cyrus F. Gibson have described a learning curve for the absorption of information technology into an organization. They found that all information technology expenditures followed a learning curve. In addition, they said that learning could be tracked as a function of the applications or uses of the technology, the demand by users for the technology, the information technology resources themselves, and the management or other structures employed to ensure that it all worked. This theory has been used repeatedly over the past two decades to help understand and evaluate how organizations and other, larger communities of interest are adapting technologies.

Growth Characteristics

In the past two decades, we have experienced the start-up of data networking. With the exponential growth during the past two years, we can conclude that the network has moved from Stage I, or start-up, to Stage II, or rapid growth. Figure 1 shows the application of the stages framework to the NREN. The x-axis shows the time divided into four stages: I, initiation; II, growth; III, consolidation; and IV, maturity. The y-axis could be drawn based on any familiar metric for those who are responsible for networks and their management. It could, for example, chart the participating organizations' cost of or total expenditures for networking, the number of users, or the amount of traffic. It could depict the cumulative value of the network over time, or it could chart the total numbers of institutional members in the network.

Now that networking is possible and available through small computers, the community's networking demand has begun to grow very rapidly in all fields and academic disciplines. The recent 25-percent-per-month growth in traffic suggests that we have passed the elbow in the learning curve and are now in the period of very rapid growth.

The network came on the scene twenty years after the introduction of the computer. After the microcomputer took hold, another fifteen years passed before the network grew exponentially. Thus it appears that the market has now absorbed the basic technologies, consumers have learned enough to put these technologies to good use, and the infrastructure has begun to emerge and provide reliable network service for a worldwide community.

NREN Stage Characteristics

The stages of growth of the NREN can be described according to Nolan's and Gibson's four stages of growth theory, and the same framework can describe the factors contributing to the growth and management of the network. The assumption is that the NREN will grow from existing networks, that it will be used for production applications, that it will be open to new technologies and new users, and that it will remain transparent in its telecommunications protocols. Because the users and sponsors will want to maintain the network's continued reliability and relatively smooth growth, they will want to make certain that the technology and its configuration keep ahead of the demands.

Figure 2 describes, in condensed form, the NREN growth characteristics. Stage I—initiation—is characterized by the technologies of the networks then available—ARPANET, BITNET, CSnet, and so on. The current stage, which is Stage II—growth—applies to the fourteen regional networks, NSFNET, the national backbone networks, the NSFNET/Merit Network Operation Center, and the many state and local networks that participate in the NREN. In the future Stage III, which I predict will start sometime after the year 2000, we might expect a period of reduced or controlled growth. By then we will have a worldwide research and education network still offered as a proprietary utility for the communities of interest in higher education research. Finally, we can envision Stage IV—maturity—as a public network in which the information infrastructure for research and education is simply one component. I predict that we will not reach that period for some twenty-five years. Perhaps Stage IV will not come even that quickly, given the developments that must first take place.

The stages-of-growth theory holds that those who are orchestrating the introduction of the technology must understand the current stage of growth and the relevant or critical factors and that they must agree on a strategy for an orderly transition from one stage to the next. In addition, it seems to me that we cannot allow any growth factor to get too far out of balance with the others or else we might risk this new infrastructure being torn apart in the process. Let us examine each of the factors that we must balance as the NREN grows.

Finances

In the initial phase of the NREN (Stage I), a sponsor funded each of the networks to enable early adapters to become easily involved without substantial institutional commitment. Some twenty years later, as institutions have had to

take over funding, strategic considerations have entered the picture. The New England Academic and Research Network (NEARnet) model, in which funding is devoted to strategic and operating concerns, appears predominant. Strategically, NSF and the sponsoring agencies are supporting the development of advanced technologies to carry future traffic and are encouraging continued use of the backbone by funding the regional network interface to the national backbone. Operationally, NSF is also supporting the smallest or most remote institutions that want to join the network. This strategy provides funds for the interested institution for two to three years, a period long enough for the institution to learn how to use the network, become committed, and figure out how to justify the production use of the network on an annual basis, independent of outside funding.

As we enter the control stage in the next century, I believe that the proprietary network utility for higher education research will come under some form of rules or regulations to ensure the fairness of rates for all the participants. Later, in a mature period, sometime after the public utilities have become deregulated, I predict that regulations will be lifted from this utility infrastructure industry, as has happened with other industries, notably transportation. In this mature period, Stage IV, the NREN will exist in a free market.

Applications

According to the Nolan and Gibson model, learning is a function of the available applications in any use of information technology, and applications have probably contributed the most to the growth and use of the network. During Stage I—initiation—the applications were experimental. A series of basic applications has evolved from those experiences, text mail or electronic mail being the most common ones today. Other basic applications include the ability to remotely log on to someone else's computer at a different location and to transfer files of information from one computer to another.

In addition, network services are becoming available, such as a form of directory assistance, security measures, and other services to keep the network functioning. By the end of the 1990s and the end of Stage II—rapid growth—we should begin to see many forms of personalized information distribution or personalized publishing. Information transmitted from one place to another will not only be published in finished form for the recipient but also be supplied in the medium preferred by the individual, on demand. Recent announcements by Xerox and Canon lead us to believe that we are beginning this period of applications. Light-lens xerography will gradually be replaced by all-digital scanning, storing, and printing. Voice, video, text, image, and all forms of information can now be stored digitally and captured and transmitted in a way that best fits the needs of the individual. The Coalition for Networked

NREN Critical Growth Factors

Stage Description	I. Initiation	II. Growth	III. Control	IV. Maturity
NREN Growth Characteristics	Start-up ARPANET, BITNET, and CSNET	NREN, Regionals, Merit, and State networks	WWREN (Privatized Utility)	"Public" Network Infrastructure Components
Finance	Funded	Subsidized	Privatized Utility	Privatized or Commercial
Applications	Trial	Transport/E-mail/ Resource Sharing	WWREN E^4—Media	Public E^4—Media
Resources	9.6K/56K	T1/T3	Gigabit	Star Trek
Management	Entrepreneurial Projects	Marketing & Service Consortia	Transport and Applicatos Utility	Public Utility and End-to-end Services
Users	Few	Pioneers & Early Adopters	WWREN Public	General Public

FIGURE 2 *Based on Nolan's and Gibson's "Four Stages of EDP Growth": Harvard Business Review, 1974, Jan.-Feb., p. 76.*

Information has focused on stimulating these scholarly uses of information technology, and we should expect to see many more examples in the next few years. However, it will take several years before the software and infrastructure will permit fully distributed and customized printing or publishing. Transmission of digitally captured and preserved documents will come first. While we can envision ordering and distributing copyrighted information over the network, the laws and other distribution mechanisms will need time to catch up. When that happens, an industry of network-based information suppliers and distributors will grow up. It will probably take many years before the NREN has a fully functional interface to outside information suppliers, to personalized communications, to demand printing, and to personalized publishing suppliers.

In the mature environment, we can expect that the individual at home or in the office will be able to interact with others anyplace, using any medium, and will be able to address an audience of one almost as easily as a group of thousands. A doomsayer might say this use of technology will take the fun out of being a person because it would tend to eliminate the need for meetings, conferences, and other reasons for people to get together. I believe that people will always find reasons to meet. Technology will simply provide for more thorough preparation and more substantive results in both personal and professional encounters.

Resources

In the early phases of Stage I growth the maximum available bandwidth on the networks was 9.6 thousand bits per second. While this level of service is still popular, the larger institutions and communication hubs are moving from T1 to T3 service, that is, from a current maximum of 1.5 million bits per second to 45 million bits per second. By the end of this decade, a reasonable goal would be T1, or 1.5 million bits per second service for most members of the NREN. For this level of service, we expect twisted pairs of copper wires will be able to carry voice, video, and data messages for a high percentage of needed applications.

While we expect to be researching gigabit speed, fast-packet switching during this period, it will not be the standard for the NREN throughout the nation. By the next century and during Stage III, the control phase, when we would expect fiber-optic communications to be widely deployed, gigabit transmissions would be economically justified for most participating large institutions and for homes in metropolitan areas.

By the mature phase—Stage IV—fiber-optic, satellite communication, and wireless broadband communication technology will take information to people anywhere at any time and then would be available to transform the barriers of time and space and bring information to wherever it is needed, on demand—a close approximation of the "Star Trek" paradigm.

Management

During the start-up stage, development activities were entrepreneurial and run like "skunkworks." At present, during the stage of rapid growth, NREN participants are engaged in a joint marketing effort to get more participation and to see that the network reaches the whole community. Practical hurdles still stand in the way of affordable service for all in the higher education and research community who want it. It will take a long time before most institutions of learning and research—from kindergarten through postgraduate and continuing education, to profit and nonprofit research laboratories—will participate in the NREN. Only then will we move from the current marketing stage to developing the required management structure for the NREN "production utility" type of service. This broad community will require the same simple access and ease of use that it enjoys with the telephone. Finally, in the mature phase, management of the NREN should resemble that of a public utility structure, managing essential and value-added services for the public from end to end.

Users

As in all the other factors of growth, we would expect to see continuing change and growth in the user community. In the initiation period, users came from a few special interest groups and were generally scientists comfortable in the use of information technology to help them do their tasks. Now, in the period of rapid growth, we are still dealing with a community of pioneers, early settlers, and early adapters of this technology, but they have been joined by a much larger higher education and research community for whom computers and networks constitute a new set of tools.

In primary and secondary schools today, relatively few networked uses of information technology exist. Not before several generations of students have grown up and taken their places in the work force can we expect a general demand for NREN services as part of a worldwide public utility, and not until sometime after that can we expect all skilled workers to depend on this technology to do their jobs. It will take many decades for this infrastructure to reach a mature state.

Strategies for NREN

The individual's view of NREN from the desktop and the information infrastructure is depicted in Figure 3. It shows the three basic elements for which a strategy is needed, that is, tools and access from the desktop, a simple network to allow communication and sharing of information, and network-based information services and resources available over the network but not necessarily thought of as part of the network. These resources might include information kept at the personal, local, campus, regional, national, or international level.

The access technology needs a great deal of attention

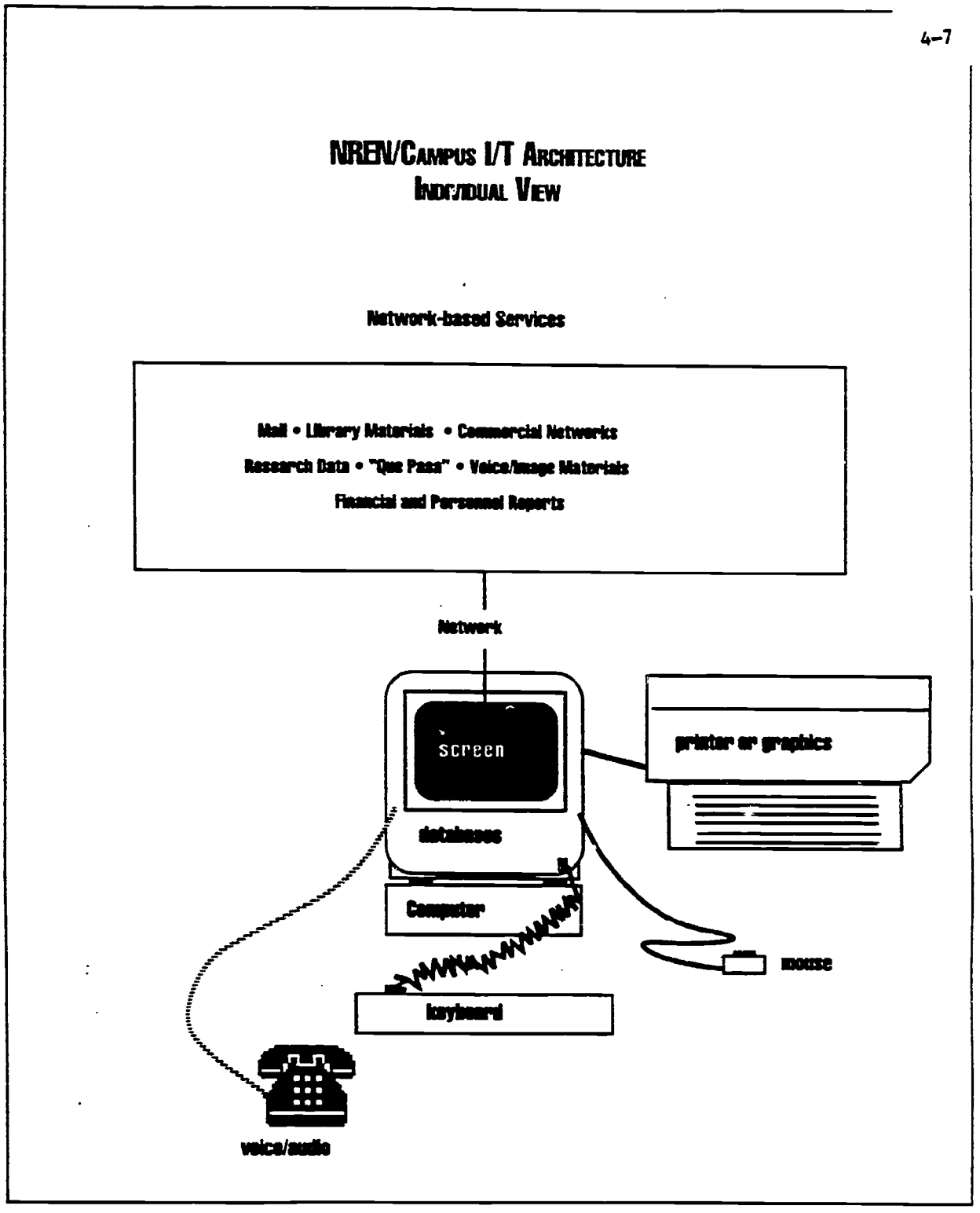
NREN/Campus I/T Architecture
Individual View
Network-based Services
Mail • Library Materials • Commercial Networks
Research Data • "Que Pasa" • Voice/Image Materials
Financial and Personnel Reports
Network
screen
printer or graphics
database
Computer
mouse
keyboard
voice/audio

FIGURE 3

and support at the local and campus levels. The strategy for higher education must include supporting the collection of the most popular technologies: Apple Macintosh, IBM PC, and UNIX workstations. While the network is depicted as a single line and might be thought of as providing a single integrated dial tone in the future, its ease of use exists only for voice today. The goal is to make the network available for connections and to transmit information in any medium.

Network-based services, which can be provided in different places and by different groups and organizations, should be considered apart from the network itself. Such network-based resources provide special services for groups or markets of special communities of interest around the world. The network responsibility, however, is simply to ensure access to these services.

In this period of rapid growth for the network, institutions of higher education must form coalitions and take appropriate initiatives to make sure that the network continues to be built. Support and funds must be found to enable all institutions, K through 12, higher education at all levels, and corporate laboratories to participate in this networking activity. Simultaneously, we must avoid the risk of counterimplementation, as suggested by Peter Keen, formerly of the Sloan School of Management at MIT. That is, we must avoid piling too many good ideas on top of one that is working, thus loading it down and causing the structure to break. NREN initiatives must focus on the network exclusively, allowing other network-based resources and communities of interest to develop and deploy services and resources to be shared over the network. These other specialized and sharable information resources should be funded and structured separately and not be included in the plans, funding, and governance of the network itself. During this growth stage, federal legislation must differentiate the NREN network, focus on stimulating its growth and development, and try not to regulate it like other forms of information infrastructure such as how the telephone is regulated today.

The Broader View

The NREN is becoming a global resource, serving the good not only of higher education and research but of all constituencies. Because of its importance, the network must eventually be managed as a public utility. Right now it should be encouraged through many forms of funding to stimulate its growth and use. The single most important common goal is to help all research and higher education institutions join NREN as soon as possible. We should allow and encourage R&D tax credits for the profit-making institutions that develop ways of offering services through the network to stimulate the development of knowledge and the growth of an information economy in the United States.

We should not institute a usage charge for network traffic until Stage III, probably not before the next decade. Instituting any practice of charging for utilization now would prematurely stunt the growth of the NREN and its stimulation of our information economy. Public policy has necessarily lagged behind the rapid growth of networks. New laws and policies should not be based on the early experiences of this data network alone or on those of the telecommunications industry as a whole. Existing public policy and law tend to inhibit the development of this network and the associated information economy. As an example, both the telecommunications industry competitive environment and the tax laws have encouraged development and investment in a vast fiber-optic network, which is now built, installed, and available for use. However, regulated tariff rates are so high that much of the fiber remains unused.

Although the practice of conserving utilization once made good economic sense, our technology, competition, and the world information economy are developing in such a way that we can no longer afford this practice. This "dark" fiber is essentially a lost opportunity, a perishable R&D resource. We need to lower tariffs for research and higher education, to find ways to use (i.e., to "light") some more of this dark fiber, and to encourage the development of the NREN. The R&D and education users should pay only the marginal costs and thus allow the scientific, technical, and scholarly community to develop new applications and information uses, many of which would lead to new information products, services, and greater economic growth.

These issues of public policy and regulation lead to only a few of the many management questions that we must answer in our effort to lead the development of the NREN. We must collectively define the NREN networ' vision and clarify the funding, applications, resources, and management and user responsibilities to maintain the NREN's health so that it grows and thrives. The Nolan stages framework is a useful tool to help identify and resolve the NREN leadership issues we face.

To keep up-to-date, all scholars and knowledge workers increasingly need to gain access to the network. This growing scholarly exchange has repercussions in the larger society and marketplace. New knowledge leads to inventions, and new inventions lead to new products. The existence of a healthy, growing NREN network is the most fundamental component of an emerging information infrastructure and will accelerate the whole process of knowledge development and stimulate the growth of research, education, and an information economy in the United States and around the world. ■

A BIMONTHLY NEWSLETTER OF RESEARCH LIBRARY ISSUES AND ACTIONS

Current Issues

NREN Issues: Funding, Equity, Innovation

by Richard P. West, Chair, Coalition for Networked Information

There is much to be pleased with on the national data networking scene. The National Research and Education Network (NREN) concept and vision are so widely understood and discussed that much of our baseline institutional technology and information resource planning is already predicated on its existence. Recent Congressional and executive branch debates over implementation topics such as fees, the topology of the physical network, and the Federal agency to be assigned operational responsibility for the NREN attest further to the NREN's widespread conceptual acceptance.

The NREN discussions reflect the excitement of creation, initiative, and leadership. The metaphors used to describe the NREN are colored with reference to newness, progress, and innovation. The introduction of this technology and its associated capabilities create opportunities that we can only begin to imagine. Some of us are even audacious enough to suggest that we are in the midst of revolutionizing the basic way we communicate information — moving from the creation, storage, and dissemination of information in printed form to electronic form.

There is no one obvious event that will be the watershed for this change. Rather, throughout the early 1990s our community will have to track and influence a number of processes that point in this general direction. The many individual changes that will unfold over the next few years will be mostly evolutionary ones, and it is essential that our community continue to take every opportunity to participate in the evolving national networking scene.

There are three core networking issues that our community should be addressing over the long run, regardless of the parade of issues that appear on and disappear from the contemporary scene: How should the network be funded and governed? How can we stimulate and manage both technological and public service innovation? How do we assure equitable access? These issues are familiar ones to librarians and managers of technology. In fact, we now recognize collectively that the same set of issues that define the networking challenge define as well the challenge of making information resources and services available on the network. Another issue that is often discussed, particularly so recently, is the physical "topology" (make-up) of the NREN. This is not a core issue requiring concerted attention over the long run, but it has assumed near-term importance because the next steps in the NREN's implementation will see major changes in this aspect of the network.

Our responsibility with respect to these policy issues is really two-fold. First, as the members of the higher education community responsible for providing networked information in the name of advancing scholarship, we should ask ourselves whether we are participating successfully in the framing and addressing of these policy issues. Equally important, we need to ask ourselves whether we are helping to shape the framing and addressing of these policy issues in ways that will achieve results consistent with the values and missions of the institutions that we serve. The answer is certainly a resounding "yes," but we need to take care to keep the scope of our deliberations and debates regarding the network and the information on the network concentrated on the core policy issues. I would like to share my views on the "physical topology" issue in the interest of promoting just this concentration.

information. Try as we may, we cannot envisage how that system will work ten years from now because it will evolve in ways that we cannot predict. As in the past, the future information technology environment will be shaped and influenced by decisions made in the private and public sector. How these policy decisions will be implemented as technology changes is impossible to predict at this moment.

Despite our inability to forecast the future, we must continue to discuss the Nation's agenda in this key area. Our policy discussions about the system of information resource delivery must focus on funding, equity, and innovation, rather than be distracted by topological discussions on how we may be currently implementing the NREN. In that spirit, I suggest that the establishment and participation of ANS advances the NREN agenda and our progress significantly because it provides a viable, new option for realizing the physical topology of the NREN. It is up to us to make sure that this option adds true value to the national networking scene. Keeping our focus on the issues of funding and governance, equity, and innovation is the best way to ensure that.

FOREIGN ACQUISITIONS AND THE NATIONAL INTEREST

by Jeffery J. Gardner, Director, ARL Office of Research and Development

American research libraries are facing a major challenge to their historic mission of providing research materials in support of research and development essential to the national interest. Changes in the global economy, developments in international publishing, and research libraries' reduced resources have conspired to place the country's leadership in research and development and graduate education at risk. While the challenge affects all disciplines, it is particularly obvious and threatening in the area of access to foreign research materials.

American libraries' collections of foreign materials are indisputably the finest in the world-in many cases richer and more comprehensive than those found in the libraries of the originating countries. Our capacity for providing bibliographic access and preserving these materials is unmatched, and our historic commitment to making the material available to the nation's scholars has contributed directly to our leadership in international education and research. However, at a time when foreign published materials represent a greater proportion of the world's publishing output, when the interdependence of nations and their economies is increasing, and when the ability of America to compete effectively in the global economy is in question, our ability to maintain our historic foreign collections strengths has been seriously eroded.

Several factors contribute to the problem. The importance of humanities and social science research focused on foreign cultures is increasing as national boundaries become less significant in the commercial and technological arenas. Foreign monographs in the humanities, arts, and social sciences are proliferating and their prices rising dramatically. Publishing in East Europe is undergoing major change, including likely increased output, and already apparent increased costs as historic exchange agreements are supplanted by direct sales. And the decline of the dollar, which the Council of National Resource Centers estimates has resulted in a forty- to fifty-percent decrease in acquisitions of foreign materials over the last three to four years, exacerbates the problem for research libraries that face budget increases in the 0% to 5% range.

The importance of addressing the foreign and international studies needs of the nation go well beyond satisfying the needs of individual scholars. Government and business leaders publicly recognize the need for increased investment in the country's capacity to compete and participate in the global economy. Educational leaders are, once again, actively promoting the development of stronger foreign language programs in colleges and universities, and there is increased scholarly interest in all aspects of foreign cultures — including social, political and economic systems, scientific and technological developments, and popular cultures. Recent events in East Europe, the Baltic states and the Middle East re-emphasize the importance of understanding the diverse cultures that make up the world in which the United States must compete, politically, technologically, and economically.

The magnitude of the problem led ARL's Board of Directors to issue the following statement at its October, 1990 meeting: "Research libraries have been forced to reduce their commitment to foreign acquisitions at a time when international research materials are becoming increasingly important to research and economic development....The Association of Research Libraries places paramount priority on the formulation of cooperative strategies for developing and providing access to foreign materials located both in North America and abroad. The Association urges the development of improved understanding of needs for foreign materials by research libraries and scholars, leading to the creation of cooperative structures and systems designed to ensure improved future access to international research materials."

Early discussions of the ARL Committee on Collection Development and meetings with the Council of National Resource Centers have identified two long-term strategies for addressing the needs in the area of access to foreign materials. The first is to work toward greater cooperation in the research library community for the development, maintenance and dissemination of foreign materials collections. The second is to re-affirm the importance of foreign collections to the national interest in order to develop greater federal support for international education and studies, including needed informa-

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PLANNING MODELS RESEARCH AND EDUCATION

By John P. Witherspoon

THE ISSUES ARE: HOW TO MAKE IT HAPPEN, HOW TO APPROACH FINANCING, AND HOW TO SUSTAIN AN APPROPRIATE LEVEL OF FEDERAL INTEREST

John P. Witherspoon is professor and chair of the Department of Telecommunications and Film at San Diego State University and coprincipal investigator of the BESTNET Project, an international, cooperative distributed network for computer conferencing, electronic mail, and access to a variety of instructional resources. This article is based on his talk at the Coalition for Networked Information meeting in Washington, DC, in March.

Late in January, Kenneth King of EDUCOM sent to a set of key senators a letter on behalf of the Partnership for the National Research and Education Network (NREN). In urging consideration of the NREN, the letter emphasized that if the stated objectives are to be realized, certain key points are essential. These were summarized as follows.

- Creation of a federal, state, and local networking partnership, with contributions from all levels, will be essential to the success of the network.
- Education in its broadest sense complements established research objectives as a reason for development of the NREN.
- All involved constituencies of the NREN must have a voice in the development of network policy.
- All fifty states should have high-capacity access to the network.

That set of principles, which must be put into operation as the NREN is created, brings to mind two comparable projects from our national past. Twenty-five years ago we were considering how to develop the national resource we now call public broadcasting. Five years earlier than that we had been debating the issue of how to build a national structure to deal with the possibilities of space communication.

Both COMSAT and the Corporation for Public Broadcasting (CPB) were created for special purposes at special times. Do models like these apply to the present situation? Change the terminology a bit and the principles set forth in Ken King's letter fit very comfortably with either CPB or COMSAT, and either could serve as a roadmap to bring NREN into being.

CPB was created because of another need for a federal, state, and local partnership, with contributions from all levels. Education in its broadest sense is what public

FOR NATIONAL NETWORK DEVELOPMENT

broadcasting is about. All involved constituencies have a voice, in this case through a complex of organizations of which CPB is the cornerstone. And all fifty states have access to these broadcasting networks—networks that didn't exist when the Public Broadcasting Act was passed.

Similarly, COMSAT was the early presiding force in the establishment of the world's primary international telecommunications system. It involved working with many constituencies, domestic and international, to develop the technology as well as the business. It involved being the earliest operating company in a brand-new field that most people saw as part romance, part high-tech, and part heading off the Soviets.

Now that it is time to consider an organizational structure for the NREN, previous experience with public broadcasting and space communication can serve as a guide.

The Start of a National Public Broadcasting Corporation

Consider the situation that resulted in the Public Broadcasting Act of 1967. In the 1960s we had a rudimentary educational television system, with about 125 stations on the air. Funding for this collection of stations was mostly local. The key national donor was the Ford Foundation.

But it was recognized that one philanthropy alone neither could nor should provide a permanent base for this emerging national resource. It was clear that a degree of federal support and leadership would be essential to make this a truly national, high-quality service. The questions were how to make it happen, how to approach financing, and how to sustain an appropriate level of federal interest.

How to Make It Happen

In approaching Congress and the administration, educational broadcasters had few knowledgeable people on their side—in the mid 1960s most people barely knew what educational television was. With so few stations on the air, a great many congressional districts were not served at all. It seemed unlikely that most members of Congress would get much supportive mail.

However, we already had the country's most honored programs for children. In addition, educational television was closely identified with education itself, from kindergarten through college. Video's potential for instruction had been well established in a series of research projects.

It was through its association with education that public broadcasting first caught the interest of many decision makers. "Sesame Street" was born at about the same time as CPB was getting started, and it is probably fair to say that "Sesame Street" was the corporation's most positive argument for appropriations in its first years.

How to Get Financing

In the beginning, funding for the smattering of local educational TV programs came from universities or school districts, audiences, contracts for educational services, and the Ford Foundation. Today's ubiquitous corporate underwriting started only when the system and its audiences became large enough to interest companies—after federal support took effect.

