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ABSTRACT

The purpose of the hearing transcribed in this document was to obtain the views of representatives of network user and provider communities regarding the path the National Science Foundation (NSF) is taking for recompetition of the NSFNET computer network. In particular the committee was interested in the consistency of the evolution of NSFNET with the goals and characteristics of the National Research and Education Network specified in the High Performance Computing Act. Another purpose of the hearing was to explore possible legislation that would expand the program into additional applications for broad public benefit, including education, teacher training, manufacturing technologies, medical imaging, and the creation of standards for the storage of data in digital libraries. Persons who offered testimony and prepared statements were: (1) Robert C. Heterick, Jr., EDUCOM; (2) Thomas J. Tauke, NYNEX; (3) Kenneth J. Klingenstein, University of Colorado at Boulder and Federation of American Research Networks; (4) Mitchell Kapor, Electronic Frontier Foundation; (5) Kenneth R. Kay, Computer Systems Policy Project; (6) Michael McDonald, Communications and Computer Applications in Public Health; (7) Sara A. Parker, Pennsylvania State libraries and representing the American Library Association; and (8) Charlie Bender, Coalition of Academic Supercomputer Centers. (KRN)

HIGH PERFORMANCE COMPUTING AND NETWORK PROGRAM

HEARING

BEFORE THE

SUBCOMMITTEE ON SCIENCE

OF THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRD CONGRESS

FIRST SESSION

FEBRUARY 2, 1993

[No. 27]

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HIGH PERFORMANCE COMPUTING AND NETWORK PROGRAM

TUESDAY, FEBRUARY 2, 1993

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
SUBCOMMITTEE ON SCIENCE,
Washington, DC.

The subcommittee met, pursuant to call, at 9:40 a.m., in room 2318, Rayburn House Office Building, Hon. Rick Boucher (Chairman of the Subcommittee) presiding.

Mr. BOUCHER. The Subcommittee on Science will come to order.

I would like to take a moment at the outset of the hearing this morning to welcome our new members to this Subcommittee and also a number of returning Members who served on the Subcommittee during the last Congress, and to offer a special word of welcome to the new Ranking Republican Member of this Subcommittee, the gentleman from New York, Mr. Boehlert, who is well known and acknowledged throughout the Congress for his work in matters of science and in that critical juncture between science and formation of science policy. It is a special pleasure to welcome him, and we look forward to working with Sherry and his staff during the course of the coming two years.

Within the next week, I will be distributing to Members of the Subcommittee a tentative suggested agenda for activities that the Subcommittee will undertake during the coming two years. It is a tentative agenda, and I would invite Members to review it carefully and to supply our staff with comments and recommendations that you have for ways that we can modify that agenda and expand the number of topics into which we will be conducting inquiries and with respect to which we anticipate taking legislative action. By design, that agenda will be updated and modified from time to time as circumstances require, and so you should view it as tentative for now and as an agenda that, over time, will be modified and expanded.

The Subcommittee will have a number of significant activities that will constitute its major focus during the coming two years. We are embarking on a major study of the health of the research system, examining the tenets that underpin federal support for science research, and that study will occupy a great deal of hearing time during the course of the coming year and hopefully will lead to a number of recommendations for legislation.

We will, during the course of this Congress, reauthorize the programs of the National Science Foundation, reauthorize the earthquake programs, and process through this Subcommittee legisla-

tion that will be a second iteration of the High Performance Computing and Research and National Education Network Act, which was enacted in 1991, and we begin that process with the hearing this morning.

We will also process through the Subcommittee legislation that implements for the United States the treaty accords reached last year that prohibit mining and associated activities in Antarctica. Those will be the principal focuses of our work. There will be additional inquiries and other items of legislation, and again I would encourage Members of the Subcommittee to share their views and their recommendations with us.

This morning, the Subcommittee on Science continues its oversight of the High Performance Computing Act of 1991. Last March, the Subcommittee reviewed the management and operation of the NSFNET, the precursor to the National Research and Education Network which is mandated and established in the High Performance Computing Act.

Since that hearing, the National Science Foundation has developed a plan for recompetition of the contractual operation of the NSFNET. The plan envisions multiple awards for functions that are now provided by a single entity. There will be a separate award for provision of the network routing authority, a separate award for the switches and the cables, the circuitry that constitute the physical components of the network, and a separate award for operation of access points to the NSF backbone. The proposed approach is intended to increase competition among commercial network providers and to foster better access by network users to information services.

The NSF has released for public comment a draft solicitation notice for the NSFNET recompetition and subsequently has received from the public a large number of comments. We understand that the NSF has modified the draft solicitation in response to those public comments and has presented the revised version in public meetings during the course of the last several weeks.

One purpose of this hearing is to obtain the views of representatives of the network user and provider communities regarding the path that is being taken by the NSF in this recompetition and with regard to its broader plans for the NSFNET. In particular, we are interested in knowing whether the evolution of the NSFNET is consistent with the goals and the characteristics of the National Research and Education Network as specified in the High Performance Computing Act.

It is essential as the network is structured that all commercial providers of network services receive equal treatment and that government policy in managing the network not favor any provider or set of providers over others. Attention must also be given to ensuring the widest possible access to the network by all parts of the research and education communities; and, finally, adequate support must be provided for stimulating the advancement of network technologies and for developing standards that will allow the emergence of seamless and user-friendly national network.

We are also interested in public views of the actions that have been taken to date by the Administration in implementing the High Performance Computing Act of 1991. In particular, we are in-

terested in the witnesses' views of the effectiveness of those administrative arrangements that have been taken to this time.

The second purpose of today's hearing is to explore possible legislation that would expand the high-performance computing program into additional applications for broad public benefit, applications such as education and teacher training, manufacturing technologies, medical imaging for the transmission of data across networking test beds, and the creation of standards for the storage of data in digital libraries in a way that they are easily accessible and easily retrievable.

As a starting point for the discussion of these subjects, we have requested our witnesses to review the strengths and weaknesses of the legislation that was introduced last year that was designed to achieve those goals. We are seeking specific recommends for improvements in that legislation and for alternative or additional application areas for networking technologies.

We are particularly interested in recommendations for the relative priorities that should be assigned among possible application areas for these technologies and in recommendations for effective program approaches for leveraging private sector participation.

I am pleased to extend a welcome to our witnesses this morning. They have all prepared thoughtful testimony, which I know the Subcommittee will find of interest, but before turning to this first panel, I would like now to recognize other Members of the Subcommittee for opening statements, beginning with the Ranking Republican Member, the gentleman from New York, Mr. Boehlert.

Mr. BOEHLERT. I want to thank you very much, Mr. Chairman. It is good to be back on this Subcommittee because of the very important work that we do, and it is especially pleasing for me to look forward to continuing the partnership that we have established.

So often people think that those of us on Capitol Hill, Republicans and Democrats, are separated in our thoughts as we look to the future. On this Committee I take great pride in saying we work well together, and we are working for the best interests of the Nation's scientific policy.

I am a long-time supporter of the High Performance Computing Initiative. Two years ago, I joined with Chairman Brown as an original sponsor of the High Performance Computing and Communications Act, and I welcome this opportunity to see how well that Act has been performing.

Another former colleague of ours with whom we worked very closely over the years has gone on to bigger and better things, the Vice President of the United States, Al Gore. We have worked very closely with him on this matter.

A special focus of this hearing will be on the emerging information network. While our vision is of a national optical fiber network that ties every home, business, and school together, the short-term reality is that we are already making great strides with an existing copper wire network. What are the possibilities and limits of our existing infrastructure, and how can we optimally exploit that network while still pushing to see broader deployment of the more versatile optical fiber network? That is a crucial question, and I am confident that our expert witnesses here today will be able to share some solid advice with us.

While I welcome all of today's witnesses, and it is an impressive list indeed, I want to extend a special welcome to our former colleague, Mr. Tom Tauke, who is Vice President for Government Affairs of NYNEX. Mr. Tauke has a reputation that is outstanding. He did great work on the Energy and Commerce Committee while serving on Capitol Hill, a progressive thinker, one that I am glad to see in this very responsible position.

I am particularly impressed with NYNEX, because they are a world leader in communications technologies, and they have been a key driver of economic development in New York and throughout the Northeast. I am especially intrigued and excited about a NYNEX project called NYNET. NYNET will tie together two world class university research centers, Cornell and Syracuse, with a world class defense laboratory, the Air Force's super-laboratory, Rome Lab, which are all centers of national excellence in information technologies. I look forward to hearing more about this innovative NYNEX-driven program. I am sure that there are useful lessons in this initiative for ways in which the Federal Government, private companies, and universities can work together for mutual advantage.

You know, I can't help but think as I reflect upon the campaign just concluded—it didn't come out exactly as I predicted, but that is another story for another day—but a vivid memory of that campaign was the sign that they had at campaign headquarters down in Little Rock, Arkansas, which said simply, "It's the economy, stupid." Well, as we look to the future and we try very diligently to find ways to inspire a more robust economy, I would suggest that the work of this Subcommittee and the topic of today's hearing will give us the direction we need. We are going to get this economy moving, and science policy is going to lead that forward movement.

I want to thank the Chairman for calling this hearing, and I want to say once again how pleased I am to be working as a partner again with him on this Subcommittee. I am looking forward to a very productive two years.

Mr. BOUCHER. Thank you very much, Mr. Boehlert.

The gentleman from Michigan, Mr. Barcia.

Mr. BARCIA. Thank you very much, Mr. Chairman.

I just want to say I am indeed honored and pleased to be a Member of this Subcommittee. I salute the leadership that you have provided this Subcommittee and your work on the Full Committee in the past and say that, as a new Member representing the Fifth Congressional District in Michigan, that I am proud to have located in my district the Great Lakes Environmental Research Center, which houses two Cray supercomputers which we are very hopeful will help our Nation and, in fact, nations around the world develop more comprehensive and more intelligent public policies relating to our environment.

In addition to the work of the Center in Bay City, the Lake Guardian will be plying the waters of the Great Lakes Basin, and that will be a major component of the work that will occur at the EPA Center in Bay City and Bay County.

So I would just like to say, Mr. Chairman—I don't have a detailed statement—I'm looking forward to the testimony of the witnesses today and hope to be an active member of this Subcommit-

tee, and hopefully, make some positive contributions toward the work that you have distinguished yourself with.

Mr. BOUCHER. Thank you very much, Mr. Barcia. We will look forward to working with you.

Another gentleman from Michigan, Mr. Smith.

Mr. SMITH. Thank you, Mr. Chairman, Mr. Ranking Member.

I look forward to learning more about this issue. I am particularly interested in how the Information Infrastructure and Technology Act might affect education.

In Michigan, we have started two pilot programs of two-way interactive television in some of our school districts that are so structured that they allow not only the advanced students to take on the kind of mathematic courses that are offered in the urban areas and transmit that through two-way interactive television to rural areas but also, on the other end of the spectrum, allow some of the expertise in Michigan that need special help in their education to take advantage of this two-way interactive television. So I am interested and curious, Mr. Chairman, to see how this program might assist in enhancing education.

Mr. BOUCHER. The gentleman from Alabama, Mr. Browder.

Mr. BROWDER. Thank you, Mr. Chairman.

I just want to thank you for your leadership on this issue, and I have no statement at this time.

Mr. BOUCHER. Thank you very much, Mr. Browder, and the chair expresses thanks to all of the Subcommittee Members for their attendance here and their interest in this subject, and we are pleased to welcome now our first panel of witnesses this morning, consisting of Dr. Robert C. Heterick, who is the president of EDUCOM in Washington, D.C., and also the head of the Computer and Communications Department at Virginia Tech, which is located in the Ninth District of Virginia; Mr. Tom Tauke, a distinguished former Member of the House of Representatives, and I'm pleased to endorse all of the comments made by Mr. Boehlert with respect to his service in the House and the creative work and the excellent advice that he now provides as spokesman for the NYNEX Corporation; Mr. Mitchell Kapor, the president of the Electronic Frontier Foundation, also in Washington, D.C.; and Dr. Kenneth Klingenstein, the Director of Computing and Network Services at the University of Colorado at Boulder, and representing this morning the Federation of American Research Networks.

Gentlemen, we welcome all of you. Without objection, your prepared written statements will be made a part of the record—and that rule will also apply to the second panel of witnesses—and we would be pleased to receive your oral summaries and would ask that you keep those summaries to approximately five minutes so that we will have plenty of time to ask questions.

Dr. Heterick, we will be pleased to start with you.

STATEMENTS OF DR. ROBERT C. HETERICK, PRESIDENT, EDUCOM, WASHINGTON, DC; THOMAS J. TAUKE, EXECUTIVE VICE PRESIDENT, GOVERNMENT AFFAIRS, NYNEX, WASHINGTON, DC; DR. KENNETH J. KLINGENSTEIN, DIRECTOR OF COMPUTING AND NETWORK SERVICES, UNIVERSITY OF COLORADO AT BOULDER, BOULDER, CO, AND REPRESENTING THE FEDERATION OF AMERICAN RESEARCH NETWORKS; AND MITCHELL KAPOR, PRESIDENT, ELECTRONIC FRONTIER FOUNDATION, WASHINGTON, DC

Dr. HETERICK. Thank you, Chairman Boucher and members of the Subcommittee. I am pleased to present testimony on behalf of the 600 higher education institutions and the 100 private corporations that are members of EDUCOM.

Since we last met, Mr. Chairman, I have left my position as Vice President for Information Systems at Virginia Polytechnic Institute and have assumed the presidency of EDUCOM. It has, however, been my very good fortune to be able to also maintain a residence in the Ninth Congressional District of Virginia.

Let me begin by noting that I am here more because of the success of NSFNET than any sense of or the lack of progress. Investment in NSFNET and connections and dramatically leveraged the federal dollar with investments on campuses and research organizations that are several orders of magnitude larger.

However, it seems to us that there is much yet to be done to realize the goals of the High Performance Computing Act of 1991. Only half of the four-year institutions of higher education and far less of the two-year institutions have realized the promise of that legislation. The situation with libraries and secondary education is even less fulfilled.

Over this past year, we have witnessed efforts to coordinate federal agency responses to the legislation, but we have seen little planning for the broad access that is envisioned in the Act. Less than 5 percent of HPC funding goes to support NSFNET and connections. Nearly all the funding is vested in federal agencies for mission-specific activities, and while OSTP coordination may work for federal agencies, it fails to address the broader constituency of the NREN which is, after all, a national, not just a federal, effort.

In conjunction with the Institute of Electrical Engineering and Electronics and the Computer Research Association, EDUCOM recently sponsored a three-day workshop to bring together the broad constituency that was envisioned in the legislation to discuss the policy issues implicit in the questions asked of OSTP by the Congress. That meeting included representatives from federal agencies, but it also included representatives from higher education, the library community, the computing industry, telecommunications companies, network service providers, and primary and secondary school organizers.

We feel that the broad views represented by those constituencies and included in the report of that workshop have not been reflected in the OSTP report. Apparently others feel similarly. The Computer Systems Policy Project recently issued a report and recommendations that we found to be very compatible with the recommendations from our workshop.

We are also somewhat concerned with the lack of public planning statements and review of the forthcoming solicitation for the evolution of NSFNET. While I'm sure that the EDUCOM constituency has great confidence in the National Science Foundation's responsiveness, we do feel that there is some risk of losing consensus when information is not broadly shared in a timely way.

As you consider future legislation, we would like to encourage your consideration of three points: first, that there should be funding for pilot projects that use the network to expand the sharing of costly and unique experimental apparatus and resources beyond those of the federally-assisted supercomputer centers; second, that there should be more focus on networked information and library access, particularly, we think, the sharing of federal information in digital formats on the NREN; and, third, and perhaps more importantly, that the current NSF connections programs should be significantly expanded to achieve the broad participation in the NREN that is envisioned in the HPCC Act.

It seems to us that the challenge of the proposed national information infrastructure is not technological but, rather, that of creating a partnership among industry, government, and public sector organizations. EDUCOM and the higher education community are eager to assist the Congress in meeting this challenge.

Thank you, Mr. Chairman.

[The prepared statement of Dr. Heterick follows:]

United States House of Representatives

Committee on Science, Space and Technology

Subcommittee on Science

Hearing on Higher Performance Computing and Networking

February 2, 1993

Statement by Dr. Robert C. Heterick, President, EDUCOM

Chairman Boucher, and members of the Committee, I am pleased to testify before the Science Subcommittee at the hearing on High Performance Computing and Networking on behalf of EDUCOM, a nonprofit consortium with 600 members from higher education and 100 from private industry. EDUCOM has focused on leading the nation's higher education community in integrating information technology into classrooms, curricula and research.

I am also pleased to appear before you in my new role as President of EDUCOM since my previous association with you, Mr. Chairman, was during my tenure as Vice President for Information Systems at Virginia Polytechnic Institute and State University

Introduction

Almost a year ago, on March 12th, 1992, my colleague, Mike Roberts, Vice President for Networking of EDUCOM, came before your committee to deliver testimony on the National Science Foundation Network. He said that:

> "Over the past five years, NSFNET has compiled one of the most remarkable success stories in the history of American Science. In this short period of time, through a partnership of government, industry and higher education, an advanced production network with the highest level of bandwidth available anywhere in the world has been designed and deployed in the research and educational community in the United States. At the same time, the network has been transformed from one serving a narrow group of supercomputer centers and federally supported research sites into one with connections to more than six hundred colleges and universities and over a thousand public and private "[1]

[1] Mike Roberts, Hearing before the Subcommittee on Science of the Committee on Science, Space and Technology, March 12, 1992, Government Printing Office, ISBN-16-038772-8 (no. 12), p.10

That rapid progress has continued over this past year. Almost all of the research and doctoral institutions in the United States are now connected to the network. New organizations, such as the Consortium for School Networking (COSN), are working to support the efforts to use the NREN productively in K-12.[2] During the year the NSFNET completed its establishment of a higher bandwidth (T-3) backbone which has allowed it to continue to keep up the astonishing growth in use.

However, much more must be done to achieve the goals for broad access for "linkage of research institutions and educational institutions, government, and industry in every state" of the High- Performance Computing Act of 1991.[3] Only half of the US four year institutions are members today and far fewer than that for the two year institutions. More libraries need to be connected along with high schools and state offices. Much more attention must be paid to the policies that support the evolution of the new National Information Infrastructure. More use must be made of the evolving NREN to share resources and increase productivity of the nation. Finally, stronger cooperation will be needed between industry, government and education to complete the vision of wide access and new applications of the NII.

High Performance Computing (HPC) Planning, Implementation and Solicitation

I would like to respond to the questions in your invitation letter about the hearing.

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[2] See the Consortium for School Networking mission statement (Appendix 2)

[3] High-Performance Computing Act of 1991, Public Law 102-194--Dec. 9, 1991, Sec. 102. National Research and Education Network (a)

Generally, the administration has taken actions that emphasize the coordination of the federal agencies but has taken limited steps in planning to achieve the Act's goals for access and involvement of the broad communities.

A number of key documents were developed by the Administration in 1992 that reflected elements of the development of the NREN planning:

Grand Challenges 1993: High-Performance Computing and Communications (HPCC) (Teal Book)

This booklet fleshes out the FY 93 budget request cross-cut for the HPCC program. It provides functional descriptions without timetable or specific projects along with general federal agency responsibilities in the program.

Public Draft of the Network Access Point Management Routing Authority and Very High Speed Backbone Network Services Provider for NSFNET and the NREN Program Solicitation

This draft drew many comments dealing with how it proposed to replace the current NSFNET backbone network services.

The EDUCOM comments, through its Networking and Telecommunications Task Force, addressed issues of context (need to place solicitation in total context of NREN, other federal programs, goals and development), stability and continuity (need to ensure stability of the NSFNET in the change over, along with adequate test planning as a key priority in the plans), routing authority (should be separate from the NAP provider), network access (concern with

changes in the responsibilities for access points to regional and private networks), VBNS (questions of bundling the backbone and NAP services).

The Federal Networking Council Interagency Coordination Plan for the National Research and Education Network (September 1992)

This document addressed relationships among fede. al agencies and the approach to the federal planning process--it was not a plan for the implementation of the NREN

The Research and Education Network Program: A Report to Congress, December 1992, OSTP

This report addresses the Congressional questions and the federal role but shows limited attention to the broad access requirements from the bill. It references the 1987 OSTP report "A Research and Development Strategy for High-Performance Computing" rather than the HPC Act in identifying the NREN goals.

Budget for the NSFNET/NREN

A measure of the priority for the program is the budget. The crosscut budget identified $804M for the FY 93 proposed program for HPCC.[4] However, the amount of the identified budget devoted to support for the NSFNET backbone and the connections program was less than 5% of that total. The NSF program, Networking & Communications Research & Infrastructure, was funded at the rate of $35.40M for FY 92 and the current plan is for $39.96M for FY 93.[5] This covers the backbone, the

[4]Grand Challenges 1993: High-Performance Computing and Communications, the FY 1993 US. Research and Development Program, p.27.

[5] Letter from Dr. Massey to the Honorable George Brown, December 21, 1992, table 2

planned solicitation and the current connections program. The potential for the NREN use in research and education is being seriously eroded by the budget allocations for NREN in the HPCC program. We believe that a redirection of HPCC/NREN funds to support connection of all levels of education and libraries should be an urgent priority in the FY 94 NREN budget.

High Performance Computing and Communications (HPCC) Coordination Office

The OSTP established an office for coordination of the HPCC Program reporting to the Director's office. While this office can perform an important coordinating function among federal agencies, it is not clear that it has the authority (for instance, over agency budgets) to carry out this complex activity. The NREN is a complex activity involving planning and coordination among federal offices, states, universities, libraries, industry and primary and secondary education. It is not clear that total responsibility is part of the charter of the current coordination office. EDUCOM has suggested that:

> "No single entity within the federal establishment, higher education or industry can accomplish of these *[planning, converging networks, expanding services to the research and educational community, developing the technology, providing the core of standards]* tasks. An effective partnership will require active participation and support from all three sectors as well as new public corporation. The principal function of the new network corporation should be to plan and oversee the effective operation of the network, not to provide facilities or operations support."[6]

The Computer Systems Policy Project recently issued a report including several recommendations for strengthening the NREN and growth toward the National Information Infrastructure (NII).[7] EDUCOM supports the recommendations for

[6] EDUCOM, The National Research and Education Network: A Policy Paper, Revised March 1990, p.7
[7] Computer Systems Policy Project, Perspectives on the National Information Infrastructure, January 12,

making the NII a National Technology Challenge and establishing a National Information Infrastructure Council, as well as investigating the establishment of a NII Implementation Entity.

Other steps may be necessary to bring about the appropriate framing of the issues and identification of a consensus among the many participants. A National Commission on the NII might prove to be an important first step to address the vexing planning of coordination issues across these many constituencies.

EDUCOM, along with Institute for Electrical Engineering and Electronics (IEEE)–US Activities Board and the Computing Research Association (CRA), took the lead in bringing together many of the constituencies to review the broad policy issues by sponsoring a three day workshop in Monterey, California. This workshop used the Congressional questions in the HPC Act about NREN policy issues as a framework for the meeting. There were 18 position papers submitted that provided the basis for the workshop discussions. There were over 80 attendees from a variety of constituencies including those from:

- Higher education,
- The library community,
- The computing industry,
- Federal agencies,
- Telecommunications companies,
- Network service providers and
- K-12 organizations

1993, p. 14-15.

The Workshop report was presented to the Office of Science and Technology Policy in order to assist in developing its report to Congress. I have included a copy of the Executive Summary from the Report as Appendix I. Some key observations were:

"• 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" is being met through broad participation in the rapidly growing use of 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."[8]

While we saw some references to the position papers in the OSTP report, we felt that the broad vision presented by these constituencies at the Workshop was not reflected in the narrow approach of its report.

[8] Proceedings of the NREN Workshop: Monterey California, September 16-18, 1992, Gillespie, R.G., (Ed), EDUCOM, OCTOBER, 1992

Comments on the Solicitation

EDUCOM and higher education in general are very concerned at the lack of progress in developing a plan for the evolution of NSFNET. The solicitation currently being developed is not a substitute for a plan. We are surprised that an undertaking as complex as NSFNET's evolution into the NREN has no publicly available, comprehensive planning document. While there have been presentations about the planned direction for the revised solicitation made at various meetings (including the Federal Network Council Advisory Committee and recently to FARNET), this does not replace public review of a crucial step. Even though we feel that what we have heard so far from NSF has been responsive to the communities' concerns, we still feel uncomfortable with the lack of public review. Failure to provide for a public review of the revised solicitation risks failing to form the necessary consensus on the long range issues EDUCOM and other organizations identified in their comments about the draft solicitation.

Comments on Legislation to Expand the HPC Act

EDUCOM supports the efforts of the Committee to address legislation for stimulating development of applications of high-performance computing and networking. We would like to suggest to several additional areas for applications:

1) One of the prominent applications of the NREN in higher education is the access and sharing of expensive instruments and resources (such as telescopes, particle accelerators, etc.). Given the costs to higher education of establishing duplicative resources at campuses, it would be important to develop national pilot projects for exploring the development of techniques

for such sharing by National Science Foundation and other agencies.

2) In addition to the proposals for a Grand Application area for digital libraries, other applications for libraries should be made explicit. For instance, national access pilot projects to encourage federal agencies to distribute information to libraries in higher education and the public sector through the NREN should be identified. For instance, a major project should be to expand the role of Federal Depository Libraries in providing access to federal information through the NREN.

3) The current connections programs (administered by NSF) should be expanded significantly to achieve the original goals of the HPC Act for broad access. Wherever possible related programs of support should be funded in connection with other agencies where appropriate to their missions and the communities of support.

Congress should consider the incentives necessary to move the demonstrations and pilot projects from the necessary special investment funding to competing appropriately for the regular agency budgets on the basis of cost effective applications.

Closing

EDUCOM enthusiastically endorses the development of the proposed National Information Infrastructure, which would bring the benefits of the NREN to other sectors of the economy. Eventually our attention can be focused on *what* is delivered and used over the network rather than *how*.

The challenge of the NII is not technological, but rather that of creating a partnership among industry, government, and public sector organizations. The NREN should be seen as an important element of the emerging National Information Infrastructure. Congress and the new administration should take the lead in developing the blueprint for the NII. Congress and the administration must formulate steps that will avoid progress on the NII being held up by regulatory and turf battles over arenas that should be revamped since the new communications and computer world blurs previous distinctions between them. EDUCOM and the higher education community are eager to assist the Congress in meeting this challenge.

In 1992, Chairman Boucher, you spoke at the Washington, DC, Net '92 Policy Conference and posed certain basic principles and assumptions that are worth repeating as the Committee considers new plans and legislation:

"• The benefits of the NREN should flow to the nation broadly and not to a narrow few.

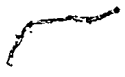
- The development of markets and involvement of industry on a level playing field is essential for the diffusion of network services throughout the nation.

- The development of the technology and management of the NREN should push the limits necessary to stimulate and meet the demand for service while ensuring reliability and stability for the users who will become dependent on the network.

- The many communities that participate in the development and use of the NREN must have a voice in its planning and management."[9]

[9]"The Challenge of Transition", Boucher, R., *EDUCOM Review*, September/October 1992, p. 35

We need the Federal government to remember these principles as we develop, as partners, these plans for the new National Information Infrastructure.



Appendix I:

Executive Summary from the Proceedings of the NREN Workshop, Monterey California, September 16-18, 1992

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 net-work 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.

Appendix: II

Consortium for School Networking

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Washington, DC 20035-5193
202-466-6296 (872-4318, fax)
cosn@bitnic.bitnet

May, 1992

MISSION STATEMENT FOR THE CONSORTIUM FOR SCHOOL NETWORKING (CoSN)

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 novel materials adapted to this new communications medium.

- The development of the human resources needed to make full and efficient use of networks through staff development programs, educational materials and software.

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.

CoSN is incorporated as a not-for-profit organization in the District of Columbia. Application for 501 (c)(3) status has been made to the Internal Revenue Service.