When it came time to seek federal support for the development of a true national system, one critical issue was how to handle the problem of federal control, which all too easily accompanies such requests. Congress eventually specified annual appropriations, an uncomfortable solution. Eventually, to minimize political gamesmanship and to ensure a reasonable planning cycle, annual appropriations were made a couple of years in advance.

Annual appropriations are by no means the only way to go. For example, the United Kingdom and several other countries charge a tax or license fee on television sets. But from the beginning that was a political nonstarter here.

A proposal by Henry Geller, an expert in telecommu-

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nications policy, also foundered that users of the electromagnetic spectrum pay a fee to support public broadcasting. Broadcasters and other users of this rational public resource were accustomed to using it for nothing.

A couple of cautionary points turn up repeatedly in these ideas. The first is economic. By and large, economists tend to prefer starting with a well-defended budget of expenses, to which a funding mechanism appropriate in both nature and amount can be matched.

Similarly, the federal government tends to prefer conventional appropriations, for two reasons. First, the amount appropriated has some relationship to a budget of expenses—at least that's the principle. Second, the process of authorization and appropriation is thoroughly political, reflecting the priorities of the day.

How to Sustain Enough Federal Interest

Public broadcasting is not a large federal expense item. However, there are those who think that public broadcasting serves primarily a generally upscale audience; that it presents a diet of news, information, and culture that is certainly a desirable but not critical asset; and that perhaps the government should reexamine this pattern of annual commitment. Why does that line of thought seem to have minimal effect?

- When the original Public Broadcasting Act passed in 1967, most members of Congress did not know much about public broadcasting, although they agreed that it had educational potential. Now, more than twenty years later, they know all about it. They watch "MacNeil/Lehrer" and even seek opportunities to appear on it. They and their families watch everything from "Sesame Street" to "Great Performances." When their hometown station manager comes to Washington, he or she calls at the congressperson's office, often accompanied by a politically prominent person from home who serves on the station's board. Public broadcasting is now established and is well regarded.
- The federal appropriation for public broadcasting represents a relatively small share of the total system income, but it is a critical share. Funds appropriated to CPB account for less than 20 percent of system income. But—and without going through the byzantine process of grants and buybacks involved—that federal share provides a crucial role as catalyst and stabilizer. So from the standpoint of those who commit federal money, the result is not only a service that is widely valued but also an investment that is multiplied over and over by leveraging funds from individuals, philanthropy, and business.
- Public broadcasting has achieved the virtue of ubiquity. Providing a valuable service to virtually every congressional district in the United States may not make a program bulletproof, but it is a lot better than any alternative you may be likely to find. A small example may be useful. One of the earliest bills ever passed for the support of this field was the Educational Television Facilities Act of 1962. At that time there was no federal programmatic support for educational television at all, but it was agreed that there would be a five-year program of appropriations to help pay for transmitters and other crucial equipment needed to bring the new system into being. That short-term program may see its thirtieth anniversary next year. It is now the Public Telecommunications Facilities Program, and it provides equipment subsidies for public television and radio and for several other educational applications of telecommunication technology. Nonetheless, although every administration for the past twenty years has tried to zero it out, on the premise that the program's original purpose has been accomplished, but it has always bounced back, one way or another. There is probably no congressional district in the United States that has not had some benefit from this program and does not want more. There is a lot to be said for both having a lot of constituents and having them just about everywhere.

The Public Broadcasting Act

The three issues posed earlier were: how to get their government's attention, how to approach financing, and how to sustain an appropriate level of federal interest. Let's turn to the mechanism that was created when the Public Broadcasting Act was passed.

The principal purpose of the act was to authorize the creation of a 501(cX3) organization in the District of Columbia, the board of which would be appointed by the president with the advice and consent of the Senate, to receive and disburse federal (and other) money and accomplish the following purposes and activities, as spelled out in the act. Note the resonance with the principles spelled out in Ken King's letter:

- facilitate the full development of educational broadcasting, in which programs of high quality, obtained from diverse sources, will be made available to noncommercial educational television or radio broadcast stations;

• assist in the establishment and development of one or more systems of interconnection to be used for the distribution of educational television or radio programs;
• assist in the establishment and development of one or more systems of noncommercial educational television or radio broadcast stations throughout the country; and
• carry out its purposes and functions and engage in its activities in ways that will most effectively keep noncommercial educational television or radio broadcast systems and local stations free from outside interference or control.

In the case of public broadcasting, the entity responsible for this list of duties—CPB—does not actually operate any network or produce any programs. The operating networks are those of the Public Broadcasting Service and National Public Radio, separate nonprofit corporations. Unlike commercial broadcast networks, in which the stations are affiliates and not central to the business structure, in public broadcasting the stations are members of the network: it is their organization. These networks are controlled by boards, which have two kinds of members: managers elected to represent the member stations and prominent citizens who lend their wisdom, their objectivity, and their political weight to the enterprise. There is much to be said for a structure of governance that is strong both in representation and in political stature.

To summarize: the Public Broadcasting Act of 1967 authorized the establishment of a corporation to foster the development of public broadcasting stations, networks, and programs as well as to carry on such secondary functions as training, research, and information dissemination. Federal funds appropriated to that corporation for these purposes are distributed in grants or contracts to stations and other parts of the system.

Though the federal appropriation to CPB is less than 20 percent of total system revenue, it is enormously important because of leveraging effects. Other sources include individual members of the audience (akin to NREN users), commercial companies, federal agencies such as arts and humanities endowments and NSF, institutions such as universities and school districts, states, and philanthropies.

Structurally, it seems like an attempt to organize anarchy, a term also used sometimes in connection with Internet. From the beginning, public broadcasting has been very participatory: one of the early leaders of the field referred to it as a long series of meetings occasionally interrupted by a program. American public broadcasting is the most decentralized broadcasting system in the world.

It's a messy situation, it's chronically underfunded, and those who assume that it's centrally managed or centrally financed simply haven't been paying attention. To anyone who has been involved in planning the NREN, some of that may sound familiar.

The Example of COMSAT

A somewhat different case also has some parallels that may be useful in setting up the NREN's governance and structure. Five years before the Public Broadcasting Act was dropped into the congressional hopper, the country was considering how to develop the potential of satellite communication. At the time, the earth's geosynchronous orbit was empty. Arthur Clarke had described it, but it was not at all clear that anybody had the rocket power or skill to park a satellite in it. America's space program had been jolted out of a rather languorous beginning by the launch of Sputnik I in 1957. To most people in American government, the importance of Sputnik was not its prospects for communication but its demonstration that the Soviets had achieved a level of power and control in rocket propulsion that could be very dangerous if it were attached to a ballistic missile rather than a low-orbit beeper.

After that launch, a furious effort to develop American power in space began. The focus was communication—in particular, to provide transoceanic telephone traffic, which meant working with friendly nations.

As a nation we needed to decide how to develop this communication satellite resource. Once again there are parallels with the NREN: the system in question was not well understood, but its potential seemed sound.

What sort of organization should represent the United States in this international effort? One faction held that since satellite communication was a spin-off of the U.S. space program, for which the people of the country were already paying, the United States should develop a public agency to provide satellite communication. Another group emphasized the importance of private-sector initiative in this field.

Though the future of satellite communication was perceived only dimly, the argument over the structure of U.S. participation was vigorous indeed. In the end, Presi-

When it came time to seek federal support for the development of a true national broadcasting system, one critical issue was how to handle the problem of federal control

dent Kennedy's forces won, and the Communications Satellite Act of 1962 established a for-profit private corporation that would operate within the bounds of current antitrust laws and government regulation while encouraging private support and "nondiscriminatory access" by "authorized users."

So we have a for-profit corporation, created by Congress and subject to the provisions of congressional acts. This Communications Satellite Corporation, which became COMSAT, was authorized to:

- plan, initiate, construct, own, manage, and operate by itself or in conjunction with foreign governments or business entities a commercial communications satellite system;
- furnish, for hire, channels of communication to U.S. communications common carriers and to other authorized entities, foreign and domestic; and
- own and operate satellite terminal stations when licensed by the Federal Communications Commission).

So again, when a structure was needed to manage a new technology-based development—which was perceived as having great importance though its implications were not well understood—the country turned to a congressionally chartered corporation.

Do These Models Fit?

There are indeed parallels to be drawn between the founding of CPB and COMSAT on one hand and development of the NREN on the other. But one question remains: are congressionally authorized companies like these feasible today? CPB, after all, was born in the era of Lyndon Johnson's Great Society program. COMSAT is a product of the Kennedy vision for space, in a time of eyeball-to-eyeball confrontation with the Soviet Union.

Certainly the Great Society notion of government as the Great Fixer does not have much currency today. There is not much question that if CPB had not yet been invented, 1991 would not be the time to try. Still, most people are glad that this particular aspect of the Great Society was ena- and the corporation continues to be seen politically as an appropriate mechanism.

Similarly, COMSAT remains an important company today, much more diverse than its mid 1960s counterpart. It continues to fill its prime statutory role in the international satellite system, but it has also evolved beyond that, as one would expect with the march of technology, business, and the world society of the information age.

Nonetheless, aspects of their genesis sound very familiar.

- Today, as then, we need to pull together diverse interests in a common structure that all concerned can recognize as theirs, because they have a stake and know that their voices will be heard.
- Today, as then, we need to build a structure that can leverage a crucial federal investment, so that the federal commitment and all the state, institutional, commercial, and other components of financing can be coordinated to build and develop the NREN.

That sounds like a public-private partnership, a political style that is in vogue today because it is often the most sensible and prudent way to get important but expensive ideas moving ahead.

The January letter from the Partnership for NREN calls for the federal government "in partnership with states and public and private network organizations and user groups" to establish an "independent, nongovernment function which could be a board, an agency, a federally chartered activity. . . ."

Try a congressionally authorized corporation. The precedents fit remarkably well: you can ensure appropriate representation; you can protect flexibility to ensure that decisions can be made and the system can work; you can leverage that crucial federal investment. You can, out of a diversity that is frustrating but absolutely essential, build a network. ■

By and large, economists tend to prefer starting with a well-defended budget of expenses, to which can be matched a funding mechanism appropriate in both nature and amount

Position Statement on NREN Policies

by
Fred W. Weingarten
Executive Director
Computing Research Association

INTRODUCTION

This paper has been prepared to help stimulate discussion at the NREN Policy Workshop, jointly sponsored by EDUCOM, IEEE/USA, and the Computing Research Association (CRA). It has not been approved by, nor is it the official policy of, the CRA Board of Directors.

The paper argues that the NREN is a three-layered, multi-faceted, (although integrated) system, rather than a single unified entity that might operate under a single set of policies. Corresponding to this more complex structure, different policies and organizational structures are appropriate for each layer.

The center layer is a pure public-information infrastructure intended to serve the general needs of research, education, and public information—what I have called a "Pure NREN." This layer poses the most difficult funding and management and policy issues for government, and it receives the most attention in this paper. In particular, a new institutional framework is proposed, in the form of a government chartered non-profit corporation to develop and manage this part of the NREN.

THE MULTI-FACETED STRUCTURE OF NREN

The NREN, as it has evolved conceptually over the last few years in the political debate, can now be best thought of as composed of three different network systems, interconnected and serving somewhat overlapping constituencies. Figure 1 illustrates the network as a set of three layers. The vertical dimension roughly represents

technological sophistication and the horizontal metric corresponds loosely to the size of the intended base of users. As the figure suggests, some overlap exists between the layers, and, of course, among the users.

The "High Technology" Research Layer

The top layer is a collection of specialized, ultra-high-speed data communication systems, based on the most advanced state of the art communications technology. These systems are the true multi-gigabit networks. These systems serve specialized research users and provide a variety of services—interconnecting supercomputer centers, carrying data from large, data intensive research instruments, or combining researchers in geographically distributed project.

Technologically., these networks will, for the most part, be custom designed and built. They push the state of the art beyond what is commercially available at any given time, and, because of this, in many cases they serve as test-beds for possible broader technological offerings in the future.

Because these networks are intended to serve specific research missions of agencies, they will be, at best, only loosely coordinated. However, agencies should collaborate to ensure to the maximum extent possible, the networks interconnect and use standardized interfaces. Such coordination will provide efficiencies both to the government and to the research users.

The "Pure NREN"

This network provides a wide range of digital data communication services not only to scientific researchers and educators, but to students and scholars in all fields. Users would access the network principally through its client institutions—colleges and schools at all levels, libraries, museums, and industrial research laboratories. The network would offer access to a variety of educational and public information services

and resources, formal and informal education, virtual museums, public health services, and access to a variety of government social services and data bases.

Technologically, the network would provide high-speed data communication services, though contracts for commercially available services. Although the pure NREN would be accessible through the switched telephone network, services that depended on the higher data rates and specialized services offered by the network would not necessarily be available or would only be accessible in limited form through that interface.

The Universal Infrastructure

The universal infrastructure will extend digital data communications to every home and office—even, if technological trends continue, to every coat pocket. The technological parameters of this network, or set of networks, is difficult to predict at this time; however, it would no doubt replace the existing telephone system. Depending on its capacity and speed (as well as regulatory decisions), it could as well substitute for a large proportion of the existing cable and broadcast infrastructure.

The universal network would reflect a compromise between the desire to make a national infrastructure as sophisticated and long-lasting as possible, and the need to make it broadly affordable and accessible to all people. The need to arrive at such a compromise will likely result in a national network that is a combination of universal, but limited capacities, coupled with an assortment of more sophisticated services to which access is more limited by price, by geographic location, or other characteristic.

POLICY ISSUES

The accompanying chart, Figure 2, briefly indicates how the answers to the policy issues of NREN vary, depending on the "layer" one is talking about.

Such an overall structure would seem to be feasible. The nation's transportation system is mixed mode, ranging from government subsidized public transportation, through private automobiles, all the way to supersonic transport. Each component of the system is governed by its own set of policies, economics, and regulations. Yet they are hopefully coordinated and coupled together to form at least a loosely coordinated transportation system.

The U.S. has numerous examples in which publicly funded or partially subsidized activities coexist in an uneasy but manageable relationship with the private sector—government publishing, schools, libraries, parcel post, or public broadcasting all provide such models.

There is not room here to develop in detail every cell in the matrix in Figure 2. The key structural proposal, however, is in the "Pure NREN" column. It suggests the establishment of a non-profit, government chartered corporation to provide a national NREN for education and broad scholarly use (including, but by no means limited to scientific research.)

The corporation, directed by a Board composed of Government representatives, providers and users, would be a relatively small coordinating organization, with three basic functions:

1) It would serve as a collector and conduit of funds from various sources, including Federal and local governments, private sector support, and, if adopted, user fees.
2) In consultation with the user and service provider communities, it would define, procure, and manage a national NREN.
3) Again in consultation these groups, it would establish operating policies, user fees, and rules governing interconnection and access.

Such a corporation would seem to be one of only a few mechanisms (if not the only one) for advancing the concept of the NREN.

- In the first place, the NREN will only result from a partnership—a combined effort among Federal and local governments, private sector providers, and a wide variety of user institutions such as universities and colleges, public schools, libraries and museums, and research organizations. Only a neutral organization such as the proposed Corporation can serve as an effective coordinating body among such a diverse group of interested parties.
- Even if they were credibly neutral parties, Federal agencies would find it difficult to say the least to design, procure, and manage such an entity. They, in fact, are not neutral. Each has its own missions and constituencies, and it has its own operating style and policies that derive from those missions. Their difficulties do not arise from lack of will or competance; but simply from the realities of management in the public sector.
- Finally, the two "layers" will not substitute; they will not provide NREN equivalent services without the coordination function provided by such a corporation. Clearly, the spill over from a "High-Tech" NREN to broad educational and public information use would be minimal. And, educational institutions, libraries, and museums, are too diverse and disaggregated market to have much individual impact on the telecommunications market without some mechanism to form an umbrella.

OVERALL POINTS

In conclusion, I want to add a few overall comments on NREN development as it is envisioned in this paper.

Do We Need a "Pure NREN?"

Could one picture an NREN composed of just the top ad bottom layers? In a sense, this question can be considered "moot." A basic assumption of this meeting is that one is needed; the question is how to get it. Clearly, in the political debate, in the legislative reports, in the language of the bill, itself, a vision of a public information network is articulated. In addition, most outside groups interested in NREN politics promote this view in one way or another.

Still, the question suggests itself time and again, and I will address the it just briefly. One can make two basic arguments, technological stimulus and social need.

The first argument is that the middle level, the "pure NREN," is a necessary step to building the universal network. It is by no means obvious that the desire for a new universal infrastructure is all that "universal." Many political, financial, and regulatory hurdles stand before it. It is in developing and gaining experience with "NREN" services that we will learn more about how such a network would be used, what it would cost, and what its social implications would be. Without the middle layer, according to this argument, the bottom layer would slow in coming and, when it did arrive, would not necessarily serve a wide variety of important social needs in an equitable way.

The second argument stems from those needs, themselves. There are important things we need to do as a nation—important problems to solve in such areas as research, education, and public heath. We cannot wait for the millenia when the universal infrastructure is finally built, nor, as already mention, can we assume that it will naturally grow in such a way as to serve those needs if and when it is built.

Structure will be "persistent" if not permanent over time.

One persistent misunderstanding is that the NREN is in some sense, an "interim" service, which will go away once the universal infrastructure is built. If the new system

in some sense were to reproduce the history of the old phone system, stepping up onto a technological plateau and not moving beyond for several decades, the view of NREN as a temporary service might be feasible. However, I expect that, for some time, the growth of telecommunications technology will resemble that of computer technology with continual technological growth and expansion, the model drawn above will be a persistent one.

Certain sophisticated, specialized demands will drive communications technology forward at the top level. Information requirements of the broader educational and research community will similarly move NREN ahead technologically. The universal system will slowly come along, only as the new capabilities are demonstrated to be broadly useful to the general public and affordable.

Need for coordination of layers

Although they have been described as three separate subsystems of the NREN, the layers, and the systems within the layers, should be closely coordinated. Users will want to move freely and without barriers among them. A researcher using a high performance data network to move around experimental data or graphic images, may need to simultaneously exchange messages with colleagues or compare results with those archived in a commercial or government data base offered over the pure NREN.

Furthermore, coordination is also needed to if there is to be the long term technology flow—from high-tech development to specialized commercial services to universal service—envisioned above.

CONCLUSION

Disaggregation of the NREN concept into the three "layers" proposed allows a more precise development of policy options. Much of the difference of opinion that has

characterized the debate to date has come from a clash of perspectives on the basic nature and purpose of the NREN. The very political process that has had success in passing legislation and promoting presidential pinitiatives has inevitably contributed to this underlying ambiguity.

It is my view that the nation needs a center layer, a "Pure NREN" to serve a broad range of research and educational needs in this country. The options for bringing such a system about are limited. We cannot expect that the Federal science and technology agencies will build it purely as a by-product of their basic R&D missions, although they will surely contribute. Nor can we expect that an NREN will spontaneously grow out of the commercial telecommunication industry reacting to pure market forces, although that industry, too, will be deeply involved. We need to invent new managerial structures to bring the NREN into being and to guide its development.

Suggested Articles

This list is by no means complete. It simply intends to add a few lesser known or m

ore recent titles that may not appear on other lists submitted for the workshop.

Kahin, Brian (ed); ***Building Information Infrastructure: Issues in the Development of the National Research and Education Network***; McGraw-Hill; 1992.

McClure, C.R. et al; ***The National Research and Education Network: Research and Policy Perspectives***; ABLEX Press; 1991.

U.S. Congress Office of Technology Assessment; ***High Performance Computing and Networking for Science***; USGPO (OTA-BP-CIT-59); September, 1989.

Weingarten, Fred; "Five Steps to NREN Enlightenment;" ***EDUCOM Review***, Spring, 1991; pp 26-30.

Weingarten, Fred; "HPCC battle focusing on money, NREN," ***Computing Research News***; May, 1992; p1 ff.

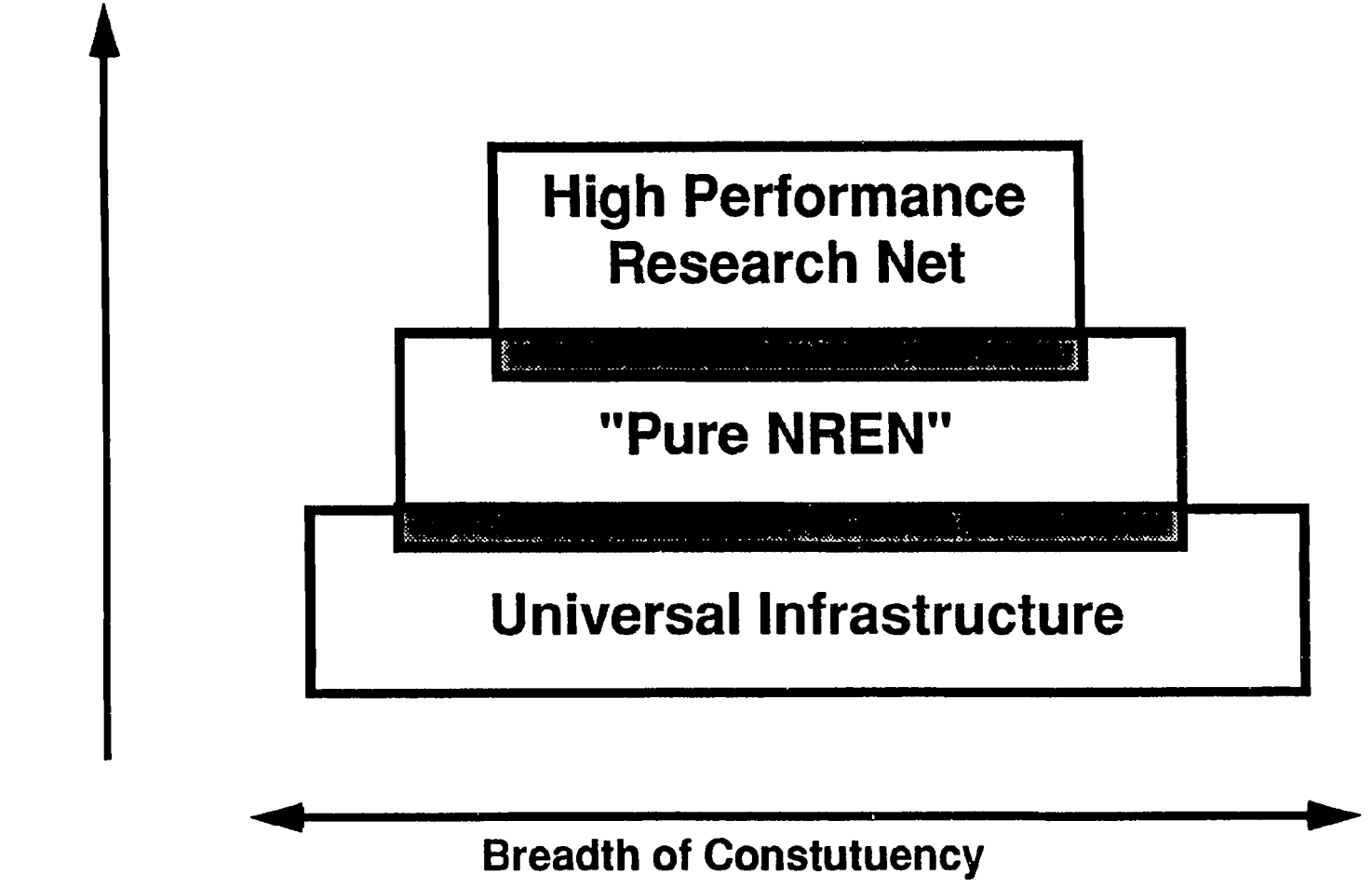

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Figure 1: Layers of the NREN

	High Performance Research Network	Pure NREN	Universal Infrastructure
Technological Characteristic	Spoecilized, state of art and developmental.	Integrated, advanced, but commercially available.	Affordable data broadband to the home
Principal Users	Government funded researchers	Institutional rather than individual focus(Schools, libraries, industrial research. Researchers ,educators, and the broader scholarly community.	Everyone
Issue			
Future Operation and Evolution	Direct agency management or specialized consortia with Multiagency coordination among nets.	Federally chartered non-profit corporation.	Private telecommunications companies develop and operate
Mechanisms for Support	Fully funded by Federal research agencies/ Possible industrial partnership in some cases.	Federal/Local/Industry subsidies with partial user fees .	Direct user fees
Charging Commercial Providers	Very small requirement, not a major issue.	Access allowed for services directly related to purpose and community served, non-discriminatory policies. Charge approximate commercial rates on transactions.	Not an issue
Commercial Users	Very small requirement, not a major issue	Directly related to purpose and community served.	Not an issue
Information Policies	Security principal issue, technological controls and highly restricted access to net.	Copyright and privacy/ security crucial, but must be addressed globally, not NREN specific. Access to gov't S&T data vital and NREN-specific issue, however.	Wide range of issues including, but not restricted to intellectual property, privacy, security and reliability. Mainly policy and legal
"Models"	Large scale research facilities and instruments	Public Transportation, postal service, Public Broadcasting.	Privately owned and operated, regulated(?) public utility

Figure 2: Policy Framework

COMPUTING RESE

The News

May 1992 *Vol. 4/No. 3*

News Analysis

HPCC battle focusing on money, NREN

By Fred W. Weingarten
CRA Staff

Last year was a watershed for the computing research community. The administration announced a special budget initiative on High-Performance Computing and Communications (HPCC), and the president signed the High-Performance Computing and Communications Act of 1992, which Sen. Al Gore (D-TN) had pushed for years. In an era when setting priorities has become a catch phrase in science and technology policy, these two events clearly are a statement by politicians that information systems are high on any such priority list.

The computing research community, however, has not had much time to enjoy the warm glow of that endorsement. All that last year's victory bought was admission to this year's fight. And this battle is shaping up to be far more complex and contentious. This latest battle has developed on at least two fronts—appropriations and National Research and Education Network (NREN) policy.

Money wars

A battle over appropriations was expected. Budget requests and authorization legislation simply were a hunting license—permission to seek appropriations of money. The fight will be a hard one. Appropriations face three particular pressures this year:

- Politicians think the electorate is in a particularly grumpy and impatient mood this election year. The resulting panic creates pressures toward tax cuts and other short-term remedies and away from longer term investment.
- Both the administration and Congress have an eye on shifting R&D spending from defense to civilian agencies, as reflected in the fiscal 1993 budget request. But this measure is running into the firewall erected between defense and civilian budgets in the 1990 budget agreement. If defense R&D budgets decrease, those savings simply are used to protect other defense expenditures. If civilian sector R&D spending increases, those increases mean other popular domestic programs were cut.
- As the costs for such projects as the supercollider and the space station escalate, it is becoming harder to maintain the fiction that science and technology spending is not, in some way, "zero sum." Last year, National Science Foundation (NSF) appropriations became directly mixed up with

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NSF evo

By W. Ric

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Canada to spend more than $1 I university-based research and t

By Douglas Powell

The Canadian government has announced funding of more than $1 billion (Canadian) for university-based

portion of the $1.5 billion to the granting councils—the Natural Sciences and Engineering Research Council (NSERC), the Social Sciences

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Policy

NREN from page 1

Space Station Freedom funds. Because these "big science" projects are politically popular, they are formidable competition for "small science." The pressures are developing even within NSF.

In the Mathematics and Physical Sciences Directorate, more than 50% of its proposed $103 million (17%) increase is earmarked for support of major research facilities, while funding for pure mathematics remained flat. Science policy leaders in Congress are calling for priority-setting, although they are less than clear about how that is to take place. However, in the House appropriations hearing, some attention was paid to the $32 million request by NSF for ongoing construction of the gravitational wave observatory (LIGO) and its impact on individual project support in physics and math.

Victims of rhetoric

More surprising than the appropriations battle is the controversy developing over NREN. NSF is finding itself a victim of its own success, in a sense, and NREN advocates are becoming victims of their own rhetoric.