Officers and Members of the Board of CoSN

Chair of the Board:	Connie Stout, Program Director, Texas Education Network
Vice-chair of the Board:	Gwen Solomon, Director, The School of the Future, New York NY
Executive Director:	John Clement, Director, EDUCOM K-12 Networking Project
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

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February 16, 1993

Representative Rick Boucher
Chairman, Subcommittee on Science
U.S. House of Representatives
Washington, DC 20515

Dear Chairman Boucher:

I am pleased to respond to your invitation for additional recommendations for improvement of the provisions of the High Performance Computing Act (PL102-194) relating to the National Research and Education Network. As I stated in my testimony before your subcommittee on February 2, EDUCOM's view is that the federal effort to advance the technology and use of computer networks for research and education has been a success, and our suggestions for further refinement in the legislation should be viewed in that light.

Since 1988, when the basic elements of the NREN program - which became part of the HPC Act - were first put in place, there has been a rapid evolution in many areas of computer networking. The Internet has grown from a highly limited and specialized federal agency research network to a worldwide enterprise with well over a million connected computer systems and a substantial amount of purely commercial use. As Mr. Tauke and Mr. Kay indicated in their remarks to your subcommittee on February 2, Internet technology is rapidly becoming the base upon which a national information infrastructure may be developed. This is a highly desirable and serendipitous result of the federal investment in NSFNET, which comprises a major portion of the Internet.

However, this rapid evolution also requires an updating of the focus and structure of federal networking legislation. The Congress is already addressing this challenge in the work of your subcommittee, in bills already introduced such as S.4 and HR. 820, and in the deliberations of Chairman Markey's Telecommunications Subcommittee on which you also serve.

It is too early to know with assurance the outcome of Congressional work in this session on the NII and the NREN, but for the purposes of my remarks on the NREN, I distinguish it from the national information infrastructure at the level of the physical telecommunications facilities of the country. That is, the federal NREN program should be viewed as highly related to but separate from the information infrastructure programs which fall under the domain of federal telecommunications policy.

I have several recommendations concerning the future of the NREN for your consideration:

(1) NREN Goals. There is a danger that access to the NREN by educational institutions may be hindered by premature termination of federal investment in network connections and in the provision of connectivity among institutions. Section 102 (b), Access, of the HPC Act provides a reasonable statement of Congressional intent in this regard. However, no measures of progress in achieving this access goal have been established. As you observed in your remarks to the National NET'92 Conference last March, the "benefits of the NREN should flow to the nation broadly and not to a narrow few." EDUCOM believes that a reasonable goal for access is to have a majority of the nation's educational institutions connected by 1995, and essentially all of them by the end of the decade.

(2) NREN Applications. EDUCOM strongly endorses the new emphasis on developing applications for the NREN which address pressing national priorities. As I stated in my testimony, the proposed areas of health care, manufacturing, lifelong learning and digital libraries are all excellent areas in which federal investment now will reap large future benefits in both the public and private sectors of the economy. I would make a point that echoes the statements of other witnesses. It is essential that the process by which federal funds are invested in this work be based on consortia and other forms of partnership which effectively engage non-federal resources and organizations. The federal Cooperative Agreement Act which has been used so successfully in the NSFNET Partnership has not been used in other parts of the HPCC program and deserves more attention outside NSF than it is receiving.

(3) NREN Management. In a time of national sacrifice to bring the federal deficit under control, it is not desirable that costly new administrative structures be created for the NREN. Sections 101 (a) and (b) of the HPC Act already provide for reporting and advisory mechanisms. My belief is that the new Administration could fulfill many of the management needs of the NREN by implementing these provisions of the law. In doing so, they should be mindful of the very widely expressed view among non-federal participants in the NREN that the program needs to adjust its focus so that it is a truly national, as opposed to federal, undertaking. In addition, there are other steps that can be taken within existing statutes if future oversight by your subcommittee reveals a need for further strengthening of management.

I hope that you and the subcommittee staff find these suggestions useful. I would be happy to arrange for further discussion at your convenience.

Yours truly,

Robert C. Heterick, Jr.
President

Mr. BOUCHER. Thank you very much, Dr. Heterick.

Mr. Tauke.

Mr. TAUKE. Thank you, Mr. Chairman. It is a real opportunity and a great pleasure for me to be here before this Subcommittee and have the chance to testify on important communications issues.

As I look at this leadership team of Boucher and Boehlert, I know this Subcommittee will be a public policy powerhouse in this Congress, and I think you are off to a good start by focusing on communications issues.

I have submitted written testimony which details, perhaps more than you want, some of our observations about NREN and the HPC. But let me take a few moments here to first try to put some of these comments in a bit broader context and then share a few of the key thoughts with you on these two items that are of especially concern to the Subcommittee.

I think it is critically important, as you and the other Members of Congress contemplate communications policy, that you understand the need for a new communications policy in the Nation. The technology and the marketplace that were the basis of the old policy have simply gone away. The technology has changed; the marketplace has been dramatically altered. So we need a new policy.

President Clinton and Vice President Gore in their campaign did a wonderful job of educating the Nation about the need for a modern communications infrastructure. They talked, when they talked of infrastructure, not just of roads and bridges but of information highways. That understanding and their commitment to a communications infrastructure is a very good place to start in this policy discussion.

It is true what they say, that the information infrastructure will increase economic development in the Nation, will improve the quality of our lives, give us better educational institutions, higher quality/lower cost health care.

But the primary policy objective that we believe that you and the other Members of Congress should have as you develop communications policy is universal access. Just as in the days of the 1934 Communications Act the thrust and goal of policy was universal service, today as we enter a new information age, the concept of universal access is the concept that should be the goal of policy. I think that is a legitimate goal of government, and I believe it is the right goal for public policy.

I think that a common vision of the information infrastructure that has developed will flow from that policy. The vision must be developed by government, the private sector, and key user groups.

In that context then, let's talk a little bit about the National Research and Education Network known as NREN. NREN is certainly part of that vision that we should have of communications policy in an information infrastructure. It is a key element of the infrastructure. But I think sometimes there are misunderstandings about what NREN is or should be. Often it is compared with the interstate highway systems, and in many ways that is correct; it is a highway, if you will, that can bring the Nation together, that offers economic benefits to the Nation, just as the interstate highway system did.

But there are key differences that have a major impact on the role of government and of public policy. First, communications networks are not fixed, stable structures. On the other hand, they are structures that are very flexible and ever changing. The technology is changing rapidly, and so, therefore, the networks are constantly evolving.

Secondly, interstate highways are different from the information infrastructure because with interstate highways government was really the only one that could build those highways, due to the massive nature of the commitment that was needed, demand for rights-of-way, and so on. So government was the only one that could build the highways, but, on the other hand, the application or users of the highway were available from industry—cars, buses, trucks, they were all there. The highway, that was built by government, improved the usefulness of the users' applications.

The information infrastructure is, in a sense, just reversed from that. The industry out there is already building the highways and probably is better suited to do so because of the nature of that information highway, but the applications are not readily available. Information access for schools and hospitals simply doesn't exist today. The applications that government needs to provide or help provide will improve the usefulness of the evolving network. That is why we believe that as you focus on this area of policy, that you should try to direct government investment on research, to research, to user-friendly applications, and to training programs.

We believe that the purpose of government investment should be to bring the benefits of information technology into the everyday lives of Americans. We believe, therefore, it is appropriate for you to subsidize certain users that are performing an important social purpose, such as educators, or health care providers, libraries. I think it is important, however, that you not build or operate, or government should not build or operate, general communications networks. And, of course, I could not let the opportunity pass without observing that government should lift the legal and regulatory barriers which inhibit the deployment of the infrastructure.

One final thought. As I, a non-tekkie, have tried to understand the high-performance computing program and NREN, I am struck by the uncertainty relating to policy. It is true that this is an evolutionary process; the network is evolving, concepts surrounding it are evolving. Nevertheless, there is a lot uncertainty about what NREN is and what Congress intends it to be. There is uncertainty about how it is supposed to work. There is a great deal of uncertainty about the decision-making processes that affect the network, and there certainly is uncertainty about what the proper role of the Federal Communications Commission, among other agencies, should be.

In my written testimony, I have attempted to offer some suggestions about how the policy can be developed and given a little more clarity, perhaps reduce the uncertainty. This is very important work that the Subcommittee is engaged in. If the proper public policy is adopted, we can realize the benefits envisioned by President Clinton and Vice President Gore and you, Mr. Chairman, and many other Members of this Subcommittee, and that vision is a better life, a higher standard of living for all Americans.

Thank you.
[The prepared statement of Mr. Tauke follows:]

70-830 O - 93 - 2

FINAL VERSION

STATEMENT OF HON. TOM TAUKE
VICE PRESIDENT, GOVERNMENT AFFAIRS, NYNEX CORPORATION
BEFORE THE SCIENCE SUBCOMMITTEE OF THE
HOUSE SCIENCE, SPACE AND TECHNOLOGY COMMITTEE
February 2, 1993

Mr. Chairman:

Thank you for the opportunity to testify before this subcommittee. My name is Tom Tauke and I am Vice President, Government Affairs for NYNEX Corporation. NYNEX is a Regional Bell Operating Company (RBOC), and the NYNEX family of companies includes New York Telephone and New England Telephone and Telegraph Companies. New York and New England Telephone provide voice and data eervices to some 12 million customers in the northeast United States.

Mr. Chairman, you have been a leader in promoting public policy which encourages the development of the nation's telecommunications infrastructure. On behalf of my industry, and the millions of customers that benefit from its services, I thank you.

It is critical that we develop a common vision now of what the national information infrastructure should be in three to five years. This vision should be developed jointly by government, private industry and the key user communities. The transition steps necessary to move from today's telecommunications networks to the vision of a national information infrastructure need to be defined. These steps involve both technological and policy transitions. By developing a state-of-the-art information infrastructure, we will improve the quality of life, increase educational opportunities, provide better health care, create jobs and strengthen U.S. competitiveness.

The nation's telecommunications infrastructure is made up of many communications and information networks - some government, some private - that generally are able to interconnect with each other. This infrastructure is a valuable national resource; development will enhance it.

In addition to the telecommunications infrastructure, there are information networks built by government, the computer industry, and other private groups. In this mix of telecommunications, computer and government networks, some were developed jointly; some were subsidized and some were not.

Establishing the proper policy framework to evolve from the current mix of networks into a coherent framework is essential. This policy framework should:

1) Ensure that all Americans have access to the benefits of the information age by renewing the nation's commitment to universal service;

2) Encourage competition by promoting the development of interconnected public switched networks to all providers of information;

3) Encourage innovation in both applications and leading-edge technology;

4) Promote the development of user-friendly applications which will meet specific social objectives - e.g., improved education and health care; and

5) Use limited government funds to leverage private investment and achieve appropriate economic and public policy objectives.

In developing these policies, NYNEX believes there are things government should and should not do.

Government should:

1) Encourage the continued development of a modern communications infrastructure by taking full advantage of private-sector capital and communications expertise;

2) Provide resources for the development and deployment of new technologies and user-friendly applications;

3) Provide funds to entities such as schools, research institutions, libraries, and health care providers to enable them to meet their communication and information needs and develop programs which emphasize the vast network applications available to users;

4) Encourage collaboration among government, industry, academia and key user groups;

5) Foster the development of standards to ensure interconnectivity and efficiency; and

6) Take the lead in resolving issues related to security, privacy and intellectual property.

Government should not:

1) Build or operate commercial networks; or

2) Subsidize general usage of communications networks.

This testimony covers seven primary topics:

1) The development of a national vision;

2) A brief review of the developing communications and data services offered by NYNEX;

3) Desirable characteristics of a national information infrastructure;

4) A policy framework for a national information infrastructure;

5) Additional recommendations for legislation;

6) Legal and regulatory impediments to the development of the infrastructure; and

7) Response to subcommittee inquiries.

I. DEVELOPING A VISION

The support for a national information infrastructure and the benefits it can provide to society is widespread. A groundswell of activity is bringing together key stakeholders.

including K-college educators, universities, libraries, government and service provider industries (for example, information, telecommunications, and computer) and organizations representing these and other groups, such as EDUCOM. These key cross-industry/cross-stakeholder groups are developing a consensus vision of the future national information infrastructure and the policy and technological transition steps necessary to realize that vision. We are actively participating in many of these key efforts and fully support them. Such efforts will provide cross-industry/cross-stakeholder advice to the federal government in a constructive way that we believe will accelerate the development of a national information infrastructure. Contributions of industry groups -- for example, the Computer Systems Policy Project's (CSPP's) paper entitled "Perepectives on the National Information Infrastructure" -- are helping the nation understand the issues confronting it.

II. THE NYNEX NETWORK

It is important for the subcommittee to understand the transition that is now occurring within the communications networks of America and the investments that are being made towards this end by NYNEX, local exchange carriers, and other communications companies. The industry is in the final stages of deploying technologies which will provide the capabilities required by our future information infrastructure. This infrastructure will provide access to high-performance networks

and services to those users in education, research institutions and other sectors who require this high-end capability. Moreover, the industry will deploy an infrastructure that provides general access to future information highways for all segments of our society, linking businesses, schools and residences to an increasingly valuable national resource.

The first step in this plan began over thirty years ago, when digital technologies began replacing analog. The industry is currently in the second major step, deploying fiber, and has recently begun the third step, substantially upgrading the intelligence in the network. Finally, the industry is currently pursuing testbed technologies that will create new information infrastructure opportunities. Each is described below.

A. Implementing a Digital Infrastructure

Since the 1960s, the Bell System and later the RBOCs have been involved in an evolutionary process of transforming the analog telephone network of the past into a digital infrastructure capable of supporting not only voice but information transport as well. In the 60's the industry began by digitizing the transmission facilities in major metropolitan areas. By the 70's, technology had progressed to where the first digital switches were introduced.

End-to-end digital connectivity is now an achievable reality and not just a vision. The first stage in this is the increasing availability of Integrated Services Digital Network (ISDN), which by the mid-90's will be available to the majority of the nation. This is an important capability which will link more and more users to a growing information infrastructure. Even with the limited penetration of ISDN to date, the availability of end-to-end digital communication is significantly affecting the way people communicate and exchange information. Stimulated by this environment, advances in video conferencing, multimedia communications, and information networking are being made possible through access to this capability. These early innovations are helping to better define some of the capabilities required in the high-performance networks, including technologies that exceed the capabilities of ISDN.

B. Fiber Optic Facilities

The decade of the 80's saw the introduction of broadband fiber facilities into telephone company networks using the digital technologies. In the 90's access to this fiber highway is being provided to the end user. Fiber alone however, would produce few benefits without the advances that have occurred in switching technologies.

The common view in the late 80's was that a public broadband network would not be available for a decade or more. But NYNEX will begin implementation of broadband switching technology supporting public network services this year. We have worked with key industry groups and with vendors to greatly accelerate our planning for this technology. As importantly, for the first time, we have worked closely with the computer industry to ensure that our network plan fully meets the infrastructure needs of this key industry segment. This has been done on a peer basis, in different industry organizations, with contributions from all interested parties.

NYNEX's planning contemplates extending the digital network so that it becomes a public broadband network. To quote Chairman Boucher: "In building our superhighway we are also planning the access roads and exit ramps which will carry such information into our homes." It is the integration of key networks and technologies which will provide the true value for the national infrastructure. Looking beyond near-term needs and planning for the future, NYNEX is engaged in experimentation and vendor discussions which, in this decade, will result in extending the high performance network to individual residences enabling services such as HDTV and advanced multimedia communications to be offered to the home.

C. The Intelligent Network

The final element that will help integrate these diverse capabilities is the increasing intelligence that is being introduced into the network. The Intelligent Network has, in fact, become an industry buzzword, portending the significant changes that are now beginning to occur. The Intelligent Network will provide the link between communication capabilities and computing capabilities. Simply, communications networks are increasingly acting under control of computer architectures which, in addition to supporting the current functionality of the network, allow new services to be introduced quickly on a global basis. In addition, the technology will permit control of communication networks to be directed by other computing systems, empowering owners of those systems to provide new services to themselves.

The first phase of the Intelligent Network is being implemented now in the context of our existing digital networks. For example, the technology permits new flexibility in how 800 numbers are administered and used both by communication companies and end users. The Intelligent Network will, in the future, facilitate the development of new services and allow customers to integrate their information technology into the public network.

For the future NYNEX is working with organizations such as Bellcore on more advanced models of the Intelligent Network. We expect to deploy this new generation of computing technology in concert with our broadband technologies. In fact, such capabilities are essential if the future vision of multimedia communications and information infrastructure is to be fully realized.

D. Healthcare and Educational Applications

Advances in transmission and switching capabilities, video phones, High-Definition Television (HDTV), and computers are forcing the convergence of what have been traditionally viewed as separate and distinct services. An element of managing this convergence is something NYNEX has worked on with hospitals in the Boston area. Media Broadband Services (MBS) is a network-based visual communication capability which permits real-time sharing of images in support of collaborative work among geographically dispersed locations. Four participants, Massachusetts General Hospital, Children's Hospital, New England Medical Center and Brigham and Women's Hospital are using MBS to transfer medical images, link physicians, view heart catheterizations and simulate surgical activity. It has the ability for two or more parties to have a multi-media "conversation." Since voice, pictures and data have differing "information density," their signals need to be synchronized and packaged for effective communications. NYNEX has developed prototype network services to ensure that people

participating in multi-media "conversations" are looking at the same images while they orally discuss them.

In education, the New York Network, NYNET, is one of the most technologically advanced networking efforts in the country. It will link Cornell University, Syracuse University, the Museum of Science and Technology in Syracuse, and Rome labs (the research center at Griffiths Air Force base) and also Columbia and Polytechnic Universities with the NYNEX Science and Technology Center over the public telephone network for the purposes of research and economic development. New York Telephone is supplying the multi-media, fiber optic gigabit network. The technology involved, Synchronous Optical Network Transmission (SONET) switched over Asynchronous Transfer Mode switches (ATM), is the leading-edge network system. On this network, the entire Encyclopedia Brittanica can be transmitted in one second.

As a final example, NYNEX supports one of five nationwide testbeds evaluating technologies and designs for the proposed NREN. NYNEX is one of seven institutions participating in Project Aurora, a project which will link MIT, the University of Pennsylvania, Bellcore and IBM in a high-speed experimental network by mid '93.

Project Aurora is an excellent example of the value of collaboration between industry and government. Funding has been made available through the Corporation for the National Research Initiative (CNRI) under the sponsorship of both Defense Advanced

Research Project Agency (DARPA) and National Science Foundation (NSF). This funding, however, is a small part of the overall cost. NYNEX and the other RBOCs have directly funded both of the participating universities through Bellcore. In addition, NYNEX and the other carriers involved (Bell Atlantic and MCI) have contributed the broadband transmiseion facilities necessary for the trial and Bellcore is contributing one of the experimental switching technologies to be evaluated. When completed this year, Project Aurora will become a key reeource in the early steps toward National Research and Education Network (NREN).

What I have described is an evolution that has occurred over decades representing investment in the many billions of dollars and made poesible by many advances in both the communications and computer industries. The era is just beginning in which the communications industry can finally integrate these key technologies and reap the promise of the information infrastructure we are describing. The capabilities provided by ISDN should be wide-epread by mid-decade. The all-digital network will become a reality. The broadband infrastructure in place is permitting the first gigabit networks to be deployed this year. Broadband access is available now and will be available to many residences by the end of the decade. Finally, the communications industry is completing a fusion of communications and computing technologies over the next eeveral years whicb will both increase the flexibility of the network as well as permit customers to control network resources from computing resources they own. This is the reality we are now implementing. NYNEX looks forward to

the opportunity to partner with government, other industry participants and key user groups in turning the vision outlined above into a national information infrastructure.

III. DESIRABLE CHARACTERISTICS OF A NATIONAL INFORMATION INFRASTRUCTURE

A national information infrastructure can bring the benefits of the information age to all segments of American society, improving the quality of life and enhancing U.S. competitiveness in an increasingly open global economy. The potential benefits to society will not be fully realized if national efforts are guided by a narrow vision focused on the need for technology in support of high performance computing. Therefore, we support a broad view of the NREN program which stresses the need to develop new networking technologies, as well as services and applications that will serve the urgent societal needs of a broad range of users and industries. Both goals are shared by the Computer Systems Policy Project (CSPP) and by legislation currently before the Congress. (See, The Information Infrastructure and Technology Act (IITA), S. 2937, 102d Cong., 2d Sess., Sec. 2(b) (1992).)

Universal access was, appropriately, not an objective of the NSFNET during the early period of technology development. However, it is a necessary feature of a national infrastructure that seeks to support hospitals, K-college education and other

important services that are widely dispersed and lacking in resources. As Chairman Boucher stated in his speech at Net '92: "...the benefits of this network should flow to the nation broadly, and not just to a narrow few." Universal interconnectivity is necessary to ensure that any individual or institution that is connected to a network service provider has seamless access to all other individuals, organizations and information sources in the same manner that a subscriber to a local telephone company has access to all other subscribers.

Some existing applications, such as electronic mail, work well on today's networks. They are not more widely used, however, because many potential users are unaware of their existence. Other potential users find the interface difficult to understand. Many other existing applications that work well on today's networks can meet many of the needs of users in the K-college, library and other user communities, but they are not widely used for similar reasons. The development of applications that: (i) have mass appeal, (ii) have user-friendly interfaces that allow for simple and inexpensive access, and (iii) use the existing infrastructure is therefore an integral part of the broad vision. This is consistent with IITA, Section 4 (Applications for Education) and IITA, Section 7 (Applications for Libraries). Once the mass market is created, we would expect market forces to be the major driver of new applications.

The development of new network technologies and leading edge applications in support of high performance computing and

multimedia communication is also an integral part of the emerging infrastructure; these developments lay the foundation for future services that will be more widely demanded. This goal is stated in the IITA, Section 3.

IV. A POLICY FRAMEWORK FOR A NATIONAL INFORMATION INFRASTRUCTURE

It is important that the overall national telecommunications infrastructure be developed with technically compatible systems based on the best technologies, standards and services produced by the computer, communications and academic communities. The use of ATM and/or SONET in all the gigabit testbeds suggests that the process of technological harmonization at the technical level has already begun. However, a similar harmonization of regulatory approaches with commercial needs has not taken place. If these regulatory issues are not addressed soon, there is a danger that NYNEX and other LECs will not be able to contribute effectively to the infrastructure, despite the best intentions of all participants.

A. Structure

To address the diverse needs of providers and users of the information infrastructure, we propose a system comprised of separate Experimental Networks and Production Networks.

Experimental Networks should consist of:

1) Government supported testbeds for leading edge networking technology and applications requiring such technology, for example, the Gigabit Testbeds; and

2) A high performance national testbed, e.g., interconnecting the four or five major supercomputer research sites.

Experimental Networks supported by the government should be used only:

1) To carry traffic directly related to the experimental goals of these networks; and

2) By those researchers who need to perform applications that require the advanced technological capabilities of these networks, and which cannot be performed on Production Networks.

These Experimental Networks will be developed by partnerships among government, private industry and target user communities. These partnerships, which can build upon the long and successful collaboration between industry, academia and government, can leverage the government's limited resources to maximize social return.

Production Networks should consist of present and future commercially available communications networks. Production Networks would:

1) Be built, managed and operated by multiple providers from the private sector;

2) Provide a vehicle for technology transfer from their experimental counterparts;

3) Offer commercial networking capablities to the business and residential population; and

4) Serve all users, including the Research and Education Community, for those applications that can be supported by commercially available network services.

The government, private sector and key user communities should jointly implement transition steps to achieve this target structure.

B. Governmental Funding For National Information Infrastructure

In "Technology: The Engine of Economic Growth," (September, 1992) President Clinton states that "... the government can serve as a catalyst for the private sector

development of an advanced national communications network...." In this role, the government should fund the following activities:

1) Research into applications and services that will provide for the urgent needs of the broad range of users in K-college education, health care and industries critical for U.S. competitiveness;

2) Research into user-friendly access and use of the networks as well as training programs to promote broad utilization by all members of society;

3) Direct subsidies to appropriate end-users — such as research facilities, schools, health care facilities and libraries — to support their access to and use of Production Networks; and,

4) Technical development of the Experimental Networks, including continued support of the research and education community's contributions to this effort.

These funds should be in the form of grants and should not result in government ownership or operation. The telecommunications community has provided substantial resources to these joint efforts, helping the government to leverage its funds effectively.

C. Rationale for the Experimental and Production Network Components

The creation of two component networks will serve end users by promoting network stability. Experimental Networks that are used as testbeds for new technologies will use unproven functionalities, resulting in a level of reliability that is unacceptable to those users who see the network as an integral part of their daily business activities. The partnerships which form the basis for Experimental Networks will permit the government to leverage its limited resources to obtain the greatest social return. Similarly, the transfer of technology from the Experimental Networks to the Production Networks will stimulate investment by the private sector.

The two-component structure also provides a framework within which the Research and Education Community can continue to be supported while ensuring all network service providers a fair, competitive market. Government funds should not selectively advantage some providers and create a disincentive for others to enter the market. Thus, the separation between Production and Experimental Networks would promote stability, effectively use limited government resources, promote fair competition, and provide incentives for private investment.

V. ADDITIONAL RECOMMENDATIONS FOR LEGISLATION

As indicated earlier, we concur with the stated purpose of IITA, that technology developed through the High Performance computing program should also apply widely in K-12 education, libraries, health care and industry. We offer several additional specific suggestions for future legislation of this nature:

A. Process for Developing Policy

To date, the process by which the U.S. has planned for the development of the information and telecommunications infrastructure has worked well. With the passage of the High Performance Computing Act of 1991 and its creation of the NREN, however, there should and will be significant changes in the way in which the infrastructure will develop.

We need a more formal, open process whereby private industry and key user groups, working together with the appropriate government agencies, can develop coherent policies for the development of the communications infrastructure. As the concept of a national information network broadens beyond the initial research-based NREN, we must determine how this activity intersects with the responsibilities of the Federal Communications Commission (FCC).

B. Incentives for Private Investment in the Information Infrastructure

As technology developed on the Experimental Networks becomes suitable for deployment in Production Networks, we encourage the government to facilitate technology transfer with tax and regulatory incentives. Examples of such incentives may include favorable depreciation treatment of investment in the infrastructure, and the temporary suspension of some regulations in geographic areas where trials can be conducted.

C. Standards

The legislation should encourage FCC participation in a forum in which private industry and appropriate government agencies can adopt technical standards focused on interconnectivity between the networks.

VI. LEGISLATIVE, LEGAL AND REGULATORY IMPEDIMENTS TO THE DEVELOPMENT OF THE INFRASTRUCTURE

As described above, there are many ways government and private industry can work together to provide a modern infrastructure for the American public--an infrastructure ready to deliver a wide range of applications to Americans to improve the quality of life in our country. The technological capabilities

are constantly improving and the public is beginning to understand the wide range of applications that may someday be available to them in the information age. But as we move toward this vision, there are many outdated laws and regulations that are slowing the process and harming America's international competitive position in communications.

Where the telecommunications and cable industries developed under regulation, the computer industry developed as a competitive industry. As the technologies converge, it is time to review these outdated rules to determine a framework that allows the U.S. to optimize its technological capacity.

One example of a barrier which affects the infrastructure is the Modification of Final Judgment (MFJ).[1] In the example of NREN deployment, the restriction on the RBOCs, which generally prohibits communications from one Local Access Transport Area (LATA) to another, puts RBOCs at a disadvantage when competing to provide network or information services. This disadvantage directly impedes technological innovation.

In addition to the MFJ, restrictions on telephone companies' ability to participate in the provision of cable

1. United States v. American Telephone and Telegraph Company, 552 F. Supp. 131 (D.D.C. 1982).

television services reduces the incentives for investment. At Net'92, Chairman Boucher stated: "The time has come when we have to give the telephone industry a fair opportunity to compete and to offer cable services." This issue, and outdated regulatory requirements for pricing, depreciation and other critical areas should be reviewed and modified to encourage the deployment of the best possible infrastructure.

VII. RESPONSE TO SUBCOMMITTEE INQUIRY

Finally, I would like to turn to the two specific purposes of this hearing, point to the sections of this testimony which bear most heavily on those purposes, and make specific recommendations.

The first purpose of the hearing is to review the progress on planning and implementing the federal High Performance Computing (HPC) program, in particular, assessing the development to date of the NREN in light of the goals and characterisitics of the NREN specified in the authorizing statute, and commenting whether the forthcoming NSF solicitation for operation and management of the NSFNet will be positive a step toward achieving the NREN goals.

The High Performance Computing Act of 1991 (HPC Act), PL 102-194, Section 102(c)(3), states that the Network shall "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." Although government funds have been greatly leveraged and this needs to continue, this stated goal simply cannot happen effectively or efficiently under the current structure of government funding and subsidization. To achieve this goal, we urge the committee to adopt the recommendations described in Sections III through V of this testimony.

Our view of the forthcoming NSF solicitation, based on a presentation by Steve Wolff at the December 17, 1992, Federal Networking Council Advisory Committee (FNCAC) meeting, is very positive. The NSF has given consideration to the comments provided by many parties and made substantive changes based on those comments. We believe it is the intent of the NSF to support the development and implementation of policy routing on the network which provides a mechanism for the Framework for a National Information Infrastructure as outlined in Section IV of this testimony and thus facilitates the attainment of the NREN goal quoted in the previous paragraph. We urge the NSF to proceed as swiftly as possible to complete the development and implementation of policy routing.

The second purpose of the hearing is to obtain recommendations for legislation to expand the HPC Act and comment on the structure and contents of the IITA introduced in 1992.

The IITA expands the scope of applications and the reach of the HPC Act. We support the expanded scope of applications and the expanded vision to reach all Americans. To make this work, however, requires more than funding specific application areas. A vision of a national information infrastructure needs to be developed and included in the legislation. A method for developing such a vision is outlined in Section I of this testimony. Similarly, a process for developing policy is needed as outlined in Section V.A. of this testimony. The legislation should also include characteristics of a national information infrastructure, a framework for the infrastructure and specify government funding principles. To accomplish this, we urge the committee to include the contents of Sections III, IV and V of this testimony in the legislation. This will meet President Clinton's goal for the government to serve as a catalyst for the private sector development of advanced communications networks and will result in an economically sustainable national information infrastructure.

The IITA calls upon the NSF to fund projects to connect primary and secondary schools to the NSFNet. We wholeheartedly agree that the government should support programs to connect schools to a national backbone(s) but not to the new supercomputer-interconnecting NSFNet backbone. Instead, the schools should be connected to Production Networks, and subsidies for access to and use of these networks by the schools could be provided by the government. Again, Sections III, IV and V of this testimony describe a fair mechanism for accomplishing this. The

mechanism described in those sections should be included in the legislation. After a transition period, the current NSFNet, which was built with major investments by the private sector and some subsidization from the government, could potentially become one of the commercial national backbones that would compete for the traffic generated by the schools. Several commercial national backbones exist now and others will likely be built. The legislation should require that they all interconnect.

VIII. CONCLUSION

NYNEX is encouraged by this subcommittee's interest in our nation's information infrastructure, as demonstrated by this hearing. We want to contribute to that vision as much as technology and our expertise permits. A public policy framework that clearly delineates government's role and the commercial role will ensure that the information infrastructure reaches its full potential--including better education for all children, better health care services, job creation and strengthened U.S. competitiveness. The government should strive for a regulatory framework that promotes fair competition, encourages innovation and allows for effective involvement among all participants and industries. But in order to reach its potential, the information age infrastructure planning needs to allow all participants, including telephone companies, to contribute all their abilities toward building the foundation of our future telecommunications infrastructure: the information highways of the future.

Mr. BOUCHER. Thank you, Mr. Tauke.

Dr. Klingenstein, we will be pleased to hear from you.

Dr. KLINGENSTEIN. Chairman Boucher, distinguished Members of the Subcommittee, thank you for the opportunity to speak. m

Few initiatives hold the potential of the NREN to affect the economic, educational, and social goals of the United States. To provide some brief context, I am the director of computing and network services at the University of Colorado at Boulder. I also serve as the chair of a steering committee for both a state network and a multi-state regional network. In addition, I am on the Federal Networking Council Advisory Committee; I have been on the board of directors of FARNET—the Federation of American Research Networks—since 1989; and, lastly, I am the principal investigator on a project to systematically integrate networking into the educational and operational activities of the Boulder Valley School District.

Networking—in particular, NSFNET—has been a remarkable success. There has been dramatic growth in usage, broad participation, full interoperability, and vibrant growth in new applications and uses. It has been a success because of federal investment at key junctures; because of the tremendous leverage of that federal investment at state, regional, and local levels; because of the compassion and commitment of many individuals, including those of the FARNET community.

We have been market makers; developing partnerships with the private sector; encouraging schools, museums, and libraries; helping local government and economic development agencies to use the capabilities of the network. The midlevels have been important agents of change, ensuring that the public sector is served. It has been a success despite the limitations and confusions of acceptable use, despite limited cooperation among federal agencies, and despite the multiple, often orthogonal visions of the NREN.

We are now at a crossroads. The NSF solicitation and the architecture it represents deserve careful scrutiny. It represents a narrowing of the broader vision. The solicitation itself is clearly improved over earlier versions and the concept of NAP's is appropriate. The solicitation, however, perpetuates acceptable use policies at least on the very high speed backbone. That policy remains a difficult and disturbing problem to administer. Most importantly, the new architecture requires a well planned transition involving users and providers in order to maintain stability.

Regarding the next stage, Congress needs to articulate the public sector needs. In particular, it must ensure that there are no barriers to the creation and dissemination of information. Congress must distinguish the HPC from the NII. High performance computing, while important, is not the key to a high performance country. The key to our future success as a society will be a ubiquitous, well engineered information infrastructure that permits our people to be effective workers and informed citizens.

We need a second wave of federal investment in new areas—K–12, libraries, economic development—again, to create the tremendous leverage that we have seen before. To this list, I would add services to rural areas. No other technology has the potential

to reduce the isolation and improve both the economic and social well-being of rural America.

Community networking for civic affairs, consumer education, and economic development is also an area of great promise. Congress should carefully monitor these investments to ensure that the programs do not become entitlement programs for federal agencies.

I thank you for this opportunity.

[The prepared statement of Dr. Klingenstein follows:]

Testimony of
Dr. Kenneth J. Klingenstein
Director, Computing and Network Services
University of Colorado, Boulder
and Member of the Board of Directors, FARNET

Before the Subcommittee on Science
of the Committee on Science, Space and Technology
U.S. House of Representatives

February 2, 1993
Rayburn House Office Building
Washington, DC

Chairman Boucher, Distinguished Members of the Committee, thank you for the opportunity to participate in the review of plans for the NREN and the National Information Infrastructure (NII). Few initiatives hold the potential of the NREN/NII to affect the economic, educational and social goals of the United States.

To provide context for my views, I would like to identify some of my networking roles. I am the Director of Computing and Network Services at the University of Colorado, Boulder. The university is a major research institution that makes intensive use today of the Internet and will need a vibrant NREN tomorrow in order to meet its research and educational missions. I also serve as chair of the Colorado Supernet Technical Advisory Committee and chair of the Westnet Steering Committee. Supernet is the official Colorado state network and provides network services to educational and commercial sectors, as well as offering access directly to citizens. Westnet is a regional network serving Arizona, Colorado, Idaho, New Mexico, Utah, and Wyoming.

In addition, I am on the Federal Networking Council Advisory Committee, which is chartered to provide counsel to the Federal Networking Council. I have been an active participant of FARNET, the Federation of American Research Networks, since its inception, and have been on the Board of Directors since 1989. Lastly, I am a principal investigator on a project to systematically integrate networking in the educational and operational activities of the Boulder Valley School District.

FARNET is an association of midlevel networks and other organizations such as telecommunications companies that are interested in national networking. The 35 members represent diverse interests but are united by their support of the mission of FARNET, which is to promote research and educational activities through the use of computer networking. In this document and oral testimony, I will attempt to distinguish those views which I believe to be widely held by the FARNET membership from those that are my own.

My testimony addresses three basic areas:

I. Assessment of the progress of the NREN program to date.

II. Comments on the proposed reconstitution of NSFNET as recently outlined by NSF.

III. Recommendations on areas for additional legislation as part of the Information Infrastructure and Technology Act.

I. Assessment of the progress of the NREN program to date.

There are several important observations to be made about the progress of the NREN program to date. Most FARNET members would concur that:

a.) The NSFNET program is one of the most remarkable success stories of our time. The exponential growth in users and usage has been accompanied by the development of new tools and applications. However, that success – in infrastructure, in enhanced educational and research opportunities, in new public-private partnerships, in improved national competitiveness in high technology – has not been without some difficulty. Both the technologies and the policies of the Internet are now facing significant stresses, and an important criterion for the next two years should be to promote remedies for the problems of success.

b.) The leverage of federal dollars in the NSFNET program has been quite unusual. In Westnet, a survey of members revealed that each dollar of federal networking funds has precipitated non-federal expenditures of thirty times as much. Few events are as catalytic as the prospect of an Internet connection showing up at an institutional doorstep. Within the midlevel networks surveyed by FARNET, approximately 40% receive less than 10% of their funding from NSF, and 56% receive less than 20%. The remainder (and the majority) of their operating costs come from user fees, state funds, and private foundations. We should recognize the impact of this effect and continue to employ mechanisms that extend the consequence of federal investment.

c.) The vision of the HPC program, and hence of the constituencies to be served, is not well defined. There is a fundamental difference between sophisticated high-performance computing goals and the more pedestrian but equally critical goal of creating a high-performance community, which uses networking broadly for effective economic and societal enterprises.

d.) There has been limited cooperation among the federal agencies. The agencies do not seem to share a common vision of the NREN, nor do they agree on their roles in federal networking. As a result, there has been a lack of integrated access engineering; the agencies have individually funded programs without building on each other's successes; and there are significant gaps in responsibilities that reduce the effectiveness of the program overall. Having said this, I will add that, given the very loose coordination mandated in PL 102-194, what has been achieved is not insignificant. Looking ahead, it will be important to address the management and coordination challenges of creating the National Information Infrastructure (NII) early and forcefully.

In addition, the planning process, seen from the vantage point of the network provider or the FNCAC member, has appeared unduly hesitant and isolated. The FNC was slow to utilize their advisory mechanisms, although there

now seems to be a more serious effort by the agencies to consult with the user base. It should be noted that the NSF has consistently sought input from the communities affected by its plans (including FARNET members, the library community, and others), although lead times have often been short.

c.) The tasks assigned to NSF have been difficult and generally not accompanied by sufficient resources and authority. In both the networking and education directorates, NSF has been well-intentioned and achieved good results despite a complex environment.

d.) There is little interaction between the NREN activities and the other three program areas in HPC. We have no idea what progress has been made in the development of advanced software technologies and algorithms, or basic research and education, for example. Since the NREN component is the smallest of the four, and since all four are supposed to harmonize, this seems to us to be a failure of the planning process.

II. Comments on the proposed reconstitution of NSFNET as recently outlined by NSF.

NSF presented a draft solicitation on the recompetition of the NSFNET backbone to the NSFNET community in mid-1992. A significantly revised version of that solicitation was presented in outline form to the FARNET community on January 21 of this year.

a.) In general, and without having seen a final solicitation, we endorse the plans of the NSF to move to a NAP-based network architecture. FARNET recommended a number of changes to the original solicitation, and its members appreciate the intent of NSF to improve its proposal. However, we are concerned that there is no holistic federal view of the NREN/NII of the future. The current NSFNET system is a complex and largely successful mixture of public and private service providers (including telephone companies), state, regional and national networking organizations, strong local networking infrastructures at the institutional level, and federally-supported backbone networks at the national level. It works because federal leadership and relatively modest federal investment have stimulated tremendous commitments of resources (human and material) at other levels.

Large changes in the existing network architecture may cause perturbations in the business, legal, and human relationships that sustain the NSFNET. Specific concerns of FARNET members include: the need for stability, the ongoing need to broaden usage in the research and education communities through a vigorous program supporting new connections, improved application technologies, and additional bandwidth when required for new scientific projects. In particular we recognize and endorse the need for change but are

concerned that the new architecture and new vendors not disrupt or undo the existing level of services to the user community. We urge that transition planning be addressed immediately and with input from users and service providers.

b.) The Acceptable Use Policy (AUP) has been a particularly vexing aspect of the current networking environment, with considerable confusion over its interpretation and a corresponding handicap to growth. While the revised solicitation appears to resolve the AUP issue for the current networking environment, it will create a similar, equally destructive, situation for the vBNS. A broadly accessible facility would create a richer and more valuable intellectual community, in which goverment, academia and industry can share. If it is necessary to have restrictions on use for the vBNS, it is essential that a more functional definition be proposed and effective mechanisms be established to resolve the cases that will arise.

c.) Certainly the high-speed vBNS will support the goal of the NREN program to move toward a gigabit network for scientific and research use, and the proposed NAP scheme should encourage and normalize participation of commercial vendors in NREN. However, the typical supercomputer user is not located at a supercomputer center, but on the campus of a university or research laboratory, and high-speed access must be extended, when needed, to the scientist's desktop. NSF may not be adequately prepared, logistically or financially, to handle these needs within its current programs.

d.) It is encouraging to see that the revised solicitation recognizes the essential role that midlevel networks perform in the overall NREN structure. Mid-level networks are a product of the fusion of local funds and energy, resulting in highly leveraged purchase of services and equipment from the private sector.

States and regions contribute seed capital (for example, the North Carolina state government provided over six million dollars to capitalize CONCERT - their state network) and ongoing operating dollars to foster economic development and the public good. The operational staff of many midlevels are motivated by the opportunity to serve their communities and are augmented by scores of volunteers; as a result, midlevels can offer exceptionally cost-effective services to their users. This combination of energy and seed capital means that large fractions of the operating budgets of the midlevels are used for the acquisition of networking services from the private sector. In the case of Westnet, for example, almost fifty percent of our yearly operating budget is for the direct purchase of circuits from the telecommunications industry, and another twenty percent is used to purchase commercial networking equipment.

e.) NSF, and other agencies, can do far more to utilize the midlevels to foster public sector interests. This is especially critical to FARNET members,

almost all of whom support programs with significant social benefits. Midlevels are market-makers, reaching out to new communities to foster broad access creating local partnerships (with business, state agencies, libraries, etc.) that respond to local needs, and targeting constituencies that often have no other champions. State networks in Ohio and Colorado have launched programs to extend library access; regionals in the west have focused on rural medical care access to agricultural information, and economic development; more than 70 percent of all midlevels are working closely with schools and school districts to extend the benefits of networking to the critical arena of K-12 education. One little-noted additional consequence of midlevels is that they serve as the training ground for students and staff who will fill unmet needs in private corporations requiring networking expertise. If midlevels are to continue as agents of change it is important for NSF, *and other agencies*, to set forth programs to support these activities.

III Recommendations on areas for additional legislation as part of the Information Infrastructure and Technology Act.

In considering the next stages in the development of the NREN and the NII, the following observations may be helpful:

a.) The federal government has an important leadership role to play in articulating the public sector needs for "national data highways" and a national information infrastructure, and establishing requirements to meet those needs. Those public sector interests, which many FARNET members are pursuing in their states and regions, include equitable access opportunities with a range of service levels available, reasonable access costs with pricing structures that do not discourage creation or dissemination of information, insuring that key pieces of the information environment (e.g. libraries and government information) are freely available, bringing target communities which might otherwise become "information have-nots" into the NII, supporting the development of improved network technologies, fostering state networks, and educating local regulatory agencies. New legislation should spell out these goals and require conformance.

b.) The relationship between the NII and the HPC is not clear. High Performance Computing, while important, is not the key to a high-performance country. The key to our future success as a society will be a ubiquitous, well-engineered information infrastructure that permits our people to be effective workers and informed citizens.

c.) Put bluntly, the new NII legislation should not become an entitlements program for federal agencies. Congress should insure, through the language of the legislation and the management structures it creates, that NII funds reach the constituencies who will develop, use and benefit from the new technologies.

d.) Early lessons from an NSF-sponsored pilot project in K-12 networking in the Boulder Valley School District, for which I am Principal Investigator, have been instructive and surprising. It appears that the impact of providing network access may be even more important for K-12 than it has been for higher education. Equal access to information technology at school seems to be synergistic with other equal opportunity goals of our society. In addition, the leverage of investment is truly impressive – a network connection can catalyze spending within the school of an order of magnitude more funds to enhance overall computing and information capabilities.

However, a great investment of funds will be needed at the local level, in environments already fiscally constrained. To motivate this local funding, we need better tools and strategies for the assessment of results, and we need to address the dissemination of our experiences to schools throughout the nation.

e.) Regarding areas for alternative or additional applications areas, I strongly feel that networks will have particular consequence to rural areas. No other technology has the potential to reduce the isolation and improve both the economic and social well-being of rural America. From support of rural medicine to access to weather and farm data, from international marketing for local products to bringing the world into a one-room schoolhouse, the network is a singular tool in this sector.

Community networking for civic affairs, consumer education, and economic development is also an area of great promise. "Freenets" and bulletin boards, despite their generally limited functionality, can offer very useful service. Incentives would be welcome that encourage communities to strategically invest in community networks.

I thank you once again for the opportunity to present my experience, and FARNET's, before you.

Mr. BOUCHER. Thank you very much.

Mr. Kapor.

Mr. KAPOR. Thank you, Chairman Boucher, members of the subcommittee.

I'm the chairman of the board of the Electronic Frontier Foundation—that's EFF. We are a non-profit, public interest organization with the public policy mission to ensure that the new electronic highways which are emerging from the convergence of telephone, cable, broadcast, and other communications technologies enhance free speech and privacy rights and are open and accessible to all segments of society.

For those of you who do not know me, I am also the principal designer of the Lotus 1–2–3 spreadsheet program and was the founder and CEO of Lotus Development Corporation and served there between 1982 and 1986.

It is very challenging to try to be responsive to the broad agenda you have set in five minutes, and I am going to do my utmost. If I engage in a somewhat telegraphic style, I hope you will forgive me and feel free to pursue that.

A great deal of the basic network technology which we see in the Internet and in the NSFNET backbone has achieved a sufficient degree of success, robustness, and development that we are in the midst of a full-fledged transition to private sector providing basic Internet connectivity as it is structured today. That is a remarkable achievement. The NSF has shown a great deal of leadership in this, and they are to be congratulated. You have very correctly raised the set of questions: What next with NREN? and I want to address those questions.

But, as you have heard from the last two speakers—it's funny, we did not prepare our testimony in parallel, but I too, want to draw your attention to the relationship of the NREN to the emerging national information infrastructure. And say that, while there is a relationship, the two are not the same and that the sorting out of private and public sector roles in the national information structure is a very, very important and broad task.

One thing that I would say as a useful metaphor is that the NREN can and should serve as a test bed for network technologies and applications that will serve many different communities.—research, education, etc. In particular, it will provide us many lessons which we will apply in the full national information infrastructure.

We do hear a great deal of discussion in terms of the NII about electronic superhighways, and I think while that it is a useful metaphor, it offers incomplete guidance for policy-makers to apply in the context of the NREN and beyond. In addition to the superhighways, as you yourself have suggested, Mr. Chairman, we can't forget, in continuing the transportation metaphor, the on ramps, the country roads, the two-lane avenues, and the side streets. All of those are, and will be, part of the national information infrastructure. I would suggest that there is a large issue in how we make the last mile, the on ramps of the NII, how we make that digital, and would suggest, following a comment from Mr. Boehlert, that in this pre-fiber era, there is a lot to be done in leveraging the existing private sector investments in copper and coaxial cable in providing a digital last-mile access to the NREN and the national

information infrastructure as we move towards full fiber network eventually.

Let me now be specific and turn to the NREN itself and try to be responsive to some specific means and methods of achieving the goals of the NREN. There are three that I want to talk about. The first is to broaden access by subsidizing users who need network access but cannot afford it, such as primary and secondary schools and public libraries. To support research into the development of applications that achieve the goals outlined in the HPCC Act and to make the networks easier to use. And third is to support research in leading-edge, precompetitive network technologies, gigabit networks, bearing in mind that there is a very sharp distinction to be made between today's production networks, that the millions of people who are using the Internet today are involved with, and the next generation of gigabit networks.

Increasing access to network resources, that is the first goal. It has been said before—and I want to echo my agreement—that there are a great many institutions—private and secondary schools and public libraries—that are still unserved. We think it would be appropriate to subsidize and provide grants and funding for these institutions to purchase network services from commercially available providers.

It is interesting how rapidly the technology is developing. When the draft solicitation came out from the NSF, there was some discussion of wanting to get 155-megabit-per-second backbone. Well, such a backbone is now commercially available from Sprint, and services can be purchased without a cooperative agreement. In fact, there is another emerging network from Metropolitan Fiber Systems that offers performance, which is equal to or better than the existing NSFNET and is commercially available and less expensive.

The thrust of my comments goes to say: Don't fund the creation of a new production backbone; instead, take the money and fund end users in the research and education community who are not currently connected to the network.

Also, we like the idea of network access points, or NAP's, as the kind of train stations or airports or seaports. These critical interconnection points for the web of networks, some government, some private, will constitute the NREN. NSF is to be commended for designing a scheme which will allow multiple competing network providers to interconnect their separate networks into one interconnected network of networks.

There are issues about the operation and governance of the network access points which I do not believe the NSF has yet addressed in a written statement. One attractive model that I would put on the table would be that of an open consortium made up of all network providers who seek to offer NREN services. These would include regional networks, commercial Internet providers, and Government agencies as equal members, who would set the terms of NAP operation at share costs. Government would still, however, have an important role in monitoring the fairness of terms of access set for these NAP's.

I want to address very quickly the issue of acceptable use policies. Chairman Boucher deserves special recognition for his leadership in House Resolution 5344, often referred to as the AUP bill,

passed into law as part of the NASA Authorization Act for fiscal year 1993. The bill opened the door for the relaxation and elimination of restrictive acceptable use policies. We think it would be appropriate for the Committee to ask the NSF what its plans are for moving forward and completing that process which you started.

In the area of applications, let me just say we absolutely support the notion of government investment to support the development of innovative new applications. Let us make sure that some of those applications involve the direct delivery of services to individuals, as well as delivery of services to institutions, and we would suggest that legislation requiring specific reporting on the types of applications actually developed and the number of users served would be very appropriate.

In summary, as you have said, Chairman Boucher, the NREN is a major step on the road to the future information infrastructure of the Nation. So far, the primary focus of federal efforts has been to develop technology to enable high-speed networks. There is still room for technological improvement, but we are at a time when the commercial sector is showing great interest in making significant investment in this area. Now is the time to redirect government funds toward bringing more users on to these networks and to the creation of applications which make the networks more accessible to all users.

Thank you.

[The prepared statement of Mr. Kapor follows:]

TESTIMONY

OF

MITCHELL KAPOR

PRESIDENT

ELECTRONIC FRONTIER FOUNDATION

BEFORE THE

SUBCOMMITTEE ON

SCIENCE

HOUSE SCIENCE, SPACE, AND TECHNOLOGY COMMITTEE

REGARDING THE

HIGH PERFORMANCE COMPUTING AND COMMUNICATIONS PROGRAM

AND

THE NATIONAL INFORMATION INFRASTRUCTURE

February 2, 1993

I. Introduction

Chairman Boucher and Members of the Committee:

I want to thank you for the opportunity to come before this committee again. I am Mitchell Kapor, Chairman of the Board of the Electronic Frontier Foundation (EFF). EFF is a non-profit, public interest organization whose public policy mission is to insure that the new electronic highways emerging from the convergence of telephone, cable, broadcast, and other communications technologies enhance free speech and privacy rights, and are open and accessible to all segments of society. For those of you who do not know me, I am also the principal developer of the Lotus 1-2-3 spreadsheet program and served as the CEO of the Lotus Development Corporation between 1982 and 1986.

You have asked me here to comment on the status of the implementation of the National Research and Education Network, and to solicit comments for your work on a new draft of the Information Infrastructure and Technology Act.[1] I am especially honored to be before this Committee today because I believe that your work on High Performance Computer and Communication program[2] is at a critical juncture. This moment in the history of federally-funded computer networking is so significant because it is a turning point in fundamental policy objectives. An impressive array of basic network technology is now fully-developed and commercially available, due in no small part to enlightened federal funding. Now, as reflected in the HPCC Act, a new set of policy priorities has been added. The new policy goal is to increase access to and usefulness of these network resources for

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[1] Introduced in the 102nd Congress, Second Session as S. 2937. (hereinafter IITA)
[2] Pub. L. No. 102-194. (hereinafter HPCCA)

many users who have been left unserved by the current federal networking programs.

In responding to your specific questions, I would like to start by addressing the relationship between the NREN and the nation's telecommunications infrastructure, as well as my view of the proper roles for government and the private sector. Following these general remarks, I will have some specific comments on the status of NREN implementation and the drafting of new legislation in the area.

II. The NREN and the National Information Infrastructure

Action on the High Performance Computer and Communications Act should be guided by the fact that the steps that this Committee takes with regard to the National Research and Education Network are a critical part of the growth and development of what many are now calling the National Information Infrastructure. We do not believe that the National Information Infrastructure should be expected to grow directly out of the NREN, or that the NREN is in any sense the first step toward the National Information Infrastructure. As it develops, the National Information Infrastructure will be composed of numerous networks, operating with many different kinds of transmission technologies, and all serving different communities of users. The public policy challenge in the development of the National Information Infrastructure is to ensure that it:

- is widely accessible and affordable;
- is governed by fundamental constitutional principles of free speech and privacy; and,
- meets the needs of all segment of the population.

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By acting as a testbed for network technologies and applications, we believe, along with many on this Committee, that the NREN can play an important role in shaping the development of the National Information Infrastructure.

In recent public discussions of the changing US and global communications environment, many have spoken of the need for an "electronic superhighway" or a "fiber optic data highway."[3] These metaphors suggest a need for ever-higher speed networks to carry vast amount of data across the country. The need for very high speed data transfer is no doubt important, especially to the academic community. Yet this metaphor offers incomplete guidance for policy-makers who are working to have the NREN achieve its goals.

In addition to the need for data superhighways, we must not forget -- to continue the transportation metaphor -- all of the on ramps, the county roads, the two lane avenues, the side streets, and even drive ways. A superhighway system, after all, would be useless without the connecting roads, streets, and all of the low-speed parts of the transportation system which feed into our fastest highways. In fact, I would submit that we have done a good job of building data superhighways already. The real problem is that we do not have sufficient access roads.[4] It is to this task -- what I call building the "digital last mile" -- to which policy makers should pay special attention.

As a basis for going forward, we should have some fundamental agreement on the proper roles for the public sector and the private sector in the development

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[3] Markoff, Building the Electronic Superhighway, N.Y. Times, Jan. 24, 1993, §3 (Business), at 1.

[4] Very high speed packet network services are now commercially available. Moreover the installed base of fiber optic cable as of 1991 was over The U.S. installed base of fiber in 1991 was 11.88 million fiber-kilometers. Of that amount, 60% is found in U.S. interoffice networks, and the balance is deployed in the local loop. Approximately 36% of worldwide fiber is installed in U.S. telecom networks. See William J. Cadogan, "Fiber for the Information Age," Lightwave, December 1992, p. 42.

of this evolving infrastructure. Government funding has done much to advance the development and commercialization of high-speed packet network technologies – the superhighways. Now that the basic network services are commercially available, government's role with respect to the NREN should shift to :

1. Subsidizing those users who need network access but cannot afford it, such as primary and secondary schools, and public libraries;

2. Support research into the development of applications that achieve the goals outlined in the HPCC Act and make networks easier to use; and

3. Supporting research in leading-edge, pre-competitive network technologies.

Beyond the NREN, the job of building the access roads is substantial and probably beyond the reasonable financial reach of the federal government alone. Here the public switched telephone network as well as other privately-owned communications networks will have to play a leading role. Government may well have to subsidize access to these services for certain targetted uses, but the services themselves would, in most cases, be provided by the private sector. Because of this interdependence of government and private effort, active coordination between this Committee and those in both houses of Congress which are active in the telecommunications field will be increasingly important.