The term NREN, to the extent it can be defined, encompasses far more than anything NSF, or any government agency, has responsibility for. NREN refers to a future vision of an interconnected web of data communication networks and information services that will serve the as-yet undetermined needs of an as-yet undetermined community of education and research users through an as-yet undetermined administrative and support structure.

That is not to say that individuals do not have their own clear answers to each of these unknowns. Those individual answers simply do not fit together to form a consensus. Neither the HPCC Act nor the administration's HPCC plan has resolved any of these uncertainties, although the act did direct the administration to produce by next year a more detailed plan with some answers to specific questions.

Because of this lack of strategic guidance, NSF has had to do quite a bit of ad-hoc policy-making, and now it is paying the price. Agency officials, busy with the day-to-day problems of upgrading and maintaining network services, have been accused of not paying enough attention to long-term planning.

Rep. Rick Boucher (D–VA), chair of the House Science, Space and Technology Subcommittee on Science, wants more emphasis on the long term. A March 16 hearing originally was scheduled in response to claims by a communications company that NSF engaged in favoritism and unfair dealing in its operating policies and in its procurement plans for upgrading NREN. At the hearing, Boucher made it clear his main interest was not in a detailed rehashing of grievances, but in holding a series of hearings that would take a thoughtful and long-term look at NSF's policies and strategic plans for the network.

Because of a lack of strategic guidance, NSF has had to do quite a bit of ad-hoc policy-making, and now the agency is paying the price.

NSF faces several NREN problems.

Management: NSFnet, which serves as the core of the so-called interim NREN, is a high-capacity backbone network that connects major nodes around the United States. The nodes primarily are regional and state networks and supercomputer centers. NSFnet usage is growing at a rate of 11% a month. The agency, in response to this escalating demand, has been pressured to bring higher speeds on line at a faster rate than planned. But users have little tolerance for delays or glitches that might occur in a transition to a higher speed.

The initial service contract is about to end. NSF faces the enormous administrative challenge of rebidding for backbone services in a commercial market that is much more aware now of the large future potential markets of this technology for global communication.

In developing NREN as a fully interconnected, shared resource, NSF is trying to coordinate a multiagency effort in which neither it nor any other agency has real lead authority to make anything happen or to force cooperation. Many other agencies, such as the Energy Department and NASA, have networks to serve science and engineering. Those networks are thought to be a

Continued on page 5

1991–92 Computing Research Association members

(As of April 16, 1992)

Academic Members

North Carolina State University (CS)
North Dakota State University (CS)
Northeastern University (CE)
University of California, Santa Cruz (CE)
University of California, Santa Cruz (CS)
Univ. of California, Santa Barbara (CS)
University of Southwestern Louisiana
University of Tennessee, Knoxville (CS)
University of Texas, Arlington (CSE)

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part of the NREN concept. However, they also serve specific agency missions. Some agencies, rightly or wrongly, seem hesitant about throwing their lot fully in with the NREN concept.

NSF also must wrestle with the problem that NREN is the first infrastructure designed to serve all of science. Federal science budgets still are directed principally by field and problem. Even capital investments in instruments and facilities generally are intended to serve a specific field or solve a particular problem. As is the tradition in the politics of infrastructure, everybody wants to use it, but no one wants to be taxed to pay for it. NSF will have a long-term struggle, especially after the bloom is off the HPCC rose, to keep funding levels adequate to meet demand. The agency may need to explore other ways to pay for the network.

Constituency: As use of the network has grown, so have the demands. In the beginning, the backbone was supposed to serve national supercomputer center users. Not long after, the backbone was to serve NSF and the entire federally funded scientific research community. That group soon was joined by industrial researchers, educators, librarians and commercial providers of information services. All of these users saw NREN as a critical tool for their work or as a critical mode for offering their services.

Not all of the constituencies are technically sophisticated, nor can they all be equally precise in describing their need for network services. But they all share the view that an electronic information infrastructure intended to serve the research and education community must somehow include them. Furthermore, at key points in the debate in Congress and the administration, these users played key roles in supporting the whole HPCC concept.

NSF's problem will be to serve these varied constituencies as well as possible, without trying to be all things to all people and watering down its vital contribution to leading-edge basic research. NSF also needs to define and order the boundaries of service in a clear and enforceable way, lest the potential user community become so broad and diffuse that NSF becomes vulnerable to the accusation, already made, that it is essentially running, or subsidizing, a common carrier communications service in open competition with the private sector.

Leading the way

In the last few years, in the separate arena of information policy, some technologists and industry leaders have been promoting the concept of a national universal broadband communication system. Views differ on the details of this system, such as how fast and how universal the system would be, what it would carry and who would provide the service. Despite these differences, there is a widespread belief that society will need such an infrastructure in a few years.

That belief was tapped in arguments for the HPCC, and much of the broad political support for the bill and initiative stems from the promise that NREN will, in some way, help accomplish that vision.

NSF has been surprised to learn that in less than a decade, its networking mission has shifted, at least in the eyes of some, from providing chemists and astronomers access to Cray 2 supercomputers all the way to helping build the nation's communication infrastructure. The phone and cable companies have been equally surprised, because they always thought that was their task.

NREN may help that vision along in tangible ways. It can serve as a testbed and prototype for hardware and software. As the constituency expands, more can be learned about the types of user services needed. NREN will be an arena in which debates on information policy—in areas such as privacy, intellectual property and access to government data—will be played out. Depending on the pricing structure, economists could learn more about costs, demand and the elasticities of the information market.

The challenge for NSF will be to see that at least some of these benefits are realized without having NREN become too embroiled in telecommunication policy, or become perceived as directly competing with the private sector—a perception that, in the current political climate, could be fatal.

CRA's job

CRA will continue to participate in the NREN debate. We are users of the network, both for research and education, and we have a direct stake in how these issues are resolved. We also have technical expertise within our community. After all, a high-speed data communications network is, from one perspective, highly distributed computational device. We have been there from the start, from the creation of DARPAnet to NSFnet. Some in our community, such as Mike Dertouzos, have been in the vanguard of calling publicly for building the new information infrastructure.

Through workshops, meetings and debates in CRN, we need to influence these policies as they evolve. All of the interested government agencies and Congress need and want advice, and we need to make our voices heard.

Canadian news roundup

By Douglas Powell

Just prior to the 1992–93 budget announcement, Minister of Science William Winegard unveiled a five-year, $27 million (Canadian) microelectronics sector campaign. The Industry, Science and Technology Canada (ISTC) ministry will provide up to $12 million, and an additional $15 million could be levered from industry.

"Canada has the ability to boost its competitiveness in a number of areas of microelectronics if we continue to build upon our innovative strengths," Winegard said.

The campaign calls for the creation of the Strategic Microelectronics Consortium (SMC), a non-profit, industry-led organization to advance Canada's microelectronics products and explore market opportunities.

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Although the Canadian information technology industry grew by 4.9% in 1991, a critical shortage of skilled software professionals is possible.

Market researcher International Data Corp. Canada Ltd. (IDC) has pegged the Canadian information technology sector—which includes computer and communications hardware, and packaged software and services—at $16.2 billion (Canadian) in 1991. The strongest growth sector remains packages software and services, and that is exactly where a new report from Employment and Immigration Canada[1] predicts a human resources shortfall.

The problem is two-fold: a declining number of computer science graduates and a lack of upgrading for those already in the workforce.

According to the report, Canadian universities, the traditional source for entry-level software workers, are producing fewer computing science graduates. A negative image of software workers among high school students has been identified as one factor contributing to the reduced numbers of people entering the software field.

Furthermore, the two-thirds of Canada's 150,000 software workers employed as in-house workers within the management information systems (MIS) departments of Canadian industry and government, increasingly are plateauing in mid-career due to a critical obsolescence of skills. The study also identified a profound lack of training or retraining.

"A general lack of recognition of the contribution of software to all aspects of Canadian life and competitiveness is evident in the dearth of software-related government policy or direction," the report said. "Worse, although lip service is given to the importance of information technology to Canada's future, among policymakers we find no evident recognition of the key to the effective use of technology: the human resources which make all computers work."

IDC expects stable growth of the Canadian IT industry until 1995, when the industry could reach the $20 billion level.

[1]Software and National Competitiveness, December 1991, Employment and Immigration Canada.

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The province of Ontario has formed a communications advisory committee as part of the province's long-awaited industrial strategy. The communications industry in Ontario, which includes Northern Telecom, employs 90,000 people, generates revenues of more than $9 billion (Canadian) annually and spends more than $600 million each year on R&D.

"The vision we have for Ontario is that of a world leader in the development and application of telecommunications," said Ontario's Minister of Culture and Communications, Karen Haslam.

The committee is expected to file its report by the end of June.

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Gilles Brassard, a specialist in cryptography at the University of Montreal, is one of four winners of the 1992 E.W.R. Steacie Memorial Fellowships, Canada's most prestigious academic award for mid-career scientists.

Brassard is acclaimed internationally for his work in zero-knowledge protocols and for developing, with Charles Bennett of IBM Research, the field of quantum cryptography.

Brassard and his colleagues began developing approaches to quantum cryptography in 1979 when, at the age of 24, he returned to his native University of Montreal as a faculty member. Brassard's approach involves the fundamental principles of quantum physics, in particular Heisenberg's uncertainty principle, to create a system for transmitting unconditionally secure information.

Position paper

THE NATIONAL RESEARCH AND EDUCATION NETWORK AND K-12 EDUCATION

Last revised: 9/2/92

Outline:

Description of CoSN, its goals, and its constituency

The Consortium for School Networking (CoSN) is an institutional membership organization that is chartered to advocate access to, and facilitate the evolution of, national and international electronic networks as resources to K-12 educators and students.

Through computer networking, the Consortium will help educators and students access information and communications resources that will increase their productivity, professional competence, and opportunities for learning and collaborative work.

The Consortium advocates the following goals:

- The timely deployment of the national research and education network, so that educators and students at any school can communicate with each other and access a wide variety of information and data .
- The development and distribution of network-based information resources for schools. These resources should include existing materials produced with funding from federal and state governments as well as innovative materials and tools adapted to this new communications medium.
- The development of the resources needed to make full and efficient use of networks through staff development programs, educational materials and software.

Detailed information about CoSN, including its officers, Board members and current membership, is provided in Attachment 1. The Consortium's intended constituency is the entire K-12 educational community, including:

- teachers, media center specialists and other educational specialists;
- students;
- school system administrators, technical and curriculum personnel;
- concerned parents and community members;
- school board members;
- educational researchers and faculty in postsecondary institutions;
- professionals – especially scientists and engineers – from academia, government and business;
- educational leaders in Federal and state government;
- leaders from professional and disciplinary groups with interests in K-12 education;
- vendors, software and other publishers, and information service and technology providers for the K-12 education market;
- technical and information specialists involved in networking; and
- business leaders, engineers and scientists from technologically-intensive firms.

The constituency that CoSN intends to include explicitly encompasses all levels of K-12 education, both public and private; every area of the academic and vocational curriculum; all student populations, including minorities, those challenged by disabilities, individuals at risk, and those with special talents and gifts.

The eventual nature, services, structure, uses, and constituencies of the National Research and Education Network (NREN)

Working toward consensus. Computer-mediated telecommunications are currently playing a central role in local and national efforts to restructure schools, provide new avenues of professional development for teachers, and enhance the teaching and learning process in classrooms (Firestone and Clark, 1991; Riel, 1992; Tinker, 1992b; Watts and Castle, 1992). There is strong consensus among participants in these projects that a national information infrastructure has the potential not only to support change in our schools, but to accelerate it. All agree on the worth of participating in the process that will help define the NREN's eventual shape and the evolution of a true national information infrastructure.

Nature of the NREN. The NREN vision involves what Beverly Hunter has called internetworking (Hunter, 1992a), and is based on a modular, distributed, standards-based scalable network architecture that can weave together the disparate networks and resources now serving K-12 education. But the NREN is also the human network that uses, provides services and resources on, and manages the NREN.

How educators use networking.

- to connect practitioners with one another.

The development of collaborations and linkages through improved communication over the long term will result in regional, national and global communities that are independent of location. [Improved communications at the local level are equally important, but cannot substitute for the NREN and are not discussed here.]

- to support curriculum reform and restructuring projects.

The best way to reach students is through engaged, learning teachers (Riel, 1992). Networks are an enabling tool with the potential to engage teachers, and help them to continue their own learning, by providing a means for technologically-enhanced communication to fit into their working day.

- to conduct student collaborations.
- to connect with mentors and supporters: subject matter specialists, volunteers from industry, academia and the community, educational researchers, vendors and information providers, publishers, etc.
- to obtain access to information resources.
- to create ongoing research and scholarship opportunities, and to foster "communities of interest."

Constituencies of the NREN: With whom and what do educators need to connect?

- Other educators and relevant information resources. Teachers need easy and reliable contact with other members of the educational community, as well as access to information resources. The structure of classroom work and the school day make it very difficult for teachers to use telephones for professional contacts; computer networks provide this access without interruptions to classroom instruction.

Many K-12 practitioners use networks at present, and there is great potential for expanding their number through the NREN; but the realization of this potential is by no means assured right now. There have been a multitude of fragmented, isolated networks serving K-12. In this situation, what you connect to often has defined who you can connect with, or what information you can obtain.

Equal access to networking provides equal opportunity to access information, sources and services reachable over the networks.

Assuring access from any connected educator or student to every other educator does not mean that restricted-access services would disappear; but such services should ideally be built upon an internetworking resource base and allow the user broader connectivity options as well. Some present arguments within the K-12 community about the uses of networking deal with this question. There are valid educational purposes for which a dedicated conference with a simple interface and limited access is optimal. However, in principle educators should have

access to other educators, and access to information resources, without such access being limited by the communications tools they use.

- potential collaborators, mentors and resource people, including professional and disciplinary societies involved with K-12 education both directly and indirectly.
- some argue for extension to programs of adult education, worker retraining, or lifelong education; or to retirees and other members of the larger community that is the setting for K-12 education (NPTN, 1991; Odasz 1992).

The eventual constituencies of the NREN could include at least all K-12 educators and potential collaborators in academia, business and industry, public libraries and information and other resource providers, and arguably others in the community. Certainly, K-12 educators believe that interested community members and those wishing to support education should not be excluded from access: for instance, both Virginia's PEN (Public Education Network) and TENET (Texas Education Network), dedicated K-12 networks provided with state funding, allow community members with a demonstrable interest in education to obtain an account. In these states, and potentially in many others, a synergy is developing which is providing an infrastructure for a public network that could eventually encompass a substantial proportion of the states' population (see Connie Stout's description of TENET in Attachment 3).

The extension of the "learning community" to the community at large is supported in the goals of the America 2000 proposal (U.S. Department of Education, 1991).

Services of the NREN. The NREN, to K-12 educators, serves a primary function as "connective tissue" for a communications infrastructure allowing every educator potentially to reach every other educator.

Access to information resources is another primary function of the NREN. In this connection it is worth pointing out that all government agencies who provide information to the public should be connected to the NREN so their information resources can be reached by the whole educational community.

Some educators argue, further, that certain curriculum and subject areas should have subject matter explicitly supported for inclusion in the NREN. Peter Copen, for instance, on behalf of the I*EARN network and projects, asks that "..the NREN accepts and validates the use of the network for work by students (and others) that has a humanitarian focus -- for people and the environment" (Copen, 1992).

In order for this technological infrastructure to reach its full potential and perform communications and information access functions, the NREN needs to

provide access to current networks and resources serving K-12 education (see Attachment 2. for a representative listing), without necessarily attempting to replace them or substitute for them.

Supporting these primary functions through services on the NREN implies:

- providing a means for easily locating colleagues;
- locating resources to support practitioner orientation and training;
- identifying collaborative projects for educators, classes and students;
- developing and sharing curriculum and best practices;
- supporting communication and information for the leadership, management and supervision of K-12 networking, and
- developing tools to support the formation of communities of interest.

As user access resources and interfaces improve over the next few years, and as the trend toward services that exploit packet-based client/server design philosophies solidifies, services based on the NREN protocols' capabilities for file transfer and remote login will move from active exploration to extensive use in K-12 education. As connectivity increases, more sophisticated services now being tried on the NREN on an informal or experimental basis (for example Internet Relay Chat, video broadcast, use of images or multimedia documents, or access to specialized computers and other instruments) will become a significant part of the dialogue about K-12 networking priorities.

NREN structure. K-12 educators support the notion of an open, distributed structure for the NREN. This permits state, regional and local groups to contribute to the system, allows for decentralized location and management of collaborations and information resources, and encourages communities to form on the basis of curriculum areas, disciplines or shared interests in addition to location.

Possible management models to apply to NREN development

It is already clear that a mix of state, regional, community, public and private groups will play a part in providing networking resources and connectivity to K-12 education. The mix of groups at present includes state educational authorities, university systems, professional associations, commercial enterprises, regional networking groups and individuals working alone or in voluntary associations. Thus a sensible management system might consist of a central body that provides essential policies, standards and coordination while allowing most details of management to be distributed among service providers and users. Such a system of independent networks might be managed by a public corporation modeled after the Corporation for Public Broadcasting; or alternatively by a consortium of public and private, state, regional and national service providers. State educational entities and K-12 educators should be actively represented in the network management structure, as should other user groups.

Congressional questions

1) **What mechanisms can we suggest for providing operating funds for the maintenance and operation of the NREN?**

- User fees are appropriate, and studies of alternative ways of structuring them should be conducted. Fixed-price strategies which fit school budgeting systems are a better alternative than usage-sensitive pricing strategies.

Fees should be uniform across geographical areas, insofar as possible. User fees should be flat (i.e., a fixed price for a time period), based on anticipated total usage or bandwidth, and not dependent on actual usage: usage-sensitive pricing structures make it difficult for schools and districts to budget in advance. State or local subsidies are to be encouraged, as are Federal subsidies for groups whose participation might need to be stimulated.

- Commercial firms with an interest in education should be encouraged to use the NREN. As available, bandwidth on the NREN backbone (the current NSFNet) should be provided for commercial connections, with higher user fees for such connection used to keep access costs for educators as low as possible.

- As backbone traffic is opened to any entity, whether commercial or not, with a substantial interest in education, limitations on usage imposed by the existing Acceptable Use policy will become unnecessary; over time, such limitations should be relaxed considerably or removed altogether. For K-12 educators, local and regional groups will develop access and use policies in accord with their mission.

2) **What should be the future operation and evolution of the NREN?**

NREN operational management should focus on:

- centralized system support, and research aimed at reducing system support requirements;
- expanding (i.e., increasing redundancy and reliability) and speeding up the NREN backbone capabilities;
- improving network-based information provision to both network operations and user services areas;
- experimental and pilot projects to provide services to new communities and to extend the range of services to existing communities (this could include low-cost connectivity options, improved interfaces, support for integrated information services); and
- coordination of procedures, standards, and use policies in collaboration with user communities and network management groups.

As indicated earlier, K-12 educators believe the NREN will evolve toward a truly national (in fact, global) information infrastructure (NII), with much greater

extension of connectivity and a much broader range of information service providers. We believe the NII should be a shared marketplace, both in the sense of a conceptual "marketplace," a medium where ideas compete, and in the strict economic sense, with competing service providers.

3) **How should commercial information service providers be charged for access to the NREN, and how should users be charged for commercial information services?**

Commercial information providers should be charged a subscription-based access fee based on anticipated usage volume, and the fee should be renegotiated periodically on the basis of actual usage.

Users should be able to subscribe to commercial information services and resources over the network. Again, K-12 educators believe that such subscription fees should not be usage-sensitive nor be so priced as to limit educators' access.

4) **How feasible is it, technically, to allow commercial information service providers to use the NREN?**

We believe it is perfectly feasible. What is more, educators believe it is necessary. It is important to encourage growth and competition in this new marketplace. We believe that the involvement of commercial information service providers will drive evolution of educational utilization of the network and will directly influence curriculum change. In addition, financial support provided through business fees will enhance educator connectivity and access to resources.

5) **How do we protect copyright of material distributed over the NREN?**

- From the K-12 viewpoint, an essential element of such protection is education. Educators are eager to participate in efforts to educate new users about their responsibilities (and the penalties for their violation) and to train them in appropriate practices.

6) **What are appropriate policies to ensure the security of resources available on the NREN, and to protect the privacy of users?**

This issue has a component of special concern for K-12 educators. In addition to protecting the privacy of users on the NREN and the security of resources, educators are held responsible for the access of minor students to materials held to be offensive by community standards.

- CoSN advocates that policies put in place for K-12 networking call for the inclusion of responsible adult educators in decisions concerning network access and usage for students. For instance, student accounts that include Internet access should be obtained through (and their nature specified by) a local adult who will be accountable for student use of the resource. Group accounts reduce accountability and are to be discouraged. As another example, mailing lists or conferences for students will have an

adult moderator, or an adult coowner and supervisor if a student is the moderator.

Security on the network, and protection of privacy, depends (among other things) on appropriate behavior by users. Schools can include in the curriculum units on appropriate use of network resources, and can require students to follow rules for appropriate use under penalty of losing access privileges. Students (and their parents) may be asked to sign agreements acknowledging a commitment to abide by appropriate use rules.

Additional policy areas and issues

User training and user community development.

- The provision of training to users is an essential element of full use of the NREN by K-12 educators.
- Support for educator training in NREN use should be provided by subsidies from the Federal government, possibly through highly leveraged grants to state and local service providers and user groups.
- Support to allow K-12 educators to adapt the NREN to educational purposes is also essential.

Elements of such support might include: workshops with curriculum and administrative groups on adapting NREN technologies for curriculum reform and school restructuring; online information resources (such as Frequently Asked Question lists and "ask the expert" mailing lists); sabbatical fellowships or released-time grants to educators expert in networking, with the explicit intent of allowing them to explore the networks and create resources on them.

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Attachment 1. Detailed description of the organization.

Officers and Members of the Board of CoSN

Chair: Connie Stout, Program Director, Texas Education Network
Vice-chair : Gwen Solomon, Director, The School of the Future, New York NY
Executive Director: John Clement, Director, EDUCOM K-12 Networking
Secretary-treasurer: Art St.George, University of New Mexico, Albuquerque

Members of the Board:
Robert D. Carlitz, Professor of Physics, University of Pittsburgh, Pittsburgh PA
Woody Kerkeslager, Vice President - Government Affairs, AT&T, Basking Ridge NJ
Jim Luckett, Executive Director, NYSERNet, Syracuse NY
Jan Meizel, Network Manager – Teacher, Davis Senior High School, Davis CA
Frank Odasz, Director, Big Sky Telegraph, Western Montana College, Dillon MT
Paul Reese, Teacher, Ralph Bunche School, New York NY
Bill Schmid, Director, Florida Information Resource Network (FIRN), Tallahassee FL
Bob Tinker, Chief Science Officer, TERC, Cambridge MA
Gary Watts, Senior Director, National Center for Innovation (NCIN), National Education Association (NEA), Washington DC

The Consortium for School Networking is an institutional membership organization with individual affiliate members. There are three categories of members:

- Professional: Institutions and organizations from the public and private non-profit sectors with an interest in K-12 education are eligible for Professional membership. This includes, but is not limited to: all educational institutions, both public and private; libraries and museums; regional, state and national departments of education and other governmental agencies; education-related organizations such as research institutes; and telecommunications organizations and agencies.

- Business: Corporations, trade associations and other organizations from the for-profit sector with interests in K-12 education and networking are eligible to be business members.

- Individual affiliates: any individual interested in K-12 education not representing a professional or business member organization may join the Consortium as an individual affiliate.

The Consortium is incorporated in the District of Columbia and registered with the Internal Revenue Service as a 501 (c)(3) nonprofit charitable organization.

Member organizations:

California Technology Project	Educ. Technology Center of British Columbia
EDUCOM	Florida Information Resource Network
National Education Association	TERC
Texas Education Network	
Pennsylvania State University	Rochester Institute of Technology
Seton Hall University	State University of New York – Albany
Western Montana College – BST	
MERIT Network, Inc.	NYSERNet
Apple Computer, Inc.	AT&T
Digital Equipment Corporation	IBM Corporation
Novell, Inc.	

As of 8/15/1992, in addition, CoSN had approximately sixty individual affiliate members. The CoSN electronic discussion forum cosndisc had over 300 participants.

Attachment 2. A sampling of networks and resources serving K-12 education. Entries accessible over the NREN are identified.

Please note: this is a very limited sampling, especially of K-12 resources and mailing lists.

State and regional educational networks.

California Technology Project -- Calif. Online Resources for Education (CORE) -NREN
Florida Information Resource Network (FIRN) -NREN
KC ShareNet (greater Kansas City area) -NREN
GCEduNet (Georgia College, Georgia)
NEDCOMM (New Mexico Educational Communications) -NREN
NYCENET (New York City) -NREN
TENET (Texas Education Network) -NREN
Virginia's PEN (Public Education Network) -NREN
WCU MicroNet (Western Carolina University, North Carolina)

"Affinity" group-based networks and bulletin boards.

Big Sky Telegraph (Western Montana College -- throughout Western U.S.) -NREN
Cleveland Free-Net and other Free-Nets -NREN
ENAN -- Educational Native American Network
FrEdMail (Free Educational Electronic Mail) (Al Rogers -- FrEdMail Fdn.) -NREN
K12-NET (subset of FidoNet) -NREN

Regional networks and commercial connection providers.

BARRNet (Bay Area region) -NREN
CERFnet (Southern California) -NREN
NYSERNET (New York) -NREN
World.std.com (Boston -area) -NREN
SURANET (Mid-Atlantic and Southeast United States) -NREN

Commercial systems providing educational services.

America Online (service to professional associations) -NREN
AppleLink (Apple Computer; Apple Global Education (AGE)) -NREN
AT&T Learning Network
PSI-NET (People Sharing Information Network) (IBM)
Specialnet (GTE); also EduNet, other services

Research and public-service-based projects.

PBS Learning Link (Public Broadcasting System) -NREN

IEARN (International Education and Resource Network, Copen Fam. Fund) -NREN
NERSC - National Energy Research Supercomputer Center, Department of Energy and Cray Research (access to supercomputer dedicated to K-12) -NREN
NGS Kids' Network (National Geographic Society)
SuperQuest (national competition for computing cycles and training) (projects at Cornell, University of Alabama, University of Illinois-Urbana/Champaign, University of New Mexico, others) -NREN
TERC (Global LabNet, Star Schools, other projects)

Assorted lists and resources of special interest to K-12 education.

EDUC-L Education Mailing List -NREN
ERIC Database (Education Resources Information Clearinghouse) (direct search through Syracuse) -NREN
ERIC Digests (WAIS resource - Wide Area Information Server -- at SURANET, UNC-Chapel Hill) -NREN
KIDSNET (mailing lists for educators, students); also includes archive as a WAIS resource on CICnet) -NREN
K-12 software (WAIS resource) -NREN
NASA Spacelink -NREN
NEWEDU-L New Paradigms in Education Mailing List -NREN
U.S. Department of Education Office of Education Research and Improvement Bulletin Boards

In addition, many of the networks and resources listed earlier have extensive lists of curriculum materials and maintain issue-oriented mailing lists.