III. NREN Implementation: Strive to Increase Access to Network Resources

A watershed has been reached in the development of underlying technology, a key goal of the first stage of the government's funding. The sign of this is that

very high speed packet network services are available from a number of commercial network providers. Now the challenge is shifting. In addition to pushing the leading edge of technology, the Committee has set for itself the task of making the network services more useful and accessible to users beyond the research and higher education community. The job of meeting both the existing needs of current users, and continuing to expand the networks reach will be difficult. But we believe that by maintaining a view of the NREN as a test-bed, and making service to particular communities a clear priority, the overall program goals can be met.

Particularly when considered in conjunction with the proposed Information Infrastructure and Technology Act, the NREN has as one of its core purposes to stimulate the development and wider accessibility of network resources for new communities of users. The original High Performance Computer and Communications Act has as one of its purposes to "expand the number of researchers, educators, and **students** with training in high performance computing."[5] and to "promote the inclusion of high-performance computing into **educational institutions at all levels.**"[6] The proposed Information Infrastructure and Technology Act also identifies the need to reach all levels of the educational community, primary and secondary schools as well as universities, in order to "improve education at **all levels.**"[7]

We are very pleased by the general direction in which the National Science Foundation seems to be following in its implementation of the Interim Interagency NREN. In order to promote broad access to Internet and NREN resources, we propose that this Committee keep the following suggestions in mind as part of the ongoing oversight of the NSF's NREN implementation.

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5 HPCCA, §3(1)(A) (emphasis added)
6 HPCCA, §3(1)(H) (emphasis added)
7 IITA, §2(b)(1)(A)

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A. Redirect funds from backbone contract to end-user institutions

Federal funding of the high speed packet networking technology that is the basis of today's Internet and NSFNET has been fantastically successful. Yet because of technological and financial constraints, the service has been limited to a narrow class of users: namely, those in the elite research and education communities. To expand access to currently underserved users, part of the HPCC program should be devoted to funding users who could not otherwise afford access to the NREN.

In order to target scarce public resources, NREN funding guidelines should distinguish between commercially available network technologies and those that are still in the research and development stages. In addition to the existence of the Internet itself, the success and rapid commercialization of other high performance network technologies testifies to the advanced state of the art of these services. In fact, today it is possible to purchase "off the shelf", 155 megabits per second network service from a major, commercial communications service providers. The original NSF Interim Interagency NREN solicitation set that data rate as the target for the first phase of the new NREN. Since the service can be purchased commercially, there is no reason for the government to enter into a special cooperative agreement with any one network provider or providers, as the original IINREN very high speed backbone solicitation envisioned.

Funds allocated for work on advanced network engineering should be targeted exclusively to the development of high-speed gigabit networking technology. An important part of the NREN will be an experimental, high-speed research network which is capable of sending data many times faster than the current NSFNET. But this new research network should not be confused with the existing "production" network now called the NSFNET. Users who depend on the

Internet for routine work should not have the reliability of their services compromised by the inevitable vagaries of a research network under development. The research network should certainly be interconnected with the production network, but their operation and funding should be kept as separate as possible.

Any subsidy that is necessary to enable users to have access to the "production" network should be given directly to user-institutions, not to network carriers. Internet connectivity is a commodity service. Users should purchase it on the open market, with support from government grants where necessary.

Subsidy that flows directly to users will help ensure that the NREN program is in fact meeting its goal of increasing network connectivity for the education community. Though many higher education institutions and a small number of primary and secondary schools have Internet access, many smaller colleges and universities, and the vast majority of primary schools and high schools, are still unserved. A program structured around direct funding will help target and leverage federal resources to bring these currently unserved institutions onto the network.

B. Ensure Openness in NAP design and Governance

In its draft Interim Interagency NREN solicitation, the National Science Foundation has called for the creation of Network Access Points (NAPs). The NAPs are the point of interconnection for all network service providers who seek to offer nationwide NREN/Internet service. The NSF is to be commended for designing a scheme which allows multiple, competing network providers to interconnect their separate networks into one, interconnected network of networks that can seamlessly link users around the country and around the world.

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Much like seaports, airports, or train stations, NAPs will be critical interconnection points for the growing volume of data on the NREN. Therefore, open, affordable access, which ensures a level playing field for all participants, is critical.

To ensure continued diversity in Internet access, it is essential that these NAPs be open to all carriers and to all types of traffic. To meet this goal, the governance rules and operating structure must be carefully monitored by the Foundation and this Committee. One attractive model for NAP operation and governance would be an open consortium made up of all network providers who seek to offer NREN services. Regional networks, commercial Internet providers, and government agencies could all be equal members of a consortium which would set the terms of NAP operation and share costs on an equitable basis. Since it would be in the interest of all members to have the NAPs operate reliably, a consortium might be an attractive vehicle. Moreover, this would relieve the NSF of burdensome management responsibility. The government would still, however, have an important role in monitoring the fairness of the terms of access set for the NAPs.

The number of NAPs ultimately sponsored, as well as the final terms of interconnection should be chosen to enable a significant number of network providers to compete in the market for NREN services. On the assumption that each network provider would be required to connect to each NAP in the country, a smaller number of NAPs would reduce the barriers to entry for smaller network providers. A NAP structure the leads to an oligopolistic market structure would be undesirable because of its likely failure to provide users with choice and competitively priced services. Since the structure of this market is still quite dynamic, adjustments in the NAP structure may become necessary in the future if severe market distortions arise.

C. Encourage Full Participation in NAPs by Government, Education, and Private Sector

The adoption of NAPs as the standard Internet interconnection points is a desirable goal and can be encouraged by properly targeting federal funds. Any federal dollars given to institutions for the purpose of enabling those institutions to purchase Internet/NREN access can be given with the requirement that the institution purchase network connectivity from a service provider which is connected to the federally-sponsored Network Access Points.

D. Eliminate AUP: Finish the job started last year

Chairman Boucher deserves special recognition for his leadership in drafting House Resolution 5344, often referred to as the "AUP Bill," which passed into law as part of the National Aeronautics and Space Administration Authorization Act, Fiscal Year 1993.[8] This measure will enable the National Science Foundation to take steps to allow the NSFNET, the Interim Interagency NREN, and the Internet as a whole, to realize its full potential as an advanced information infrastructure. As this Committee knows, a relaxed AUP is important to make more information resources available on the network. Only through the elimination of restrictive "Acceptable Use Policies" will the network services supported by the National Science Foundation realize the goals outlined in High Performance Computing Act of 1991. Now, this Committee should ask why the NSF has not yet acted to finally eliminate this rule.

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[8] Pub. L. No. 102-588

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E. Provide Mechanisms for Protecting Privacy and Security of Information on the Network

As the NREN and the Internet as a whole is more widely used and relied on, privacy and security must become policy priorities.[9] 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.[10] Until these policies are changed, 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.

IV. Information Infrastructure and Technology Act Recommendations

Just as federal funding for underlying network transport technologies was essential to promote the development of network hardware and operating systems, federal stimulus for applications development can play an important role in

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[9] HPCCA, §101(a)(2)(1)(1)

[10] The Office of Defense Trade Controls in the State Department controls the export of data encryption software which is included on the U.S. Munitions List in the International Traffic in Arms Regulations (22 CFR Parts 120-130, know as ITAR). During the 102nd Congress, the Federal Bureau of Investigation issued its Digital Telephony Proposal, which would require communications firms to reduce the overall level of security in their networks in order to facilitate law enforcement wiretapping efforts.

encouraging the creation of innovative applications which make the network easier to use and which enable new communities of users to take advantage of network resources. Legislation should carefully target categories of applications. The NREN is an ideal testbed for developing new applications, especially for the library and education communities, whose needs are less likely to be satisfactorily addressed by the private sector. But to fulfill its testbed role, the NREN must reach a sufficient number of users, who can then serve as participants in the various applications experiments that are conducted. Without a sufficiently broad reach, the NREN will fail in its mission to be a prototype for services that enable exchange of information "among all citizens and residents of the US."

We would suggest that the following priorities be establishing in any new version of the Information Infrastructure and Technology Act.

A. Support applications that bring new users and uses to the network

The NREN offers a unique opportunity for the development of new applications. If properly designed, an educational application developed at a school in Virginia can be used, tested and refined by network users all around the country, provided the network has a sufficiently broad reach. The best results will be achieved in the end if government can support many diverse experiments and see which work well. In a network environment, the successful prototypes will propagate quickly. As an example, the proposed Information Infrastructure and Technology Act calls for the creation of digital libraries over the NREN.[11] At present, however, very few local, public libraries have full access to the Internet, and would thus be unable to participate, as users, in the digital library experiments. The

[11] IITA, §7(b).

results of the experiments, then would be application programs that only meet the needs of the advanced research and university libraries that are already on Internet. To achieve the broad goals of the legislation before this Committee, it is important to involve a diverse community of users in the NREN.

B. Applications should contribute to fundamental domestic policy goals: health, education, and competitiveness

As written, the Information Infrastructure and Technology Act from last session identifies important areas of concern such as health care services and educational tools as the intended beneficiaries of applications research. While this Committee should certainly leave implementing agencies freedom to select the most promising applications possible, new legislation ought to target at least some portion of the research efforts to applications that involve the delivery of direct services to individuals. To ensure accountability and make future oversight efforts more effective, any legislation should require specific reporting on types of applications actually developed and numbers of users served.

C. Applications must address the needs of people with disabilities in the initial design phases

Chairman Boucher has said that the NREN will lead to "and infrastructure serving the needs of all sectors of society"[12] To realize this goal, the needs of people with disabilities should be taken into account in the early stages of application design process. Computer and communications technologies have tremendous potential for meeting the special needs of people with disabilities. But to do so, concerted efforts must be made throughout the design process. This Committee can

[12] 138 Cong. Rec. E1734.

ensure an inclusive design process by recognizing this need in legislation that it drafts.

V. General Goal: Promote Access to Emerging National Public Network: The new public forum

As Chairman Boucher said last year, "the NREN is a major step on the road to the future information infrastructure of the Nation."[13] It is not, the entire infrastructure itself, nor should it become that. By managing the NREN as a resource with the broadest possible accessibility to the research and education communities, and by supporting research into the development of critical new applications, the NREN can be a model for networked information services which benefit many critical segments of society. But to achieve these broad benefits, it will be necessary to broaden the traditional focus of the HPC program.

The goal of developing technology to enable high speed networks has been the primary focus of the federal efforts until now. While there is always room for technological improvement, the commercial sector is showing great interest and making significant investment in this area. Now is the time to redirect government funds toward bringing more users onto these networks and to the creation of applications which make the networks more accessible from these users.

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[13] 138 Cong. Rec. H5342 (June 29, 1992)(102nd Cong, 2nd Sess).

Mr. BOUCHER. Thank you very much, Mr. Kapor, and the Subcommittee expresses its thanks to all of the witnesses who have testified on this first panel for their thought-provoking comments and their recommendations for the direction that should be taken with respect to the NSFNET and ultimately the National Research and Education Network.

Let me ask each of you if you would comment on the general direction that the NSF is taking with the recompetition and its future plans for the NSFNET by essentially restricting in the future the use of the NSF backbone to those who need that very high capacity and then, in effect, relegating the others—meaning the low-end users, those who do not require a very high capacity—to the purchase of network services from the regionals and/or from commercial networks. What do you think the implications of that policy generally are?

And I would ask specifically whether, since it entails the necessity of some reduced level of subsidy to the regional networks and an increasing reduction in that subsidy over time, that there may be some risk of some of the regional networks disappearing, with the effect that some institutions might then be left without access to network services. Is that a legitimate concern? Are there other concerns that we should be aware of with respect to this general policy, and what do you think about that policy in the broad sense?

Mr. Kapor, you seem to be ready to answer. What is your response?

Mr. KAPOR. In general, we think that NSF is taking exactly the right approach. As far as the production Internet goes, the phasing out of an NSFNET-funded backbone is exactly the right direction because there are multiple, competitive, commercial providers that are prepared to offer connectivity.

We think that subsidies to the regional networks should be phased out as quickly as possible without disrupting the connectivity of the network; perhaps on the order of a year should be sufficient. We think that the risk of a balkanization of the network resulting form the end of government subsidization to regional networks is actually very low.

There may be some regional networks which cannot meet the challenge of transforming themselves into unsubsidized providers. There are many regional networks that will do just fine. In any event, there is such healthy and robust private sector competition that I believe the result will be a higher level of service at lower costs from a competitive marketplace. That means that institutions in all areas will be offered multiple ways of purchasing connectivity.

Mr. BOUCHER. Dr. Heterick, do you care to respond on behalf of the education community with respect to the potential that some of your constituents might be left either without service or with a diminished level of service?

Dr. HETERICK. Well, I think I would reiterate a point I made in my opening comments, that it seems to us that the question of access is critically important, and there are many unserved and underserved facets of both primary, secondary, and higher education that we think should be an important thrust of future legislation and NSF activities, certainly consistent with the budget they have.

In that sense, actions that are taken that tend to defer the possibility of increased access don't seem to us to be in the best interest.

Mr. BOUCHER. Do you think this policy is going to decrease access, or are you genuinely concerned about that as a real potential?

Dr. HETERICK. Congressman, the information I have on NSF's point of view on this is very third hand at the moment, and one of the problems that I think we have had is the lack of formal statements delivered in general public fora where people could have better ideas of what they have in mind.

Mr. BOUCHER. Well, let me pursue that response, and I would like Mr. Kapor and Mr. Klingenstein in particular to join in this discussion. Is the NSF appropriately soliciting public comment with regard to its plans for the recompetition and the general shift in its anticipated usage of the backbone, its general plans for the requirement that users not needing that high capacity purchase connectivity from commercial providers? Is the NSF appropriately soliciting comments?

Tell me about the structure that the NSF has set up in order to get advice from the people who will be affected by these decisions.

Dr. HETERICK. We have always found NSF to be extremely open and desirous of input from the community. I think the issue that I am speaking to here is that, having received it now, we would like a more formal statement of what their position is in time to have a chance to react to it.

Mr. BOUCHER. So you think some additional presentation from the NSF to the interested community of what its intentions are and what their anticipated consequences of that decision being implemented will be would be useful to you.

Dr. HETERICK. We think that would be extraordinarily helpful.

Mr. BOUCHER. All right.

Dr. Klingenstein.

Dr. KLINGENSTEIN. Chairman Boucher, I would concur that the NSF has done a wonderful job of inviting participation for the first round of the solicitation and that the revised solicitation appears to be much strengthened.

With regard to the VBNS, it is my sense, wearing my campus-based hat, that there is as much need for high-speed band width to the campus as there may be between supercomputing centers. It is the physicists and chemists on my campus who want to fly through their data sets, as they say, that will need high-speed band widths.

I'm a little skeptical of the ability of NSF to handle the number of requests and the volume of funds necessary to support high-speed band widths to the desktop of the research community.

With regard to the long-term life of regional networks, I think regional networks, in general, are prepared to go out of business if they need to. I think their primary concern is to support the public sector networking. If they are going to be phased out in an economic marketplace, so be it, but Congress has to ensure that the good works being done currently by the midlevels are perpetuated, that there are agents of change working slowly, carefully, with K–12, with libraries, to bring them on to the network.

I would suggest that the phase-out for the subsidies may need to be longer than what Mr. Kapor suggested. That seems a bit pre-

cipitous, but I think the writing is on the wall and we are prepared to live or die in the economic environment but that the government needs to ensure that the good works continue.

Mr. BOUCHER. Two questions to you. First of all, do you think that the NSF has been appropriately open to comments from your constituents as the recompetition has been structured and—your response to that first.

Dr. KLINGENSTEIN. Yes, I do. I think that we held a workshop in early July in Boston that NSF sponsored, and it was a very productive meeting, and the input came back to NSF, and we saw a presentation two weeks ago in Denver that seemed to show that NSF was modifying the solicitation significantly.

Mr. BOUCHER. And do you agree with Dr. Heterick that some more formal presentation of intentions now be presented from the NSF?

Dr. KLINGENSTEIN. It wouldn't be negative, but the clock is ticking on all this, and there is the need to get on with business at the same time.

Mr. BOUCHER. Okay. The other question, and the more substantive one, that I have of you is, as a representative of the regional networks, do you think that there is any substantial risk that with the movement on to the backbone of just the high end uses and with people otherwise who don't require that high capacity being required to purchase connectivity to the network, to the Internet, that there will be an adverse effect on the regionals that might, in fact, cause some of the regionals to fail and then leave institutions without access to network services at all? Is that a legitimate concern? Is there any real potential for that?

Dr. KLINGENSTEIN. I think it is a real concern, especially in the far west and the mountain areas where the distances between institutions is significant. In Westnet, over 50 percent of our costs go to purchasing circuits from inter-exchange carriers.

I would prefer to see a commitment by the Federal Government to establish a point of presence in every state and then, from that point of presence, networking fan out. That state orientation was in the original NREN legislation, and I do not see it in the current formulation.

Mr. BOUCHER. Would you present to us a more formal presentation or proposal with regard to having a point of presence in every state and amplify that into any other suggestions that you have for ways that we could assure that as this trend continues, that the regional networks are not disadvantaged and that we don't run the risk of leaving some institutions out in remote areas without access to network services, so just a more formal presentation of that proposal.

And I'm not suggesting you do it right now, but that you submit it to us in writing, and then we can talk with you and perhaps have you back at another hearing later to discuss it in greater detail.

Dr. KLINGENSTEIN. Surely.

Mr. BOUCHER. I do have a response that I want to make to Mr. Tauke for his provocative question about the extent to which the Federal Government ought to be involved in operating a network, but I'm going to defer that until we have an opportunity for other

Members of the Subcommittee to propound their questions and make their comments.

So this time having expired, I'm pleased to recognize Mr. Boehlert.

Mr. BOEHLERT. Thank you, Mr. Chairman.

Mr. Tauke, I'd like you to briefly describe, if you will, the NYNET program that I mentioned in my opening statement. It is quite exciting, and I think we would like to hear more about it.

Mr. TAUKE. The program that you described is a project in which NYNEX is involved. It is a project which hooks many of the research and educational institutions in New York State, and it is a project which we believe exemplifies the kind of advanced deployment of technology that can come from a partnership in the private sector, industry, as well as the public sector. We believe that this kind of investment is the right kind of investment for the Government, and we believe that it is an investment which will improve the quality of education for those involved and help with research.

Mr. BOEHLERT. You really haven't publicly announced this yet, have you? When does NYNEX plan to do so? I mean you can't get much more public than this forum.

Mr. TAUKE. I think the announcement has been—I guess we haven't publicly announced it, Sherry.

Mr. BOEHLERT. I guess we just did. [Laughter.]

When NSF establishes a so-called production network, will NYNEX and the other regional Bell operating companies be able to participate in the provision of that network?

Mr. TAUKE. First of all, I think it is important in this response in part to the comments that were made in response to the chairman's questions—it's important that we have some kind of distinction between what we call experimental networks and production networks. We believe that where there is technology that is experimental, that it is appropriate for the Federal Government to fund networks, or where the networks are key to the carrying out of experimental technology that the Government has a role to play in funding.

We think, however, once the technology has evolved to a point where it is being commercially deployed, that then there is no need for Government funding, and that is what we call production networks.

Now generally speaking, when we get to the stage of production networks there is a role to play for NYNEX, the other regional Bell operating companies, and local exchange carriers, as well as the commercial long-distance carriers.

However, due to a number of the restrictions that are contained in the law at the current time, including the restriction on cable/telco cross-ownership, the modification of final judgment restriction on long-distance carriage by the regional Bell operating companies, we are restricted in the way in which we can offer services to end users via the production networks.

We think that as part of a broader policy, not directly relating to what you do with this legislation but as part of a broader policy, it would be useful to the development of the Nation's infrastructure if some of those restrictions were lifted.

Mr. BOUCHER. One other question of you, Mr. Tauke. What is your opinion about a Government subsidy being given directly to the NSF backbone network versus the users of the network?

Mr. TAUKE. If when we talk about a backbone we are talking about what we refer to as an experimental network, we think that then a Government subsidy, if you will, is appropriate. But generally the Government should not be trying to subsidize networks. Instead, the Government should be attempting to subsidize those users who may not be able to afford the networks and provide assistance to the development of applications to get access to the networks.

I think you are hearing that pretty much from everybody on the panel. Everybody is suggesting to you that there is a real need to give assistance to users so that they can gain access to the highways, the information highways, that are already out there, and there are two forms for that assistance. One is direct subsidy so they can pay their bills; the other is assistance in the development of applications.

Mr. BOEHLERT. Thank you. And I think I am hearing the same message from all on that one, and I do appreciate the manner in which you are presenting your responses to my questions, because I'm a non-tekkie myself. We have gone from the preppie era to the yuppie era, and I guess there are some others of us that are non-tekkies.

And a little lesson on how you get to be a senior member of the Science Committee: Eleven years ago, I came to Washington, D.C., with a lot of enthusiasm and submitted to my resume, and the lords of the back room looked at the resume and they said, "This guy Boehlert, the last science course he took was high school physics, and he got a C; he's a natural for the Science and Technology Committee," and that's why I'm here; that's the way Congress works. [Laughter.]

Dr. Heterick, you recommend that significantly greater resources be directed to support the cost of connection of schools and libraries to the network. If total funding for the network does not increase—and we are going to do our level best to see that it does—would this remain your first priority?

Dr. HETERICK. Yes, Congressman, it would, and let me suggest that, as I think Dr. Klingenstein mentioned here, the critical issue here is to draw the States into this process. Primary and secondary education, a major portion of public library initiatives, are really State activities and State-funded operations, and one of the things that we are looking for is a significantly broadened access that brings all of these communities into this process, and while it brings greater communities in, it also brings in other sources of funding other than perpetuating Federal subsidies for individuals to use the network.

Mr. BOEHLERT. Thank you very much.

Mr. Kapor, we all want to see our schools and labs and libraries linked together. I think that is a high priority with all of us. Do you see any tension between the desire to rapidly establish such a network and the desire to push the envelope by investing more in network R&D? Is there a danger in moving too fast in a given technology?

Mr. KAPOR. I wish I could claim I was a non-technologist, but I can't. There is always risk when you have rapidly moving technology, which is the case in networking, but that is just a fundamental, it's a given. There is no circumstance I can imagine in which we don't confront the consequences of rapidly evolving technology. So what I think we have to do is, we have to manage risk down, and one way that it can be done is to be very clear in establishing agreement that there are these different levels of networking.

There are production networks that are really offering commodity services; there are precompetitive technologies in their initial deployment; and then there is pure research; and we need to have, I think, a different funding regime for each one, from moving towards no subsidization for things which are commodity services to the traditional role of funding pure research.

The way you manage the risk down is to know when a technology is ready to move from one stage to the next so you have an orderly transition with some advanced planning, and I think that is possible to do if there is a consensus among all the stakeholders that this is the regime that we'll have.

That way, if people know that three years or five years down the road gigabit networks are going to be out of their test beds and ready for deployment, there can be a strategy for reducing the Government involvement as that moves into more of a production network, and I think we are learning enough to begin to be able to manage that process, and that would be the way I think we should go.

Mr. BOEHLERT. Thank you very much.

You know, I think all of you can help us. You have all had kind words to say about NSF, and its an enthusiasm I share because I think that agency does an outstanding job and we have been properly giving more resources to NSF. That is the good news. The bad news is, we are losing the administrator, the director. He is leaving to go back to academia, the University of California, I believe. So if you have any suggestions, send them down to the White House. We need somebody to keep up with what Mr. Bloch did and Dr. Massey has been doing at NSF, because I think it is a great national resource that is underappreciated.

That's all for now, Mr. Chairman. I'll come back a little bit later.

Mr. BOUCHER. Thank you very much, Mr. Boehlert.

The gentleman from Alabama, Mr. Browder.

Mr. BROWDER. Mr. Chairman, I'm going to yield to you so you can get on with those questions that you are interested in, and also I see that you have been scribbling down some more, so I'll yield my time back to you.

Mr. BOUCHER. Thank you very much, Mr. Browder. I appreciate your generosity.

The gentleman from Minnesota, Mr. Minge.

Mr. MINGE. I also will yield my time and participate by listening to your questions.

Mr. BOUCHER. Thank you.

Let me say to my friend, Tom Tauke, that I appreciate his thoughtful comments and recommendations here this morning, and I understand the concern that the local exchange carriers through-

out the country have a potential competition from the Federal Government through the National Research and Education Network.

Let me offer as best as I can the assurance that it is certainly not the intention of those advancing the high-performance computing and national networking program to offer commercial competition to telephone companies. The idea is that the highest capacity which is in excess of that offered by the commercial providers would be offered by the Federal Government and would continue to be offered by the Federal Government until such point in time as the commercial providers reach that level of ability, and when they do the federal role would diminish and evaporate in that particular area.

So I think the intent is as you have suggested that it should be, not that on an ongoing basis the Federal Government provide this service when exactly the same kind of service is at that time available from the private sector. If you have any comments or suggestions beyond that, I would welcome it.

Mr. TAUKE. First of all, Mr. Chairman, we appreciate your clarity in outlining what you believe the goal of the program should be. That has been most helpful. I think it is fair to say that from time to time there has been a misunderstanding of what the intent of Congress is in the program and some uncertainty, as I alluded to in my testimony, about what the intent is.

The processes used by the National Science Foundation, which you alluded to in other questions to other people on the panel, have allowed for a lot of openness, and they have been very good in that respect. I would say as just one outsider looking in, however, it appears as if there is some uncertainty sometimes about the direction of policy adopted by the National Science Foundation, and the processes are not as formalized as we often have in government. In many ways that is good, given the nature of this enterprise, but I think from time to time it creates uncertainty.

Right now, we are in a period of some uncertainty. We think we are supportive of the direction in which the NSF is going, as several of the panel members alluded to, but we too aren't quite certain exactly if our understanding is the same as the direction and the policy that the NSF is going to finally pursue.

The last point I would make is that this is getting to be a bigger deal, you know. It started off as kind of a modest little enterprise, and it potentially could become a much bigger enterprise, especially when we begin talking about hooking up the elementary schools, the health care providers, and others throughout the Nation.

There is a need for greater clarity as to what the role of government should and should not be. That is why we have offered as a framework for establishing that clarity the differentiation between experimental and production networks, trying to give some thought as to where the funds should flow.

We think that what we are saying is in sync with what you are saying, and we applaud you for your leadership on this issue, and we certainly don't claim to have all the answers on it, but we are trying to be useful in this process so that we do draw the lines. And the bottom line is, of course, we don't like government-subsidized competition, but at the same time, we recognize that there

is a role for government to play and we want to work with you in developing that proper role.

Mr. BOUCHER. Let me offer our full cooperation in that effort and suggest to you that we intend to process a second iteration of the high-performance computing legislation—call it Son of HPC—during the course of this Congress, and so there will be a legislative vehicle within which to provide the level of clarification which you suggest is currently absent.

Why don't you propose some amendments to us that, in your view, would establish that level of clarity. I think it would be helpful to us to have those recommendations, and we will keep the record of this proceeding open until we receive that from you. So if you could do that, that would be, I think, a step in the right direction.

Mr. TAUKE. We would be delighted to do so. To which bill should we use as a base when attempting to propose amendments?

Mr. BOUCHER. You will have a bill very shortly that you can use as a base. We intend to introduce legislation that will provide for the applications of networking technologies that were first suggested in the bill introduced in the last Congress upon which no action was taken, that would be the legislation to which amendments could be made.

I have read over section 102 of the High Performance Computing Act, and to my interpretation it is very clear that the Federal Government would not be involved in competition with commercial providers, but it never hurts to clarify our intent to the satisfaction of all parties concerned, and we will make every effort to do that.

Mr. TAUKE. Mr. Chairman, if I might just observe, you know, if you go around and talk to people on the campuses of the Nation, I'm sure you will find, as I have—and you don't even have to go to campuses, you can go to other places—that people use Internet now for a whole variety of commercial uses.

I talked a few weeks ago to a student who happened to attend a university in this Nation who had a boyfriend who happened to be attending an institution over in Europe for a year. They spent the entire day hooked up via Internet working on research papers but also with their mailbox on the screen exchanging notes, E-mail, nice communication. But that we do not believe is appropriate communication that should command government subsidies. That we see is commercial communication that should be part of the commercial network.

Mr. BOUCHER. Could I just say on that point, I think everyone would agree, and the direction in which the NSF is moving now is to restrict the use of its subsidies and its high-speed backbone to those users who require that high capacity, and for things like E-mail and other lower-end uses there would be an expectation under the NSF's current direction that those services be purchased from commercial providers.

So I would gather that your industry would then endorse that direction of the NSF which I think meets your objectives.

Mr. TAUKE. We do support that direction, and I only raise this example, Mr. Chairman, so you understand why the concerns have arisen. It isn't because of anything that you have said or because we disagree with the directions of the NSF, it's because there have

been other visions of this network that are different from yours and because of some things that are happening in the real world today which we think are being addressed by the NSF.

Mr. BOUCHER. Okay. Well, it's a thoughtful discussion, and we will look forward to your specific recommendations on how we can clarify that intent.

Let me ask finally this panel to comment on the activities that the Administration has taken to date to implement the High Performance Computing Initiative. There is a confederation of agencies that are working under the guidance and coordination of the Office of Science and Technology Policy. Tell us, if you will, how effective those steps have been and whether those activities are in conformance with the objectives of the HPC legislation.

Any volunteers?

Dr. Heterick.

Dr. HETERICK. Thank you, Mr. Chairman.

I think we have the perception that OSTP has attempted to bring some coordination to federal agency activities, but I would have the observation that there are many federal agencies who do not participate in that coordinated effort.

Mr. BOUCHER. Which ones should be participating that presently are not?

Dr. HETERICK. Well, I think you will find that many sectors—while someone from the Department of Agriculture, for instance, is on the FNC, I think you will find many areas within Agriculture are not actively participating. The Department of Education, I think, is another place where you don't have active participation in NREN activities, and I don't know—that may be a consequence of the agency choices rather than the coordination effort, but certainly there are issues that extend well beyond federal agencies, and it is not clear to us how OSTP provides that kind of effective coordination to institutions of higher education, public libraries, primary and secondary schools, all of which are envisioned as participants in the NREN activity.

Mr. BOUCHER. Are you suggesting that some affirmative outreach on the part of OSTP might be appropriate to try to enlist more participation, more advice, as this process goes forward?

Dr. HETERICK. Absolutely, and I think you would find that EDUCOM, CSPP, other organizations, have suggested that maybe a national commission or something of that nature might be a way to approach this problem and understand the coordination of a national rather than a federal activity.

Mr. BOUCHER. Has EDUCOM shared these comments with OSTP, or is this the first time that you have talked about your concern that appropriate coordination is not being provided and appropriate advice not being received?

Dr. HETERICK. The results of the workshop I mentioned in my testimony were shared with OSTP late last year.

Mr. BOUCHER. And those comments were a part of that workshop?

Dr. HETERICK. Yes, sir.

Mr. BOUCHER. Any other comments with regard to that?

Dr. Klingenstein.

Dr. KLINGENSTEIN. Mr. Chairman, first of all, sitting on the Federal Networking Council Advisory Committee, I would suggest that that group was very slow to convene and that the issues presented to the FNCAC were initially not of substance. I think there has been a shift over the last few months, and I think that there is a more sincere effort by the FNC to use its advisory mechanism.

I would also concur that there are some federal agencies who are not full participants. I guess I would identify the Department of Education as a critical agency, especially for K–12. I think there is a number of good experiments being conducted at this point through the Education and Human Resources Directorate inside NSF. The results of those experiments must be disseminated and utilized by the Department of Education in formulating an approach to linking K–12.

As profound an effect as the network has had on higher education, I think it will ultimately have more of an effect on K–12.

Mr. BOUCHER. Thank you.

Mr. Kapor.

Mr. KAPOR. Yes. I have two points. The first is, it might well be appropriate to establish a policy which direct agencies to purchase services on production networks where appropriate as opposed to undertake the construction of new, duplicative facilities. We have seen a tendency from time to time for different agencies to want to go their own way, and perhaps the technologies are at a state of maturity where their needs really can be met with off-the-shelf technology but they may need a nudge in coordination.

And the second is, if we do go forward, as I hope we will, with a scheme for these network access points which the NSF has proposed, it might also be very appropriate to obtain the voluntary and cooperative participation of the other agencies in agreeing to connect to these network access points with the understanding that that doesn't mean they necessarily interconnect with every single other network that is connected there because these NAP's are what are called policy free.

The fact that you are physically connected is one thing; you then enter into agreements as to who you actually send packets to, and that would allow for a kind of multiplicity of different types of use policies to coexist. But if the agencies don't connect to the NAP's, it is going to fundamentally weaken that at the new interchange points.

So there are some issues for OSTP to coordinate.

Mr. BOUCHER. What about the pace of this work?

Mr. KAPOR. Well, I really want to echo what Mr. Tauke said. The major problem I see is that of uncertainty. We do not—NSF does not seem to be operating under publicly known and fixed time lines; things happen; announcements are made. The process is very open, but yet it is very unstructured, and that introduces uncertainty, it makes planning difficult, and it maintains the possibility of surprises. Again, I want to echo what has been said before——

Mr. BOUCHER. So you would see a clear need for better structure internally within the NSF as it is making these advances toward a more capable backbone and with regard to other policies for use of the backbone and for the recompetition for backbone services—for network services.

Mr. KAPOR. Absolutely. I don't want to stultify the process, that would be terribly unfortunate, but I think a more structured process would reflect the fact that there are a lot more players now and that it is a bigger pond, it is not a small group of, you know, computer science networking researchers and a couple of people at NSF who have a stake in this thing, and I think a slightly more formal structured process is appropriate given the increasing complexity and widespread participation in the network.

Mr. BOUCHER. Let me shift the focus of the question and ask you about the pace of the confederation of agencies working under the supervision of OSTP to formulate plans for the National Research and Education Network. Is that moving as quickly as it should?

Mr. KAPOR. I sense that it could move more quickly.

Mr. BOUCHER. Okay. You should go into politics, Mr. Kapor. That's a good answer.

Mr. Tauke.

Mr. TAUKE. We believe that there is some need for the Federal Communications Commission to be involved in this process. Exactly where it should be involved in the process I'm not certain, but as this process involves the greater communications infrastructure of the Nation there is a role for coordination with the FCC.

Mr. BOUCHER. What kind of role would the FCC have? It is hard for me to envision a role for the FCC in what is merely a research and education network. Assuming that it adheres to its function and doesn't go beyond that into commercial competition, why would the FCC be involved?

Mr. TAUKE. First, we believe that the Federal Communications Commission has a role to play in the standard setting process, which is critical for the orderly development of the network.

Secondly, we have talked quite a bit today about the evolution of technology from, for lack of better terms, experimental networks to the commercial or production networks, and I think that the Federal Communications Commission has a role to play in that process.

We—I believe, as I started today talking about, have to look at this not as a separate entity or separate little thing off here to the side. That maybe is what it was a couple of years ago, but we envision it being something more, and it should be part of our vision of an information infrastructure, and in that capacity there should be some coordination with the Federal Communications Commission.

We will give you additional thoughts as we look at what legislation you offer, but I don't think—I didn't want to let the opportunity pass without raising the question of FCC involvement in some way.

Mr. BOUCHER. Your specific recommendations on that front would be welcome, and we will certainly take them into account.

Let me finally ask this panel, if the structure that we are contemplating for the second iteration of the High Performance Computing Act, the one that leads to more definite applications, is appropriate, the structure that we are thinking about is essentially the same one that is now grappling with implementation of the original high performance computing legislation, and that is a variety of agencies, each with a mission, each with a function, within

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the overall context, being coordinated by OSTP. Is that the right approach for us to take with regard to applications that will be the subject of the next bill?

Any comments?

Dr. Heterick.

Dr. HETERICK. I think you would find strong agreement among the constituency that EDUCOM represents that the issues in front of us really are grand applications, and I think you have heard this from any number of other sources. Certainly the life-long learning reskilling issues and the need to build the kind of applications that make them integral to the network are critically important; medical care, health care, issues, absolutely vital; the creation of digital libraries, and all of these, require applications to make them flow freely across the network; and, finally, I think in a national competitiveness sense, the manufacturing issues that are so important to this country's competitive sense.

Mr. BOUCHER. That is a pretty good answer for the next question I was going to ask, but let me get your answer to this one. What about the administrative structure? Is that appropriate? Assuming that we have the right applications in mind—and we will get to that in a minute—what about the administrative structure to achieve those applications?

Dr. HETERICK. I think you would find, again, among EDUCOM constituents, a sense that this is something more than a federal effort, it is a national effort, and we need a management and an administrative kind of structure that allows the national effort to blossom.

Mr. BOUCHER. And you are arguing for greater involvement by the education community.

Dr. HETERICK. Yes, sir.

Mr. BOUCHER. Okay. That is a point understood.

Mr. Kapor.

Mr. KAPOR. I think it is very important to have a process, administrative process, that treats the interests of end users and commercial providers of services and application developers as first-class participants. Now I wish I could give you something concrete to supplement the agency structure, but I fear that if it is just basically at the first level structured as coordination among agencies, the input and influence and participation of all these other groups will only be present in a diminished form, and I would look to the direction of increased involvement perhaps in an advisory way but in a structured way that is guaranteed to get input so that we don't wind up simply with applications that serve interests of particular agencies. Obviously, those have to be there, but there are broad generic needs that need to be addressed, and we would be happy to give some further thought to this and try to make this concrete if that would be of interest.

Mr. BOUCHER. That would be helpful.

Dr. Klingenstein.

Dr. KLINGENSTEIN. Mr. Chairman, I do think it is appropriate to use agencies, with two important caveats: the first, that this is not an entitlements program for those agencies, that the money needs to get down to the people in the field; a second condition would be

for stronger coordination; I think coordination to date has been limited.

And then I wonder and am concerned that if we use agencies, who will speak for all those people who are not directly represented by an agency as we start to look at the impact in rural America, as we start to look at the impact of community networking, the electronic communities, such as what is happening in Blacksburg, what agencies will speak for that.

Mr. BOUCHER. Okay. Those are all excellent comments, and any further illumination that you care to provide on how we might look at the administrative structure we would appreciate.

And then, finally, let me ask you this, and this probably is the most important of this set of questions. Are the applications that we are looking at the right ones? Are the resources to accomplish an implementation of those applications adequate? And is the various allocation of resources among the applications the appropriate allocation?

The applications basically that we are looking at are education and teacher training, the creation and dissemination to industry of manufacturing technology, medical data and medical imaging over a high-performance computing and networking test bed, the creation of digital libraries, and the setting of standards for the ready retrieval of digital information over these networks. Are these the right applications? Can you think of others that we ought to include in the legislation? What about relative allocation of resources among them?

Mr. Kapor.

Mr. KAPOR. I think that is a very good set of areas to focus on, but let me just suggest that, in addition, in trying to develop applications—I've been a software developer for 15 years now—we need to pay attention not only to the content of the application—for instance, educational materials—but also the underlying facilities that will be required to make the application work, and in particular if we talk, for instance, about medical data and imaging, the need for facilities that protect privacy and provide security to the information which is traversing the network is very important, and that is not only the case with medical applications but any type of application that involves personal data, and there is technological development in the area of encryption that I think should be an integral part of the applications development effort and would call your attention to the fact that, while there is raw technology available, there are federal policies that interfere with the efficient and widespread use of encryption technology, including export control laws and attempts to require network service providers to dumb down their network security.

So I think in order to achieve the application goals we not only have to focus on education in medical imaging but find a way to address some of these policy issues preventing the development of facilities which will make the application successful.

Mr. BOUCHER. Okay.

Dr. Heterick.

Dr. HETERICK. Well, I think we must have the same barber because we have the same list; I'm not sure.

Mr. BOUCHER. You mean you and I have the same list?

Dr. HETERICK. Yes, sir.

Mr. BOUCHER. Good. That's what I expect of all my constituents, of course. You understand that.

Dr. HETERICK. And I try to behave appropriately, sir. [Laughter.]

I think that is a good list of four strategic areas and certainly support efforts directed in those particular application areas because I think they are far expansive beyond rather limited domains, and each one of them carries with it, I think, an implication for the cost structure of this country, of the various institutions in it, and I think that is a grand set of applications, frankly.

Mr. BOUCHER. Okay. Good.

Dr. Klingenstein.

Dr. KLINGENSTEIN. If HPC is also to stand for "high performance country," then I think we need to, in addition to the list that you have provided, focus on economic development at the state and local level, servicing rural America, and servicing the community as a whole through community networks and freenets, et cetera. There is a tremendous amount of good that can be achieved through those mechanisms.

Mr. BOUCHER. Okay. Thank you for those comments.

Let me say to this panel that we will keep the record of this hearing open—I'll pick a date—for a month, and during that time, if you could develop additional recommendations responding to this specific set of questions, most particularly the last set of questions concerning administrative structure, the kinds of applications that we are consideration for the next iteration of this Act, the priority among them, the allocation of resources for each of those, I think that would be very helpful to the Subcommittee, and we would welcome that.

Mr. Tauke, we will look forward to getting from you suggestions with regard to definitional clarity and hope that you can provide that rather shortly.

I want to thank this panel for its testimony this morning. You have helped us considerably as we conduct this inquiry, and I'm sure we will be talking with all of you again.

And, with that, this panel is excused, and we will turn now to the second panel of witnesses this morning and would ask that they come to the table at this time: Mr. Kenneth Kay, the Executive Director of the Computer System Policy Project; Ms. Sara Parker, the Commissioner of Libraries for the State of Pennsylvania, representing today the American Library Association; Mr. Michael McDonald, Chairman of Communications and Computer Applications in Public Health, and President of Windom Health in Berkeley, California; Dr. Charlie Bender, Chairman of the Coalition of Academic Supercomputer Centers, and Director of the Ohio Supercomputing Center, from Columbus, Ohio.

Without objection, your prepared written statements will be made a part of the record, and the Subcommittee would welcome your oral summaries, and, again, we would ask that your oral summaries be kept to approximately five minutes so that we will have time to engage in a discussion with you about the matters that you address.

Mr. Kay, we will be pleased to begin with you this morning.

STATEMENTS OF KENNETH R. KAY, EXECUTIVE DIRECTOR, COMPUTER SYSTEMS POLICY PROJECT, WASHINGTON, DC; MICHAEL McDONALD, CHAIRMAN OF COMMUNICATIONS AND COMPUTER APPLICATIONS IN PUBLIC HEALTH, AND PRESIDENT, WINDOM HEALTH ENTERPRISES, BERKELEY, CA; SARA A. PARKER, COMMISSIONER OF LIBRARIES OF PENNSYLVANIA, AND REPRESENTING THE AMERICAN LIBRARY ASSOCIATION, HARRISBURG, PA; AND DR. CHARLIE BENDER, CHAIRMAN, COALITION OF ACADEMIC SUPERCOMPUTER CENTERS, AND DIRECTOR, OHIO SUPERCOMPUTING CENTER, COLUMBUS, OH

Mr. KAY. Mr. Chairman, thank you very much.

My name is Ken Kay. I'm the Executive Director of the Computer Systems Policy Project, which is a policy group made up of the 13 CEO's of the largest American computer manufacturers. We are delighted to be asked to testify this year. I want to commend you for holding these hearings.

The CSPP recently issued a report on the National Information Infrastructure which was released earlier this morning, and I'd like to ask that the report be made a part of the record.

Mr. BOUCHER. Without objection.

[The report follows:]

Computer Systems Policy Project

John Sculley Apple

Robert E. Allen AT&T

Perspectives on the National Information Infrastructure:

Eckhard Pfeiffer Compaq

CSPP's Vision and Recommendations for Action

James E. Ousley Control Data

John A. Rollwagen Cray Research

Ronald L. Skates Data General

Robert B. Palmer Digital Equipment

Lewis E. Platt Hewlett-Packard

John F. Akers IBM

Edward R. McCracken Silicon Graphics

Scott G. McNealy Sun Microsystems

James G. Treybig Tandem

James A. Unruh Unisys

What is CSPP?

The Computer Systems Policy Project (CSPP) is an affiliation of chief executive officers of American computer companies that develop, build, and market information processing systems and software. CSPP's members include the chief executives of Apple, AT&T, Compaq, Control Data Systems, Cray Research, Data General, Digital Equipment, Hewlett-Packard, IBM, Silicon Graphics, Sun Microsystems, Tandem, and Unisys.

Upon forming CSPP in 1989, the CEOs made a commitment to work together to develop and personally advocate public policy positions on trade and technology issues that affect their industry, all high-technology industries, and hence, the nation. That commitment continues today.

To date, CSPP has issued the following reports which outline the CEOs' positions on a variety of issues.

- *Perspectives on Market Access and Antidumping Law Reform*, May 1990.
- *Success Factors in Critical Technologies*, July 1990.
- *Perspectives on U.S. Technology Policy, Part I: The Federal R&D Investment*, February 1991.
- *Perspectives on U.S. Technology Policy, Part II: Increasing Industry Involvement*, February 1991.
- *Expanding the Vision of High Performance Computing and Communications: Linking America for the Future* (Report and 7-Minute Video), December 1991.
- *Perspectives on U.S. Technology and Trade Policy: The CSPP Agenda for the 103rd Congress*, October 1992.

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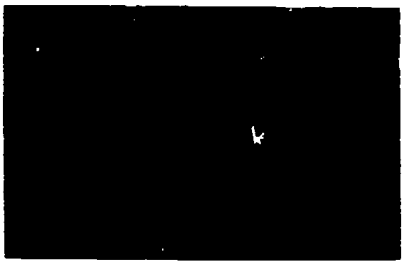
Perspectives on the National Information Infrastructure:

CSPP's Vision and Recommendations for Action



The Computer Systems Policy Project
January 12, 1993

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Executive Summary

As the 21st century approaches, our nation's challenge is to find ways to rekindle economic growth, remain competitive abroad, and create the kinds of jobs that will enable Americans to raise their standard of living. This will require that we be more productive and innovative than our competition abroad, and that we act more quickly and more efficiently.

Across a range of industries, Americans are increasingly turning to information technology to do just that. Our ability to generate and exchange information, technology, and ideas is helping us to increase output, decrease costs, improve quality, and bring new products to market. The United States has a unique opportunity to capitalize on this increasing reliance on information technology and the benefits it can bring.

We are currently the world leader in computing and communications technologies, yet we have not taken steps that will allow us to make the most of our potential. This report calls for concerted efforts by the U.S. public and private sectors to develop and deploy an advanced information infrastructure that will put our information technology advantage to work for all Americans.

Throughout history, the United States has been successful, in part, because we have taken bold steps to make our national resources available to individual Americans by creating a variety of underlying foundations or infrastructures. Our transportation, telephone, electric power, and water systems are all solid examples of this tradition. By developing the infrastructures to make these resources readily accessible to individual Americans and easy to use, we have experienced an economic prosperity, quality of life, and global competitiveness virtually unmatched by any nation. We need to build on this tradition to carry us into the 21st century.

A national information infrastructure, which will be as accessible and easy to use as our existing national infrastructures, will revolutionize our ability to communicate and collaborate by erasing geographical boundaries. It will enable us to tap into our existing resources of creativity and knowledge. It will lead to the development of products and services today unimagined. It will create new jobs and economic strength for individual Americans. It will accelerate the development of critical technologies. And finally, it will enable us to address more effectively many societal problems, including challenges in the areas of health care, education, and manufacturing.

The call for a national information infrastructure builds upon the High Performance Computing and Communications (HPCC) Program. The HPCC Program is an excellent first step. It provides an initial research foundation to create a more extensive information infrastructure that will be broadly accessible to the public and capable of meeting a wide variety of information needs. Nevertheless, it alone is not enough. CSPP believes the United States must make a national commitment to create a new national information infrastructure that complements, builds upon, and delivers the advantages of the research being performed in the HPCC Program, enabling the private sector to create new services that will benefit individuals in all walks of life. This will require improving upon and linking together current communications, computing, information, and human resource capabilities. More importantly, it will require developing new capabilities to enable broad access to a variety of public and private information resources. Finally, it will require the integration of a range of computing and communications technologies to enable transmission of text, images, audio, and video to anyone, anywhere, at any time.

CSPP believes the first step is to develop a consensus vision — across industries and with the government — of what the information infrastructure should be. It will also require building a widespread understanding of the benefits this infrastructure could bring to individual Americans. On the following pages, CSPP presents its vision of the national information infrastructure (NII). In addition, CSPP recommends the following actions be taken by the new Administration, Congress, and U.S. industry:

Summary of Recommendations

Administration Agenda

1. Make the NII a National Technology Challenge
2. Establish a National Information Infrastructure Council
3. Establish an NII Implementation Entity
4. Invest in Research for an NII
5. Fund Pilot Projects to Demonstrate Technologies
6. Develop a Public Education Program
7. Make Government Information Easily Accessible

Legislative Agenda

1. Authorize a National Information Infrastructure Council and Appropriate Funds for its Operation
2. Authorize and Appropriate Funds for Research and Technology Demonstrations

Industry Agenda

1. Continue Investments to Develop and Deploy an NII
2. Continue to Invest in Research and Development of Applications
3. Reach Out to Other Industries
4. Promote NII Efforts
5. Develop and Participate in Pilot Projects
6. Develop NII Goals and Milestones

Finally, CSPP believes the public policy principles outlined at the end of this report must be addressed jointly by the private sector and government before the information infrastructure of the future can become a reality.

Background

In December 1990, the CEOs of CSPP met with Administration officials to discuss their public policy positions on technology issues. At that meeting, CSPP was asked to assess the High Performance Computing and Communications (HPCC) Program and provide recommendations to increase industry's involvement and interest.

On December 3, 1991, after almost a year of review and analysis, CSPP issued its report and video, "*Expanding the Vision of High Performance Computing and Communications: Linking America for the Future*," concluding that the HPCC Program is a significant and critical undertaking. It would, CSPP determined, advance research in high performance computing and networking technologies as well as increase the use of high performance computers to solve important science and engineering problems. At the same time, CSPP observed that the HPCC Program could provide a foundation for something more. If properly designed, HPCC research could advance the development of technologies to help solve a wide range of social and economic problems and improve the competitiveness of U.S. industry by providing the foundation for a national communications and information infrastructure.

CSPP continues to support the HPCC Program and believes it should remain a national research priority. CSPP applauds the recent creation of a new, improved management structure for the Program, which will provide a clear mechanism to coordinate, manage, and govern the implementation of the Program and a central point for private sector interaction. In addition, CSPP commends Senator Al Gore and Representative George Brown for introducing the Information Infrastructure Technology Act in the summer of 1992 to move the HPCC effort to a new level.

The research and technology advancements supported by the HPCC Program remain a high priority for CSPP. In October 1992, in the *CSPP Agenda for the 103rd Congress*, we recommended enhancing and expanding the HPCC research agenda to: 1) provide the foundation for an information and communications infrastructure of the future; 2) bring the benefits of HPCC technology to individual Americans in areas such as health care, education, and manufacturing; and 3) develop technology demonstration projects.

In addition to supporting the HPCC Program, CSPP believes the nation must focus on creating the information infrastructure for the future. Together, the HPCC Program and the NII will provide the means to address the difficult challenges the nation now faces. HPCC research advancements will pave the way for the applications a national information infrastructure will make possible, and the infrastructure will provide a vehicle to deliver the benefits of HPCC research. The following report describes our vision for the infrastructure and recommendations for action that will help to make the vision a reality.

Part I: CSPP's Vision

Introduction

Information in the 21st Century

In the future, the United States' primary resource for generating economic prosperity, improved quality of life, and global competitiveness will be our ability to quickly and efficiently generate and exchange information, technology, and ideas.

Increasingly, across a range of industries from banking and retail to automotive and aerospace, information technology has become instrumental in product development, manufacturing, marketing, sales, and service. The flow of information has become the foundation for improving productivity and increasing innovation in most every business enterprise. U.S. industry is not, however, the only beneficiary. Information technology continues to become an increasingly integral part of the every day lives of individual Americans.

The information infrastructure of the future will revolutionize the way individuals relate with one another by enabling us to work together, collaborate, and access and generate information without regard to geographical boundaries.

Automated tellers, airline reservation systems, anti-lock brakes, and personal computers are just a few examples.

As we face the 21st century, we have an advantage over our foreign competitors. We currently lead the world in computing and communications technologies. But to make the most of the increasing reliance on information technology and our current strengths, we, as a nation, need to take the bold step of developing and deploying an advanced information infrastructure that will help us remain more productive and more innovative than our competitors abroad.

The National Information Infrastructure

What Is It?

The infrastructure of the future is a nationwide system that will allow all Americans to take advantage of our rich resources in information, communication, and computing technologies. It will link together a range of institutions and resources, from schools and businesses to libraries and laboratories. More importantly, it will link together individuals, from senior citizens and students, to health care professionals, manufacturing managers, and business people from all fields.

The information infrastructure of the future will revolutionize the way individuals relate with one another by enabling us to work together, collaborate, and access and generate information without regard to geographical boundaries. It will enable fundamental changes in the way we educate our children, train and retrain our workers, earn a living, manufacture products, deliver services of all kinds, and interact with family and friends.

Throughout its history, the United States has followed a tradition of creating underlying national foundations — infrastructures — that have fostered a quality of life in America unmatched by any nation. Our transportation, electric power, and water systems are all solid examples of this tradition. As we move into the 21st century, these existing infrastructures will continue to be important, but they, alone, will no longer be sufficient to meet our national needs.

Today, we think nothing about turning on a faucet and immediately getting hot water for a shower, flipping a switch and getting electricity to

make coffee, and another switch to get a weather report. We pick up the telephone without a second thought. We must create an advanced information infrastructure for the future that will provide Americans with the same easy access to all sorts of information and people.

The information infrastructure, used in conjunction with a collection of "information appliances" — tools that will combine computing, communications, and video technologies, for example — will give people in rural areas ready access to libraries, museum exhibits, job information, and medical care now only available to those who live near those resources. People all over the country will be able to work and interact with others, without even knowing their collaborators' locations. By making information resources readily available and easy to use, the information infrastructure of the future will revolutionize our ability to access the information we need and our ability to collaborate and cooperate with others.

This infrastructure will integrate four essential elements — communications networks, computers, information, and people — to create a whole new way of learning, working, and interacting with others. A more detailed description of the elements of the infrastructure includes the following:

Communications Networks

- a network of interconnected and interoperable public and private communications networks ("public" networks refer to those networks, such as the public switched telephone network, that are open to use by anyone; "private" networks refer to those that are limited to use by a specific group of people meeting certain criteria, such as corporate networks), providing services ranging from high to low speed, allowing a range of uses anytime, anywhere;
- agreed-upon technical standards for piecing together the network, having all its pieces work together, and plugging into it;
- the capacity to transmit information, at both high and low speeds, in a variety of data formats, including image, voice, and video; and
- multiple mechanisms, perhaps including digital signatures, to support the electronic transfer of funds in exchange for services received.

Computers

- high-performance computers resident on the communications networks to provide intelligent switching and enhanced network services;
- powerful personal computers and work stations — including machines that respond to handwritten or spoken commands and portable, wireless devices — that are easy to use and mask the complexity of the underlying system so people can tap into it as easily as they dial a phone; and
- distributed computer applications that are widely accessible over the network (which acts like a lending library) and that help people perform a wide variety of tasks quickly and easily.

Information

- public and private databases and digital libraries that include material in video, image, and audio formats; and
- information services and network directories that assist users in locating, synthesizing, and updating information.

People

- people of all ages and backgrounds who are easily able to use the rich and varied resources available through the infrastructure to improve how they learn, live, and work; and
- people who create, package, communicate, and sell information in the many new ways made possible by the existence of the information infrastructure.

Why Is It Important?

The investments the nation has made over the years to develop our existing transportation, communications, and energy distribution infrastructures were instrumental in making the United States an economic and political world leader. They were also instrumental in improving the quality of life for individual Americans. To remain an economic power in the 21st century, the United States must have in place an infrastructure that allows us to compete in the Information Age by providing a tool to be continually more productive and innovative.