Attachment 3. TENET - Texas Education Network, by Connie Stout
[Text available; to be inserted here later]

Attachment 4. Internet/NREN - THE community learning network (A community of communities) by Frank Odasz, Big Sky Telegraph
[Text available; to be inserted here later]

TENET
Texas Education Network
by Connie Stout

Texas is a diverse state with more than 1,050 school districts that range in size from student populations of more than 190,000 to less than 10. More than 3.2 million students and over 200,000 teachers, support staff, and administrators work in Texas schools each day. The Texas Education Agency has long recognized the need for effective and low-cost communication among and between the more than 6,400 public school campuses, the 20 regional education service centers, colleges and universities, and other educational professionals in Texas. Since 1985, the Agency contracted for an electronic network with THE ELECTRIC PAGES, a commercial network operated by GTE. The TEA-NET (Texas Education Agency Electronic Network) provided electronic mail and bulletin boards to approximately 650 of the administrative offices in school districts in Texas. In November of 1988, the State Board of Education adopted the 1988 - 2000 Long-Range Plan for Technology. Incorporated within the plan was a request to establish a k-12 statewide communications network to link all school districts and their campuses. The requests were incorporated into Senate Bill 650 which was passed by the 71st Legislature. Senate Bill 650 (Section 14.042 of the Texas Education Code) authorized the establishment and maintenance of an electronic information transfer system, the Texas Education Network (TENET).

The Agency evaluated alternatives for the acquisition of services necessary for the creation and maintenance of an enhanced electronic communications network capable of transmitting information among and between the members of the public education system in Texas. Agency staff conducted a nationwide review of telecomputing networks, telecomputing hardware, software and training. The telecomputing network reviewed included: proprietary networks such as GTE, CompuServe, AT&T, AppleLink, America Online; statewide networks such as Pennsylvania's PennLink, Florida's FIRN, Virginia's, VA.PEN; and, other "grassroots' networks like FrEdMail and K12 Net. In addition, input was solicited from teachers, administrators, the regional service centers, and the educational organizations that had been utilizing the TEA-NET network.

Review of existing and proposed networks resulted in the formulation of three essential requirements:

* Network standards which would allow this network to scale as growth and new advanced technology demanded.

* Network standards based upon TPC/IP and OSI protocols to permit inter-operability between networking systems.

* Network standards for UNIX based operating system to permit multi-tasking for educators utilizing the system.

Following a Request for Proposal process, which did not result in an award, the staff met with staff at the University of Texas System to consider using the Texas Higher Education Network (THEnet) as the network carrier. THEnet, currently providing connectivity to the majority of the major post-secondary institutions in the state, is a NSF regional network connected to thousands of other networks worldwide through the Internet. Analysis of the available networking alternatives showed that an approach based upon interagency contracts with The University of Texas System for telecommunications services was the option which would realize both the most cost-effective system and increased services to Texas K-12 students and educators. Several other states including Virginia, California and Florida are considering adopting similar models to bring connectivity to their public school educators.

The configuration of TENET is based upon a distributed design. The local hosts are a series of message processing and storage units (MPS) which are Unix systems with 24 Megabytes of memory, 1 Gigabyte of disk, and backup tape. The University of Texas System Office of Telecommunication Services houses one system which functions as the central host. Local phone access as well as 800 line service is provided in Austin. Seven other message processing and storage (MPS) computer systems are distributed across the state at university sites to store messages and support applications.

The Computation Center of The University of Texas at Austin provides help-desk services for the public education community in the use of the TENET through the expansion of existing THEnet information center operations. Applications on the system are designed and implemented by The University of Texas System Office of Telecommunication Services in cooperation with the Texas Education Agency.

By contracting with the existing distributed network of The Higher Education Network (THEnet) public school educators are brought onto an electronic network with rich resources which include online library catalogues, educational computer archives, public databases, and instructional hypermedia libraries. The distributed computer system, when fully implemented, will permit local access from fifteen major metropolitan centers in the state. Toll-free lines are available to educators located outside the local calling areas. As the traffic increases on the network, local access will be expanded through additional nodes. Utilizing THEnet also recognized and supports national efforts to link higher education with public education and offers the potential for expanded access and extended services over the network.

Another key component to success networking involves adequate training and support. The Texas Education Agency worked with the Texas Center for Educational Technology to design curriculum for course delivery through a mix

of expertise available at the Center, other universities, and regional education service centers. Training on the Texas Education Network is now being conducted statewide through the 20 regional education service centers through a training of trainers model.

The analysis of the interagency approach realizes the following advantages to the K-12 community:

* Utilization of an existing tax-supported network.
* Increased access to other state agencies serving public education.
* Increased access to the wealth of resources available in the university community.
* Training designed to meet unique needs and resources available to the state education community.
* Access to network services at minimal cost to Texas educators.
* Rapid implementation of networking services.
* Extension of the potential use of the system to include curriculum based projects as well as administrative projects, thus expanding the benefits of the network to teachers and students.

The basic components of the TENET network include:

* Electronic mail: The TENET network utilizes the PINE mailer designed by the University of Washington. The mail service extends beyond the community of educators in Texas to educators using other state, national, and international networks.

* Electronic bulletin board: The bulletin board, with capabilities for indexing and searching, makes it possible to post information from a many locations within the state for educators to access.

* Electronic conferencing: Conferencing differs from a bulletin board in that it establishes a climate of interaction thus allowing educators from different locations to discuss important topics.

* Electronic Databases: Electronic databases contain information accessible by all Texas educators.

* Workstation communication software: Software which will permit educators to edit and prepare files for transmittal, as well as request or send information to and from bulletin boards, conferences and databases, prior to actually connecting to the network, is an integral part of the design. This will minimize the time each educator will be directly connected to the network and will reduce the cost of telecommunications time. Currently the TENET network is utilizing Kermit. However, there are plans in place to customize the communication software.

* Telnet: A capability which permits resource sharing between networks is an important part of the network design which permits educators to have access to many resources on the Internet.

* Remote file transfer - ftp: This capability permits sharing computer files from many networks.

The benefits of the electronic network extend beyond just electronic mail and computer conferencing. The network supports collaboration between K-12 educators and post-secondary educators. For a nominal fee of $5 per year and no online cost, Texas administrators, teachers, and students have the capability to extend their communication to thousands of educators and students throughout the United States and countries around the world. By using the TENET network, not only are they able to utilize many major university libraries such as the University of Texas, Texas A&M, University of California, University of Hawaii, and University of Colorado, but they also have access to resources such as NASA's Spacelink in Huntsville, Alabama. By utilizing NASA, teachers are able to communicate with astronauts and scientists as well as retrieve classroom materials for their own use. Other resources on TENET include UPI news, CNN Newsroom lessons, and Newsweek Lessons. In addition, by the beginning of 1992, the network will feature an online encyclopedia and a study skills guide.

The capabilities of the TENET network also include electronic mail gateways to many other major networks. Some of these networks include AppleLink, CompuServe, MCI mail, AT&T mail, FrEdMail and Fidonet. These capabilities are available to Texas educators without an additional charge.

Forty Texas educators, representing a broad range of expertise, were selected as TENET Master Trainers. They received training in three areas: use of the network, conference moderation, and curriculum integration. Twenty of the trainers were from each of the educational service centers. The additional twenty trainers represented school librarians, math supervisors, computer coordinators, and representatives from professional organizations such as the Texas Computer Education Association (TCEA), the Texas Association of School Boards (TASB), the Texas Association for Supervision and Curriculum Development (TASCD), and the Texas State Teachers Association (TSTA).

The TENET network uses USENET conferencing software on the system to create Texas specific conferences. All of the TENET conferences are moderated by educators so that as telecommunications is introduced into classroom, an understanding of how to create an environment for learning and network etiquette can be established. All of the educators functioning in the role as a moderator on TENET will have had training to help nurture and guide conference participants as they begin to explore the use of telecommunications.

Since the network began operation on August 26th, more than 9,800 users are accessing TENET. They average 10,500 logins per week and more than 75 new users apply for an account each day. Telecommunications projects are an ongoing part of many Texas educators. One such project is an example of how telecommunications can bring students, teachers and members of the community together through collaboration across state and national boundaries. This effort brought students, teachers, and community members in El Paso closer to their peers in the East Texas community of Sour Lake. During the past several years, the Agency has provided support for other such projects tailored to specifice needs by classroom teacher. Examples of such projects include projects which enabled handicapped students to share their writingn with other geographically dispersed students throughout the state and nation. In addition, the Induction Year pilot supported new teachers as they were inducted into the profession of teaching. Through a collaborative effort with educators in the state, the Agency supports the use of telecommunications as an instructional application which extends learning beyond physical barriers and time constraints.

Internet/NREN - THE Community Learning Network
(A Community of Communities)

by Frank Odasz, Director of Big Sky Telegraph
Western Montana College

The online medium has great promise for providing an unprecedently superior method of matching needs and resources worldwide. The opportunities for collaborative work between physically distant persons are unlimited, but the medium is new and different enough to require carefully planned training for all members of society.

Survival in the information age requires K-100 lifelong learning for all members of society. At this time, the Internet cannot technically handle the volume of all members of society having realtime access, despite the growing awareness of the Internet rapidly becoming THE education and global trade link worldwide. Deciding to refuse this vital access to a segment of our society could have disasterous human consequences for those individuals.

Maximum connectivity is required to fulfill the potential of the Internet. Distributed conferencing COULD allow ALL members of society access to Internet information exchange, as batched calls from free, public access community systems would economically be transferred during the low-usage nightly hours. Thousands of such systems are already operational. Communications between people may be needed more than the transfer of huge graphic files and bandwidth intensive realtime use of the Internet. The Internet in its present form CAN adequately serve as a transfer medium between local and regional systems through automated nightly polling calls.

Revealing solutions to the problem of mass access would be unveiled if a study were done on the value/volume ratio of the highest value resources (infovalue) and capabilities the Internet offers for learners, entrepreneurs and resource providers. If most high value information were primarily textual and average information requests could be met with merely pages, vs hundreds of pages, then distributed conferencing should economically provide for most needs. Direct realtime access may not be necessary for most information sharing tasks.

Infovalue assessment needs to be done on benefits and uses best suited to both realtime access and distributed conferencing. The high volume files and instantaneous access might not match the high infovalue needs meetable with distributed conferencing. This is a vital point where economics dictate the options and highbandwidth lines or expensive terminals are not available. The evolving ever-faster modems make distributed conferencing increasingly attractive.

Once the infovalue/volume ratio is fixed, the economics/ infovalue/volume would make the only practical directions forward, very clear, and common sense. Necessary, are funded ongoing demonstrations of all levels of Internet access, for all types of community-wide needs, to allow the most efficient models to evolve in the economically competitive race for maximum information value for minimal training/effort.

Public resistance to this medium testifies that the training effort/connections cost /infovalue ratio is yet unbalanced.

Effective use of realtime access may best be left initially to librarians who can navigate the complexities and mentor citizens' more complex information needs. Eventually, home realtime access, and the citizen teleliteracy to benefit from such bandwidth, will evolve, as high value information becomes available through better user-friendly interfaces and the technologies for low-cost realtime access dissemination improve.

What appears inevitable in our joint battle to stay afloat in an age of infooverload, are better ways to share our areas of expertise more broadly, because no one can stay current in all areas. This is the human analogy to database access.

The NREN has opportunity to offer a combination of connectivity options, extending into the home, and involving every citizen through a combination of high bandwidth direct access and distributed conferencing using local and regional systems.

The proliferation of low-cost microcomputers and notebook computers testify to the individual empowerment of computers and telecomputing. The proliferation of individual telecomputing power may well become the basis for national economies and power.

Each community needs a system for enjoying local benefits of telecomputing for civic discussions and dissemination. Local bulletin board type systems can provide free local access to all community members. An online "community of communities" can be created, multiple conferences being shared between consenting systems, and the Internet, on any topic through only minutes of nightly connect time.

We share the assumption that in the information age, connectivity would make a difference, but we've not studied the appropriate levels of connectivity against the value of the benefits of the various types of information accessed. Rather than access to file archives, graphics or databases, we need connectivity with each others minds, ideas, and hearts.

Today, distributed conferencing can keep costs within feasible range, allowing K12 students and teachers to exchange email with anyone on the Internet, and order files via FTP.

Free local home access becomes feasible using local systems with distributed conferencing, allowing access for continuing education, discussion of local issues and system customization to suit local needs.

The issue becomes the training and promotion of successful models. Identifying the most beneficial telecomputing uses and related info for teachers, businesspersons, and community members and demonstrating how resources from the Internet can be reposted locally.

The challenge is bringing the advantages of telecomputing to as many citizens as possible, the risk is viewing the NREN as being for an elite group, only. Without using distributed conferencing and local/regional systems, the NREN may not benefit most taxpayers.

Citizen teletraining for political acceptance of high bandwidth systems requires teachers and citizens must see the value firsthand before becoming economically committed. They need local systems as the first small step toward acceptance of the medium and eventual high bandwidth systems.

THE NATIONAL RESEARCH AND EDUCATION NETWORK

A Position Statement prepared for the
Monterey NREN Workshop by the

EDUCOM NETWORKING AND TELECOMMUNICATIONS TASK FORCE

I. ORGANIZATION

EDUCOM is an association of American colleges and universities with common interests and programs in the fields of computing, networking and information technology. Membership currently stands at five hundred and seventy institutions. The EDUCOM Networking and Telecommunications Task Force (NTTF), is composed of forty-five EDUCOM members and twelve corporations and organizations with a special interest in the development of computer based networking for research and education.

II. NATURE, GOALS AND CONSTITUENCY OF THE ORGANIZATION

NTTF represents the networking views of a majority of the research universities in the United States. It has taken public policy positions on behalf of this constituency for a number of years. Selected NTTF publications are listed in the Bibliography.

III. LONG TERM NREN MODEL

A. Background.

The legislative history of the NREN began as a result of Congressional interest in the improvement of computer networks to support research challenges of national importance, such as climate change, manufacturing design and medical imaging. Further study and testimony presented during Congressional hearings revealed that the potential social and economic contributions of advanced networks were both broad and deep, including:

- advances in research resulting from the networking of large scale computational resources, such as supercomputers and databases, together;
- support for scientific and other forms of collaborative work through real time network facilities which tie individuals in geographically distant locations together;
- integration into educational curricula at all levels of computer based instruction and network access to information resources;
- opening of vast archives of federal technical, scientific and economic data now stored in electronic but inaccessible form;
- creation of nationwide citizen access via the network to educational programs, to public information of all kinds, and to commercial information resources related to both work assignments and to recreational activities.

As enacted, the High Performance Computing Act of 1991 (Public Law 102-194), creates a federal NREN initiative designed to "provide researchers and educators with access to computer and information resources and act as a testbed for further research and development of high-capacity and high-speed computer networks."

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The intent of the NREN bill is to make progress on two objectives simultaneously:

(1) speed up the development of high performance network technology and improve the process by which the technology is transferred to the private sector;

(2) expand access to networked computer and information resources within the research and education communities.

A useful long term model for the NREN must address both the "process" goals related to development and technology transfer, and the "access" goals related to expanded use of advanced network technologies within research and education. These twin goals are complementary but their implementation requires a variety of tactical approaches within a single overall strategy.

B. NREN and National Information Infrastructure

As the public policy debate on the NREN has evolved over the last several years, it has become apparent that many of the goals envisioned for the NREN are equally applicable to the evolution of an advanced national information infrastructure (NII), which goes beyond the boundaries of the research and education communities. There has been little disagreement on the desired characteristics of the future information infrastructure:

- Ubiquitous, with universal accessibility for homes, businesses, and public sector organizations,
- Digital and broadband, able to support a wide range of integrated voice, video and data applications,
- Based on openly developed, interoperable standards,
- Containing adequate protections for individual rights,
- Market driven, with products and services primarily from the private sector.

The convergence of thinking about the goal-states for the NREN and the NII is shifting the focus of attention from what the NREN and NII *should be* to a debate over *how to get there.* Significant areas of disagreement on "process" exist, including:

- federal NREN/NII programs and levels of investment,
- governmental policy/regulation setting and protection of the public interest,
- Standards development and adoption,
- Relationship between the NII and communications industry deregulation.

C. NREN/NII Process Issues.

We are entering a period in which the one hundred year old narrowband voice telephone network will be replaced rapidly by a new worldwide computer/communications infrastructure based on broadband packet switched networks in which voice, data and video signals are fully integrated to meet varying customer needs.

The realization of an integrated applications environment based on such a broadband infrastructure will require a coordinated program of technology investments, with assistance from government, from research and education, and from industry.

Developmental contributions to advanced networks, in the form of basic research, applied development, pre-commercial testing and deployment, and technology transfer to

the private sector, are all important parts of a national advanced networking strategy. A concerted effort, based on work by individuals and organizations from many parts of society, both public and private, will be necessary. The working out of an effective NREN/NII partnership, one capable of addressing and resolving the policy and funding barriers noted above, will be an important part of the effort. In the long run, the computer, communications, information and entertainment industries must be the primary source of the trillion dollar investments in hardware, software, databases and facilities which will provide network services. The key to unlocking investment capital is creation of a strategic NII plan and the leadership to pursue it effectively.

D. Access Issues

The networks within the NREN/NII system will have diverse characteristics, including differences in technical implementation, types of use, and business orientation. The following cases represent typical situations that will be encountered:

(1) Prototype networks that are open to a limited class of sophisticated users on a "try this at your own risk" basis, with the intent that such use will assist in the development process. Funding for this case will likely be directly to the developers as part of a program grant or contract. No recharge of costs will be feasible given the character of the network and its use.

(2) Pre-commercial networks or network database applications, which have passed the prototype stage, but for which the full scope of use and of commercial marketability are unknown until a base of users can be established. This type of network service is particularly attractive to public sector institutions because it matches their mission goals of improved education, research and public service. This constituency is willing to take risks and accept less than fully commercial standards of user support and reliability in pursuit of their vision of better instruction and advances in research. Because the chosen technology is in transition from development to commercial status, and because the users are tax supported institutions, normal cost recovery methods are not feasible. Instead, a mix of grants from sponsors and fund allocations from within the institutions will be used to cover service costs. This is already the case with networks such as NSFNET.

(3) In time, services which successfully emerge from the development and pre-commercial process are adopted within the private sector and generate a return on costs incurred and capital invested through market pricing mechanisms. Ideally, the services are offered by more than one source, thus giving users a choice and ensuring a competitive marketplace.

This discussion illustrates the diversity of the services environment within the future NREN/NII system and the fact that no single funding strategy will be suitable for the network system, its services, and its users.

With respect to overall funding responsibilities for network access and services, the NTTF has long advocated a cost sharing arrangement for the NREN in which sponsors and funding sources for the components of the NREN provide a fair share of necessary funds.

- The principal responsibility of the federal government will continue to be the provision of funding for R&D for advanced and pre-commercial networks, and the provision of operating funds for networks which are mission related to programs of federal agencies, their contractors and grantees. A continued high level of federal investment in the development and pre-commercial use of advanced network facilities and services is absolutely essential to a national strategy for competitiveness in this key economic sector.

• The principal responsibility of state and local governments will be to ensure that funds are provided for network operating costs to meet the requirements of all levels of education and the general information needs of the public.

• The principal responsibility of the private sector will be to invest in the commercial applications of advanced network services and to support a robust, affordable and widely accessible advanced communications infrastructure for the United States.

IV. HISTORICAL MODELS THAT COULD BE APPLIED TO THE NREN

A transportation analogy is frequently used for the NREN, substituting high speed digital bits of information for the canals, highways, and railroads of earlier eras. In each of these prior efforts, the federal government played an important initiating and sustaining role.

The NTTF looks forward to an opportunity to assist in developing an appropriate management and oversight structure for the NREN that includes participation by major constituencies and stakeholders. The technology of the network itself, already partially realized in today's Internet, will permit effective communication among managers and technical experts in geographically distant sites and thereby promote an organizational structure of minimum size and maximum effectiveness.

It may be useful to guide new management proposals with a few basic principles:

- Ensure that the recently created federal coordination office for HPCC functions effectively.
- At the federal level, set general guidelines for the NREN, with provision for distributed implementation and funding.
- Use available federal funds for maximum leverage in meeting goals of the network through cost sharing and partnership arrangements.
- Create a participatory governance structure for the NREN that reflects a balance of public and private sector values and needs.

Further comments on NREN management may be found in section VI (A) below.

V. COMMENTS ON NREN REPORT QUESTIONS

Section 102(g) of the Act requires the Director of OSTP to provide the Congress with a report dealing with the following questions concerning the NREN. The questions are sequenced here in approximate order of importance to NTTF members.

A. *"(2) the future operation and evolution of the Network."*

The NTTF recommends that the Congress, in its oversight hearings on P.L. 102-194 and in its hearings on the pending information infrastructure bills, S.2937/HR5759, explicitly adopt a model for the NII in which the NREN program plays a key role of energizing and leveraging public sector resources to assist in the realization of an advanced information infrastructure for all Americans that also meets research and education needs for access and services.

B. *"(1) effective mechanisms for providing operating funds for the maintenance and use of the Network, including user fees, industry support, and continued Federal investment;"*

The NTTF believes that existing funding mechanisms, including governmental contracts, grants, cooperative development agreements, and standard services procurements, are adequate for the needs of the NREN if used appropriately. The more important issue is establishing priorities for types of support and obtaining the requisite funding levels. See discussion above in section III (D).

C. *"(6) appropriate policies to ensure the security of resources available on the Network and to protect the privacy of users of networks."*

This general issue has been extensively studied in the last five years. The most comprehensive treatment is in the 1990 report of the Computer Science and Telecommunications Board of the National Research Council, "Computers at Risk." The report contains a number of policy recommendations for federal action which are endorsed by NTTF.

The Computer Security Act of 1987 provides legal coverage for many specific situations which arise on federal networks. A number of states have adopted similar protections for their jurisdictions.

Personal privacy on the NREN is a more complicated issue for a number of reasons. First, the general provisions of "common carriage" as contained in the Communications Act of 1934 were intended to deal with situations in which individuals were conversing with each other over a dedicated analog voice circuit. Computer networks, by contrast, are normally not connecting individuals in real time over dedicated circuits. They are transferring packets of information between two computer systems over transmission facilities which are generally in shared use with other systems. In the future, when broadband, multimedia networks such as the NREN emerge, the network may be exchanging voice, video and data packets between two users simultaneously, thus further confusing the differences between principles applied to low speed voice circuits and those needed for high capacity shared facilities.

Another privacy complication results from the fact that many maintenance and error correction techniques used with the Internet and its connected computer systems require the examination of individual packets and computer files associated with network services.

The simplistic application of common carriage principles to NREN privacy is likely to worsen the situation, not improve it. As noted above in section C, the revolution in telecommunications from an essentially voice only national system to an international broadband, multimedia system of networks, both public and private, will require substantial updating of the U.S. Communications Act. Appropriate experts should be tasked to develop a definition of personal privacy in such a networked world and to recommend revisions in our law where necessary to meet new requirements for the protection of individual rights.

D. *"(5) how to protect the copyrights of material distributed over the Network;"*

Infringement of copyright is not an issue uniquely associated with computer networks. However, a worldwide network with virtually instantaneous transmission of entire volumes of material previously distributed in book form does magnify the potential for infringement manyfold.

Areas for abuse include theft associated with intercepted transmission of copyrighted plain text, as well as copying or redistribution of copyrighted material by the recipient which exceeds the limits of legally permitted fair use. There are a variety of means in use and becoming available, such as encryption, to deal with the first type of abuse. The second type is more difficult, because it involves individual actions occurring in a variety of organizational and geographic settings.

Since this general issue has already been raised in connection with revisions to the Copyright Act, it should continue to be dealt with in that context, i.e., as a special case of copyright protection and enforcement, rather than as an area in which new legal sanctions associated with the NREN are enacted. In saying this, the NTTF wishes to emphasize that it regards protection of intellectual property as a right and responsibility that is central to institutional integrity and ethical behavior by members of the university community.

E. *"(4) the technological feasibility of allowing commercial information services providers to use the Network and other federally funded research networks;"*

Many commercial information networks are already connected to the Internet and the number is growing rapidly. Technological feasibility is not a significant issue with today's technology, although it may cause some problems as broadband services are introduced during the next five years. The expanded market for information services that will be generated by broadband, multimedia transport on the network will justify the investments that the private sector providers will need to make to upgrade their services.

Transport access across other federally funded research networks for commercial information providers should be subject to the normal procurement rules for network services for such networks. There is no useful distinction between agency acquisition, to meet mission requirements, of network transport services and network information services.

F. *"(3) how commercial information service providers could be charged for access to the Network, and how Network users could be charged for such commercial information services;"*

Commercial information service providers are already connecting to both public sector and private sector providers of Internet access. The financial arrangements vary, but are typically based on an annual fixed fee based on network capacity used.

Existing commercial information networks use a variety of charging schemes for their services to end users, including flat rates, variable rates, and combinations of the two.

In general, billing arrangements for individual network services subscribers are likely to continue to be adequate where the individual is paying from his or her own funds. There are many examples, such as Compuserve and Prodigy, where this works satisfactorily.

One troublesome area is where an organizational entity, such as a university department or library, is making the financial arrangements for access to information services on behalf of its faculty and students, whose individual use patterns are difficult if not impossible to predict in advance. Although this situation may be new to computer information networks, it is a common problem in many institutional and organizational environments. There is no generalized solution, nor any single network policy, capable of addressing the problem. It should be worked out on a case by case basis between providers and consumers, including the use of model agreements such as those being developed by the Coal'tion for Networked Information.

There is no reason for governmental involvement in pricing and cost recovery methods of private information providers. In fact, government intrusion into the pricing area might delay the development of this market. In the few cases where monopoly behavior might be a concern, the firms involved are (or should be) subject to existing restraint of trade laws, such as Wright-Patman and Sherman.

VI. OTHER IMPORTANT POLICY ISSUES

A. NREN Program Management Within the Federal Establishment

Since the first annual report required by the NREN legislation is not due for some months, it is premature to draw firm conclusions on the quality of program management that is being exercised. Until the creation in September, 1992, of the federal coordinatiojn office for HPCC, the administrative arrangements for the NREN were remarkably diffused for such an important program. At the present time, there continues to be a lack of identifiable accountability for program management and no clear statement of program milestones or commitments against which to measure progress. No effective arrangements for participation in program management by the non-federal constituencies of the NREN

have been established.

Remedial steps to improve NREN program objectives, management and accountability should be considered by the Administration and by the Congress in its next cycle of oversight hearings.

B. Network Subsidies

There has been controversy over the use of centralized agency or institutional funding to procure commercial network services, on the grounds that "subsidized" network services (i.e. unpriced to individual end users), will result in inefficient overuse of the services. This is not an easy issue to resolve, because the potential utility of individual end user decisions in a priced environment tends to be offset by the loss of buying power which any one user enjoys. Most governmental entities, and many institutions, have chosen to concentrate their information technology buying power in the office of a senior executive, and in some cases, to band together in cooperative buying arrangements for similar services. The use of internal recharge systems in such situations varies widely.

C. Network Acceptable Use Policies

Acceptable use policies began as a means to ensure that use of the federally funded portions of the Internet, chiefly NSFNET, conformed to the restrictions of agency program and appropriations language, which generally specifies that federal funds may not be used for purposes not included in program authorizations and agency enabling legislation.

Several characteristics of NSFNET have made it extraordinarily difficult for the acceptable use policy to function effectively. First, only a small part of the network is directly funded by NSF, namely the current T3/T1 backbone facilities, and even they are managed and operated by a joint venture under a cooperative agreement in which extensive cost sharing among the partners is taking place. The state and regional networks, and the campus and research site networks, which are part of the end to end services of NSFNET, are operated and almost entirely paid for by non-federal funds.

Second, in contrast to the mission oriented networks of most federal agencies, which largely connect federal employees and contractors, NSFNET has a specific program goal to provide network connectivity as broadly as possible within the education community, for purposes consistent with institutional research, education and public service missions.

Third, NSFNET and other federal networking programs have a program goal to assist in the transfer of Internet technology to the private sector and to encourage the growth of commercial Internet services.

The current confused situation includes a wide spectrum of views, the boundaries of which may be described as follows:

Advocates of a broad interpretation of acceptable use argue that all activities on campus networks that are permitted by institutional policies should be legitimate traffic on any portion of NSFNET (or the NREN). This includes access to and from commercial information providers since they are a normal part of institutional activities. It also includes connections between for-profit firms that are members of state and regional networks, since their membership contributes both programmatically and financially to the health of the overall network.

Advocates of a narrow interpretation of acceptable use argue that transporting commercial traffic over a fully federally funded backbone or network facility constitutes private gain at public expense and should be prohibited. They also argue that, pushed to its logical extreme, the broad interpretation argument would keep the federal government permanently in the network services business, which is inconsistent with commitments to move the technology into the private sector.

Congressman Rick Boucher, Chair of the House Science Subcommittee, has introduced legislation that would permit NSF to allow non-research and education traffic on NSFNET in circumstances where doing so would advance overall goals of the program. If passed, this relief would defuse the current situation and remove uncertainty that exists today among private sector information providers as to their ability to use NSFNET as an access method for their research and education clients.

The NTTF believes that an updated acceptable use policy is needed, one that is capable of being easily implemented in the diverse environments of campuses, and one that encourages rather than inhibits growth in research and education uses of the network.

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A. Organization

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ELECTRONIC FRONTIER FOUNDATION

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B. Nature, Goals, and Constituency of the Electronic Frontier Foundation

The Electronic Frontier Foundation (EFF) was founded in 1990 based on a shared conviction that a new public interest advocacy organization was needed to educate the public about the democratic potential of new computer and communications technologies and to work to develop and implement public policies to maximize civil liberties and competitiveness in the electronic social environments being created by new computer and communications technologies. Our primary mission is to insure that the new electronic highways emerging from the convergence of telephone, cable, broadcast, and other communications technologies enhance First and Fourth Amendment rights, encourage new entrepreneurial activity, and are open and accessible to all segments of society.

The EFF is committed to ensuring that the rules, regulations, and laws being applied to emerging communications technologies are in keeping with our society's highest traditions of the free and open flow of ideas and information while protecting personal privacy.

C. Vision of NREN

1. NREN as a Test-bed for the National Public Network

In discussions about the Interim Interagency NREN, National Science Foundation officials have reiterated their intention that they are NOT building a

national information infrastructure. In a strict sense this is true, but in enacting the NREN legislation and taking the first implementation steps, the Congress and federal agencies are taking a critical step toward what we call the National Public Network, the vast web of information links evolving from computer and telephone systems. By the end of the next decade, these links will connect nearly all homes and businesses in the U.S. They will serve as the main channels for commerce, learning, education, and entertainment in our society. The new information infrastructure will not be created in a single step: neither by a massive infusion of public funds, nor with the private capital of a few tycoons, such as those who built the railroads. Rather the national, public broadband digital network will emerge from the "convergence" of the public telephone network, the cable television distribution system, and other networks such as the NREN.

Not only will the NREN meet the computer and communication needs of scientists, researchers, and educators, but also, if properly implemented, it could demonstrate how a public information network can be used by many other groups in the future. As policy makers debate the role of the public telephone and other existing information networks in the nation's information infrastructure, the NREN can serve as a working test-bed for new technologies, applications, and governing policies that will ultimately shape the larger national network.[1]

So, while the NSF may say that it is not building infrastructure, the components put into place now, such as the planned network access points, will be critical links in the evolving infrastructure fabric. If poorly implemented and narrowly conceived, the building blocks of the NREN may be a testbed for nothing at all. But if the steps taken now by the NSF and other participants in

the NREN project are made carefully, they can serve as important incubators for the next generation of public information infrastructure.

2. Expand the number of users who have access to the Internet and NREN

The tremendous popularity of the Internet has already demonstrated the value of public data networks among higher eduction and research institutions. Congress should adopt policies which help make Internet resources accessible to an ever-broadening community of users. In the 1960s, the average fifth grader had no need to use the ARPANET to access remote computing power. But in the 1990s, students down to the elementary school level can benefit from having access to libraries and other on-line educational resources from all around the country.

As information technology becomes more and more sophisticated, some have warned that we could be dividing American society into the "information haves and havenots."[2] Let us use the NREN as one of many tools to enable all segments of society to have access to important information and communication resources.

3. Enhance "access to electronic information resources maintained by libraries, research facilities, publishers, and affiliated organizations."[3]

Millions of scientists, students, government workers, and even the occasional Congressional staffer rely on the Internet as a primary computer and communications tool. Researchers exchange scientific information, students further their education, government workers communicate with others working on publicly-funded projects, and some of us even use the Internet to stay in touch with political developments.

The more information that is accessible over the Internet, the greater its value to its users, but the potential of the Internet as an information dissemination medium for both public and private institutions has only just begun to be explored. Congressional policies that allow both non-commercial and commercial information providers to offer their services over the NREN will enhance the productivity and creativity of researchers, educators, students, and other NREN users.

4. Support the free flow of ideas: The NREN as Public Forum

Currently, the academic community relies on the Internet as a forum for exchanging scholarly research and data. Traditional academic freedom of speech, as guaranteed by the First Amendment, should be protected in this new forum. Beyond this, as more and more individuals and organizations rely on the NREN and connected networks as a public forum for speech, the letter and spirit of constitutional guarantees of free expression must be extended to electronic networks.

In a society which relies more and more on electronic communications media as its primary conduit for expression, full support for First Amendment values requires extension of the common carrier principle to all of these new media. A telecommunications provider under a common carrier obligation would have to carry any legal message regardless of its content whether it is voice, data, images, or sound. Some networks and some carriers may, because of their mission, justifiably have restrictions on the content that they will carry. But as a general rule, we should strive for networks with few or no restrictions on content.

5. Promote "research and development leading to commercial data communications and telecommunications standards."[4]

The HPCA recognizes two important areas of research for the development of the NREN. First, much basic engineering work remains to be done in order to provide the high-speed (gigabit) data transmission services required by certain applications, such as supercomputing and high definition video and graphics. Second, in order to bring the benefits of network information services to a wider community of users, standards for data presentation and access need to be developed. For example, because most libraries catalog books according to standard systems which we have all been taught, we can walk into almost any library and find the books we need. If electronic information services are to be truly useful beyond a narrow group of technical workers, much progress must be made toward making the services easy to use.

D. Historical Models: The Early Days of the US Postal Service

One of the first public infrastructure initiatives in the history of the United States was the creation of the US Postal System. The postal system was understood to have two major goals: to promote dissemination of information around the vast new country and to facilitate commerce. The goal of information exchange was seen as so important that an internal cross-subsidy was built into the postal system which allowed newspapers to travel free of charge, and gave newspaper editors free use of the mails for purposes investigating stories and exchanging information with other editors.

High on the agenda of the Continental Congress in 1775 was to establish a postal system that was independent of the British colonial system and which would meet the needs of the revolutionary army. The Congress found that:

> [T]he present critical situation of the colonies render it highly necessary that ways and means should be devised for the speedy and secure conveyance of Intelligence from one end of the Continent to the other.[5]

So, on July 26, 1775, a resolution was passed creating a post office and at the same time named Benjamin Franklin Postmaster General. Aside from the desire to achieve an efficiently run system, a national postal system seemed to have a higher political and symbolic value to a number of commentators and public figures of the day. Benjamin Rush, a Philadelphia physician, who was in favor of a strong central government to promote national unity, wrote:

> For the purposes of diffusing knowledge, as well as extending the living principle of government to every part of the united states -- every state--city--county--village--and township in the union, should be tied together by means of the post-office. **This the true non-electric wire of government.** It is the only means of conveying heat and light to every individual in the federal commonwealth. Sweden lost her liberties, says the abbe Raynal, because her citizens were so scattered, that they had no means of acting in concert with each other. **It should be a constant injunction to the post-masters, to convey newspapers free of all charge for postage.** They are not only the vehicles of knowledge and intelligence, but the centinels [sic] of the liberties of our country.[6]

In the early 19th Century, this privilege of "free exchange" for newspapers was expanded to include magazines, pamphlets, and other publications. Artifacts of this subsidy can be seen in the special mail rates still in place for magazines, books, and non-profit institutions.

The history of United States policy with respect to various public infrastructure developments demonstrates one undisputable fact: public policy has a critical role to play in promoting public infrastructure. Looking back to various projects from past -- the TVA, the REA, the Government Document Depository System , or the Interstate Highway program -- may give us an indication of what sort of public goods we have accorded most value. From the list above we see support for the value of local economic development, improved standard of living, access to important public information, and promotion of interstate commerce.

With the recognition that public policy has a role to play, the real challenge is to clarify the values which ought to be promoted. The EFF has been arguing for a telecommunications infrastructure guided by the following objectives:

- *establish an open platform for innovation in information services that is ubiquitous, affordable and includes a critical mass of features;*
- *promote competition in communications services;*
- *promote free expression by reaffirming the principles of common carriage;*
- *foster innovations that make networks and information services easy to use;*
- *protect personal privacy; and*
- *preserve and enhance socially equitable access to communications media.*

E. Issues Raised by the High Performance Computing Act

1. Funding the Network

- *Commercial users should pay their fair share of network costs, but fees should be structured to promote uses that are considered socially important though may not be economically self-supporting.*

While it is not the federal government's obligation to provide every potential user community with free or even subsidized network access, there is a strong public interest in promoting use by certain institutions and classes of users. Through rate structures which include special low charges for non-profit institutions, libraries, educational institutions, and newspaper publishers, US communications policy stretching back to the early Postal System has recognized that certain forms of communication are vital to the cultural and political health of American society. Just as commercial use of the postal service cross-subsidizes non-profit use, and tax payers support educational television, it may be appropriate to create similar subsidy structures for the use of network systems.

2. Future Operation and Evolution of the Network

- *Seek policies to promote network access to a broader community of users, but not all necessarily on the NSF vBNS.*

EFF places a high value on bringing the benefits of on-line communication to an every broadening community of users. Furthermore, we believe it is vital that there is the maximum possible interconnection among electronic networks. The NSF's plan to have open access Network Access Points (NAPs) is a positive step toward the goal of expanded interconnection. The NSF-funded research backbone, therefore, need not be the medium whereby new classes of users gain network access.

3. Access fees for Commercial Information Service providers

[see point 1 above]

4. Technical Feasibility of Mixed Commercial and R&E Usage

- *Since a mixed-use network is an important policy priority, federal research dollars should be targeted toward advances in routing technology that would facilitate such usage patterns.*

Existing international communications infrastructures, such as the public switched telephone network that connects virtually all countries of the world, have solved the problem of sharing network costs equitably. Even though the telephone networks of various nations have great variations in internal fee structures, a single global system has been forged. The exact model adopted by the international telephone network may not be appropriate for the NREN and the Internet. Yet, a funding paradigm for mixed use networks seems to be a problem that can be solved with concerted policy effort and sufficient technical resources.

5. Protecting Intellectual Property on the Network

- *In a multi-media information environment, intellectual property regimes evolved for print and single-mode broadcast media are inadequate to achieve the desired goals of promoting innovation, expanded access to information and protecting private investment .*

EFF believes that an intellectual property regime for digital media must be developed which serves the traditional dual role of promoting dissemination of information to the public and protecting personal property. We have not studied this issue carefully enough yet to have a single set of recommendations, however.

6. Security and Privacy

- *Robust encryption technology and clear privacy policies are necessary to protect the privacy and security of the increasing number of users who will come to depend on the NREN and the Internet as a whole.*

A key to both security and privacy for digital network systems is robust encryption technology. Such technology is already available in the form of public key encryption systems. Unfortunately, both federal law enforcement and intelligence-gathering agencies have created a number of serious roadblocks -- including export control laws and attempts to require network service providers to "dumb down" their network security -- to the wide-spread use and adoption of this encryption technology. Until these policies are relaxed, real security and privacy will be difficult to achieve. Even with the necessary technology, a clear set of privacy principles must be adopted in order to assure that the constitutional rights of network users are protected.[7]

F. Bibliography

M. Kapor and J. Berman, Building the Open Road: The NREN as a Testbed for the National Public Network, in Building Information Infrastructure (B. Kahin, ed. Harvard, 1992).

M. Kapor and D. Weitzner, Social and Industrial Policy for Public Networks , in Global Networks: Computers and International Communication (Linda Harasim, ed. MIT Press, forthcoming).

NOTES

[1] The NREN "would provide American researchers and educators with the computer and information resources they need while demonstrating how advanced computers, high-speed networks, and electronic data bases can improve the national information infrastructure for use by all Americans." HPCA, Sec 2(a)(6)

[2] [2] *Modified Final Judgment: Hearings Before the Subcommittee on Telecommunications and Finance of the House Committee on Energy and Commerce,* 101st Cong., 1st Sess. 2 (1989) (Opening Statement of Chairman Markey). Chairman Markey set the following goal for the development of new information services:

> to make [information services] available swiftly to the largest number of Americans at costs which don't divide the society into information haves and have nots and in a manner which does not compromise our adherence to the long-cherished principles of diversity, competition and common carriage.

[3] HPCA, Sec. 5(e)

[4] HPCA, Sec. 5(d)(2)

[5] Journal of the Continental Congress, May 29, 1775.

[6] B. Rush, "Address to the People of the United States," in The American Museum, January 1787. (The first issue of a Philadelphia monthly magazine.

[7] For a comprehensive statement of privacy concerns in the development of the NREN see Statement of Marc Rotenberg,Washington Director, Computer Professionals for Social Responsibility (CPSR), Open Forum on Library and Information Service's Roles in the National Research and Education Network (NREN),National Commission on Libraries and ,Information Science (NCLIS),Washington, DC, July 21, 1992.

Submitted by
FARNET, Inc.
for the EDUCOM/IEEE/CRA NREN Policy Workshop
Monterey, CA
September 16-18, 1992

A. Organization

FARNET (the Federation of American Research Networks), Inc.

B. Nature, Goals and Constituency of the Organization

Founded in 1987, FARNET is a non-profit association governed by a board of directors. Its mission is to promote the use of computer-based communication networks to enhance research and education; specifically, to strengthen the capabilities of its members, to improve the quality of Internet user support and information services, and to represent the interests of the members in the national arena.

The membership includes 36 organizations:

State based networks	16
Multi-state regional networks	7
Supercomputer center networks	4
Telecommunications carriers	4
National networks	3
Canadian provincial net	1
Universities	1

C. Eventual nature, services, structure, uses and constituencies of the NREN

Nature

The NREN will include a mix of public (i.e., owned outright by, or purchased by, governmental institutions) and private facilities. Its importance will lie in the fact that it serves a community of people and organizations whose use of computer-based communication is grounded in the public interest. It will **not** be a single, homogeneous, publicly-owned communications network.

The NREN may become a powerful new means of enabling and enhancing the sharing of information -- a critical function in a democracy. The risk is that, like any endeavor that purports to be "in the public interest," it will attract multiple and competing definitions of "the public interest."

Major issues: How to handle "boundary conditions" between segments of the NREN (government agencies, private industry, public education, etc.). How to balance competing interests.

Stakeholders: All users. All providers of services and facilities. Federal agencies. Congress. White House/OSTP.

Critical assumptions: Somehow, the "public good" will prevail. Competing interests will not destroy the open nature of the current Internet.

Services

The services will include electronic mail, conferencing, directories of information, database access, access to remote facilities such as supercomputers and scientific instruments, etc. International access will be important. Billing and accounting, privacy and security services will be available. Services for training users and support personnel will be well developed.

Major issues: Who pays for the development of the tools, systems and databases that these services are built on? How are the costs recovered? Can the flexibility and openness of the current Internet be preserved?

Stakeholders: All users. All providers. Developers of tools and systems.

Critical assumptions: It is possible to maintain a balance between public and private (uses, service providers, etc.).

Structure

As new constituencies enter the NREN community of interest, the locus of authority and control will continue to decentralize. That is, much as we have seen the once-centralized ARPANET, which served a limited defense-related community, expand and its boundaries dissolve, the NREN will continue to attract new communities. Each of these will have its own culture and its own set of values, goals, and constraints, which will be added to the NREN "stew."

Because the concept of an integrated information network is so powerful, some of the more parochial interests of each group will be mitigated as they seek to participate in the NREN. However, the realities of how each group obtains funds and where organizational lines of authority are

drawn will persist. For example, in public (K-12) education, decision-making happens at the district and state levels. Local control and involvement will be essential to the success of NREN in K-12 schools. This argues for the vision of the NREN as a community of interest, encompassing many types of communications technology and facilities, rather than a single homogeneous entity.

Uses

The NREN will support education (multiple levels), research (university, governmental, and private corporate), information delivery (from libraries, government agencies, and commercial information providers), and technology transfer (government-industry-university).

Constituencies

Public Law 102-194 mentions specifically: Federal agencies, "research institutions and education institutions, government and industry, in every state", "State and local agencies", and "libraries, research facilities, publishers, and affiliated organizations." In addition, groups ranging from the Computer Systems Policy Project to the NSF midlevel networks have encouraged the involvement of new interests, including health care, lifelong learning, and economic development. At this point, the public perception of the NREN may be that it is "all nets to all people."

Major issues: Given the reality of flat or declining Federal budgets, what are the priorities per the HPCC bill as enacted? How susceptible are these to political pressure?

Stakeholders: Every constituency that wants to be part of the NREN.

Critical assumptions: There is enough commonalty among these constituencies that a program can be developed that will satisfy them all sufficiently.

D. Possible historical models

We have no comment on this question since we have not examined it as an organization.

E. Comments on Congressional questions and ranking of importance to your constituency

1) Effective mechanisms for providing operating funds for the maintenance and use of the network, including user fees, industry support and continued federal investment.

Priority (on a scale of 1 to 5, where 5 is highest priority): **5**

Point 1: The Federal investment in the NREN is highly leveraged already by a combination of user fees, industry support, public investment at the state and local levels, and expenditures within organizations (on computers, local area networks, and other infrastructure) to allow them to participate in the Internet. In one multi-state regional network the ratio of non-Federal to Federal investment has been documented at more than 30 to one. This pattern is likely to continue.

Point 2: The fee structures of many of the state and regional networks support "cross-subsidization": higher fees are charged to for-profit users and/or to large institutions than to smaller and/or educational users. Remote areas, which are expensive to serve, also benefit from cross subsidization in the current situation. It is false to assume that this practice is somehow inimical to free-market capitalism. In industry, the counterpart is differential pricing for commercial, educational, and government customers (a well established practice, for example, in the computer industry). Common carriers, on the other hand, are regulated so that even small or remote customers have access to basic services at an equitable price. The benefits of cross-subsidization in the NSFNET have been significant.

Point 3. Some ideas about how further to leverage Federal investments:

Specify that states or other beneficiaries of Federal funds contribute matching funds
Permit Federal agencies to make their facilities available for public use on a qualified basis (as in contemplated in the NSFNET)
Levy a "sales tax" or other surcharge on information providers and other service providers who benefit economically from network access, and reinvest this tax in the NREN infrastructure

Point 4. Federal support should be targeted to specific needs. In particular, it should fund (or stimulate) high-risk, but potentially high-payoff, areas of research and development. It should also support the connection of underserved communities to the network.

2) The future operation and evolution of the network;

Priority (on a scale of 1 to 5, where 5 is highest priority): **5**

Large users -- universities, research laboratories, and businesses -- will continue to drive the evolution of high-end network services. At the same time, a growing number of smaller organizations will be clamoring for access at the "bottom." Services for this constituency will be developed by entrepreneurs, volunteers, and existing vendors to the PC market. Network operation will be handled increasingly by the common carriers and by value-added vendors of telecommunications services. Regional and state networking associations will continue to add value by aggregating demand, developing new (higher-layer) services, and building and supporting communities of interest.

3) *How commercial information service providers could be charged for access to the network and how network users could be charged for such commercial information services.*

Priority (on a scale of 1 to 5, where 5 is highest priority): **4**

Commercial information service providers add value to information by organizing, verifying, updating, providing uniform access to, and customizing it. Consumers recognize this added value; it is why they pay publishers and database services. The simplest way to charge commercial information service providers is to impose a tax on revenues gained from network access. Since providers set the price of their information services, and consumers buy as much as they perceive to be of value to them, the revenues should provide a good indicator of the value of the service to both.

How will consumers pay? Use your Mastercard or Visa!

4) *The technological feasibility of allowing commercial information service providers to use the Network and other federally funded research networks.*

Priority (on a scale of 1 to 5, where 5 is highest priority): **3**

There has already been considerable development of prototype and small-scale services of this type. The current barriers have less to do with technology than with policy. Because the policies are unclear, or inconsistent across Federal agencies, commercial providers are uncertain about what is permissible and hesitant to experiment.

5) *How to protect the copyrights of material distributed over the Network;*

Priority (on a scale of 1 to 5, where 5 is highest priority): **2**

FARNET expects that these issues will be successfully resolved by organizations such as the Coalition for Networked Information.

6) Appropriate policies to ensure the security of resources available on the Network and to protect the privacy of users of networks.

Priority (on a scale of 1 to 5, where 5 is highest priority): **4**

The difficulty lies less in making the policies than in enforcing them. The issues here are technical (software and protocols to support adequate security and privacy must be developed) and educational (users must be informed about their rights and responsibilities).

F. Additional questions or policy areas of importance

Transition from current NSFNET system to next phase
Governance of the NREN
Regulatory issues
NSFNET Appropriate Use Policy

Submitted by FARNET, Inc., 100 Fifth Avenue, Waltham, MA 02154

Statement of the Library of Congress Regarding NREN Policy questions to be Addressed at the NREN POLICY WORKSHOP

Convened by
IEEE-USA Committee on Communications and Information Policy,
EDUCOM, and
the Computing Research Association
in Monterey
September 16-18, 1992

CONTENTS

INTRODUCTION

This statement presents the views of the Library of Congress regarding issues and opportunities associated with the National Research and Education Network (NREN), and its interim facility, the Internet.[1]

A. ORGANIZATION

The Library of Congress is the world's largest repository of knowledge and information and contains an astonishing richness both of printed materials in almost all languages and of nonprint materials in almost all media. The Library possesses not only an unmatched collection of materials from and about the United States, but also collections of foreign-language books that are often the largest outside the country of origin, as well as massive collections of manuscripts, rare books, maps, music, prints and photographs, and film.

B. NATURE, GOALS, AND CONSTITUENCY OF THE ORGANIZATION

The Library was created by the Founding Fathers of our nation to serve the Congress; and it has also come to serve the library and research communities of the nation. The Library serves Congress by providing the objective and accurate information required for the proper conduct of the affairs of state. It is a major world center for scholarly research, but it also supplies cataloging data to all the nation's libraries, and recorded and Braille materials to 150,000 handicapped Americans each year. The Library serves the creative community through its Copyright Office, mandated by Congress to administer the Copyright Act, Title 17 U.S.C. for the protection of intellectual property rights. Among the national libraries of the world, the Library of Congress is the institution most easily and widely accessible and most universal.

C. YOUR ORGANIZATION'S VIEW OF THE EVENTUAL NATURE, SERVICES, THE STRUCTURE, THE USES AND CONSTITUENCIES OF THE NREN

In our view, the highest priority for NREN development is the development and expansion of user-friendly information services of value throughout the K-12, higher-education, library, and research communities.

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[1] The term "Network" is used here to denote the Internet and/or NREN.

NREN's greatest value will come from making diverse information resources more readily available to all these communities. As the national library, the Library of Congress expects to play a key role in making valuable information resources available to NREN users.

The Library itself expects to be an avid user of NREN. We are already significantly involved in using the Network, and we anticipate a rapid expansion of our presence in this community.

The Network will also become increasingly important in the dissemination of appropriate elements of the Library of Congress' collections throughout the United States, operating always strictly within the requirements of the copyright laws and regulations. For example, we have a number of imaging projects at various stages of development. In addition to books and periodicals, the Library's collections encompass many formats. We have recently undertaken an experiment with a private corporation involving the digitization and high-speed transmission of multimedia materials from the Library's collections.

To expand and update our existing International Legal Data Base, our Law Library is currently testing the basic elements of an International Legal Information Network, consisting of images of official sources of law interfaced with abstracting and indexing terms. This system is critical for advising the Congress on currently applicable statutes and regulation in foreign nations, and for a wider dissemination of our legal resources within and outside the U.S. We anticipate providing these services on the Network.

The Library is currently using the Network, as well as other commercial services, to disseminate an electronic, surrogate version of a major Library of Congress exhibition of *Documents from the Archives of the Former Soviet Union*. Our plans include provision of electronic versions of future exhibitions as part of our outreach to the library and scholarly communities. The Library's Science and Technology Information Initiative is beginning Network-based activities. And the Library's Cataloging Directorate is working on the online sharing of cataloging data among libraries and information services via the Network.

The Library employs a number of specialists in the Congressional Research Service (CRS) to research issues for the Congress. In recent months, hundreds of information sources and scholarly discussion groups have emerged on the Network, and we anticipate that CRS specialists will become increasingly dependent upon it as a powerful facility for accessing information and tracking research and policy developments. Likewise, across the Library, our legal specialists in the Law Library, copyright specialists in the Copyright Office, the American Folklife Center staff, the Office of Scholarly Programs, and others expect to use the Network to extend their consultation with the research and policy development communities.

D. SUGGESTIONS AND RATIONALE FOR POSSIBLE HISTORICAL MODELS (SUCH AS THE TENNESSEE VALLEY AUTHORITY OR THE PUBLIC BROADCASTING SYSTEM) THAT COULD BE APPLIED TO NREN DEVELOPMENT

In our view, the best historical model for NREN development is the Internet itself. While there is certainly room for improvement and higher levels of funding at all levels, the strength of the Internet model is the valuable cooperative relationships that have evolved at the grass roots level throughout the United States to make the Internet grow. While a case can be made for strengthened coordination and facilitation at the Federal level, achieving the promise of the NREN will depend on active participation and contributions from an array of agencies and organizations that produce, organize, and disseminate important information resources. These include, at the Federal level, the Library of Congress, the National Library of Medicine, the National Technical Information Service, the National Agricultural Library, the Government Printing Office, and the various Federal agencies that produce information of educational, commercial, and scientific value.

Given the budget realities in Washington, we believe that the political energies of NREN supporters are better focused on securing appropriations under various *existing* program authorizations or expanding those programs rather than obtaining authorization for any new, central organization. To the extent that some Federal agencies are not adequately participating in NREN development activities, directly working to secure more enthusiastic support and voluntary cooperation from them is of more value than setting up new programs. Authorizations already on the books--not only for NREN, but for a wide array of information resource programs--are fully adequate for supporting greater levels of NREN participation by Federal agencies. There already exists a substantial and growing interest among Federal agencies in using the Internet to provide broader access to important databases. Harnessing this strong forward momentum for developing NREN resources will be key to its success.

E. COMMENTS ON CONGRESSIONAL QUESTIONS--THE HIGH-PERFORMANCE COMPUTING ACT OF 1991 (P.L./S. 102-194) REQUIRES A REPORT TO CONGRESS IN DECEMBER OF 1992 THAT ADDRESSES THE FOLLOWING QUESTIONS

item 1. Effective mechanisms for providing operating funds for the maintenance and use of the Network, including user fees, industry support and continued federal investment.

We believe the current broad funding pattern should be maintained, with its reliance on Government funding for principal elements, and financial participation by industry and NREN users. This is likely to be the best formula for keeping NREN services closely aligned with the priorities and needs of a very diverse community of participating constituencies.

item 2. The future operation and evolution of the network.

We are in full agreement with P.L. 102-194, Section 102(c)(3) that the NREN should "be designed, developed, and operated in a manner which fosters and maintains competition and private sector investment in high-speed data networking within the telecommunications industry." NREN ultimately must be available to all who need access to the information and education resources it makes available. The private sector must continue to be an active partner in developing this national infrastructure.

item 3. How commercial information service providers could be charged for access to the Network and how Network users could be charged for such commercial information services.

The Federally-subsidized NREN should continue to be interconnected with unsubsidized commercial Internet access providers. Commercial information service providers should be linked to the NREN communities through commercial gateways, and pay full market rates for their Internet connections. Network users should be charged for commercial information services directly by the vendors of those services, much as they currently are by Internet-accessible services like Dialog and OCLC.

item 4. The technological feasibility of allowing commercial information service providers to use the Network and other federally funded research networks.