An information infrastructure will enable the U.S. to tap into the vast resources of knowledge and creativity that already exist in this country. As the volume and complexity of our information resources has increased, it has become almost impossible for any individual or business to take full advantage of what is available. An information infrastructure will make the benefits of information technology as available to individual Americans as the transportation infrastructure made available the benefits of automotive technology and the communications infrastructure made available the benefits of telephone technology. It will create new opportunities for the development of products and services we cannot even begin to imagine today, creating new jobs and economic strength for Americans and providing a resource for our current workers to continuously improve and upgrade their job skills.

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In addition, an information infrastructure will accelerate the development of critical U.S. technologies. A strong consensus exists as to what technologies bolster the competitiveness of our economy and where we stand in those technologies relative to the rest of the world. Initiatives to develop, deploy, and use an information infrastructure will create a market demand for many of these technologies, spurring an increase in private sector investment. Moreover, these technologies would be put to work in the real world, a testing ground more powerful than the laboratory and with the potential to directly benefit individual Americans by generating advancements in commercially relevant technologies and creating an infrastructure they can use.

Finally, the information infrastructure will lead to the development of a range of new "information appliances" that will allow Americans to tap into the resources of the infrastructure in ways beyond our understanding today. Some of these tools for the infrastructure could include interactive learning devices, wireless computers capable of simulating design and engineering plans on-site, and pocket size devices allowing doctors access to medical resources from remote locations. The only thing that will limit the shape, form, and use of these appliances is our imagination.

Why Should The United States Act Now?

Today, many of the changes taking place in our economy and influencing our competitive position are driven by the advent of the information age and the new set of economic ground rules this has created. In the information age, the value of the products and services we exchange is increasingly a function of their information content and the knowledge used to create them rather than the raw materials used to produce them. Because of this shift, the ability to easily access and share information and stimulate the creation of new ideas is essential to maintaining a strong economy, developing world class industries, and enhancing the quality of life for every citizen. America now has the opportunity to create the information infrastructure required to achieve this.

A coordinated, focused drive for a national information infrastructure will enable us to more effectively and efficiently devote our collective talents to developing the competitive edge against other nations.

Other nations, including Japan, Germany, France, and Singapore are taking significant steps to upgrade their own infrastructures and have long-term plans in place to continue doing so. With U.S. industry and government working together as partners, we can build on our already strong lead in information technology to maintain our current lead, help us compete abroad, and improve our quality of life at home.

A coordinated, focused drive for a national information infrastructure will enable us to more effectively and efficiently devote our collective talents to developing the competitive edge against other nations. Working together toward a common goal, America will realize the benefits of an information infrastructure sooner — we will establish the standards the world will need to follow and we will be the first to market with important new products, services, and applications for the infrastructure. More importantly, we will be able to dramatically change the way Americans learn, care for the sick and elderly, and manufacture products.

The following descriptions provide a glimpse of the important benefits an information infrastructure could make possible.

The Potential Benefits

Health Care

Americans spend more on health care than on any other industry, but they are getting less in return for their expenditures than is possible. For many people, health care is too expensive and often unavailable. CSPP believes that computing and communications technologies can provide solutions to both of these shortcomings.

Health care is a large, high growth, recession resistant industry, with spending rising about 2 1/2 times faster than GNP. In 1991, health care spending totalled $738 billion, or 13% of GNP, up from 7.3% of GNP in 1970. The Health Care Financing Administration projects that the nation's health outlays will reach $1.6 trillion by the year 2000. The soaring cost of health care has triggered concern about the ability of the nation to continue providing quality health and medical care as well as the ability of individual Americans to afford it.

Health care is extremely information intensive. Each year, Americans make approximately 636 million visits to doctors' offices for ambulatory care. In addition, 23 million surgical procedures are performed annually. Each visit and procedure generates large amounts of medical and financial data. There is presently no means to preserve or track that information for use in future or related health care situations. In fact, the cost of managing health care information is one of the prime causes of the increasing cost of health care.

Improving the management of this information through a health care information infrastructure will enable efficiency gains and cost savings throughout the entire health care process. First, roughly 20% of annual health care expenditures go to administrative costs, including processing an estimated five million health care claims per day. Computing and communications technologies offer new opportunities to improve the manage-

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ment of and access to health care-related information and to reduce costs for processing insurance claims through electronic payment and reimbursement. Second, better access to medical data and patient medical histories will help improve doctors' diagnoses by providing fast and easy access to accurate, complete, and up-to-date information. Third, high speed networks will enable residents of rural areas and inner cities to enjoy the benefits of the latest medical technologies and expert opinions without leaving their home towns. Finally, easy access to information by individuals in their homes on self-care and healthy lifestyle practices will enable people to better manage their own health, reducing the number of visits to doctors' offices and hospitals, and increasing the likelihood that medical problems will be identified earlier.

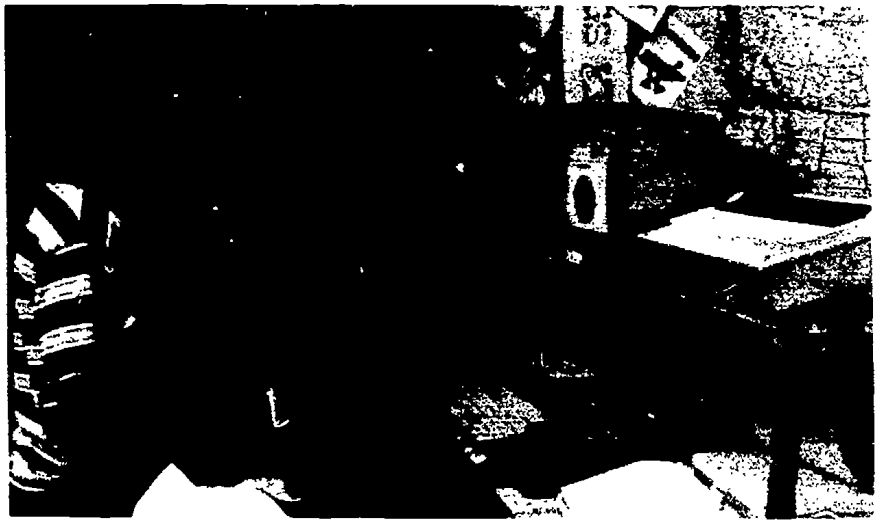
The challenge is to create a medical information infrastructure that will support the following types of applications that could help, in the near and longer term, to solve the health care problems the nation is experiencing:

■ **On-Line Patient Records** — Hospitals, doctors' offices, and community clinics will be interconnected through high speed networks. Patient records, including medical and biological data, would be available to authorized health care professionals anytime, anywhere (with privacy assured) over these networks. This would enable health care providers to access immediately, from any location, the most up-to-date patient data, including medical images from tests, resulting in improved diagnoses and more informed treatment decisions.

■ **Medical Collaboration** — Medical personnel will use interactive, multimedia telemedicine technologies to collaborate and consult with each other over distances. Doctors in hospitals or offices will consult on short notice with experts located anywhere in the nation; emergency room physicians will provide vital assistance to emergency medical personnel on the scene via wireless technologies. Patients and their doctors would have instant access — at affordable cost — to experts and specialists, no matter where the patient is located.

■ **Surgical Planning and Treatment** — Physicians and surgeons will use high speed computing technologies to simulate the function of human organs to facilitate medical diagnoses and treatment decisions, and to plan complex surgical procedures. Imaging and modeling techniques will be used to produce realistic and detailed 3D models of a patient's organ, to develop the most effective and safe surgical procedures, to demonstrate planned procedures to patients and medical students, and to develop alternate non-invasive treatments. With high speed networks, images could be transmitted instantly to experts located elsewhere for confirmation of diagnoses and treatment recommendations.

Education



To ensure a secure and prosperous future, Americans need to be able to think critically and to have access to the widest possible body of knowledge. The work force requirements of the future will increasingly require people to be able to learn new skills to adapt to changing job requirements and new technologies and to use knowledge and information to make decisions. Changes must be made to the United States' education system to ensure that it will give individuals the skills they will need for lifelong learning in a high wage, information-based economy of the future.

Meeting these challenges will require extending America's edge in computing and communications technologies to education services in schools, communities, work places, and homes. An information infrastructure for lifelong learning will offer unprecedented potential for improving lives by making knowledge readily available and usable by all Americans. Such an infrastructure would provide a tool for addressing many of the learning needs the country is facing, including, for example, making additional resources available on-line for teachers who want to improve their skills and update their knowledge; providing a means for Americans to continually acquire the new knowledge to adapt to the multiple careers many will likely undertake; providing seniors and disabled or homebound Americans direct access to information resources critical to their health and welfare; and providing better access to information that affects our quality of life and cultural awareness.

Effective deployment of a computing and communications infrastructure for education and lifelong learning requires well trained and technologically experienced teachers and administrators

An information infrastructure for lifelong learning will offer unprecedented potential for improving lives by making knowledge readily available and usable by all Americans.

who can facilitate the use, installation, and management of new instructional technologies such as digital interactive video, local area networks, and gateways to national networks. Users and students will need new skills to help them retrieve, review, categorize, and analyze the information and knowledge they will be able to access. This will require investment in training for educators and students in the use of new technologies, development of model curricula and new instructional techniques, development of new information resources, improvement in the quality of existing resources, and extension of public access to electronic schools and libraries.

A national information infrastructure will create an enormous range of education and lifelong learning applications, such as:

■ **On-line Job Training Libraries** — Interactive, multimedia, digital libraries will be available on job sites to provide workers with task-oriented information that they could use, at their own convenience and pace, to improve and upgrade their job skills and performance. Workers in any job — assembly lines, retail outlets, sales, or offices — would be able to continuously upgrade their skills and learn new skills at any time through customized training libraries.

■ **Electronic Libraries** — Students will use on-line electronic libraries in classrooms and at home to learn more about any topic. For example, if a student wanted to learn about the works of Shakespeare — or about a specific play — he or she will simply turn on a computer and, with the flick of a switch, be connected to the entire works of Shakespeare, complete with photographs, videos, and recordings. The electronic libraries will include software tools to help students find the information they need, identify relevant data, analyze, and present the information and will provide access to information and reference specialists to help users locate the material they need.

■ **Virtual Laboratories & Field Trips** — Through virtual laboratories, students will perform science experiments using equipment and facilities located anywhere in the United States, including at the national laboratories, in collaboration with some of the nation's best laboratory scientists. Students will also take "field trips" to museums, observatories, science exhibits, and research centers without leaving the classroom.

■ **Collaborative Learning** — Students of all levels and ages, teachers, and experts will collaborate, in real time, via high speed networks, on a wide variety of learning projects. The collaborators will access information and high performance computing resources located throughout the country, such as images collected by NASA's Earth Observing System satellites, and would work together to develop research projects that focus on their own interests.

Intelligent Manufacturing

The U.S. manufacturing enterprise faces enormous challenges over the next decade just to keep up with new information and new technologies. The industrial world is rapidly moving to "electronic commerce," in which suppliers and design collaborators will be on-line; factories will be highly programmable and staffed with highly skilled personnel; product design and manufacturing will be fully integrated; and custom-made, high-quality products will be manufactured rapidly in small quantities. Failure to keep pace and maintain technological leadership will threaten our long-term competitive position in the world market.

Increasingly, to stay competitive, companies of all sizes must be able to respond rapidly to customer demands for high-quality products at low cost. This requires manufacturing and design processes that are highly efficient and flexible to enable the shortest possible design, development, and production times. Companies able to adapt and apply the latest information and communications technologies to their manufacturing processes will have an advantage over their less innovative competitors in the future. The challenge, therefore, is to develop, deploy and apply the technologies for a manufacturing infrastructure that incorporates computing and communications technologies to support integrated development, engineering, and manufacturing processes.

It is critical to ensure that small and medium manufacturers are stakeholders in this new infrastructure. Small and medium manufacturers are vital to the nation's economic development and growth, accounting for 40 percent of GNP, half of all employment, and more than half of job creation. Providing small and medium companies with access to computing, communications, and

information resources will enable them to adopt new technologies and manufacturing techniques, reducing the cost of doing business and increasing efficiency and productivity.

Work is already underway in the private and public sectors to expand the use of advanced computing and communications technologies in the manufacturing process, but much more is needed. HPCC Program research in aerospace vehicle design and advanced materials are just a few examples of the application of high performance computing to benefit our industries. Computer-aided design (CAD) and computer-aided manufacturing (CAM) technologies are being incorporated into U.S. manufacturing enterprises at increasing rates. However, CAD/CAM technologies, which are further advanced than many other intelligent manufacturing innovations, still need improvement before they can be widely implemented and must be integrated into both the design and manufacturing processes to fully realize their benefits.

A national information infrastructure has the potential to significantly increase the productivity and quality of U.S. manufacturing by enabling applications such as:

■ **Concurrent and Distributed Design, Engineering, and Manufacturing.**— Manufacturers of products, from automobiles to airplanes, and from machine tools to televisions, will distribute scheduling and production across geographically dispersed facilities to reduce production delays, minimize manufacturing, transportation, and inventory costs, perform design, engineering, and manufacturing concurrently, and leverage unique skills and availability of skilled resources. Large amounts of information, such as engineering modeling data, product specifications, test specifications, and bills of materials, will be distributed and shared among dispersed facilities in real time. All of these techniques will significantly reduce the time to develop new products and bring them to market.

Companies able to adapt and apply the latest information and communications technologies to their manufacturing processes will have an advantage over their less innovative competitors in the future.

■ **Electronic Commerce for Manufacturing Enterprises** — Companies of all sizes will increase their efficiency and productivity while reducing costs by incorporating electronic commerce into their operations. Through links with suppliers, customers and local, state and federal governments, companies will be able to conduct virtually all of their essential business opportunities electronically, including: locating the best suppliers to meet their needs, identifying potential customers for their products, placing and receiving orders, exchanging payments, and ascertaining the latest government regulations affecting their businesses and submitting required compliance reports electronically.

■ **Virtual Design and Manufacturing Project** — Manufacturers of complex, expensive products will use virtual design facilities to model, simulate, and visualize product designs and manufacturing processes in advance, saving the costs of building prototypes. Eventually, virtual reality technologies will permit product designers to "walk through" new products before actually building the products and through manufacturing facilities before production begins.

Part II: Recommendations for Action

By investing in the HPCC Program, the United States has already begun investing in the research for an infrastructure based on high speed networks, high performance computers, and on-line information. CSPP will continue to work with Congress and the new Administration to implement our recommendations to improve the structure of the HPCC Program. However, we must now make a national commitment to take the next step to develop a new national information infrastructure that will provide us with the best opportunity to compete in the global economy of the future.

Through a public and private partnership to develop and deploy a national information infrastructure, we will not only lay the best foundation for remaining internationally competitive, we will also give ourselves the best chance to solve many of our domestic challenges — the declining quality of education, the skyrocketing cost and limited availability of high-quality health care, and the need for businesses of all sizes to increase quality and productivity — which increasingly require the ability to access and use large amounts of distributed information.

We must now make a national commitment to take the next step to develop a new national information infrastructure that will provide us with the best opportunity to compete in the global economy of the future.

The time to act is now. Creating a national information infrastructure of the future will require improving upon and linking together current communications, computing, information, and human resource capabilities. More importantly, it will require developing new capabilities to enable broad access by millions of Americans to public and private information resources and to enable people to generate, transmit and receive text, images, and video anywhere, at any time.

Before the comprehensive information infrastructure of the future can be realized, a broad cross-section of American industries, academic and research institutions, and the federal government need to agree on a common vision for the effort. With a common vision in place, the private and public sectors can make a commitment to do what they need to do, independently or together, to make the vision a reality. While the private sector has primary responsibility for developing and making available the services, products, networks, and applications to make the infrastructure possible, the federal government has an important role as a catalyst in stimulating the effort and creating a regulatory environment that will encourage private sector investment and implementation.

To accelerate the development and deployment of a national information infrastructure, CSPP recommends that the Administration, Congress, and the private sector begin a joint effort to take the following actions:

Administration Agenda

1. Make the NII a National Technology Challenge: The President should declare the national information infrastructure a new national technology challenge. The President should, in his State of the Union address and his FY94 budget submission, issue a challenge to Congress, industry, academic, and research institutions, and potential users to work with him to create a new information infrastructure.

2. Establish a National Information Infrastructure Council: The successful development and deployment of a national information infrastructure will be contingent upon the government adopting a vision and a strategy for its implementation. The best way to accomplish these objectives is to establish a National Information Infrastructure Council, chaired by the Vice President, to provide a management focus for the effort. Members of the Council should include the Secretary of Commerce, the Director of the Office of

Science and Technology Policy, the Chairman of the Federal Communications Commission, and the heads of other federal departments, agencies, and White House Executive Offices who have roles or responsibilities in the information infrastructure, and private sector experts, including representatives of industry, user groups, and research institutions. The Council should have as its initial responsibilities:

- adopting a vision for an NII;
- working with the private sector to develop and adopt several concrete goals for the NII, with accomplishable milestones;
- coordinating the NII activities of the various government agencies and departments; and
- developing a strategy to address the information infrastructure policy principles listed following these recommendations.

3. **Establish an NII Implementation Entity:** Establish a federal entity to implement the National Information Infrastructure Council's vision, plans, strategies, recommendations, and other directions. The entity should have the responsibility and the authority to:

- manage and focus the NII research agenda, including research performed by the national labs;
- coordinate, in conjunction with other appropriate agencies and departments, the NII technology demonstrations; and
- develop strategies to overcome policy and regulatory barriers affecting the deployment by the private sector of a national communications network of interoperable, interworking networks.

4. **Invest in Research for an NII:** The FY94 budget request should include funds for precompetitive, generic research on enabling technologies for an NII, such as the following:

- research on the generic, enabling technologies needed to address challenges in health care, education and lifelong learning, and intelligent manufacturing;
- research on the scalability problems associated with aggregating many high, medium, and low speed users;
- technologies and architectures to ensure the security of information available in an NII and to guarantee privacy of information;
- interoperability;
- integrity and robustness of networks and databases;
- human/computer interfaces, such as speech and handwriting recognition and machine intelligence; and
- research on creating and managing distributed electronic databases and libraries, such as indexing databases, digitizing libraries, and organizing material.

5. **Fund Pilot Projects to Demonstrate Technologies:** In conjunction with industry, the federal government should fund pilot projects to demonstrate the application of high performance computing and communications technologies to health care, education and lifelong learning, and manufacturing. Such projects will help solve problems in scaling technologies and accelerate development of standards.

6. **Develop a Public Education Program:** Request the National Research Council of the National Academies of Science and Engineering to develop, in conjunction with the private sector, a program to educate the general public about the potential benefits of an NII and the impact it will have on their lives.

7. **Make Government Information Easily Accessible:** An information infrastructure could provide federal, state, and local governments with a system to better serve their citizens while reducing the cost of providing those services. Through a national information infrastructure, people would have ready access to the most up to date information about their entitlement to health, education, housing, and social security benefits. Citizens could, for example, use the infrastructure to register to vote, renew their drivers licenses, and pay their taxes. The National Research Council should assess federal information collection and dissemination policies and practices and make recommendations on how such policies and practices should be changed to make public information easily available and accessible to citizens through the NII. The NII implementation agency should be charged with developing a strategy to implement the recommendations across all affected departments and agencies

Legislative Agenda

1. **Authorize a National Information Infrastructure Council and Appropriate Funds for its Operation:** Introduce legislation to authorize creation of a National Information Infrastructure Council to oversee development of the NII and appropriate funds for its operation.

2. **Authorize and Appropriate Funds for Research and Technology Demonstrations:** Introduce legislation, based on the Information Infrastructure and Technology Act of 1992, to authorize research on NII technologies and demonstration projects in health care, education, and manufacturing, and appropriate funds for such projects.

Industry Agenda

1. **Continue Investments to Develop and Deploy an NII:** The U.S. computer industry is investing billions of dollars each year in research and development relevant to an NII. Industry must continue to work to develop and deploy the NII, including:

- deployment of interoperable communications networks;
- development of on-line databases and applications;
- development of easy to use computers and information appliances; and
- training people to design, develop, and use the various elements of the infrastructure.

2. **Continue to Invest in Research and Development of Applications:** Companies must continue independent and collaborative efforts to invest in research on NII technologies and development of new products and services.

3. **Reach Out to Other Industries:** CSPP will initiate a project to encourage other industries likely to benefit from the applications made possible through an NII to join the effort to achieve an NII.

4. **Promote NII Efforts:** A wide range of affected industries should form a non-profit group to work with the National Research Council to promote the NII.

5. **Develop and Participate in Pilot Projects:** Industry should undertake an effort to develop strategic plans and facilitate the formation of teams to design technology demonstration projects in health care, education and lifelong learning, and manufacturing.

6. **Develop NII Goals and Milestones:** The private sector will work with the Infrastructure Council to develop specific examples of accomplishable goals for an NII, with concrete milestones, such as, for example, a nationwide system of on-line patient records accessible by any authorized health care professional, anywhere; and all small and medium manufacturing companies networked with the manufacturing extension centers.

Policy Principles for a National Information Infrastructure

The public and private sectors have important roles in making the information infrastructure a reality. While the development and deployment of the infrastructure must be led by the private sector, guided by the forces of a free and open market, the federal government can accelerate its implementation by acting as a catalyst and a coordinator.

CSPP has identified the following important public policy principles that will have to be addressed jointly by the public and private sectors before the information infrastructure can become a reality. CSPP looks forward to working with the new Administration, new Congress, and other industry groups to address these issues.

1. **Access** -- Because an informed citizenry is essential to the nation's growth, all individuals must have access to the NII.

2. **First Amendment** -- To ensure freedom of expression in an NII, First Amendment principles guaranteeing freedom of speech, as articulated by U.S. courts, should apply to electronically-transmitted communications.

3. **Privacy** -- Consumers of NII services have a right to privacy in their use of the NII.

4. **Security** -- Information available through the NII must be protected against unauthorized access, tampering, and misuse, consistent with the needs of the applications and the desires of the user.

5. **Confidentiality** -- NII users must be free to use effective, industry-developed encryption to ensure confidentiality of communications and data.

6. **Affordability** -- To promote maximum use, the NII must be affordable.

7. **Intellectual Property** -- The fundamental principles of copyright should apply to electronically-available information in the same manner as for other media.

8. **New Technologies** -- While it is impossible to anticipate all of the technologies that will eventually be part of the NII, the political and regulatory environment must encourage the development of new technologies and their incorporation in the NII.

9. **Interoperability** -- The NII must support maximum interoperability among networks in this country and internationally.

10. **Competition** -- Service providers must have fair and open access to the NII in order to assure competition among such providers.

11. **Carrier Liability** -- Information services carriers and distributors who have no editorial control over the contents of electronic information should not be liable for the content of the information transmitted over the NII.

Mr. KAY. As we perceive, looking at the continuum from HPCC through NII, I think that we find that the subjects you have put in front of the Subcommittee this morning really lend themselves to being looked at in three phases. Phase one is the HPCC program itself; phase two is the applications phase, which I think is represented by the Information Infrastructure Technology Act; and phase three, we believe, is the NII itself; and what I would like to do is simply address those three phases briefly with the areas where we see need for improvement or additions.

With regard to HPCC, the computer industry CEO's are very strongly supportive of the program. They think it is a very important building block for the effort to reach an NII. We also want to commend both the Congress and the agencies working within the program who have really done a good job of, in many ways, being out ahead of industry in thinking about this issue.

However, I think there are two important areas where improvements need to be made, and I think the Chairman alluded to them earlier. The first is, we have recommendations with regard to HPCC management. The HPCC program is—one of our CEO's described it as eight preexisting government missions with a ribbon tied around them, and I think there is some truth to that.

We have argued for the last 18 months to create stronger management and coordination of the program. We believe those efforts in part led to the HPCC Coordination Office, which is now chaired by Dr. Lindberg of NLM. We, though, believe that that Coordination Office is not enough of a management structure, and as we head toward an NII, that the Congress ought to look seriously at moving from coordination to actual management.

I think the CEO's, as could be expected, feel that the current loose coordination structure is one that they feel will not succeed in an area as complicated as this, and particularly as you worry or begin to worry about the interaction between HPCC and an NII, it is going to be even more important that there be central management, that the Congress be able to see what goals the program has set for itself and whether those are met and have accountability to one person, and we don't think the current structure lends itself to that.

Secondly, we would ask you to look at the area of private sector input. While several people have referred to the FNC Advisory Group, there is no HPCC advisory group to date. One has been called for in the legislation; it has not yet been formed; it needs to be. And we also would mention to you that two of our CEO's whose names had been put forward to serve on the PCAST advisory group on HPCC—and due to a set of regulations coming out of the White House General Counsel's office, they were not permitted to serve on that advisory group—we think it would be important for you to make sure that as you oversee the HPCC advisory commission, that you make sure that people of the best intellect and best ability in the country be in a position to serve on that group.

Moving to the applications phase, we would simply say that we strongly support the Information Infrastructure Technology Act. We think that the right applications have been chosen. We think that ultimately the HPCC program won't receive public support if it is not viewed to be tied to these public beneficial activities.

We would suggest to you that there are two areas that you need to look at with regard to this Act itself. One is an omission, we believe, which is that there isn't a research agenda for the National Information Infrastructure which has been included in this bill. The HPCC program has a research agenda devoted to establishing the NREN and Grand Challenges, but the NII has a separate set of research challenges which we think are very important, and they would include those issues in the research area that go to millions of end users and the problems of scale-ability of architecture, and we don't think the current HPCC program has that research agenda in it, and we think that your new bill ought to include such a research agenda.

Secondly, we again would raise the issue of management and would raise questions as to whether the OSTP is really the appropriate home for the management of a government agency. Coordination makes a lot of sense, and it is set up to do that, but in terms of whether or not it is a programmatic entity and was designed to oversee a program and have program accountability, we would suggest that the Congress may want to look other structural alternatives for the Information Infrastructure and Applications Act as well.

Finally, with regard to the NII itself, we would observe that neither of these two bills—neither the HPCC program nor the proposed Information Infrastructure Act—describes the National Information Infrastructure as a national technology challenge or as a legitimate goal of a federal, corporate, academic, public alliance. We think that that needs to be done, whether it is done in the context of an Information Infrastructure Act or additional legislation.

We think the NII needs to become a very specific national technology challenge, and we believe there needs to be a new entity created to help facilitate a dialogue between the private sector, the public sector, academe, to discuss the vision of a national information infrastructure as well as a whole host of public policy issues that we think get raised by a national information infrastructure.

The Information Infrastructure Technology Act that was introduced in the last Congress does not address this set of issues, and it is for that reason that the CSPP in its report specifically suggested that an information infrastructure council be created that would be a forum that could take both of these activities on—the discussion about what is our joint vision for an NII; the computer industry has modestly put its vision forward, but many other industries need to come forward, many other public groups need to come forward, and share their vision of an NII. There needs to be a forum where the government and industry and other affected communities can discuss this vision and come to some closure on it so we can begin a plan. We think that entity needs to be put in place.

And, secondly, at the end of our report we have suggested about 11 areas of public policy where such a council should begin deliberating, and those are areas some of which were covered on the previous panel, including access, First Amendment, privacy, security, confidentiality, affordability.

But we don't see either the HPCC program or the current Information Infrastructure Act providing the kind of forum where those

issues could be discussed, and I think our CEO's at this point think that it is time for both the Congress, the Administration, and those of us in industry to get behind the National Information Infrastructure as a stated public policy goal that we can all jointly work on, and we look forward to working with you, Mr. Chairman, and your Subcommittee in that effort.

Thank you.

[The prepared statement of Mr. Kay follows:]

STATEMENT OF KENNETH R. KAY
EXECUTIVE DIRECTOR
THE COMPUTER SYSTEMS POLICY PROJECT

BEFORE THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

SUBCOMMITTEE ON SCIENCE

IMPLEMENTATION OF THE HIGH PERFORMANCE COMPUTING AND COMMUNICATIONS PROGRAM

AND THE

PROPOSED INFORMATION INFRASTRUCTURE AND TECHNOLOGY ACT

February 2, 1993

I. INTRODUCTION

My name is Ken Kay. I am an attorney with the law firm of Preston Gates Ellis & Rouvelas Meeds and serve as Executive Director of The Computer Systems Policy Project. CSPP is an affiliation of chief executive officers of American computer companies that develop, build, and market information processing systems and software. CSPP's members include the chief executives of Apple, AT&T, Compaq, Control Data Systems, Cray Research, Data General, Digital Equipment, Hewlett-Packard, IBM, Silicon Graphics, Sun Microsystems, Tandem, and Unisys. The CSPP CEOs work together to develop and advocate public policy positions on trade and technology issues that affect their industry, all high-technology industries, and the nation.