We are not aware of any feasibility problems.

item 5. How to protect the copyrights of material distributed over the Network.

We are continuing to monitor our traditional copyright services, how they are being used for current electronic publishing, and how they might be influenced by the NREN and the expanding networking and electronic publishing environment. Mechanisms for registration and deposit of electronically published materials are being considered, as are possibilities of electronic deposit of other materials and electronic submission of copyright applications. In this vein, we are also beginning to investigate the possible use of digital signatures and public key cryptography for these purposes. These techniques can also be used to protect copyrighted materials and other forms of intellectual property while they are being transmitted over the Network.

item 6. Appropriate policies to ensure the security of resources available on the Network and to protect the privacy of users of networks.

Just as there are laws and regulations to protect the privacy of users of the telephone and the public mail system, we feel there should be in place similar laws and regulations to protect the privacy of users of electronic transfer systems.

We are in support of the full development of reliable encryption standards and techniques for protecting electronic information. We refer to the efforts of the National Institute of Standards and Technology (NIST) and support efforts to reach consensus soon so that these developments can be implemented as a practical means to provide privacy and security in the network environment.

Moreover, we strongly feel that examination of existing laws such as the Computer Security Act of 1987 and the Computer Matching and Privacy Protection Act of 1988 be employed for NREN policy as well.

F. ADDITIONAL QUESTIONS OR POLICY AREAS YOU THINK ARE IMPORTANT

1. The governance of the NREN.

The governance of the NREN has evolved as a loose and almost anarchic set of formal and informal committees, confederations, and individuals. But, somewhat astonishingly, it works; a potent demonstration of the democratizing power of the new information technology. We see no reason to significantly modify these somewhat elusive, but workable, structures.

The Library of Congress should be centrally involved in the core structures of this pattern of governance, particularly in full institutional membership in the Federal Networking Council. Also, we should clearly play a role in working with the recently formed National Coordinating Office for High Performance Computing and Communications.

2. *Fair use in the network environment.*

Fair use is a perplexing issue as users are contracting for use of copyrighted material as if the fair use doctrine did not exist. A more critical concern is the scope of fair use in this environment, and a review of copyrighted principles enables us to address it.

- The fair use doctrine places certain limits on the exclusive rights of copyright owners outlined in section 106 of the copyright law.[2] Fair use is an expression of congressional intent to encourage the creation of new literary, artistic, and musical works, while maximizing their public availability.

- Traditional elements of the fair use doctrine are set forth in section 107 of the 1976 Copyright Act. Favored uses include reproduction for purposes such as criticism, comment, news reporting, scholarship, or research. In making a decision to copy a work, a party must consider (1) the purpose and character of the use, including whether such use is of a commercial nature or for nonprofit educational purposes, (2) the nature

[2]We do not discuss here other limitations on the copyright owner's exclusive rights, such as the exemption covering library reproduction.

of the copyrighted work, (3) the amount and substantiality of the portion used in relation to the copyrighted work as a whole, and (4) the effect of the use upon the potential market for or value of the copyrighted work.

The current law was enacted before extensive use of electronic information transfer systems existed. Although at this time, no court has addressed fair use of online electronic databases, we expect courts will apply fair use criteria in largely the same manner that it applies them to traditional media. Concerns of publishers and users of electronic information include protection, compensation, and fair use. Questions arise about methods of clearing rights, verifying and authenticating information, and creating compensation mechanisms among buyers, sellers, and third parties involved in licensing activities. For NREN to attempt final resolution of fair use issues at this time appears premature The best hope for certainty is guidelines negotiated among authors, publishers, librarians, and end users. Our national Copyright Office would be pleased to assist in this process.

CONCLUSION

The new dependency on a high-speed, high-capacity network causes us to be keenly interested in the questions being addressed at this workshop. The future operation and evolution of the Network is important to us, and the Library is willing to assume appropriate leadership and team responsibilities.

We commend your organizations for calling together the library and scholarly communities to address the important issues associated with the National Research and Education Network. Together with these and other colleagues in informational institutions across the country, we are looking for assurance that this vital service will develop into an increasingly useful operational asset.

The world of information generation and distribution is changing very rapidly, featuring many yet unresolved controversies, and involving the rapid creation of whole new industries, as well as the transformation of others. As with all institutions seeking to develop strategies to deal with these conditions, our policy predispositions, as stated here, are subject to change in response to changes in relevant conditions.

Our hope is that the library and information services community--and related parties--can develop ways of working together to resolve these controversies in the development of a set of national information goals that will serve the nation well as we move into the next dynamic phase of our economic development.

White Paper for the NREN Policy Development Workshop

by the
Committee on Communications and Information Policy (CCIP)
H. D. Wolf, author

August 15,1992

I. Introduction

A. Committee on Communications and Information Policy (CCIP)

The IEEE is the world's largest engineering society, representing over 315,000 members worldwide, of whom 250,000 live and work in the United States. The CCIP is a committee of the IEEE United States Activities, established as a central focal point to bring their capabilities to bear on national communications, computer, and information technology policy issues. The Committee was established in 1982.

B. Nature, Goals and Constituency

The IEEE seeks to advance the fields of electrical, electronics, optoelectric and computer engineering by disseminating scientific and technical information on a global basis. Within the IEEE, United States Activities, CCIP addresses issues relating to the broad scope of communication services and information processing and develops policy recommendations on those issues.

The membership of the CCIP includes Electrical and Electronic Engineers and associates in the voice, video and data communications and information processing industries. They include the creators and implementors of the technology for HPC and NREN as well as users of the technology.

C. Decision Criteria

It has become clear during the preparation of this white paper that a set of decision criteria for NREN policy approaches are needed. We propose the following as one set to use for resolving any differences:

1. Who is the best decision maker for this issue?
2. Who is the best allocator of available resources?
3. Will this approach provide maximum public benefits?
4. Will this approach provide maximum spillover benefits?
5. Is there a marketplace for these goods and services?
6. Is there a practical path to this future vision and an associated implementation plan?
7. What is the 'right' organizational element to decide the research tools and technology to use?
8. Does this empower the researcher/user to do the research or control the tools, technology, resources and costs to do the job?

It is recommended that at the start of the workshop a set of decision criteria be addressed and agreed upon to make it easier to resolve differences later.

D. Ultimate NREN Characteristics

The nature of the system, the services it should offer, its structure, the uses to which it should be directed, and the proposed user constituencies may help to determine what is the NREN and what should it become. The need for pushing the state of the telecommunication art, as technological boundaries expand, is a 'given' to CCIP and, therefore, strongly influences our comments.

1. Nature

a. Establish and maintain a state-of-the-art design, development and assessment testbed telecommunication function.

b. Maintain Research & Education researcher access to integrated supercomputing, parallel processing and high-speed data communications technology at an affordable cost.

c. Stimulate the creation and evolution of an integrated commercial electronic infrastructure.

d. Maintain an effective and efficient bridge between the telecommunication testbed function and the growth and evolution of the integrated commercial electronic infrastructure.

e. Assure compatibility among related federal agency network programs.

2. Services

a. Provide data, video and multimedia connectivity without financially undercutting public switched telephone networks.

b. Enable high-performance workstations with visualization and animation software to be inter-linked to supercomputers and other hosts.

c. Network mainframes to each other and to data storage peripherals for rapid memory access.

d. Link supercomputers in different centers or even link networks of supercomputers to provide metacomputers for resolution of "Grand Challenge" problems.

e. Provide other 'store and forward' capabilities among network hosts as the technology evolves.

3. Structure

a. Maintain a federation of linked physical networks.>

b. Maintain a permanent facility for accelerating state-of-the-art telecommunications technology evolution.

c. Use the testbed for network procedure, administration and operation assessments.

d. Establish a standard interface that enables customer premises equipment to be differentiated from network equipment.

e. Exercise a utilization and fee policy for the government developed, government built infrastructure when used by non-government organizations.

4. Uses

a. Integrate supercomputing, parallel processing and high-speed data communications.

b. Create virtual networks of supercomputers.

c. Access research devices, supercomputers and very large scientific data bases.

d. Maintain a leading edge testbed for development/study of:
- basic technologies,
- applicable free space or guided network (nonradiating) technology,
- high level applications
- standards, policies, and network operational procedures
- electronic mail

5.	Constituencies of NREN - Proposed Access	Testbed	Integrated Commercial Electronic Infrastructure
a.	Researchers-Academic	XX	XX
b.	Researchers-Fed Agency	XX	XX
c.	Researchers-Industrial	XX	XX
d.	Engineers-Telecommunication	XX	XX
e.	Engineers-Computer Science	XX	XX
f.	Engineers-Hardware/Software	XX	XX
g.	Engineers-System Development	XX	XX
h.	Management-Research	XX	XX
i.	Management-Engineering	XX	XX
j.	Management-Network	XX	XX
k.	Management-Education	XX	XX
l.	Undergraduates		XX
m.	K-12 Students		XX
n.	Network Providers	XX	XX
o.	Computational Providers	XX	XX
p.	Application Providers	XX	XX

q.	Commercial Users	XX
r.	Individual Users	XX

E. Applicable Historical Models

1. Public Broadcasting System

Rationale: Significant public benefits; educational content, program quality and programming variety; Government created, user supported by direct contributions.

2. National Highway System

Rationale: Massive public benefits for commerce, access, and speed; Government created; user supported by indirect tax on gasoline.

3. Supercomputing Research Centers

Rationale: Public 'spillover' benefits from academic and industrial research, improvement in U.S. competitive positions; government funded; free to academia; charges for service to industrial users.

4. United States Post Office Rationale: Public benefit from 'low cost', 'reliable', 'rapid' document distribution; government funded; user pays by size and weight of document and speed of delivery.

5. Agricultural Extension Service & Library Service

Rationale: prime example of successful government program that increased productivity growth rate by 6% per year from (1940-1979), enabled 3% of labor force to provide one fifth of the 1983 exports. (See attachment)

6. Libraries

Rationale: Significant public benefit as a primary educational and business information center as well as a local meeting site; Government created; user supported by tax contributions.

7. Continental Railroads

Rationale: Massive public benefit in transport of high volume of people and products; Government created; user supported by direct payments.

8. Tennesee Valley Authority

Rationale: Government investments at producer and consumer levels (National Rural Electrication) yielded

low cost energy, flood control, reclammation and recreation benefits; loans repaid at low interest rate; utilities could not justify investment in remote site electrication; self sufficient operation.

II. Discussion

A. General

The issues to be discussed during this policy workshop can be expressed in the following five overview issues:

1. who allocates and controls the resources for HPC/NREN research used by the several constituencies.

2. the commercialization of the network,i.e. who pays for what services and under what circumstances payment is required.

3. the models to use for establishing future policy.

4. the technology basis for NREN evolution,

5. the need for any additional legislation to assure maximum public benefit from the growth and evolution of NREN.

Our responses will consider these issues, break them down into ten additional ones, six of which come from the HPC legislation and four from CCIP, and then rank the ten from first through tenth.

B. Issues and Comments Identified in the HPCC Legislation

We differentiate between the NREN design, development and testbed function and the integrated commercial electronic infrastructure technology evolution function. The first is oriented toward technology assessment and selection, while the latter is viewed as technology application, modification, adaptation and every day use. The process by which the NREN and associated infrastructure technologies have been and will be selected is critical to satisfying the foreseen needs. We believe the government should invest in high risk, high benefit technology. Therefore, a continuing R&D program is mandatory for NREN telecommunications to maintain a leading edge and competitive U.S. posture. Our position associated with each legislative issue is summarized in the following paragraphs:

1. "Effective mechanisms for providing operating funds for the maintenance and use of the network, including user fees, industrial support and continued federal investment" (Rank = Fifth)

a. Apply a tax or dedicated charge to the communication traffic issued from every node.

b. Establish product providers as dial-900-service telephone

equivalents with part of the charges allocated to NREN use.

c. Establish a fund for NREN infrastructure composed of the above taxes/charges collected.

d. Apply the funds to NREN infrastructure creation, development, testbed operation and network use.

e. Require Research and Education participants to contibute some research, design, development, implementation and/or operational support to further the development of the NREN.

Underlying Issues: Separation of testbed network functions from commercially provided network ones; who pays what fees; when those fees apply; also maintenance of R&E researcher access at affordable costs.

2. 'The future operation and evolution of the network" (Rank = Fourth)

a. Learn on the NREN testbed while the system is relatively small.

b. Enhance the probability of foreseeing problems through assessing state-of-the-art alternatives.

c. Structure possible solutions before they can become financially burdensome.

d. Influence rapid transition from testbed technology successes to commercial venture incorporation.

Underlying Issues: Parallel evolution of the testbed and integrated commercial electronic infrastructure; their interfaces and their technology transfer; resource allocation and control.

3. "How commercial information service providers could be charged for access to the network and how network users could be charged for commercial information services" (Rank = Sixth)

a. Use a minimum, near zero, charge to access the network.

b. Charge for communication traffic .

c. Partition bandwidth to avoid misuse, e.g. run output of a 2400 baud modem over dedicated 56kb line, not a 45Mb one.

d. Provide volume discounts.

e. Consider the purpose of the user function for setting their charges (i.e. public benefit potential)?

f. Place the accounting burden on the seller of a service.

g. Keep accounting algorithm development and execution costs to a minimum.

Underlying Issues: Separation of testbed network functions from commercially provided network ones, who pays what fees, when they are paid; planned path for evolving integrated commercial electronic infrastructure; also maintenance of R&E researcher access at affordable costs.

4. "The technological feasibility of allowing commercial information service providers to use the network and other federally funded research networks" (Rank = Eighth)

a. Charges for network access, connect time and traffic load may be required for everyone, with volume discounts and grants-in-kind provided to selected user communities.

b. Network use charges should be small.

c. Manage by exception (level of mis-use) and e.g. number of packets issued.

Underlying issues:Technology is not the issue; use charges are. Also who should control the funds to pay for use: government, the provider or the end user.

5. "How to protect the copyrights of material distributed over the network" (Rank = Ninth)

a. CCIP has little expertise in this subject matter. In addition, other, more competant forums are better equipped to address the issues.

b. CCIP considers these issues as a design requirement that would be satisfied by the best available technology at the time the copyright protection rules are imposed.

Underlying Issues: What are the design requirements to satisfy copyright protection needs.

6. "Appropriate policies to ensure the security of resources available on the network and to protect the privacy of users of networks" (Rank = Tenth)

a. We believe that privacy rights (however established) must be seriously considered whenever they arise in telecommunication related and other technological developments.

b. Both technologists and policymakers have responsibilities toward addressing privacy issues. Technologists, however, must keep public policy issues in mind from the beginning stages of developing new products and services.

c. We are strong proponents of technology advancements that evolve at a pace consistent with market conditions and technological innovation, and which are consistent with public policy towards privacy

d. We believe this society must adopt policies which balance taking advantage of new technological opportunities with the preservation of privacy, individual rights and other societal values.

Underlying Issues: Elimination of artificial barriers to new technology introduction.

C. Additional CCIP Questions or Policy Areas of Importance

7. Transitioning the Network to Private Operation
(Rank = First)

a. Maintain the R&D function to push the state-of-the-art for the life of the NREN and for future integrated networks;

b. Evolve in parallel the integrated commercial electronic infrastructure to service the federal agencies, the industrial organizations and the academic institutions by developing investments that build upon the NREN validated technologies.

c. The network should be a force to draw public sector, academia, providers and business sectors together, possibly using network usage policy as the unifying glue.

Underlying Issues:Separation of testbed network functions from commercially provided network ones, who pays what fees, when, and planned path for evolving integrated commercial electronic infrastructure. Also maintenance of R&E access at affordable costs.

8. Models: Strategic Alliance in Infrastructure Investment and Commercialization Implementation (Rank = Second)

a. To understand the tradeoffs and recommend appropriate paths between the public good and their beneficial spillovers and the private good , requires an economic model to help select the appropriate federal government investments in infrastructure and an implementation model to enable selection of the technology for an interim production network that can lead to an integrated electronic commercial infrastructure.

b. Use asymmetric pricing. It was done for the highway system where the price to the user is zero (it's free) while the large costs necessary to bring the system into being are covered by a broad, general tax or dedicated charge that is related to the use of the

system e.g. packet volume.

c. Use NREN to improve NREN, to explore public policy alternatives, and to add to economic spillovers that provide social benefits that may not be captured if the service were performed privately.

d. There are two sides of the marketplace to keep straight: public goods and their associated spillovers vs private goods. NREN is a strong public good.

e. We need a strategic alliance among government, academia, industry and the using communities to provide economic public goods with associated beneficial spillovers that result in private products that are socially beneficial.

f. We propose the ELECTRONIC SHOPPING MALL as an implementation concept and a bridge between NREN as a test bed and the integrated electronic commercial infrastructure as a reality.

A shopping mall can be a real or virtual place. The owner/manager of a facility provides the infrastructure for vendors to market, display and sell their products and services, for customers to visit, browse, try, select, buy, return and solicit help and for government (local, state and federal) to exercise legal, financial, environmental and societal control as well as support technology investment and security. See the attached description for a more complete discussion.

Underlying Issues: Development in detail of the two models and identification of their critical linkages.

9. System Requirements for a National Information System Infrastructure (Rank = Third)

Features and characteristics from the viewpoint of the NREN user raise a variety of technology, financial and policy issues:

a. Provide inexpensive access to NREN; consider a flat fee based charging process.

b Enable realtime transmissions i.e. file transfers at high rates.

c. Provide for maximum data compression ratios to reduce network use costs.

d. Assure open access is always available to do R&E research.

e. Keep the cost of federal-agency-academia electronic interactions low.

f. Accept rapid time to market when socially

beneficial, not as a demand of a research program.

g. Let Government be responsible to assure access for innovator communities.

h. Consider the function performed by a researcher in determining his cost for network access and use?

i. Establish an electronic gateway to provide public access to a wide range of Federal databases containing public information stored electronically.

j. Encourage competition in NREN technology conversion to the public sector among carriers.

k. Make the network simple to use.

l. Include in federal research grants host, access and connect time allocations to enhance competitive pricing by competing organizations.

m. Provide access policy and controls that discourage junk mail/faxes, obscenities, and other network clogging traffic.

n. Establish constraints on access to e-mail lists.

o. Develop and test state of the art hardware and software products on the network which, e.g.:
- allow video transmission at reduced times (i.e. faster than frame rates)
- provide store and forward capabilities

Underlying Issues: Resolution of competing user community requirements e.g. state of the art capability, low cost network access/use charges and reliable, low traffic links.

10. The Cost Tradeoffs to Develop Use Tracking Algorithms (Rank = Seventh)

We recommend using the following guidelines to develop the NREN charging algorithm:

a. The charging algorithm should balance the cost of providing the service, the cost of doing the accounting and billing and the goal to encourage maximum network useage.

b. Assume a chargeback policy that encourages, not restricts, the availability of new services.

c. Apply the goal of 'universal service' embodied in the Communications Act of 1934. (A chargeback policy that seeks to only recover costs may not meet broader social goals. A government sponsored network must weigh considerations of access to resources that may not be justified on a purely cost basis.)

d. Apply a consistent cost accounting methodology whether or not the result is reflected exactly in the final chargeback.

e. Pay close attention to fixed and variable cost elements, e.g. the fixed cost of a dedicated port used to gain network access versus transit switches that actually route packets.

f. Consider these elements in establishing cost for service: - access ports used - volume of traffic - quality of service with guarantees on throughput, loss probability, average delay and delay variations.

Underlying Issues: Separation of testbed network functions from commercially provided network ones; who pays what fees; when they apply.

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IV. Attachments

'A Proposed Electronic Shopping Mall'

'A Comparison and Contrast of the Land Grant College Economic Model and the NREN'

CCIP Position Paper: "High Performance Computing and Communications" 1992

CCIP Position Paper: "Technological Advancement in Telecommunications and the Issue of Privacy" 1992

Educom Bulletin, Summer/Fall 1988 'Economic Benefits and Public Support of a National Education and Research Network'

The CCIP Proposed Model for Electronic Commercial Infrastructure Implementation: The Electronic Shopping Mall

We propose the ELECTRONIC SHOPPING MALL as an implementation concept and a bridge between NREN as a test bed and the integrated electronic commercial infrastructure as a reality.

A shopping mall can be a real or virtual place. The owner/manager of a facility provides the infrastructure for vendors to market, display and sell their products and services, for customers to visit, browse, try, select, buy, return and solicit help and for government (local, state and federal) to exercise legal, financial, environmental and societal control as well as support technology investment and security.

The owner/manager (various agencies, corporations, consortia or individuals) tailors the shopping mall for the site and the expected customers and vendors in compliance with regulators' and marketplace requirements. He does or subsidizes some 'research and development' (i.e. basic or evolutionary adaptations and improvements) to assure that the mall remains marketable. He improves the infrastructure as required. He adapts the infrastructure where necessary for new technology introduction. He charges vendors for use of his infrastructure and expects a percentage of the vendor's profits as the business grows. He pays his taxes to the local, state and federal governments. He provides security to his vendors and customers.

Vendors market their products and services within the mall, in trade media, directly to customers and over generally available media. They identify requirements for the owner/manager to consider in upgrading the mall. They do or subsidize research, develop and introduce new technology and compete for customers and market share. They demonstrate, test, innovate and modify. They adapt to customer requirements. They provide the products and services for which customers are willing to pay.

Customers identify their needs and visit the mall they have chosen based on its proximity, access, performance authorization, price or products/services availability to satisfy those needs. They compete for resources to expand their knowledge base, their budgets, scope of activity and responsibility.

Government represents societal, environmental and legal requirements in the marketplace. They underwrite, constrain, tax, regulate and resolve inter-organizational issues. In addition, they risk investments in high benefit, state of the art

technology because of potential spillover benefits.

Our model assumes that the roles of the participants remain the same, except that the customers require equipment and may pay an entrance fee for access, that the 'place' may be real, virtual or a composite of both. The products and services are delivered to the customer at his site(s). We also assume that the malls may have restrictions on who can access, when they can access and what they can buy. The malls are linked so that, e.g., federal agencies can access their own mall, corporate malls and/or general public malls. Products and services may be represented at only one or several or all malls.

Can this model, in some form, become a basis for implementing a practical, future, integrated electronic commercial infrastructure?

Economic Benefits and Public Support of a National Education and Research Network

by Alan K. McAdams, Thomas Vietorisz, William L. Dougan, and James T. Lombardi

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Copies of the complete "NYSERNet Market and Economic Impact Study" are available from NYSERNet, 1095 Avenue of the Americas, Room 1913, New York, NY, 10036, 212-395-4480, via BITNET KARENT@NISC.NYSERNET.

"Should there be a national scientific and technical computer network? Should there be a government corporation or utility with direct responsibility to scientific and technical users? Such questions have been raised since the creation of the Office of Science Information within the National Science Foundation in 1958, and they have been asked over and over again in a number of governmental and National Academy of Science studies in subsequent years. No answers have been forthcoming; no policy exists."[1]

Daniel Bell, a well-known commentator on the post-industrial society, wrote these words in 1979. Almost a decade later, the same lack of a clear national policy persists. This is the policy problem we wish to address here—but in a context that is somewhat broader than that of science and technology alone, embracing in addition the activities of all knowledge workers, particularly those in education. To do so, we distinguish between two types of information—"new" and "current" information—which play quite distinct social and economic roles. Research and development, together with education, form a major part of the category of "new" information.

We also argue that "new" information plays a critical role in precipitating economic growth and international competitiveness, and that a satisfactory rate of development of such "new" information requires the infrastructure support of high-speed packet switching data networks. Such networks now operate mostly for data transmission purposes, either within university environments, or else interconnecting major research universities with each other or with advanced nonacademic research centers. The packet switching capabilities of these networks will eventually extend to voice and video transmission. Other networks (so far mostly based on low-speed, publicly switched telephone lines) are beginning to interconnect and serve pre-college educational institutions. We identify four important trends in the rapid evolution of networks in the research and educational environment to establish the significance and potential magnitude of the contribution of these networks to U.S. innovation, economic growth, and economic competitiveness.

We regard data networks devoted to research and education as absolutely critical to the economic future of the U.S. We establish how they differ from commercially oriented networks the bulk of their benefits accrue to society as a whole, and not to the particular organizations or individuals that create them. Since these public benefits, therefore, cannot be sold in a market, research and education networks cannot be self-generating or self-financing. Government funding thus is both necessary for their survival, and fully consistent with the rationale for the free market—a means of filling the gap in the ability of the market to bring such benefits into being. Research on research networks demonstrates also that these networks need purposeful promotional efforts by dedicated management to insure their satisfactory growth.

Research and education networks merit the same kind of support that the

federal government has in the past extended to the national mail system, the continental railroads, and the national highway network. Specifically, we propose that the government provide funding for a national high-speed packet switching data network (with eventual voice and video capability), serving the research and educational needs of knowledge workers.

We recommend limiting areas of federal government support for networks to that just discussed, plus the providing of free access to the national network for decentralized educational units within individual states—from pre-school through university levels. We recommend that the federal government share with the states the cost of connecting such decentralized educational units to the national network.

Our conclusion is that a national research and education network and its extensions will come about in the U.S. in response to worldwide competitive pressures. Given the initial qualitative estimates of the vast potential benefits if the national network is established soon enough to represent a competitive advantage to the U.S., and its relatively small estimated cost, we recommend that the federal government move boldly now to establish the national network. The U.S. cannot afford to wait until it is pushed into an effort that is either too little or too late.

The Role of Networks in a High-Information Economy

"Current" Versus "New" Information. Recent discussions of the economics of information offer several distinct classifications of information-related activities derived from underlying statistical data, grouped either by industry or by occupation.[2] We find that, though these classifications differ in significant detail, they are quite comparable with respect to their conceptual foundations.

The classifications either directly or implicitly recognize a significant dichotomy. For our purposes, this dichotomy most clearly emerges from the work of Dunn (1970). Dunn's contribution is succinctly summarized in the following passage, taken from a recent analysis of the USENET Computer Network:

"Edgar S. Dunn suggested that the organized activities of humankind fall into two broad categories. First, there is organization which is directed at the management of ongoing activities: those that assure the routine maintenance of the life of the individual, family, or social organization. Second, there are activities that are developmental in nature. This second class of activities is directed to solving problems, changing the behavior of individuals or organizations and leads to experimentation with changes in the nature of the goals and controls that define human social behavior.

Dunn states that these two classes of activity require two quite different types of information. Management activity requires more repetitive information, which is more commonly quantitative in nature and needs little qualitative information related to values and goals. Development activity, on the other hand, is less interested in routine and is more concerned with knowledge relationships and is also more apt to need information about goals and values. Dunn also suggested that the design of an information utility to serve the routine needs of management is a vastly simpler task than the design of an information system to serve the creative needs of developmental activities. The fundamental question for our society is to what extent do we wish to allocate resources to deliberately design mass information utilities to enhance social creativity?"[3]

We designate the two kinds of information Dunn distinguishes as "current" versus "new" information. The kind of "new" information conceptualized in broad social terms by Dunn is of transcendental importance for the future of United States society.[4] The type of information the National Network is meant to carry is this "new" kind of information.

"New" Information, Growth, and Competitiveness. We maintain that the rapid expansion of "new" information is vital for technological progress and the international competitiveness of United States industry, on several scores:

1. "New" information embodied in scientific research (together with technical R&D) provides the jumping-off point for the development of high-tech industries, which in turn constitute the cutting edge of modern industrial growth. According to an NSF-supported research project (recently cited in *The New York Times*)[5] which surveyed scientific papers referenced in United States patents, patented inventions are increasingly drawing on pure science, as measured by the growing average number of literature references. The U.S. leads this trend, with Japan quite far behind[6]: if correct, this is an important advantage that must not be lost.

2. "New" information is getting "newer": the time lag between scientific discovery and technological application has been shrinking over the last decade. The research project cited above has found that the average lag between scientific article and patent has decreased from 8 to 7 years (all

"'New' information embodied in scientific research (together with technical R&D) provides the jumping-off point for the development of high-tech industries, which in turn constitute the cutting edge of modern industrial growth."

nations); the U.S. leads here, too, with an average closer to 6 years. To preserve this lead, it is of prime importance to provide excellent domestic channels for the rapid diffusion and in-depth discussion/assimilation of new scientific and technical knowledge.

In this light, it is a cause for concern that historical series on occupations for the U.S. show the proportion of workers in "new" information activities peaking in 1972 (Machlup, 1980). In Japan on the other hand, the proportion apparently continues to grow (Morris-Suzuki, 1986).

3. "New" information is vital for sustaining social and cultural change, an area in which the U.S. is in serious difficulty, especially with respect to the organizational changes that are required for putting innovations to good use. According to a recent study (Cohen and Zysman, 1988):

"American difficulties in sustaining manufacturing innovation lie not in our machines and technology, but in organizations and the use of people in production, in the strategies for automation and the goals we attempt to achieve with production innovation. The problem is not with our robots or with our local area networks, but with our understanding of how to exploit their productive promise."[7]

Dunn's conceptualization of "new" information is particularly relevant to this problem. As shown by the earlier summary, he focuses explicitly on the instrumental role of "new" information in solving problems, changing the behavior of individuals or organizations, and allowing experimentation with changes in the nature of the goals and the controls that define human social behavior.

Dunn's dichotomy emphasizes the qualitative difference between "new" and "current" information. It is this qualitative difference that makes "new" information into a strategic tool of economic growth and international competitiveness—and by the same token, reveals defects in this qualitative aspect as the Achilles heel of a modern society.

Yet it is just this qualitative aspect that is most likely to be deemphasized in a policy context dominated by technological considerations. Cohen and Zysman comment:

"The first question is how technologies are used. One recent study compares the use of flexible manufacturing systems (FMSs) for the production of comparable products in Japan and the United States. The average number of machines in the Japanese FMS was six, and in the American system, seven. However, the number of parts made by an FMS in the United States was 10; in Japan, the average was 93, almost ten times greater. The annual volume per part in the United States was 1727; in Japan only 258. The Americans used the tools as instruments of an old-style approach to manufacturing. They also failed to exploit them for introducing new products. The rate of new product introduction was 22 times as great in Japan as in the United States. With few exceptions, the flexible manufacturing systems installed in the United States show an astonishing lack of flexibility in use, in many cases performing worse than the conventional technology they replaced. The technology itself is not to blame. It is the management that makes the difference."[8]

In other words, what is required for new technologies to be used effectively is a qualitative change in management practices—which in turn have to be embedded within a changed corporate culture surrounding the production process. Such qualitative change involves the generation and wide diffusion of large amounts of "new" information. This can be enormously facilitated by the availability of a high-speed education and research network to which technical and managerial professionals have ready access. The development of a user community around such a network can result in intensive interactions between many individuals who would otherwise not have been in touch. Experience with USENET, a worldwide UNIX-based computer network, indicates that within the user community the focus of interaction, initially centered on technical issues, has tended to shift gradually in the direction of organizational and social questions.

"...within the user community the focus of interaction, initially centered on technical issues, has tended to shift gradually in the direction of organizational and social questions."

4. "New" information is at the core of the educational effort which determines future productivity. In an environment of growing international competition, the relatively high standard of living of U.S. workers cannot be sustained except on the basis of differentially higher productivity. Yet, productivity is no longer grounded in traditional mass-production technologies, but in adaptation to change as a way of life.

As 3, above, has shown, modern high-information technologies (such as FMSs) require a deliberate, continual revolutionization of the production process: to produce many different parts, to introduce new products continuously, to improve the process whenever possible. In such an environment, attempts to stabilize produc-

tion can destroy competitiveness, rather than bolster it—as would have been the case in the previous mass production era. More generally:

"The explosive growth of the 'fourth sector' or 'knowledge sector' of the economy has entailed a new, extensive synthesis of work and learning. As a result, learning is no longer viewed merely as a preparation for work, but as an inherent part of most American jobs. In particular, the 'embedded training' in most operating systems, from aircraft to powerplants to factories, has dissolved the barrier between performance and training."

This situation has two consequences for "new" information as the carrier of the educational effort. First, "new" information for educational purposes has to be transmitted in a more and more interactive mode as the emphasis shifts from content to process from specific subject matter to the acquisition of skills that permit the rapid assimilation of new knowledge patterned in a variety of ways. This puts a premium on effective communication channels. Second, the organization and diffusion of "new" information for educational purposes has an economy-wide impact on productivity:

"In the post industrial, knowledge-based economy, learning has become a strategically critical industry. The productivity of the learning industry has become a limiting factor for the productivity and competitiveness of the U.S. economy as a whole."[10]

These observations are important for policy makers at many levels and in many fields, including education, science, technology, industry and trade.

"New" Information: The Role of High-Speed Packet Switching Networks. In the previous section we attempted to establish "new" information as vital for U.S. innovation, economic growth, and international competitiveness. We now continue the argument in favor of government funding of a high-speed national research and education network by showing that networks of this type constitute an essential element of infrastructure support for the expansion of "new" information.

Within the category of "new" information, both R&D and education are becoming increasingly dependent for their effectiveness on modern telecommunications, especially high-speed packet switching networks that now routinely operate at T-1 levels or better. These have been developed to transmit large data sets efficiently; they are in principle capable of carrying voice, data, and images. The technology for switching packets at very high rates, approaching the hundreds of millions of bits per second, is now under development.

The range of activities associated with computer networks in university environments has recently been documented (NYSERNet/MEIS, 1987, 1988). The rapidly increasing impact of new technologies and new organizational forms on pre-college education has likewise been surveyed (Perleman, 1987). Finally, the emergence of online network user communities has recently been documented in an article referring to the USENET network (Durlak et al., 1987).

Four important trends can be discerned on the basis of the above sources:

1. Many key research activities at leading research universities place increasing reliance on advanced computer services that are available through high-speed packet switching networks. These networks are either local area networks (LANs) on university campuses or wide area networks (WANs) that interconnect universities and particular nonacademic, advanced research facilities.[11] Research-oriented network users require from the network, functional capabilities such as transfers of large data sets, computational services at supercomputer speeds, access to huge disk "farms," access to massive databanks, etc.

Users also want the network to deliver the widest possible connectivity to service points offering such functions. And they badly want transparency, that is, the same ease in using their familiar operating system procedures for accessing functions at the other end of the network as they are accustomed to enjoy when accessing the hard disk or printer on their desk.

These users do engage in some interaction via the networks, but currently this rarely goes beyond electronic mail or at most the exchange of successive drafts of joint articles. Thus, the networks at this stage primarily support individual—rather than interactive— generation of "new" information, together with fast access to already available "new" information.

2. The enormous future potential of computer networks in education is already evident, even though education, as a key area in the generation and diffusion of "new" information, has barely begun to place significant reliance on such networks. It is suggestive that education-oriented network users appear to undertake more inter-

"The enormous future potential of computer networks in education is already evident, even though education, as a key area in the generation and diffusion of 'new' information, has barely begun to place significant reliance on such networks."

active use of networks—sharing ideas and resources—than do current research-oriented users. The following instances illustrate the potential of networks in education.

At the university level, cooperative development and testing of teaching materials have been observed at Dartmouth, in both the NORTHSTAR network[12] used in engineering instruction under Dartmouth's approach of educating the "liberal arts engineer," and the the KIEWIT Network with over 6000 Macintoshes interconnected (new multimedia and hypermedia approaches making local use of the Macintosh Hypercard).[13] There is reason to believe the availability of teaching materials such as these will increase rapidly, and can if properly orchestrated, lead to a significant upgrading of instruction techniques throughout higher education and beyond.

At the pre-college level, a national microcomputer network, Kendallnet, demonstrates the potential of networks in generating and diffusing "new" information for both general and special educational purposes. This network, based on publicly switched telephone lines, interconnects schools for the deaf in Washington, DC, California, Florida, and other parts of the country. The network provides for the sharing of information on the implementation and use of the CMES (Computer Managed Education System) developed at Gallaudet University, including its curriculum and instructional software resources.

Perleman's recent survey, *Technology and Transformation of Schools* (1987), points out the far-from-obvious relationship that exists between a) the new computer and telecommunication technologies available for transforming our schools and b) the critical educational needs of our high-information society.

Perleman emphasizes that in the teeth of entrenched resistance from educational bureaucracies, our school systems must change. Radical organizational changes will be required in the learning process as a whole. The new computer and telecommunications technologies may be our only means for bringing about the hoped for results. The driving force likely to insure fundamental organizational change is the need to bring under control runaway costs of school systems operating in the traditional way.

"Perhaps the most interesting trend connecting computer networks and the expansion of 'new' information is the emergence of a network-user community as an intellectual, social, and political entity."

Networks for "new" information are thus an essential infrastructure requirement for changing current relationships in our approaches to education—as well as in our approaches to high-tech production. As such, these networks constitute a necessary, but not sufficient condition for moving in a satisfactory manner in the direction of a high-information society.

3. Perhaps the most interesting trend connecting computer networks and the expansion of "new" information is the emergence of a network-user community as an intellectual, social, and political entity. The network generates interactions among a broad range of individuals who would not have been brought together by other communications media. These interactions revolve around both technical issues and the kind of qualitative issues of social organization and values which have been emphasized by Dunn as playing a central role in cultural and social change.

Thus the network acts as the catalyst in the formation of a new kind of community which has a high potential for generating "new" information of the kind most important for economic growth and international competitiveness. The technical side of this potential was the first to be recognized. According to an account written in 1979:

"The most exciting accomplishment of the network...and one of its most valued assets was the emergence of a 'user community.' In the reality of that community—cooperatively sharing its data, its algorithms, and its ideas, discussing and resolving issues of software design, language choice, and protocols—was the hard evidence that linking computer resources could and did result in improved human-to-human communication."[14]

A recent analysis of the user community that emerged around the USENET network (Durlak et al., 1987) confirms that the first important user interactions revolved around precisely the same kind of task-oriented technical issues; but Dunn's question, "To what extent do we wish to allocate resources to a utility that enhances social creativity?" is still the key question. USENET was originally designed as a task-oriented network, but since 1983, social creativity interests have expanded more rapidly than the task-oriented interests. Much of the current tension in the system revolves around the older task-oriented users versus the new socially-oriented users generating volumes of social information."

In sum, computer data networks

oriented to carrying "new" information provide an indispensable element of infrastructure support for research and education. They also act as catalysts in bringing into existence network user groups that have a unique potential for generating and diffusing "new" information, both on technical matters and on matters of social organization, values, and controls.

4. The research and educational environments increasingly are generating unique and indispensable contributions across multiple stages of the innovation and development process for the information and communication industries. The major research universities play an important role as locations for innovative approaches to LANs and as nodes of WANs that carry data at high speed in the service of research and educational activities. Conversely, the universities are assuming an increasing importance in providing leadership in generating and testing new technologies for the information and communication industries. Moreover, the educational and research environment as a whole is assuming a key role in the commercial introduction and test marketing of these new technologies. Not only does this environment provide initial marketing opportunities, but in the process it also generates the only reasonable basis for making forecasts of broader commercial marketing prospects. Thus the operation of networks serving the research and education environment also provide indispensable test beds for the development of commercial networks.

Commitment to Networks Oriented to "New" Information

We argue that networks oriented to "new" information cannot be self-generating or self-supporting; we argue also, on the other hand, that since they generate the important public benefits governmental funding for them is fully justified. The role of these networks in promoting economic growth and international competitiveness is the key to this justification.

Networks for "New" Information are not Self-Generating. Recent work (NYSERNet/MEIS, 1988) has conclusively shown that high-speed packet switching data networks serving education and research are not self-generating. These networks need proactive management in order to create and safeguard opportunities for expanding network use in the face of ongoing, rapid changes in a) technology and products, and b) user requirements and expectations.

If network management were to restrict itself simply to providing a packet-carrying service, network utilization would not expand at a rate commensurate with the potential benefits such utilization can confer on the users and thus—and more importantly—on society. There is nothing that assures that such networks will automatically be used to their potential. From the user's point of view, the particular character of a network's performance can constitute either an important element of attraction, or an equally important element of deterrence to its use. Great effort and significant resources are required to assure that it is the former, rather than the latter, that is achieved. Network performance elements which require proactive management are the precise functionality, the degree of connectivity, and extent of transparency the network provides. The significance of each of these elements is illustrated, discussed, and analyzed in the context of four specific networks in the second (1988) NYSERNet-MEIS report.[1]

Networks for "New" Information Are Not Self-Financing. The high-speed packet switching networks serving education and research are not capable of being self-financing. Initial operations, e.g., in the case of NYSERNet, which is quite typical, have involved heavy subsidies from federal, state, and telephone company sources. Contributions from universities at which network nodes are located (and whose faculties and staff have been primary, first-round beneficiaries of access to the new network) have represented only a modest percentage of the total operating costs, with scant prospects of substantial increase.

The Need for Public Support. Public financing of these networks, given their vital contributions to economic growth and international competitiveness, is thus a necessity. In terms of economic theory, the case for such financing rests on the argument that when substantial "external" economies are generated, paying for these out of public sources is not a violation of the rationale of the free market, but an extension of this rationale into an area where a "market imperfection" exists.

The contributions of networks oriented to "new" information, to economic growth and international competitiveness, are "external" in the sense that they accrue to persons who are outside the range of market transactions involving network operators and network users. In effect, there is a gap in the organization of markets for economic goods and services, since no market exists in which the large benefits conferred by the networks on the public as a whole could be sold as specific "services." Thus the public benefits created cannot be captured in

"...the universities are assuming an increasing importance in providing leadership in generating and testing new technologies for the information and communication industries."

the form of private revenues to network operators; they cannot be "internalized."

From a theoretical point of view, the purpose of public funding is to offset this market gap, and to create a private benefit where the markets do not generate one. If no such public funding where to occur, the result would be that network operators would receive false economic signals. The absence of revenue corresponding to a socially valuable "output" would cause the output to be curtailed, and so the social benefit would be reduced or, perhaps, completely lost.

"The high-speed national data network oriented to research and education must, therefore, be operationally distinct from commercial networks."

Focused Public Support of a National Network for "New" Information

We provide somewhat finer definition to our arguments in support of government funding of education and research networks. The former arguments for public funding apply to some extent to all high-speed networks, regardless of whether they carry "current" or "new" information. The same is true of all transport and communication networks, because all of these have the striking public benefit of creating a single economic unit of the United States. The federal government has recognized the public benefits of transport and communication networks in the past, by providing major resource contributions to the national mail system; to the establishment of the continental railroad network; and to the national highway system. This is as it should be.

Appropriate Restriction of Support. In the present situation, however, it is wise to restrict the case for governmental resource contributions exclusively to the proposed national educational and research network, leaving out commercial telecommunications that are capable of self-supporting operations—for two reasons.

First, the public benefits, in terms of economic growth and competitiveness, are much greater for networks oriented to research and education than for commercial networks. This is because it is "new" information that provides the key to the nation's future.

Second, the distinction must be made for reasons of political practicability, since public funds are always scarce. To the extent that commercial networks are capable of self-support, they will provide significant amounts of "external" benefits even if they receive no public funds; but networks oriented to research and education are not capable of sustaining themselves on their own. For them, public funding is a necessity if they are to survive and grow.

The high-speed national data network oriented to research and education must, therefore, be operationally distinct from commercial networks. Nonetheless, it may well prove to be economic for the national network to make flexible use of connector and/or switching capacity provided by public carriers such as AT&T, MCI, Sprint, etc.

Cost Sharing with States: Network User Categories. In addition to its support for the higher education components of education and research networks, there is economic justification for the federal government to share with the states the cost of connecting decentralized educational units, from pre-school through university levels, to the national network. To establish this it is necessary to distinguish among three categories of users who are likely to be connected to the network in differing ways (NYSERNet/MEIS, 1987) and who differ in regard to the benefits they create:

1. Researchers and others at major research universities and other research institutions at primary network nodes;
2. Knowledge workers at public schools operated by local school systems; smaller educational and research institutions at other levels in the system; and
3. Knowledge workers associated with category 1 and 2 institutions acting as individuals from their homes.

The ability of the relatively few Category 1 institutions to shoulder a large share of network costs on behalf of their researchers is very limited. At the same time, research and educational innovations at these major research universities and other comparable institutions give rise to the largest "external" benefits. Therefore, it is both justifiable and feasible to propose that the federal government fund the full network operating costs that are incurred at these primary nodes.

Public schools and many of the other smaller educational and research units (Category 2 users) fall within the educational responsibilities of individual states. Their operations are normally funded and/or regulated under state laws. The federal government has, however, traditionally and appropriately provided support for selected educational activities. We propose that the cost of connecting schools and other smaller educational and research units (whether public or private) to the national high-speed data network be shared between the federal government and the states.

We propose that the connection of Category 3 users to the national network should be encouraged to be made through their institutions but

that full cost should be charged to these users under appropriate public utility regulatory statutes. Their respective institutions should share these costs to the extent that benefits of network access and use are joint and thus accrue also to their institution.

network oriented to research and education. This includes the funding of appropriate portions of the Category 1 and 2 user groups on the regional networks, as well as the full backbone. It has become quite clear from recent experience that the existing regional

"These networks need proactive management in order to create and safeguard opportunities for expanding network use in the face of ongoing, rapid changes...."

Conclusion

In making the case for governmental funding of the proposed high-speed national data network oriented to research and education, we have emphasized the distinction between "current" and "new" information. We have attempted to spell out the vital role played by "new" information in economic growth and international competitiveness, considering not only its more obvious quantitative effects, but also its qualitative aspects and their resulting impacts on social and cultural change.

We have also endeavored to show, based on materials originating in recent studies, that the networks oriented to research and education provide the indispensable infrastructure support without which the generation and diffusion of "new" information would be severely handicapped. In fact, considering rapidly growing international competitive pressures, the absence or poor performance of such networks would in all probability slow the expansion of "new" information. This would further jeopardize the competitive position of the United States in international markets and even in the domestic market.

On the basis of these arguments we feel that a solid case emerges for funding by the federal government of the proposed high-speed national data networks are not capable of financial self-support. Moreover, even with considerable outside support these networks require strong, proactive management to overcome the many technical, organizational, and cultural resistances that slow down their widespread, effective utilization.

As pointed out above, federal support should extend to sharing with the states the cost of connecting schools and other smaller educational and research units to the national network, to spread the benefits of the national network as widely as possible The goal should be to connect all decentralized research and education activities.

The order of magnitude of the funding required to fulfill these objectives is very small compared to the public expenditures this country devotes to the support of research and education—even an extravagant estimate is well under one percent of that total. Yet, the potential payoff from an early implementation is vast. It appears inevitable that public funding of the proposed national network will come about eventually, in response to worldwide competitive pressures. We propose that, instead of waiting to be pushed into an effort that is too little or too late, the nation move boldly now to establish the national network to bring about a major competitive advantage for U.S. industry and thus help insure a U.S. lead in high technology and economic competitiveness.

Footnotes

1. Bell (1979), p. 79.
2. Recognition of the scientific and social importance of information goes back to the nineteenth century; there is a surprisingly clear conception, in the writings of some of the classical economists, of the respective roles that information and energy play in industrial development. The modern discussion of the economics of information, nevertheless, begins with the work of Machlup (1962, 1980) and Arrow (1979). Important contributions have also been made by Dunn (1970); Engelbrecht (1985, 1986a, 1986b); Jonscher (1981, 1983, 1984); Karunarathne (1984, 1986); Komatsuzaki and Tanimitsu (1983); the OECD (1981); Porat (1977); and Rubin and Huber (1986).
3. Durlak et al (1987), p.3.
4. Based on occupational categories, workers in "new" information now comprise some 18% of all information workers: R&D (4%), education and training (10%), and creative and design (4%). Workers in "current" information comprise the remaining 82% of the total: management and supervision (25%), finance and accounting (14%), marketing and selling (14%), brokerage and buying (4%), and clerical and secretarial (25%). Source: Jonscher (1983), p. 19, Figure 2, average of 1978 and 1990 (forecast), rounded.
5. The research was undertaken by Computer Horizons, Inc., of Haddon Heights, NJ; as reported by William J. Broad, "Science and Technology: the Gap Is Shrinking Fast," *New York Times*, April 5, 1988, pp. C1,6.
6. We have some unresolved questions about the role of scientific references with respect to Japanese patents obtained in the United States. It is conceivable that some scientific references which would be appropriate might be omitted if they refer to Japanese basic research performed under corporate auspices.
7. Cohen and Zysman (1988), p.1111.
8. Cohen and Zysman (1988), p.1113; citing from Jaikumar, 1986. pp.10,69.

9. Perleman (1987), p.23.
10. Perleman (1987), p.ES-1.
11. See NYSERNet/MEIS, 1988, for detailed descriptions of four academic computer networks operating at Cornell and Dartmouth.
12. NYSERNet/MEIS (1988), pp. 13-14, A19-A20.
13. NYSERNet/MEIS (1988), pp.16, A4, A14-A18.
14. Denicoff (1981), p.374.

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"...the networks oriented to research and education provide the indispensible infrastructure support without which the generation and diffusion of 'new' information would be severely handicapped."

ENTITY POSITION STATEMENT

HIGH-PERFORMANCE COMPUTING AND COMMUNICATIONS

The Institute of Electrical and Electronics Engineers, Inc.

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(202) 785-0017

The High-Performance Computing and Communications (HPCC) program is essential to maintaining U.S. global leadership. The IEEE-USA commends passage of the High-Performance Computing Act of 1991 and recommends rapid implementation of its elements.

Our future technology leadership relies upon these elements:

- Scientific research, development, and engineering are enhanced and transition time to market shortened when professionals have ready access to remote data sources. Such linkages enable complex data base analyses, couple human intellect to machine capabilities to optimize use of human pattern recognition capabilities, and help those professionals tackle problems that were not possible to solve without such high performance capabilities.

- Industrial design and manufacturing is more competitive and transition to a developed product is accelerated when using (1) simulations to evaluate paper designs more rapidly, accurately, exhaustively and at less cost; (2) visualizations and animations to enable insight to development and manufacturing challenges; and (3) Computer-Aided Design linked to Computer Integrated Manufacturing processes to eliminate barriers between engineering and manufacturing.

- High speed networks: (1) provide voice, video and data connectivity; (2) enable high-performance workstations with visualization and animation software to be linked to supercomputers; (3) interconnect computer mainframes to each other and to data storage peripherals within one data center; and (4) link supercomputers in different centers or even link networks of supercomputers to provide metacomputers for resolution of "Grand Challenge" problems.

These elements will help establish and enhance our competitive stance in the global economy, maintain economic viability and product excellence, and ensure the viability of critical national security systems.

As approved by USAB — July 30, 1992

Approving Entity — Date

IEEE-USA recommends the following actions be considered in the HPCC program:

- Develop estimates of high-performance computing needs and available resources; refine theory and experience of how new computer architectures work and can be programmed and enhance computational methods and software operating systems, compilers and applications.

- Encourage the computing and communications industries and users to integrate supercomputing and parallel processing and high-speed data communications to make computer technology more affordable and accessible. Develop virtual networks of supercomputers and meta machines of networked computers. Focus, plan and disperse the technology investments in such a way as to stress a competitive posture for the American high-performance computing industry.

- Design the NREN (National Research and Education Network) to achieve data rates in excess of the 1 Gbps to accommodate projected user demand for data-rich applications, such as scientific visualization, and to support access to research devices, supercomputers and very large scientific and engineering data bases.

- Structure the NREN to serve as a leading-edge testbed for the development and study of basic technologies, applicable free space or guided network technology, high-level applications, standards, policies and network operational procedures using Internet, an amalgam of Federal agency networks, private systems, state and regional networks and local research center and university networks, as an initial testbed possibly leading towards a commercial network entity.

- Leverage Federal resources by requiring current and future HPCC participants to contribute some research, design, development, implementation or operational support to the expansion and use of the infrastructure created.

- Make early market insertion of new technologies, developed through both industry and government-supported resources, an HPCC goal. Focus on storage capability, data extraction and analysis software, optoelectric (e.g. amplifiers and star couplers) communication devices, and network management applications.

- Resolve legal issues regarding the protection of intellectual property, identification of liability under open access to systems, and personal privacy associated with service and product utilization data collection before the network is operational.

BACKGROUND

Traditional computer design strategies are running into basic physical limits, e.g. the so-called "von Neumann bottleneck." The machines cannot carry the burden of delivering trillions of computations per second. Computer designers are using new arrangements of computer elements as well as new technology to circumvent the limitations. Applied research and engineering needed to develop subsequent generations of computers is fraught with financial and technical risk.

U.S. firms at the leading edge of this technology tend to be relatively small -- sometimes too small to make the necessary investments in research without reasonable assurance of appropriate results. In order to attract substantial private investment, the high-performance computing market needs to be strong, predictable and based on well understood user requirements. The Federal government also needs to continue to increase its investment in research at this generic level. Furthermore, Federal funding at the generic applied research level must be focused, planned and dispersed in a manner that will stress the competitive posture of the American HPCC industry and user communities. In addition, by supporting local area networks of computers, Metropolitan Area Networks for small geographic regions, and wide area networks that link computer LANS, a meta machine can be assembled that is large enough to address the "Grand Challenge" issues once the distributed processing application software coordination problems are resolved. The high-performance computing community needs a long-term, well-funded and tightly coordinated Federal High-Performance Computing Program as part of the HPCC Act of 1991 to achieve its goals.

NREN will use transport media capable of handling a factor of ten to one hundred times the goal of 1 Gbps data rate. That data rate is sufficient to accommodate simultaneously 50 channels of broadcast quality HDTV, transmitting text or graphics on the network from two high-end performance workstations or from forty personal computers. A massive data volume would be generated, simulating air flow over a hypersonic aircraft's surfaces, if one assumes ten test points for each of a million grid points on the surface. Similarly, non-invasive radiosurgery treatment requires planning the positioning of radiation beams and the specification of their intensity such that a tumor receives 80% of the dosage and the surrounding tissues only harmless levels. In these cases, data may reside in remote hosts and require transmission to a local computer, marriage with local host data processing, and graphic portrayal for rapid assimilation by the user for decision-making. To avoid bottlenecks, network capacity must support such user demands.

Internet, a network of networks, already exists as an initial amalgam of Federal agency networks, private systems, state and regional networks and local research center and university networks. This pattern of networks will continue with NREN growing more complex as all the potential participants join the system. As the demands for connectivity and capacity by users grow, the challenges of leadership increase. Learning while the system is relatively small enhances the probability of foreseeing the problems and structuring solutions before they become financially burdensome. In addition, alternate technical solutions can be assessed for segments of the network.

The leveraging of Federal resources occurs through joint Federal and private investments in research, development and product creation for the U.S. economy. One past example is a $12,000,000 DARPA investment that accelerated the creation of three high-performance workstation companies and the much larger Federal investment in the application of the technology. It can also result from the requirement that researchers, developers and users of NREN capabilities contribute to the process of creating a viable infrastructure, in addition to paying for use of the NREN capabilities.

Research and development as well as manufacturing consortia should be encouraged in technologies vital to the United States. Participants contribute researchers, facilities, administrative support, funds, and their dedication to achieving mutually beneficial products and services. The research is shared, but the product development remains on a competitive basis which results in the rapid insertion of the technology into the marketplace.

There are a variety of interfaces in the HPCC integration challenge and the required product enhancements, improvements or development. Large memory capacity, universal data handling tools, all-optical network components, the software to manage a hybrid network, and visualization workstations are key. HPCC helps the process of product development. Early market insertion assures availability of resources for development of future generations of new products.