Mr. Chairman, I'd like to commend you and your subcommittee for holding this hearing. The High Performance Computing and Communications (HPCC) Program is important, and bringing attention to its goals and its implementation is both timely and appropriate. I also thank you for moving quickly to include the Information Infrastructure and Technology Act on the agenda of the 103rd Congress. CSPP looks forward to working with you to ensure its enactment.

II. THE HIGH PERFORMANCE COMPUTING AND COMMUNICATIONS PROGRAM

In December 1990, the CEOs of CSPP met with Administration officials to discuss their public policy positions on technology issues. At that meeting, CSPP was asked to assess the High Performance Computing and Communications Program and provide recommendations to increase industry's involvement and interest.

On December 3, 1991, after almost a year of review and analysis, CSPP issued its report and video, *"Expanding the Vision of High Performance Computing and Communications: Linking America for the Future,"* concluding that the HPCC Program is a significant and critical undertaking. The program would, CSPP determined, advance research in high performance computing and networking technologies as well as increase the use of high performance computers to solve important science and engineering problems. At the same time, CSPP observed that the HPCC Program could provide a foundation for something more. If properly designed, HPCC research could advance the development of technologies to help solve a wide range of social and economic problems and improve the competitiveness of U.S. industry by providing the foundation for a national communications and information infrastructure.

CSPP continues to support the HPCC Program and believes it should remain a national research priority. However, we believe that the program's implementation could be more effective if improvements are made in three areas: 1) program management; 2) private sector participation; and 3) expanding the program to include research needed in health care, education, and manufacturing.

1. Improve Program Management

CSPP applauds the establishment last year of a new HPCC Coordination Office and the appointment of Dr. Donald Lindberg, the Director of the National Library of Medicine, as its Director. This new office provides a clear mechanism to coordinate the implementation of the Program and a much-needed central point for private sector interaction. Dr. Lindberg is to be commended for his early leadership in his new role and in his willingness to reach out to interested parties.

However, CSPP is concerned that the new office is chartered to provide coordination, not management, and does not have sufficient resources to adequately provide the kind of oversight that is needed to ensure the program's success. CSPP believes that for the HPCC Program to move forward effectively, additional management authority is required to set program goals, assess progress toward those goals, and to enable close interaction with the Information Infrastructure program. CSPP urges the subcommittee to examine the HPCC Coordination Office's charter, mission, and resources, and assess whether a stronger management role for the office would increase the program's effectiveness.

2. Improve Private Sector Input

CSPP believes that the research and technologies developed through the HPCC Program have the potential to provide the nation with the foundation for an infrastructure that will help improve the quality of life for all Americans in the 21st century and beyond. Investments in HPCC research can best be maximized through regular, ongoing input from the private sector. Currently, advice can be provided informally through the Federal Coordinating Council on Science, Engineering, and Technology and through the individual agencies. The Federal Networking Council Advisory Committee provides a formal means for the private sector to provide input on federal networking activities. However, there currently is no high-level mechanism for private sector input to the HPCC Program. The High Performance Computing Act directs the President to establish an advisory committee on high performance computing that includes representatives of the research, education, and library communities, network providers, and industry, who are specially qualified to provide advice and information on high performance computing. CSPP considers the appointment of such an advisory panel critical to provide the means for private sector input into the program.

3. Expand the Program

In our December 1991 report, CSPP recommended expanding the HPCC Program and budget to include funds to begin research needed to solve problems in health care, education, and manufacturing. CSPP commends then-Senator Al Gore and Representative George Brown for introducing the Information Infrastructure and Technology Act in the summer of 1992. While CSPP strongly supports that legislation, which brings the HPCC effort to a new level, we continue to believe there is a need to expand the HPCC research program to include research relevant to education, health

care and manufacturing. Specifically, CSPP recommends adding the Department o Educat on to the program and expanding the roles of the Department of Health anc Human Services, the Department of Commerce, the National Science Foundation, and the other HPCC agencies, as appropriate to address these new areas.

III. THE INFORMATION INFRASTRUCTURE TECHNOLOGY ACT

CSPP strongly supported the Information Infrastructure and Technology Act when it was introduced last year and has recently recommended that it be reintroduced and passed by the 103rd Congress. By authorizing funds for demonstration projects in health care, education, manufacturing, and libraries, the Act is consistent with CSPP's recommendations for accelerating development and deployment of the National Information Infrastructure. Pilot projects and testbeds are essential to demonstrate the application of NII technologies in new areas and the benefits that they will make possible, such as the cost savings that may be achieved in the management of health care data, to accelerate the development of standards, to address the problems in scaling new technologies, and to bring together researchers from industry, government, academia, and the user communities in the development of solutions to difficult problems.

CSPP supports the Information Infrastructure and Technology Act because it will help address challenges the nation faces in health care, education, and manufacturing. The following are brief descriptions of some of the improvements the nation may be able to achieve through an NII.

A. Health Care

An NII will offer new opportunities to improve the management of and access to health care-related information and to reduce costs for processing insurance claims through electronic payment and reimbursement. Better access to medical data and patient medical histories will help improve doctors' diagnoses by providing fast and easy access to accurate, complete, and up-to-date information. An NII will enable residents of rural areas and inner cities to enjoy the benefits of the latest medical technologies and expert opinions without leaving their home towns. Finally, easy access to information by individuals in their homes on self-care and healthy lifestyle practices will enable people to better manage their own health, reducing the number of visits to doctors' offices and hospitals, and increasing the likelihood that medical problems will be identified earlier. The following types of applications could help, in the near and longer term, to solve the health care problems the nation is experiencing:

- **On-Line Patient Records** -- Hospitals, doctors' offices, and community clinics will be interconnected through high speed networks. Patient records, including medical and biological data, would be available to authorized health care professionals anytime, anywhere (with privacy assured) over these networks. This would enable health care providers to access immediately, from

any location, the most up-to-date patient data, including medical images from tests, resulting in improved diagnoses and more informed treatment decisions.

- **Medical Collaboration** -- Medical personnel will use interactive, multimedia telemedicine technologies to collaborate and consult with each other over distances. Doctors in hospitals or offices will consult on short notice with experts located anywhere in the nation; emergency room physicians will provide vital assistance to emergency medical personnel on the scene via wireless technologies. Patients and their doctors would have instant access -- at affordable cost -- to experts and specialists, no matter where the patient is located.

- **Surgical Planning and Treatment** -- Physicians and surgeons will use high speed computing technologies to simulate the function of human organs to facilitate medical diagnoses and treatment decisions, and to plan complex surgical procedures. Imaging and modeling techniques will be used to produce realistic and detailed 3D models of a patient's organ, to develop the most effective and safe surgical procedures, to demonstrate planned procedures to patients and medical students, and to develop alternate non-invasive treatments. With high speed networks, images could be transmitted instantly to experts located elsewhere for confirmation of diagnoses and treatment recommendations.

B. Education

An NII will be an essential tool for meeting the education challenges of the future. An NII will offer unprecedented potential for improving lives by making knowledge readily available and usable by all Americans. Education and lifelong learning applications such as the following would provide tools for addressing many of the learning needs the country is facing.

- **On-line Job Training Libraries** -- Interactive, multimedia, digital libraries will be available on job sites to provide workers with task-oriented information that they could use, at their own convenience and pace, to improve and upgrade their job skills and performance. Workers in any job -- assembly lines, retail outlets, sales, or offices -- would be able to continuously upgrade their skills and learn new skills at any time through customized training libraries.

- **Electronic Libraries** -- Students will use on-line electronic libraries in classrooms and at home to learn more about any topic. For example, if a student wanted to learn about the works of Shakespeare -- or about a specific play -- he or she will simply turn on a computer and, with the flick of a switch, be connected to the entire works of Shakespeare, complete with photographs, videos, and recordings. The electronic libraries will include software tools to help students find the information they need, identify relevant data, analyze, and present the information and will provide access to information and reference specialists to help users locate the material they need.

- **Virtual Laboratories & Field Trips** -- Through virtual laboratories, students will perform science experiments using equipment and facilities located anywhere in the United States, including at the national laboratories, in collaboration with some of the nation's best laboratory scientists. Students will also take "field trips" to museums, observatories, science exhibits, and research centers without leaving the classroom.

- **Collaborative Learning** -- Students of all levels and ages, teachers, and experts will collaborate, in real time via high speed networks, on a wide variety of learning projects. The collaborators will access information and high performance computing resources located throughout the country, such as images collected by NASA's Earth Observing System satellites, and would work together to develop research projects that focus on their own interests.

C. Intelligent Manufacturing

Increasingly, to stay competitive, companies of all sizes must be able to respond rapidly to customer demands for high-quality products at low cost. This requires manufacturing and design processes that are highly efficient and flexible to enable the shortest possible design, development, and production times. Companies able to adapt and apply the latest information and communications technologies to their manufacturing processes will have an advantage over their less innovative competitors in the future. The challenge, therefore, is to develop, deploy and apply the technologies for a manufacturing infrastructure that incorporates computing and communications technologies to support integrated development, engineering, and manufacturing processes, and to enable applications such as:

- **Concurrent and Distributed Design, Engineering and Manufacturing** -- Manufacturers of products, from automobiles to airplanes, and from machine tools to televisions, will distribute scheduling and production across geographically dispersed facilities to reduce production delays, minimize manufacturing transportation, and inventory costs, perform design, engineering, and manufacturing concurrently, and leverage unique skills and availability of skilled resources. Large amounts of information, such as engineering modeling data, product specifications, test specifications, bills of materials, will be distributed and shared among dispersed facilities in real time.

- **Electronic Commerce for Manufacturing Enterprises** -- Companies of all sizes will increase their efficiency and productivity while reducing costs by incorporating electronic commerce into their operations. Through links with suppliers, customers and local, state and federal governments, companies will be able to conduct virtually all of their essential business opportunities electronically, including: locating the best suppliers to meet their needs, identifying potential customers for their products, placing and receiving orders, exchanging payments, and ascertaining the latest government regulations affecting their businesses and submitting required compliance reports electronically.

- **Virtual Design and Manufacturing Project** – Manufacturers of complex, expensive products will use virtual design facilities to model, simulate, and visualize product designs and manufacturing processes in advance, saving the costs of building prototypes. Eventually, virtual reality technologies will permit product designers to "walk through" new products before actually building the products and through manufacturing facilities before production begins.

While we strongly support the legislation and look forward to working with the subcommittee to get it passed, CSPP recommends making two changes in the bill as it was introduced last year:

1. Include funds for research in precompetitive, generic enabling technologies for an NII, such as the following:

   - research on the scalability problems associated with aggregating many high, medium, and low speed users;
   - technologies and architectures to ensure the security of information available in an NII and to guarantee privacy of information;
   - interoperability;
   - integrity and robustness of networks and databases;
   - human/computer interfaces, such as speech and handwriting recognition and machine intelligence; and
   - research on creating and managing distributed electronic databases and libraries, such as indexing databases, digitizing libraries, and organizing material.

2. The Information Infrastructure and Technology Program, like the HPCC Program, will require strong management and accountability. CSPP recommends that an Executive Branch department or agency with significant roles and responsibilities in the information infrastructure be assigned to manage and implement the Information Infrastructure and Technology Program. This department or agency would provide a clear mechanism to coordinate, manage and govern the implementation of the program, and to ensure that the program's goals are achieved.

IV. CSPP'S NII VISION

In addition to supporting the HPCC Program, CSPP believes the nation must focus on creating the NII, which, together with the HPCC Program, will provide the means to address the difficult challenges the nation now faces. On January 12, 1993, CSPP released a report describing the computer industry's vision of an NII and

recommending some steps the Administration, Congress, and the private sector can take to achieve the vision. The following is a brief summary of CSPP's vision.

In the future, the United States' primary resource for generating economic prosperity, improved quality of life, and global competitiveness will be our ability to quickly and efficiently generate and exchange information, technology, and ideas. The NII will allow all Americans to take advantage of our rich resources in information, communication, and computing technologies by linking together a range of institutions, resources, and individuals. This will revolutionize the way individuals relate with one another by enabling us to work together, collaborate, and access and generate information without regard to geographical boundaries. It will enable fundamental changes in the way we educate our children, train and retrain our workers, earn a living, manufacture products, deliver services of all kinds, and interact with family and friends. The NII will give people in rural areas ready access to libraries, museum exhibits, job information, and medical care now only available to those who live near those resources. People all over the country will be able to work and interact with others, creating new opportunities for the development of products and services we cannot even begin to imagine today, creating new jobs and economic strength for Americans, and providing a resource for workers to continuously improve and upgrade their job skills.

The NII will integrate four equally important and essential elements -- communications networks, computers, information, and people -- to create a whole new way of learning, working, and interacting with others. While the private sector has primary responsibility for developing, deploying, and implementing these elements including the networks, services, and applications, the government has important roles in creating a regulatory environment that will stimulate private sector investment, supporting research on generic technologies, funding demonstration projects, coordinating the activities of the many agencies involved, and working with the private sector to develop solutions to the myriad of policy issues that must be addressed.

V. RECOMMENDATIONS FOR ACTION

By investing in the HPCC Program, the United States has already begun investing in the research for an infrastructure based on high speed networks, high performance computers, and on-line information. CSPP will continue to work with Congress and the new Administration to implement our recommendations to improve the structure of the HPCC Program. However, we must now make a national commitment to take the next step to develop a new national information infrastructure that will provide us with the best opportunity to compete in the global economy of the future.

CSPP's plan for the near term is to focus on developing support for the NII from potential user communities in health, education, manufacturing, and government information. We will be working with Congress and the Administration to fund precompetitive research for the NII and demonstration projects in health care,

education, manufacturing, and accessing government information. In addition, we will be working with Congress and the Administration to create a high-level, joint government-private sector body to develop a national vision of an information infrastructure and to coordinate and oversee the federal activities.

Before the comprehensive information infrastructure of the future can be realized, a broad cross-section of American industries, academic and research institutions, and the federal government need to agree on a common vision for the effort. With a common vision in place, the private and public sectors can make a commitment to do what they need to do, independently or together, to make the vision a reality. In addition to the recommendations described above, CSPP recommends that the Administration, Congress, and the private sector begin a joint effort to take the following actions:

Administration Agenda

1. **Make the NII a National Technology Challenge:** The President should declare the national information infrastructure a new national technology challenge.

2. **Establish a National Information Infrastructure Council:** The successful development and deployment of a national information infrastructure will be contingent upon the government adopting a vision and a strategy for its implementation. A National Information Infrastructure Council, chaired by the Vice President, should be established to provide a management focus for the effort. Members of the Council should include the heads of all federal departments, agencies, and White House Executive Offices who have roles or responsibilities in the information infrastructure, and private sector experts, including representatives of industry, user groups, and research institutions. The Council should have as its initial responsibilities:

    - adopting a vision for an NII;
    - working with the private sector to develop and adopt several concrete goals for the NII, with accomplishable milestones;
    - coordinating the NII activities of the various government agencies and departments; and
    - developing a strategy to address policy issues that need to be resolved to make the information infrastructure possible, such as, for example, privacy, security, interoperability, wide access, affordability, and freedom of speech.

3. **Establish an NII Implementation Entity:** Establish a federal entity to implement the Information Infrastructure Council's vision, plans, strategies, recommendations, and other directions.

4. **Develop a Public Education Program:** Request the National Research Council of the National Academies of Science and Engineering to develop, in conjunction with the private sector, a program to educate the general public about the potential benefits of an NII and the impact it will have on their lives

5. **Make Government Information Easily Accessible:** The National Research Council should assess federal information collection and dissemination policies and practices and make recommendations on how such policies and practices should be changed to make public information easily available and accessible to citizens through the NII. The NII implementation agency should be charged with developing a strategy to implement the recommendations across all affected departments and agencies.

Legislative Agenda

Authorize a National Information Infrastructure Council and Appropriate Funds for its Operation: Introduce legislation to authorize creation of a National Information Infrastructure Council to oversee development of the NII and appropriate funds for its operation.

Industry Agenda

1. **Continue Investments to Develop and Deploy an NII:** U.S. industry must continue to work to develop and deploy the NII, including:

   - deployment of interoperable communications networks;
   - development of on-line databases and applications;
   - development of easy to use computers and information appliances; and
   - training people to design, develop, and use the various elements of the infrastructure.

2. **Continue to Invest in Research and Development of Applications:** Companies must continue independent and collaborative efforts to invest in research on NII technologies and development of new products and services.

3. **Reach Out to Other Industries:** CSPP will initiate a project to encourage other industries likely to benefit from the applications made possible through an NII to join the effort to achieve an NII.

4. **Promote NII Efforts:** A wide range of affected industries should form a non-profit group to work with the National Research Council to promote the NII.

5. **Develop and Participate in Pilot Projects:** Industry should undertake an effort to develop strategic plans and facilitate the formation of teams to design technology demonstration projects in health care, education and lifelong learning, and manufacturing.

6. **Develop NII Goals and Milestones:** The private sector will work with the Infrastructure Council to develop specific examples of accomplishable goals for an NII, with concrete milestones, such as, for example, a nationwide system of on-line patient records accessible by any authorized health care professional anywhere; and all small and medium manufacturing companies networked with the manufacturing extension centers.

VI. CONCLUSION

As the 21st century approaches, our nation's challenge is to find ways to rekindle economic growth, remain competitive abroad, and create the kinds of jobs that will enable Americans to raise their standard of living. This will require that we be more productive and innovative than our competition abroad, and that we act more quickly and more efficiently. Across a range of industries, Americans are increasingly turning to information technology to do just that. Our ability to generate and exchange information, technology, and ideas is helping us to increase output, decrease costs improve quality, and bring new products to market. The United States has a unique opportunity, in the HPCC Program and through an NII, to capitalize on this increasing reliance on information technology and the benefits it can bring.

A national information infrastructure, which will be as accessible and easy to use as our existing national infrastructures, will revolutionize our ability to communicate and collaborate by erasing geographical boundaries. It will enable us to tap into our existing resources of creativity and knowledge. It will lead to the development of products and services today unimagined. It will create new jobs and economic strength for individual Americans. It will accelerate the development of critical technologies. And finally, it will enable us to address more effectively many societal problems, including challenges in health care, education, and manufacturing.

The HPCC Program is an excellent first step. It provides an initial research foundation to create a more extensive information infrastructure that will be broadly accessible to the public and capable of meeting a wide variety of information needs. CSPP commends the Congress and the Administration for putting in place, through the HPCC Program, a solid foundation for the national information infrastructure of the

future. The Information Infrastructure and Technology Act, which will help ensure the technology developed under the HPCC Program is applied widely in education, health care, manufacturing, and libraries, is the next logical step. CSPP commends the Science Subcommittee and Chairman Boucher for moving quickly to include it on the agenda of the 103rd Congress and looks forward to working with the subcommittee to ensure its enactment.

Mr. BOUCHER. Thank you, Mr. Kay.

Mr. McDonald.

Mr. MCDONALD. Mr. Chairman, it's an honor to testify before this Subcommittee today.

My name is Michael McDonald. I'm Chairman of Communications and Computer Applications in Public Health. This is an association of approximately 800 individuals working or who have interest in health informatics. I'm also president of Windom Health Enterprises, which works with cities and corporations, counties, HMO's, hospitals, in the area of reducing health care costs while improving health status, some of which is done through communications and computer applications.

I am going to be speaking to you today about the merits of the High Performance Computing and Networking Project in regards to the health of Americans and the viability of our health system. I would like to state up front that this project is critical to the future health of Americans, as well as to the prosperity of the Nation and the functionality of the health system as we enter the 21st century.

If designed and implemented properly, the High Performance Computing Initiative and the National Research and Education Network will provide important keys to resolving some of the present health care crisis, and this can do so while spawning a broad and diverse information economy that will serve the Nation well into the next century.

I would like to start off by illustrating how important health information is in terms of its impact on individuals' lives. My first daughter, Mikayla, was born with cystic fibrosis, and if we as her parents, along with her health professionals, had had access to information, she may have been saved from disfiguring scarring. I don't mean to sound ungrateful for the medical care we received because, in fact, we had outstanding health care. What would have happened if we had lived in a rural area or did not have access to such good medical care, most likely Mikayla would have died, as many infants and children do every day, out of a lack of access to health information and decision support.

Today, the absence of a national health information infrastructure is costing our Nation about $72 to $100 billion a year. Along with this heavy toll, there is heavy toll in terms of premature death, disability, reduced productivity, and diminished quality of life. With the proper health information infrastructure, we could be saving around a trillion dollars within this decade.

It was in this spirit that a plenary which I chaired on the National Health Information Infrastructure was held last November. Out of this plenary, five elements of the National Health Information Infrastructure were defined: First, computerized patient records and clinical information systems, potential savings, around $15 billion a year, according to an Arthur D. Little study; second, home-based telemedicine, with savings between $15 and $20 billion per year; third, personal health information systems which would give the public access to pretty much anything they would want to know about their health 24 hours a day, seven days a week; potential savings, $40 to $60 billion per year; this is probably the largest ticket item; fourth, population data structures which would improve outcomes research and surveillance of epidemics and endemic

diseases; potential savings undetermined at this time but perhaps as much as $20 billion per year; and then electronic data interchange and electronic claims structures; potential savings, $6 billion per year.

The High Performance Computing and Networking Project can catalyze rapid growth, as well as long-term growth of the information economy, including health informatics. However, as presently written, H.R. 5759 does not address issues of the present health care crisis, nor does it create a balanced approach to the development of a national health information infrastructure, some of the elements of which are in a precompetitive stage and may need some Government involvement.

I would suggest three areas of change to the legislation. One is the context; the original wording should be changed to reflect today's health care realities and to focus on solutions to the health care crisis. Second, additional players need to be added; the language should be redrafted to more appropriately address activities of a broader group of centers, agencies, and offices of the Department of Health and Human Services, and the coordination itself may have to go to a higher level than NLM to allow for that broader group.

Application areas. The six application areas in relationship to health care are very important, but they probably are not going to have the greatest impact on health care costs, and they represent only one-fifth of the areas that I have mentioned above, so for that reason I think we have to look at allocation of monies. The applications as listed may represent only about one-fifth of the funding that is needed, and perhaps it needs to be allocated as presently written.

So, in conclusion, this project is very important to the health of Americans in building the National Health Information Infrastructure, and in building this infrastructure we can make significant contributions to breaking the dangerous upward spiral of health care costs. To do so, health applications must be strategically demonstrated, especially in the areas of greatest savings, which would be home-based telemedicine, personal health information systems, and population data structures.

If the High Performance Computing and Networking Project demonstrations address today's crucial health issues, we can grasp a unique opportunity to prepare our Nation and reorient our health care system for the 21st century.

Thank you for allowing me to comment on this truly valuable and historic legislation.

[The prepared statement of Mr. McDonald follows:]

McDonald *2/2/92*

STATEMENT OF MICHAEL D. MCDONALD, MPH
CHAIRMAN OF CCAPH (COMMUNICATIONS & COMPUTER APPLICATIONS IN PUBLIC HEALTH)
PRESIDENT OF WINDOM HEALTH ENTERPRISES

BEFORE THE SCIENCE SUBCOMMITTEE OF THE
HOUSE SCIENCE, SPACE, AND TECHNOLOGY COMMITTEE

Mr. Chairman:

It is an honor to testify before this subcommittee today. My name is Michael McDonald. I am chairman of Communications and Computer Applications in Public Health (CCAPH), an association of approximately 800 individuals with an interest or involvement in health informatics. CCAPH works with professional associations, like the American Public Health Association, and government on issues of health informatics research, development, education, and policy analysis. I am also president of Windom Health Enterprises, a California-based corporation specializing in the design of health systems and health-oriented communications. Windom's clients include large corporations, HMOs, hospitals, cities, counties, and the Federal government.

Today, I would like to talk to you about the merits of the High Performance Computing and Network Project and its impact on the health of Americans and the viability of our health system. I will use the terms, "health informatics" or "health-oriented telecommunications," to refer to the use of computers, interactive information strategies, or communications for health purposes. These terms are a natural extension of the concepts behind the High Performance Computing and Networking Project.

I would like to state up front that this project is critical to the future health of Americans as well as to the prosperity of our nation and the functionality of its health system, as we enter the 21st century. If designed and implemented strategically, the High Performance Computing Initiative and the National Research and Education Network will provide an important key to resolving the present health care crisis while helping to spawn a broad and diverse information-based economy that will serve our nation well into the next century.

I will first illustrate the importance of advanced health-oriented communications and computer applications by talking about how the ability to access information affects individual lives. I will then outline how one of our nation's most critical goals -- lowering the cost of medical services while continuing to improve health status and health service outcomes -- can be achieved, through health-oriented telecommunications. I will conclude by making suggestions regarding the redirection of the health focus of this legislation to better serve the building of a national health information infrastructure that will aid us in diminishing the burden of further medical cost inflation.

The Impact of Health Information on the Lives of Individuals

Let me illustrate how access to health information impacts the lives of individuals. My first daughter, Mikayla, was born with Cystic Fibrosis (CF), which usually affects breathing and digestion. If we, her parents, and her doctors had had access to

information systems which allowed us to quickly and easily explore information on alternative diagnostic and treatment approaches, she might have been saved from lifelong disfiguring scarring.

I don't mean to sound ungrateful for the medical care she received. Since the first month of life, she has lived a virtually normal life other than taking enzyme capsules when she eats to help her digest food. We were lucky to have been in an urban hospital and to have had an extraordinary resident that was able to catch her distress early. What would have happened if Mikayla had been born in a rural area or had physicians with less up-to-date expertise? She would surely have died -- as infants and children do of preventable and treatable illnesses every day *because of a lack of appropriate information and decision support.*

Today, the absence of a national health information infrastructure may be costing our nation as much as 70 to 100 billion dollars a year. That figure, however, cannot begin to measure the heavy toll taken in terms of premature death, disability, reduced productivity, and diminished quality of life. In other words, we could save approximately one trillion dollars by around the turn of the century if we had a proper health information infrastructure in place along with other changes to the health system.

McDonald *2/2/92*

The National Health Information Infrastructure Plenary

Last year, the first plenary on the national health information infrastructure was held at the American Public Health Association Annual Meeting in Washington D.C. This Plenary, which included a broad spectrum of leaders from the health sector, identified the most central development needs of the national health information infrastructure. Participants developed issues and recommendations to be submitted to a task force on the National Health Information Infrastructure this year. The five primary elements they identified as lowering medical cost inflation, while improving access and quality of care, are discussed below.

1) **Computerized Patient Record and Clinical Systems**

The system we, as a nation, adopt for accessing, storing, and transmitting medical information should allow records to be accessed instantaneously anywhere in the country by authorized personnel. According to an Arthur D. Little study, approximately $15 billion a year could be saved by implementing this type of system. The system should include a universal medical data dictionary. It should have a multimedia interface that allows access, storage and transmission of text, audio, and visual information (X-rays, pathology slides, medical imaging capability). Enhanced computing capability would improve and enable many new applications such as surgical telepresence.

Telepresence and virtual reality capabilities in the operating room can expand the

functionality of minimally invasive surgery and improve clinical outcomes. For example, a patient with a gall bladder operation using traditional surgery would normally have significant scarring and would need to stay in the hospital for days or weeks. In an operating room with telepresence, a surgeon inserts a fiber optic videoscope into the abdomen of the patient through one port (small hole) and robotically-operated surgical instruments through another port. As a result, the surgeon can now look into the body via a computer workstation several feet or several thousand miles away from the patient. The benefits from this approach are many: minimal infection risk (because the abdomen is not opened up to the air and, therefore, remains sterile); minimal or no scarring (because the surgical ports are small); the patient can often leave the hospital the next day with far less pain and complications (because the trauma and complications from minimally invasive surgery are dramatically reduced).