Lastly, intellectual property, e.g., software licenses, can be misused by anonymous users on an open network. Similarly, access to host computers by network users, can be interpreted as introducing a user liability for misuse of the facility or for inducing harm to the user from system design/ manufacturing errors. Hence, the liability cuts both ways. Permission to collect product and service usage data from a two-way transmission line to a facility as well as ownership and resale of that data, has system design and, of course, societal or privacy impacts. Operational requirements should be developed to provide guidance for system designers, developers, operators, providers and users.

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DISCUSSION PAPER

prepared by the

INFORMATION INDUSTRY ASSOCIATION

on Development of the National Research and Education Network (NREN)

Introduction

The Information Industry Association offers the following observations on key issues affecting development of the National Research and Education Network (NREN). This paper is intended to stimulate further discussion and work toward resolution of these issues. It is not intended as a formal statement of IIA positions on specific public policy questions surrounding NREN development. This paper was prepared by the Internet/NREN Issues Task Force of IIA's Public Policy and Government Relations Council. For further information, contact IIA, 555 New Jersey Ave., N.W., Suite 800, Washington, DC 20001, 202/639-8262 (phone), 202/638-4403 (fax).

About IIA

The Information Industry Association is the trade association of companies involved with the creation, distribution and use of information in electronic formats of all kinds. IIA's membership includes the leading electronic publishers, on-line database providers, CD-ROM and other optical publishers, videotex and audiotex services, and companies serving specialized markets for financial, consumer, and other information. The focus of this paper is shaped by the experiences and concerns of IIA member companies that distribute information via on-line services, and of companies that provide such services. These services include electronic bulletin boards, dial-up-and-download, and interactive retrieval services. Some of these services, such as Dialog, Dow Jones News Retrieval, Mead Data Central, and WESTLAW, are global in scope and offer a broad spectrum of information, while others serve more specialized groups of investors, professionals, researchers, and other market segments. Some of these services already have a significant presence in the academic and research communities, and a few of them are beginning to connect to these communities via the Internet.

Since its founding in 1968, IIA has been committed to the advancement of core principles that have helped to shape the growth of a dynamic and competitive information industry. Among these core principles is strong, clear protection for copyright and other proprietary rights vital to encouraging the development of innovative and valuable information products and services. Another core principle acknowledges the economic and social value of encouraging a competitive marketplace of diverse sources of information, and fashioning the proper role for government in regulating and participating in that marketplace. These and related issues continue to shape IIA's perspective on cutting edge issues such as the development of NREN.

We offer the following observations to stimulate further dialogue among information companies, and with other parties involved with the planning and implementation of NREN development.

Opportunities of NREN

The development of NREN offers important opportunities for companies that provide information content and on-line distribution, and for information consumers in various market segments and the public at large. The potential for public benefit can best be achieved if NREN is planned, developed and managed in a way that maximizes the participation of private sector information companies as part of a diverse group of entities offering information access over the network.

The obvious beneficiaries of policies encouraging commercial participation in NREN will be network users. Existing commercial online services provide over a terabyte of full-text and abstracted databases, a volume that is growing rapidly. The scope and depth of coverage is enormous: hundreds of newspapers and magazines; abstracts of scientific and other scholarly material; full text of legal materials going back to the 1800's; full-text patent information; up-to-the-minute newswires; encyclopedias and other reference works; and many other resources of immeasurable value to researchers and academics. Many institutions already provide access to services like Dialog and Nexis for selected scholars, or ration access through their libraries. NREN offers the potential for a dramatic expansion of this access both within and outside academe.

Development of the NREN also promises a host of entrepreneurial opportunities that will expand U.S. competitiveness, spur technological innovation, and build wealth. Several companies have already developed profitable innovations that are associated with improvements in the Internet. Others look to the future. Over the past two decades, the information industry has been home to many of the nation's foremost innovators. They and others who seek new linkages and interfaces between existing on-line services and Internet users will build upon a wide variety of opportunities and synergies, many of which are not even knowable at present. These innovations will lead Internet, and the evolving NREN, to a new level of service and utility.

Of course, the development of new and enhanced networks represents a market opportunity for existing information industry players and new entrants into the information business. Some 8 million users already have access to Internet, and the number is growing rapidly. Some obstacles to the growth of this market have already been identified — for instance, the Acceptable Use Policy of NSFNet, which could severely limit commercial interest in Internet unless it is eliminated, modified, or circumvented. But as Internet evolves into NREN, other problems loom on the horizon. Unless these can be resolved in a manner that encourages commercial participation in NREN, the new network is unlikely to achieve its goals, and the hopes of NREN advocates will be dashed.

Concerns about NREN

Among the chief concerns of IIA members are the following:

1. Copyright protection. Virtually all the information products and services provided by IIA member companies are protected, wholly or in substantial part, by proprietary rights claims, chiefly copyright. This protection may extend to individual items within a database; to the entirety of a database which is licensed to an on-line provider; and/or to the aggregate of a service's databases, if it constitutes an original compilation. These copyrights are fully enforcible, both as to individual works and as to compilations, following the Supreme Court's decision in Feist Publications, Inc. v. Rural Telephone Service Co., Inc., 111 S.Ct. 1282 (1991). The new networked environment must provide adequate and practical protection against abuse of these intellectual property rights, including unlawful appropriation, improper access, or other infringement of the copyright owner's exclusive rights. This concern is reflected in the High Performance Computing Act (HPCA) itself, which lists as a network characteristic that NREN must "be designed and operated so as to ensure the continued application of laws ... that protect copyright and other intellectual property rights" (section 102(c)(5)).

2. Contractual relationships. Apart from the provisions of copyright law (and other intellectual property law), most information companies further protect their intellectual property through subscriber agreements entered into with, and enforceable against, each person or organization wishing to access their databases through an on-line service. Generally, these services permit access only via passwords issued upon the execution of appropriate agreements. Among other things, subscriber agreements define the uses to which downloaded information may be put and/or the length of time and authorized purposes for which a subscriber may retain such information in machine-readable form. Establishment of a license relationship with individual users not only puts users on notice of restrictions on use of information obtained on-line, but also facilitates training, customer support, and billing.

In response to the desires of academic institutions, which want to centralize their campus-wide networking (and their access to on-line information resources) via Internet, a growing number of on-line services now offer Internet access. While so far there have not been any insurmountable difficulties, the "wide open" Internet environment means that the ultimate user may never be known to the service provider, and it may be impossible to enter into, much less enforce, a subscriber agreement with individual users. This explains why these services are currently accessible to Internet users only to the extent that Internet is treated as simply another public data network (like Tymnet or Telenet). Expanding such access in the NREN will depend upon the development of a universally accepted protocol for on-line execution of binding and enforcible subscriber agreements. Otherwise, NREN access to on-line services will be inhibited by the requirement that each end-user must continue to execute a separate written subscriber agreement.

3. Compensation mechanisms. Considerable costs are incurred in providing information via online services. Among the elements justifying compensation are the skill, expertise, labor and capital invested by the information supplier in collecting, arranging, compiling and processing information, as well as the intellectual effort, labor and capital invested by the online service in designing and maintaining the databases, creating and supporting the retrieval service, and providing needed training and customer support to subscribers. Of course, the value obtained by the user also justifies compensation to the provider. While this compensation can in theory be paid in a variety of ways, including taxpayer subsidy and institutional support, the starting point — in the NREN environment as well as elsewhere — should be the assumption that market forces and competition determine the price, as set by the service itself or the information provider, as the case may be.

Information prices may be set according to one or more of several paradigms. These include:

Hourly rates, based on the time the user spends in the service's databases. Sometimes different rates will apply to different databases.

Transaction charges, in which each search in a database, or each access to a separate service, incurs a charge, regardless of the time spent.

Per record charges, in which the user pays for each quantum of information actually used, whether viewed online or printed after conclusion of the session.

Offline transmission charges, in which a separate rate is charge for downloading or printing of information outside of the online session. Special software can also be used to meter charges for information printed or downloaded while the user is engaged in the session.

Block pricing, in which the user pays a fixed rate for a fixed volume of usage, and some other rate for additional usage.

Flat rate pricing, in which the user pays a fixed monthly or annual fee regardless of the volume of usage.

While no single paradigm will be appropriate for all who access online services via NREN, instituting any of them (or any combination) will require the development of accounting mechanisms that are lacking in today's Internet. The existing network offers no capability for tracking an individual user's utilization of services available through the network. Thus, billing is possible only in direct subscriber relationships between the user and an information service provider. None of these providers will be comfortable opening up its service to ad hoc access without reliable accounting and billing mechanisms. The authors of the HPCA recognized this when they mandated that NREN "have accounting mechanisms which allow users or groups of users to be charged for their usage of copyrighted materials available over the network" (section 102(a)(6)).

4. Data integrity and security. The ease of downloading, user manipulation, and downstream transfer of information in the NREN environment threatens the integrity and security of the data the information provider makes available on the network. This vulnerability undermines the prospects for effective copyright enforcement or strong contractual relationships, and threatens to confuse the issue of who provides the value the user obtains from the information. The network must offer a capability to label information as proprietary to, or protected by, a particular information provider. As a complementary capability, there must be a way to indelibly indicate that data has been altered or labeling removed. These capabilities must be ubiquitous and simple to invoke.

Clearly users have a vital interest in this problem as well, since they must be able to rely upon data without concern that an intermediate user may have changed it. Without adequate protections for data integrity and security, the potential for tort liability for damages stemming from a user's reliance on altered data may by itself be enough to discourage commercial information providers from participating in the network. See also HPCA section 102(c)(5), which requires NREN to be "designed and operated so as to ensure the continued application of laws that provide network and information resources security measures."

5. Non-discrimination. Commercial information companies will be attracted to NREN if it offers a level playing field for competitive services; they will be repelled if heavy thumbs are detected on the scales. Potential sources of discrimination include the federal government, which acts as information provider, partial funder, and umbrella for a massive cohort of users; and network operators, which could control both conduit and content. Non-discriminatory treatment of all content providers must be assured; that is, no provider should receive benefits (i.e., faster transmission, greater security, more favorable routing, priority processing, enhanced access to customer network use information, preferential placement in directories) greater than those offered to any other provider. Efficient mechanisms for enforcement of this standard must also be provided.

6. Other issues. The resolution of other concerns will also greatly influence whether or not information companies find NREN a viable means of reaching out to users. Aside from the immediate question of the future of AUP, these concerns include: (a) the stability and predictability of pricing and terms of connection to the network; (b) the reliability and robustness of the network as a distribution medium; (c) the availability of useful directory services; (d) the creation of a transparent and balanced mechanism for settling policy questions concerning the operation of the network. For the most part, the concerns that information companies bring to the table on these issues are not unique to them, but rather are shared by many other potential network participants and users. IIA members look forward to working with other interested parties to tackle these and other issues of mutual concern, and by resolving them, to take Internet and ultimately NREN to ever higher levels of service and utility.

1122p 8/17/92

National Association
of State Universities
and Land-Grant Colleges

A. ORGANIZATION: The National Association of State Universities and Land Grant Colleges (NASULGC)

B. NATURE, GOALS AND CONSTITUENCY OF THE ORGANIZATION:

Founded in 1887, The National Association of State Universities and Land Grant Colleges (NASULGC) is the nation's oldest higher education association. A voluntary association of 149 public research universities located in all 50 states and the U.S. territories, NASULGC campuses enroll more than 2.7 million students and claim upwards of 20 million alumni.

Dedicated to supporting excellence in teaching, research and public service, state and land-grant universities have played a pivotal role in the growth of American higher education and the development of democracy. Twenty-six of the top 39 research universities are members of NASULGC; these campuses invest about $4.5 billion annually in science, engineering, and other research and development. Today, NASULGC members award about a half-million degrees annually, including about one-third of all bachelor's and master's degrees, 60 percent of all U.S. doctorates, and 70 percent of America's engineering degrees.

NASULGC member institutions span the map from Maine to California, and the nature and concerns of these campuses are as diverse as the country itself. Given the wide geographic disbursement of NASULGC campuses, the informational linkage

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envisioned in the National Research and Educational Network promises to serve as a means to bridge the distances and differences among the university community for the common goal of maintaining America's preeminence in higher education.

However, in order for a network on the scale of NREN to become a reality, there must first exist a productive working relationship between government, business and industry, and education. It goes without question, that the most important element of this partnership is a shared vision on how the rapid advances in computer networking can help address the needs of the entire nation today, and, more importantly, tomorrow.

Rapid changes occurring with electronic technologies will affect learning, classroom teaching, libraries, student life, the publication process, the workplace, modes of research and public outreach. These changes raise vital issues for colleges, universities and the nation and have led to a convergence of interests among traditionally separate technology areas.

In response to the profound effect the use of technology is having on the creation, preservation, and dissemination of knowledge and information, NASULGC has recently formed the Commission on Information Technology (CIT). The goals of the CIT are to: (1) identify and develop policy positions and advisory assessments on information technology and related policy issues of concern to NASULGC; (2) publish reports and guidelines, sponsor workshops and provide other educational support to enhance NASULGC member institutions ability to deal with information policy issues of importance to them; (3) work with other Commissions at NASULGC and other associations and with agencies of the federal government to identify and address technology issues of mutual interest, to shape proposed federal policies relating to

- The network provides for an improvement in research productivity that will exceed the investment by many times;
- The network provides access to research tools to many small institutions thereby increasing their ability to be competitive;
- The network provides access from the universities to industry and federal research laboratories.

Information Policy and Questions:

a.) Intellectual Property/Copyright Protection:

-Fair use provisions provided for higher education in the 1976 copy right law are being eroded. Legal advice designed to reduce exposure of individual institutions has the aggregate effect of limiting faculty and student access to scholarly information.

-The rights of intellectual property created by university faculty are frequently given to commercial publishers who then sell it back to universities. Thus, universities may incur high costs for works they funded.

b.) Privacy, Security and Freedom of Expression:

-Computer text can be broadcast anywhere in the world and campus policies designed to deal with on-campus speech and published material may need to be altered to fit this changed environment.

-Policies for inspections of information stored on campus computer systems need to be established. These will not be the same as those for inspecting an office of dormitory.

c.) Scholarly Publishing:

-Related to the copyright issue, publishing and increasing costs are limiting accessibility to publications by authors, faculty and students. Should the producers, scholarly societies, university presses, and libraries gain a measure of control over the scholarly publishing system?

d.) Cooperation Using Electronic Systems:

-University libraries can afford fewer materials in traditional format and hope to get the information from other libraries or in alternate electronic form. What are the protocols and costs for such a system? What should the networking standards be?

information technology and to inform them on issues of importance to the NASULGC membership.

The NREN objective of linking together university libraries, super computers, and national databases is certain to inspire both educators and students to explore and expand the frontiers of knowledge. The National Association of State Universities and Land Grant Colleges and its Commission on Information Technology is fully devoted to the goals of the NREN, and will continue to work in support of its construction. Academia certainly stands to benefit from, contribute to, and be affected by NREN. It is essential that institutions of higher education become active participants in the NREN partnership.

C. HIGH PERFORMANCE COMPUTING - TOPICS FOR CONSIDERATION:

Technology Infrastructure/Management:

The National Research and Education Network (NREN) is a high speed network being developed by the government and industry with minor university input. Universities need to participate in the development of this network (i.e. management suggestions, funding levels) more vigorously so that it reflects both the research and educational needs of those institutions. Some points regarding the future uses and value of NREN to the higher education community are:

- NSFnet (the backbone of the NREN) already ties over 1,000 universities together;
- The network is used for scholarly cooperation in research and teaching;
- New instruments, such as telescopes, depend on the network to allow control and cooperation remotely from the physical site of the instrument;
- The major research libraries are using the network to plan for the exchange of material and avoidance of unnecessary duplication;

NREN Policy Statement

Sprint is a diversified international telecommunications company with $8.9 billion in annual revenues and the United States' only nationwide all-digital, fiber-optic network. Its divisions provide global long distance voice, data and video products and services, and local telephone services to more than 4 million subscriber lines in 17 states.

HPCC 1991 and what it may hold

The passage last fall of the High Performance Computing and Communications Act of 1991 has stimulated the imaginations of scientists, educators, policy makers and technologists throughout the country. In it's one sentence preamble, the bill, S. 272, describes it's purpose "To provide for a coordinated Federal program to ensure continued United States leadership in high-performance computing". The language of the act unfolds to offer a broad interpretation of this mandate. In the legislation provisions are made to task the various federal agencies with promoting the development of the applications, information services and access to the Network which will manifest the full value of NREN. Central to this value is the influence the Network can have on U.S. competitiveness through the efficiencies next generation information infrastructure can bring to business and through the tools it can bring to education and re-training efforts. While the bill is virtually all-encompassing in it's scope, it offers little direction as to how the charter shall be carried out. There is little demarcation of agency responsibility and the bill's language leaves it's designated objectives open to wide interpretation as to the appropriate level of effort and involvement to be applied towards their achievement.

To fully realize the opportunity NREN presents, policy makers must view it as what Branscomb[1] describes as an enabling information service, rather than a prescriptive technology investment. The distinction here is whether the Network is viewed solely as a vehicle to support specific technology and research initiatives, or as an open platform which will encourage the development of a broad range of anticipated and unanticipated products, services and applications. This paper attempts to outline the rationale for pursuit of this larger vision and steps which will be required for it's fulfillment.

The High Performance Computing Act of 1991 properly recognizes the significance of information technology with regard to productivity, industrial competitiveness and economic growth. Not only should NREN be seen as an enabler of basic scientific research, but as a means to "demonstrate how advanced computers, high-capacity and high-speed networks, and electronic data bases can improve the national information infrastructure for use by all Americans". Kapor and Berman describe NREN as the prototype for the National Public Network[2], a perspective which takes an all-encompassing view of NREN's potential implications. When evaluated in this broad context, the potential return on NREN investment goes far beyond that which will be realized within the high-performance computing industry.

The ability to move and manage information is one of the key differentiators to which business must turn in striving to compete in the global marketplace. The Network will strengthen our economic vitality both through the direct efficiency gains organizations are able to achieve and by exploiting the educational opportunities that it presents. In terms of educational applications, the Network will of course not serve as an end in itself, but as a medium which will support distance learning programs and information sharing. Much success has already been realized in applying distance learning to re-training efforts. For school children, benefits will be realized both through the resources which are brought to them over the Network, as well as through the enhanced technological literacy they will gain via exposure to the Network and it's peripherals. Additional

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[1]p. 21, Branscomb, *Information Infrastructure for the 1990s: A Public Policy Perspective*, in Kahin, ed., Building Information Infrastructure.
[2]p.199, Kapor and Berman, *Building the Open Road: The NREN as Testbed for the National Public Network*, in Kahin, ed., Building Information Infrastructure

applications include the ability to leverage our healthcare dollars through remote access to medical diagnostic hardware and personnel.

Investment in NREN has the potential to yield return not only in terms of the research, collaboration and information sharing it will support. Development of the network itself will spawn substantial business opportunity. It is expected that many new business will appear to provide services and applications which will be enablers of and be enabled by the Network. A portion of the value introduced by these new products will be captured by the entrepreneurs that bring them to market. This may be the breeding ground for the next Bill Gates or Steven Jobs.

Development guidelines

The vision painted here is optimistic, but not unrealistic. To realize the full array of positive externalities which may result from investment in NREN, several objectives should guide the development of the Network.

- The platform should provide a means of accounting for utilization of the network and the services it supports.
- Competition should be promoted
- There should be no monopoly providers.
- the government should purchase commercial network services, as opposed to government exclusive networks.

A common theme in these principles is to create an environment which fosters creative entrepreneurialism. This will promote, with guidance provided by market forces, the development of the services and applications through which the true value of the Network will be realized.

Accounting

The ability to account for utilization of the Network on both time and volume bases will provide potential service providers a means of easily charging for their services. This is not to say that all use of the Network should generate utilization charges, but merely that the capability to account should exist in the system.

The services which sprout from the information fabric of NREN will be introduced by a variety of different provider types. It is expected that initially many will be small proprietorships, perhaps being run out of the home. These services will bring much of the potential benefit of the Network. The value is not in the network itself, but in that to which it provides access and the ease it is able to provide in locating, organizing and recovering information resources. To encourage the development of such capabilities and resources, it will be necessary to provide developers with a means of easily re-couping their investment. Further, by implementing a network-wide system, significant economies of scope will be realized. In developing this system, input on system requirements should be sought from the parties that will be affected.

While charging is in principle a sensible capability for the network in practice it can be problematic. In the author's experience, there is a floor of approximately one cent required to be expended in charging for any event on the network. Thus the value of resources consumed by the event should be somewhat greater than one cent. For example, if counting IP packets on a source-destination cost roughly one cent per packet, while the value of the network resource consumed by the transaction is roughly .001 cent then charging should be on a fixed basis.

In development of a charging algorithm costs can be broken down into several component elements: the incremental hardware and provisioning costs required to provide access to a user, the user's consumption of the network resource (i.e. volume of traffic) and service guarantees, such as throughput, loss probability average delay and delay variability. In other words, in developing cost accounting principles attention must be given to the costs of connecting a user to the network and to any effect the user will have on quality and availability experienced by other users.

Competition and the AUP

One of the principle criticisms the NSFNet has faced is the monopoly status it has granted ANS. This status is a function of both the networks Authorized Use Policy (AUP) and limit of the contract to a single awardee. Through a mandated commitment to standards, the issue of inter-carrier interoperability can be

mediated. As pointed out by Kapor and Berman[3], deregulation of public phone service has yielded end-user benefits in the form of technology advances and lower prices. Similarly, pricing of network services should be determined by the market. The proliferation of Internet services has already led to price competition and this will continue as more players enter the market. Further, providers are encouraged to introduce a variety of pricing methodologies, in order to appeal to a wide variety of potential users. For example, budget constrained institutions such as public libraries and K-12 schools represent a potentially large user community. In addition to offering a large potential market, the connection of these institutions to the network will increase the overall value of the network by adding additional information resources. This encourages commercial service providers to offer a set of flat rates, providing new users an accurate sense of the costs they will incur.

Promoting competition among providers of the Network will encourage the availability of an efficiently priced network, and one that is oriented towards end-user needs. To maximize the influence of the market on the evolution of NREN and the National Public Network, subsidies should wherever possible be provided to end-users, rather than service providers.

The AUP has not only limited the ability of service providers to offer ubiquitous access and confused the market-place, it has stifled the development of information services that would be provided over the network. Unclear of the implications of providing a commercial service over the net, potential providers of information services have generally chosen to stay away (with the notable exception of several freely available services developed through University research). These services would be of benefit to all users of the network, including the research and educational institutions the NSFNet is intended to serve. If NREN is to be a successful prototype for the National Public Network, it must encourage the development of new types of services.

[3]p.205, Kapor and Berman, *Building the Open Road: The NREN as Testbed for the National Public Network*, in Kahin, ed., Building Information Infrastructure

Procurement of commercial network services versus government exclusive networks

The NSFNet backbone and ESNet offer an opportunity to contrast two federal procurement strategies used for investment in advanced network services. The NSFNet was provided under a Cooperative Agreement, while ESNet is being procured under contract as a commercial service offering. The Cooperative Agreement can be regarded as similar to a research grant. Under the NSFNet Cooperative Agreement the provider is under no obligation to meet any strict service or performance criteria. In contrast, the ESNet contract will bind the service provider to a specific set of requirements. This provides the procuring agency, in this case Energy, with added assurance that end-user needs will be met.

Procuring commercially available services also provides value in terms of cost savings. It allows the procurement of leading edge services without having to finance the entire cost of the infrastructure. This cost will be shared across all customers of the service. If the procurement was for a private network, the agency would be faced with bearing the entire cost. The NREN and interim NREN network procurements call for bleeding edge technology. This technology comes at a high cost to both the service provider and the user. In particular, implementation of SONET transmission technology will require a very large investment on the part of carriers. The cost of providing SONET to the government can be reduced significantly by allowing (or insisting, as in the case of ESNet) providers to distribute the cost across multiple customers. Lastly, purchasing commercial services ensures early technology transfer. The private sector will have access to the same leading edge technology available to the government.

Thoughts on evaluating the investment

Fulfillment of the vision of NREN as an incubator for the development of the a powerful national information infrastructure will require a greater commitment of resources than merely putting in place a high-speed net to serve near-term research purposes. Some would argue that pursuit of this broader vision should be left to the private sector and not promoted through government subsidy. To

properly evaluate this investment, it is important to consider the unique nature of the good itself. Unlike most investments, the network will increase in net value, as its subscriber base increases. The more users and resources on the Net, the greater value it holds to each individual. In addition, economies of both scope and scale are achievable. Increasing the size of the Network will incur diminishing marginal costs, and serving a variety of markets with one underlying infrastructure will allow support features such as network management and monitoring to be shared and not duplicated. Lastly, the Network will serve as fertile ground for a new arena of commercial services. It can be expected that these new enterprises will substantially repay the NREN investment through tax revenues and job creation.

A possible historical model

In the late 1800s the nation was faced with the challenge of disseminating and implementing the results of ongoing scientific research in order to promote industrialization. Breakthroughs had been made in engineering and production processes and the country was rich in raw materials, but there was no adequate workforce trained to oversee development. In response to this problem a network of informal educational outreach programs was designed to connect local people to the modern research findings through which they could identify and find answers to problems in the management of their homes, farms and businesses. Teaching was conducted by a county staff supported by a group of specialists from the state extension office of a lead university. The staff planned and executed all educational programs in cooperation with local leaders. In addition to the hands-on, on-site work the extension service provided, educational tours, field meetings, conferences, lectures, group discussions, bulletins, mailings and radio and television have been employed. The Agricultural Cooperative Extension Service was officially established in 1914 when President Woodrow Wilson signed the Smith-Lever Act into law. Since that time the extension service has proven effective in supporting the application of research proven practices throughout local communities.

Today we are in the midst of transition from an industrial-based economy to the information age and the Agricultural Extension Service offers a possible model for driving grass roots level understanding of the applications and benefits of

NREN utilization. Many institutions, such as local schools and rural hospitals, which could benefit through the use of our developing information infrastructure lack awareness of the services which will be available and the technical expertise to access these services. A cadre of locally placed networking missionaries could assist these institutions in the implementation of appropriate systems and programs. Such a system would leverage existing technical expertise across multiple organizations and relieve these organizations of the burden of discovering for themselves the resources and productivity enhancements which are available to them through the Network.

Investment in development of an extension service should be considered an investment in addressing national crises in education and healthcare. Healthcare costs could be contained by letting small and rural hospitals benefit from advanced diagnostic machinery and medical experts in large urban teaching hospitals. In the education sector, the last decade has brought a new understanding of how children learn[5] and successful programs have been implemented locally around the country[6]. Where we have failed is in the dissemination of this knowledge and the replication of proven programs. The combination of trained extension agents and the Network infrastructure offer a possible means of seeding our schools with needed access to resources and training.

Conclusion

It is necessary that NREN policy include the provision of applications that will benefit communities beyond those narrowly focused on research. The business, economic and educational development potential of NREN warrants that it be undertaken as a true industrial policy initiative. Building the Network alone will not stimulate development of the peripheral services and applications that bring value to potential users. Careful attention must be paid to ensure that the Network proves to be fertile ground for this development and to ensure that potential users understand relevant Network applications and how to access the

[5] Office of Technology Assessment, *Power On! New Tools for Teaching and Learning*, Congress of the United States, Washington, DC, 1988.
[6] United States General Accounting Office, *Effective School Programs: Their Extent and Characteristics - Briefing Report to the Chairman*, Committee on Education and Labor, House of Representatives, United States General Accounting Office, Washington, DC, 1989.

net. Participation of users and potential developers of value-added services in the Network planning and development process will be an important step in achieving this.

Appendix B

Workshop Participants

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