2) **Home-based Telemedicine**

According to the Arthur D. Little study, home-based telemedicine could save between $15 billion and $20 billion dollars per year. Home-based telemedicine would allow the health professional to monitor and interact with the patient remotely via a system that merges the computer, video, and the telephone. It would also allow the practitioner to utilize more technological support and expertise through an intelligent network while visiting the patient in the home. It would help the elderly to remain self-sufficient in the home longer and aid the chronically ill in receiving more of the care

they need outside of the hospital and doctor's office. According to a recent study at Dartmouth, physicians doing follow-up by telephone clinical visits reduced the number of clinical visits by 28% and hospital days by around 30%. Telemetry (the ability to measure physiological functions remotely), data aggregation and analysis, and two-way video applications would further expand the quality and scope of telemedicine.

3) **Personal Health Information Systems**

Even assuming that personal health information systems were used only 25% to 35% of the time that self care could solve a health problem, $40 billion to $60 billion a year could be saved. Research and development efforts in the fields of self care and health promotion (e.g., HealthWise studies, the Stanford/Blue Cross study, Employee Managed Care Corporation's trials, and the Harvard Community Health Plan's home computer link) demonstrate that more than 95% of the first line of health decision making is accomplished outside of the health system today by the individual alone or with the help of family and friends. Seventy to eighty percent of health problems can be managed by self care. When an individual needs medical attention, seventy percent of a correct diagnosis depends upon the information a patient tells a physician.

Unfortunately, the tools available to aid the individual in taking care of themselves and becoming an active and informed part of their health care are the most undeveloped parts of our health system. As a result, far too many people (common estimates are

50% to 80%) entering the health system do not really need a physician's care. Large numbers improperly utilize the system (e.g. using the emergency room for back strain or a cold). In addition, 60% of those who end up with serious health problems come into the health system too late and as a result require more heroic, painful and costly therapy.

Part of the reason self care, prevention, and health promotion are so underdeveloped is that traditional print and mass media do not allow the individual to access health information when they need it in a form that aids appropriate decision making. Health-oriented telecommunications is likely to revolutionize this part of the health system by making available anything a person needs or wants to know about their health 24 hours a day, 7 days a week in the home, school, workplace, or through public terminals (like public telephones with video screens and digital capabilities). Unlike the non-interactive media, the interactive personal health information system will give the individual customized information and decision-support unique to them. For example, the system would know that a system user named John is a 54 year old man with diabetes and a family history of heart disease by accessing data John makes available from his personal health record . It would also "consider" many other factors from his medical history and periodic risk assessments, if available, when giving him information and decision-support. In regards to chest pain or even a request for an exercise plan, the system's responses would be very different for John than for a 25 year old athlete without significant risk factors.

4) **Population Data Structure**

There needs to be a standardized population data structure underlying the medical and personal health information systems that allows aggregration and access on the local, regional, and state levels in near real-time. Today reporting of diseases is poor and the aggregation of population data is cumbersome and time consuming. A well designed and implemented population data structure is essential for improving outcomes research and surveillance of epidemics and endemic disease patterns. Better outcomes data would lead to more uniform, effective and efficient clinical guidelines. If public health professionals had the ability to instantaneously, reliably and systematically aggregate data in real time from medical records and personal health information systems -- independent of personal identifiers -- control of epidemics and endemic disease patterns would become far more effective. Cost savings are undetermined in this area, but are likely to be significant, perhaps in excess of $20 billion per year, if the results are properly utilized.

5) **Electronic Data Interchange and Electronic Claims Processing**

Approximately 26% of health care costs in the United States go toward administration. Canada spends less than half of this amount. Part of the reason for this difference is that there are 1500 different insurance companies in the United States using many different claims forms in the United States, Canada has one form. By switching to a electronic unified claims form and other forms of electronic data interchange for health

care administative transactions and inventorying, the Arthur D. Little study indicates that approximately $6 billion could be saved per year.

The Plenary's work, in addition to discussin the five key health information infrastructure issues outlined above, also drafted the following core policy recommendations to support the evolution of the infrastructure.

Privacy and Confidentiality

The privacy and confidentiality of all health records must be maintained. Strong precedents and methods (e.g., traditional confidentiality regarding medical claims, encryption strategies, census data privacy protection) exist that can be used to formulate policy in this area, but more still needs to be done. Without the ability to ensure the privacy and confidentiality of electronic health and medical information, the full potential of a health information system will not be realized. Information must be accessible for outcomes research and surveillance without personal identifiers or any threat to confidentiality. Information must be available for emergency care. Strategies exist for the segmentation of records, but a single approach, or set of approaches, has yet to be endorsed on a national basis. The individual must be able to control access to their records. Guidelines should be constructed with the help of both government and professional associations to diminish liability for those adhering to nationally accepted guidelines.

Universal Access

Just as the United States now has universal phone service, the principles for universal access within interactive multimedia must also be established. This is absolutely essential if we are to bring health information services to the economically disadvantaged. These populations generally have greater problems with their health. The cost of providing medical care for the disadvantaged is in the hundreds of billions per year and yet there are still large numbers of people improperly cared for. A fraction of the cost now spent on medical services could be used to build the infrastructure to save not only dollars, but lives.

Universal access to interactive multimedia must include not only two-way imaging transfer to and from professional offices and hospitals, but two-way, digital, switched, broad band capability into homes. The greatest medical savings will result from empowering the public to take better care of their own health by providing interactive health information and decision support. An additional benefit of developing the infrastructure to provide universal access to health information is that the same infrastructure would support library, educational, entertainment, telecommuting and other information services.

Coordination and Standardization

A properly designed and interconnected national health information infrastructure would immediately improve coordination of services. This might start with coordination among agencies, but would also help overcome discontinuities in services and coverage throughout the health system. Data set standardization is essential. The communication industry must also set standards for ease of use and connectivity. This provides a significant challenge today, given the interLATA restrictions on the Regional Bell Operating companies which can lead to separate and incompatible technical protocols. Coordination and standards efforts should extend to system content as well as to services used in conjunction with the information systems.

Quality Assurance

Data integrity (i.e., information accuracy, currency, and reliability) is critical to the health information infrastructure. If quality standards for health records are set, outcomes research will blossom, yielding valuable information having direct impact on the quality of health care. It will also help us evaluate and refine health reform efforts.

Ideally, core life- and health-critical data for the personal health information systems would be established at the highest level of scientific authority. For example, the Institute of Medicine might oversee the dispersement of SBIR grants to develop a standard set of core health information for the personal health information system.

This would not only ensure the quality of the health and life critical data delivered directly to the general public, but it would simultaneously diminish the liability of such information by having it created and certified as correct and up-to-date by the world's experts.

The core information, if sponsored by government or private foundation funds, could be put into the public domain. This would catalyze the growth of a wide variety of information providers to create further health information content to expand upon the life- and health-critical core information. Given that there are substantial standards-setting activities already underway, government should make an effort to aid this process and be careful not to supercede efforts that would otherwise accomplish the same end with broader consensus.

Focused Demonstrations and Clearinghouse

Focused demonstrations would bring attention to the potentials of health information services, test their viability, and catalyze their growth. A clearinghouse of health information services and technologies (e.g., Department of Health and Human Services' Center for Advanced Health Communications Technologies) would coordinate information regarding these projects and act as an incubator for other public and privately funded projects.

McDonald *2/2/92*

The Significance of The National Research and Education Network

The High Performance Computing and Network project, if properly designed, directed, and expanded, will catalyze the rapid growth of a diverse and fruitful information-based economy -- including within the health sector. The outcome will be products and services that serve the public interest, the creation of jobs, and the generation of profits and, therefore, tax revenues. The telephone companies claim that this will create over a million and a half Bell company jobs for information services alone within the decade. Job creation in the entire information infrastructure could be many times this amount. John Sculley, President of Apple Computer, claims that a three and half trillion dollar marketplace (including computers, telecommunications, and information services) will evolve by around the turn of the century. If the vision of the telecommunications and computer industries is even partially correct, the information sector will be the most vital and vibrant part of the American economy well into the 21st century.

Our government can not take on the task of building the entire intelligent network by itself. Nor should it involve itself in activities that free enterprise can appropriately address. It should, however, nurture leadership within the private sector by helping to direct its gaze toward the future market opportunities. Hopefully, this will decrease the amount of corporate and legislative time and resources fruitlessly spent trying to protect existing interests, to the detriment of building the much larger future market opportunities. The government should be looking for willing partners not only in the large and medium-sized businesses, but also in the small information providers far

down the economic food chain -- where so often the greatest innovations take place. If the government is able to provide this type of leadership through efforts like the High Performance Computing and Networking Project, the United States will blaze a rapid path toward realizing Vice President Gore's goal of a thriving information sector that supports all other sectors of the economy.

The High Performance Computing and Networking Project could establish vital demonstration projects to support the development of the national health information infrastructure. We know that government research and development of this type (e.g., the Highway infrastructure projects of the 1950s) greatly aid early development of any infrastructure. Government funding in infrastructure will encourage businesses to invest, therefore, stimulating the growth of very successful new economic sectors.

The High Performance Computing and Networking Project has a high probability of not only catalyzing economic growth, but also redirecting our society toward more environment-friendly and energy self-sufficient economic activities. It is logical to choose the health sector for demonstration projects, since information is so crucial for good health and efficient health services. Moreover, properly directed demonstrations could even significantly reduce medical cost inflation and, as a result, help diminish the federal deficit. In order to effectively address these important societal initiatives, the health applications demonstrated by the project must support the goal of significantly lowering medical cost inflation while improving access and quality of health services.

Some of the advanced health-oriented telecommunications applications such as telepresence and virtual reality applications are dramatic and compelling improvements to medical care. Such applications can extend the effectiveness of minimally invasive surgery, for example. However, the greatest contribution to lowering medical costs lies not in directing large amounts toward ultra high tech medical applications, but rather in building a balanced approach to the five application areas specified earlier as key elements of the health information infrastructure (computerized patient record and clinical system, home-based telemedicine, the personal health information system, population data structures, and electronic data interchange and electronic claims processing).

Once implemented, 50% to 75% of the cost savings -- easily $50 billion to $75 billion per year -- will result by accomplishing two goals: 1) empowering the public to take better care of themselves and make wiser choices about their utilization of health services; and 2) helping chronically ill and aging individuals to receive appropriate medical services and supervision while living better and fuller lives in the comfort of their own homes, surrounded by their family and friends. Priority should be given to these applications, given their significant potential contribution.

To help with this restructuring, I recommend the following:

1) altering the language on pages 3 and 4, under Sec.2 FINDINGS AND PURPOSE, Part (b)(1)(C), of H.R. 5759 which states, "improving the provision of health care by furnishing health care providers and their patients with better, more accurate, and

more timely information;"

Given that medical costs have now reached a point in which they are stifling economic recovery and the management of the Federal deficit, we as a nation must reduce the cost of health care, or at least stop its further cost inflation. In order to place the language of this bill within the context of health reform, it is recommended that this clause should be rewritten to read, "lowering the cost of health care while expanding access and quality of health services by furnishing better, more accurate, and more timely health information to the public and their health providers;"

It is believed that this rewording would be more appropriate than the original language, if this legislation is to attempt to build a balanced health information infrastructure that serves the public (both well and sick) as well as the medical care system. In this context the personal health information system, population data, home-based telemedicine, and unified claims structure can also be addressed appropriately.

2) altering the language on page 7, under (6), of H.R. 5759, which states, "The Department of Health and Human Services, particularly the National Institutes of Health and the National Library of Medicine."

This should be redrafted to more appropriately address a broader group of centers, agencies, and offices of the Department of Health and Human Services, particularly the Centers for Disease Control, Agency for Health Care Policy and Research, and the Office of Disease Prevention and Health Promotion, as well as the National Institutes

of Health and the National Library of Medicine.

If the legislation is to help build a health information infrastructure addressing issues broader than medical care as specified in the five elements above, more agencies and offices must be involved to manage this broader mandate. For this reason, the overall health activities of this project should be overseen at the Office of the Assistance Secretary of Health.

3) On page 17, under SEC.6 APPLICATIONS FOR HEALTH CARE., I will not recommend specific language for this section at this time because of its reference to the "Plan developed under section 701 of the National Science and Technology Policy, Organization, and Priorities Act of 1976," with which I am not presently familiar. I would recommend that the National Institutes of Health, and particularly the National Library of Medicine develop technologies in the six areas of section 6 of H.R. 5759 as stated. In addition the National Institutes of Health, the National Library of Medicine, or the appropriate offices, centers, and agencies I note above should manage the demonstrations having to do with applications that go directly to the general public, or deal with prevention, self care, health promotion, outcomes research, home care, or population data. These areas, which are critical to the health information infrastructure, have not traditionally been strengths of the National Library of Medicine and have tended to play a small role in the research done at the National Institutes of Health. Given that the six applications listed in section 6 are extensions of traditional medical care applications and will not be the biggest contributors to medical cost savings, it is recommended that two fifths of the funding now proposed for allocation to

these areas remain toward these six stated areas in Section 6 of H.R. 5759. However, three fifths of the recommended resources in H.R. 5759, or additional resources, should be reallocated toward applications for the general public, or deal with prevention, self care, health promotion, outcomes research, home care, electronic claims transfer, or population data as outlined in this document above.

CONCLUSION

If this legislation can supplement its present focus on medical applications alone with the other areas proposed as elements of a balanced health information infrastructure, it can help build an infrastructure from which we can reverse the present decline in the health of Americans in comparison to other nations. I would submit that this project's demonstrations must address the undeveloped areas of our health system in order to help break the dangerous upward spiral of medical care costs.

The health information infrastructure can be a major contributor to reducing the costs of health care by designing our information society include applications which assist our chronically ill and aging citizens to be more self sufficient in their home environment, while still receiving quality care. It can provide the public as well as providers with better, more accurate, and more timely health information, so that we as citizens can become more responsible consumers of health care and be more able to maintain and improve our own health. In addition, this project can play a crucial role in stimulating the development of an approriate population data network and provide

crucial demonstrations of how a universal electronic medical claims structure should evolve.

The interactive media have very significant advantages over the traditional mass media in terms of these types of applications. If the High Performance Computing and Networking Project demonstrations address these health issues, we will have grasped a unique opportunity to prepare our nation and reorient our health system for the 21st century. I thank you for allowing me to comment on this truly historic and valuable piece of legislation.

Mr. BOUCHER. Thank you very much, Mr. McDonald.

Mrs. Parker.

Ms. PARKER. I am representing the American Library Association. I am also a state government official that has responsibility for the 6,500 libraries in Pennsylvania and their cooperative programs. Our 647 public libraries have the potential to generate some of the most innovative uses of the network for the widest range of individuals. They also have the kind of community information files that can help solve grass-roots problems.

Recently in Pennsylvania we have begun a project to provide connectivity for 140 libraries that are not already on the Internet. These are libraries such as Lycoming College, Boiling Springs High School, the Balch Institute for Ethnic Studies, and the Hershey Public Library. The goals of our project were to put all the libraries on one electronic mail system to create an interactive calendar of library events and training and to provide full Internet access.

Our connectivity needed to be as transparent as possible because we had many libraries already on the Internet which we needed to add without redundancy, and we had a separate network which was running pilots for school libraries.

We have used federal funds through the Library Services and Construction Act for this project.

Broader access, as Congress conceived it, is needed for the institutions which Congress referenced in the High Performance Computing Act. The National Science Foundation appears eager and able to fulfill the responsibilities, but it is not funded to do so.

One of the most important areas for us is increased access with more focus on education, training, and support for the use of the network. We would encourage you as a committee to think of adding a fifth applications area to "Son of HPC", and that would be an application which relates to government information. NREN should be the primary mechanism which the government uses to provide access and delivery to federal information, and that flow should be integrated into networked public information arising from the activities of state and local government.

The change from a print to electronic libraries is prompting a significant change in the role for libraries from ownership to access to information. This means new ways of access and a widely dispersed system of resources through a distributive system. If we are to preserve our intellectual heritage through the digital library, NREN applications also need to stimulate the digital conversion of library resources.

At this stage, continued NSF support for midlevel networks and of the connections program is essention. Connectivity may be a commodity quickly, but the other services and values provided by midlevel networks cannot be easily replaced, and there are strong partnerships between library networks, state government, and the midlevel networks.

Congress can further its NREN vision by building components into both new and existing legislation. Congress could add resources to establish resource connectivity through many of the current grant programs, and this, I think, would encourage federal agencies and departments that do not already have strong participation to partner with the NSF.

Congress could, for example, in its pending reauthorization of the Elementary and Secondary Education Act, authorize funding for connectivity for schools and their libraries. There is an existing example in which the reauthorization of the Higher Education Act added in its title to library programs specific encouragement of NREN-related projects. The Library Services and Construction Act already exists as a vehicle for extending connectivity and the information infrastructure to libraries of all types.

The American Library Association strongly supports passage of an NREN application bill that would build on the legislation introduced in the last Congress. We have specific recommendations. This includes ensuring that in the application on education that public libraries are specifically named for their role in support of education and life-long learning.

We believe there should be a new component for key government information, including depository libraries and support for pilot projects to make federal and state government information available over the network.

We also support within the digital library component pilot projects in the conversion of library resources to digital format, the development of integrated approaches to organizing and location information in the digital library and strong education and training programs. We feel the network has been a major success story to date. The federal investment has spurred a much larger investment by industry, institutions, and other levels of government, and a strong commitment will ensure that continued investment and help to quicken the development of the National Information Infrastructure.

Thank you.

[The prepared statement of Ms. Parker follows:]

SUMMARY OF STATEMENT

Sara A. Parker, Commissioner of Libraries
Pennsylvania Department of Education
Representing the American Library Association

Before the House Subcommittee on Science
February 2, 1993

The NREN VISION

The National Research and Education Network (NREN), as Congress envisioned it in the High-Performance Computing Act, is more than a federal research network. The NREN, as a testbed for the National Information Infrastructure, extends to schools, libraries, and communities, and has the potential to transform research and education and to address critical social needs. The NREN vision is beginning to be addressed in Pennsylvania through a variety of statewide efforts, aided with the stimulus of federal Library Services and Construction Act (LSCA) funds.

The Library Role

Libraries, located in almost every community, are natural public access points to the network and sources of information and training in its use. Libraries are also providers of network information resources, ranging from the current online public access catalogs and community information files, to pilot projects in the conversion of our intellectual heritage (full text, graphics, video, and multimedia) to digital formats.

NSF Solicitation

NSF has worked diligently to implement its HPCA duties, but has been given neither clear responsibility nor adequate resources to realize the congressional vision. Its solicitation process appears to be focusing on the technical architecture of the network and on the federal research role. For libraries to become full partners in the NREN vision requires a public planning process for the national NREN program, a meaningful voice for libraries and other involved constituencies in NREN planning and management, and a government role in assuring a broadly available, high-capacity, affordable, interlinked, network system to educational institutions and libraries.

Realizing the Congressional Vision

Parts of the congressional vision have yet to receive attention and need more emphasis. Much too small a percentage of the HPCC budget is being used to support the network, and reallocation within this budget is urgently needed for (1) connecting all levels of education and libraries; (2) making federal and state government information available over the network, especially through the existing federal Depository Library Program; and (3) education and training programs and an integrated approach to organizing and locating electronic information resources.

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Support for NREN Applications Bill

American Library Association strongly supports passage of an NREN applications bill which would build on legislation introduced in the last Congress. Consistent with our three points above, we recommend the Subcommittee (1) expand the education component of an applications bill to include public libraries in their role in support of education and lifelong learning; (2) a new component to provide high-level connections for key government information depository libraries and support pilot projects to make federal and state government information available over the network; and (3) support, within the digital library component, pilot projects in the conversion of library resources to digital formats, development of an integrated approach tc organizing and locating electronic information resources, and education and training programs.

Statement of

Sara A. Parker, Commissioner of Libraries
Pennsylvania Department of Education
Representing the American Library Association

before the
Subcommittee on Science
Committee on Science, Space and Technology
U.S. House of Representatives

February 2, 1993

I am Sara Parker, Commissioner of Libraries and Deputy Secretary of Education for Pennsylvania. I am also appearing on behalf of the American Library Association, a nonprofit educational organization of more than 55,000 librarians, educators, information specialists, and friends of libraries. Thank you for the opportunity to testify on the progress made by the Federal High Performance Computing Program and to make recommendations for legislation to follow the High-Performance Computing Act of 1991. As a representative of the constituencies which will both help build the National Research and Education Network and link it to users, I speak for many in commending Congress on its vision. The NREN Congress designed in Section 102 of the Act can indeed pave the way for a National Information Infrastructure for use by all Americans.

NREN, if fully implemented as Congress envisioned it, would provide an appropriate role for the federal government which ensures equity of access and use of the network by institutions which serve a public purpose. NREN is more than a federal research network or a high-speed backbone between supercomputers. It extends beyond the research and academic communities to primary and secondary educational institutions, libraries and to the public. NREN has the potential to provide information and technologies to address critical social needs. It has to be developed in a National as well as Federal context.

At this time there appears to be unity of Congressional and Presidential vision. This will, I hope, strengthen the partnership for building NREN - federal, state and local government, university, library, education related communities and the private sector. There is fundamental need for a continued federal presence in the evolution of the network. This central presence will ensure equity of access to networks and that access is broadly based so many communities and constituencies can benefit.

The Congressional vision is certainly being realized at the local level in Pennsylvania.

The State Library of Pennsylvania, as an agency of state government, is responsible for the development of libraries and for the cooperative relationships between them. This is true of the 50 state library agencies in the 50 states. The responsibility of my office under statutory authority for

interlibrary cooperative programs includes connecting the libraries of Pennsylvania to the emerging NREN.

A commitment to economic development, and Pennsylvania's position as a high-tech state, led to development of PREPnet (the Pennsylvania Research and Economic Partnership Network). This high-speed data transmission network is the mid-level network connecting Pennsylvania to the Internet. It has 110 members from all sectors.

Pennsylvania has over 6,500 libraries; 5,000 of those are in our public and private schools. There are over 250 academic libraries. Our 650 public libraries range from The Free Library of Philadelphia with over 5 million volumes to our smallest library which serves about 300 people. Public libraries have the potential to generate some of the most innovative educational uses of the network for the widest range of individuals. Public libraries are ubiquitous and politically neutral agencies. They have significant community information resources and can play a key role in using NREN to address grassroots problems.

Recently, we have begun to provide connectivity for 140 libraries not already having Internet access, libraries such as Lycoming College, Boiling Springs High School, the Balch Institute for Ethnic Studies, and the Hershey Public Library. Access is through the Health Sciences Libraries Consortium of Philadelphia. The goals of our project are to put all of the libraries in Pennsylvania on a single electronic mail system; to create an interactive library events and training calendar; and to provide full Internet access for libraries.

Priorities were clear. We needed to ensure the libraries which are federal depositories or state depositories of government information were on the network. The 28 district library centers and county public library systems, both having responsibility for service to smaller public libraries, need access to the Internet. We wanted to move collaboration and cooperative programs into an electronic environment and end reliance on paper, telefascimile and surface mail. Thus all of the academic library consortia and members of the Council of Pennsylvania Library Networks, which represent the state's 175 library cooperatives, were encouraged to participate.

Pennsylvania State University has been important in the earlier development of a network system throughout the Commonwealth. Building on an electronic extension of the State Agricultural Information system, called PennPages, the Department of Education uses the Penn State system to reach 499 of our 501 public school districts. PENN*LINK has a pilot project for Internet access in which seven of the school districts participate. For example, North Pocono High School has 75 students in a meteorology class using the Internet to reach the National Weather Service. Six journalism students and twenty-six world history students exchange letters with Russian and Slavic students. These Pennsylvania high school students will send the $10 each Russian school needs to pay to continue their Internet access for next year. A small amount here is a large, difficult to find, amount in Russia.

Pennsylvania's connectivity needed to be as transparent as possible so libraries already on the Internet could be added without redundancy. We also

needed an easy interface into PENN*LINK for school libraries. The Health Sciences Libraries Consortium was chosen from eight other alternatives because it already had in place user-friendly front end design. Its menus make it easy for small libraries to participate in the network. Libraries will also be able to use all of the value-added services provided to the Consortium members. Medline and group contracts for database searching are examples.

We have used federal funds from the Library Services and Construction Act (LSCA), administered by the U.S. Department of Education, to fund this project. We are using approximately $67,000 of LSCA Title I (Public Library Services) to fund public libraries and approximately $360,000 of Title III (Interlibrary Cooperation and Resource Sharing) to fund all types of libraries. We are using additional LSCA funds of $210,000 from both titles for a program in consumer health information which will link public libraries and hospital libraries to health resources to deliver information on AIDS and Alzheimer's disease to people throughout the state.

The High-Performance Computing Act of 1991, in authorizing NREN, has encouraged state libraries to make a good beginning to involve libraries. NREN, as a complex web of cooperating networks, may develop through many stages as mid-level networks and state governments cooperate. The creation of the High-Performance Computing Advisory Council mandated by PL102-194 is essential to strengthen and expand development going forward on several levels.

Broader access is needed for the institutions which Congress referenced in the High-Performance Computing Act. Section 102, the National Research and Education Network, places clear responsibility on federal agencies for the linkage of research institutions, educational institutions, government and industry. The network is to provide users with appropriate access to "high-performance computing systems, electronic information resources, other research facilities and libraries; electronic information resources maintained by libraries, research facilities, publishers and affiliated organizations." The National Science Foundation is eager and able to fulfill its responsibilities in this regard, but it has not been funded to do so.

Many of the public institutions named by Congress in its vision have serious constraints which affect their participation in the emerging NREN. These include lack of equipment, the mix of hardware and software which makes interoperability difficult, limited financial resources and lack of expertise to use networks.

Increased access requires more focus on education, training and support for the use of the network. As noted by the Association of Research Libraries, pathways to accommodate differing skill levels should be developed and an infrastructure created that includes support services, training materials, workshops, help lines, development of documentation and more. Outreach services should identify new communities of users and their distinct information needs. Programs and services should assist users in utilizing the network. Coordination between network providers and service organizations should yield an integrated approach to user services and access. The skills of librarians in organizing and finding information will be important to ensure students, small businesses, independent researchers and others are able to access the resources on NREN.

Public libraries, schools and academic institutions can help achieve the Congressional vision. Librarians help build a network that is user-friendly. They improve the organization of electronic information resources. Librarians are and have been in the forefront in helping design the intellectual access to the resources on the network. NSF and other agencies should encourage network demonstration and development projects involving interdisciplinary teams with library science participation.

Collaboration between state libraries and the mid-level networks is important as state level resources are made available. This includes mounting databases to enrich the intellectual and information content of the network. Pennsylvania has 29 library catalogs on the network. Penn State University mounts PennPages as part of the Agricultural Extension Service and EDIN, its economic development database. PENN*LINK is building files on school reform and performance-based learning. Schools contribute their succeseful programs in restructuring to the database.

Libraries of all types and sizes hold unique resources and widely share information about them. With support, the bibliographic information and full contents could be made available on the network. Public libraries have much information held in community information files which may be of value to other communities.

Adding government information to the network should be a fundamental goal. We recommend a separate section for this application in any new NREN bill.

- NREN should be a primary mechanism which the federal government uses to provide access to and delivery of federal information. This flow should be integrated with networked public information arising from the activities of state and local government. Passage of the legislation such as the Government Printing Office WINDO/Gateway bill would also improve public accessibility to federal government information.

- State libraries feel a particular responsibility to make state government information available through the network. The North Carolina State Library has arranged for the network to carry a digital library of the states' history, the state's administrative code, JOBLINE, purchase and bidding contracts, course offerings from the state colleges, and the full text of bills as they are introduced in the North Carolina Assembly. Legislative and other government databases could be a driving application to spur progress toward a National Information Infrastructure.

- Local public libraries work actively to make local government information available. The Carnegie Library of Pittsburgh through its NeighborLINE Project has created a database to provide technical assistance to neighborhood groups for economic development, physical renovation of the neighborhood, community service and community-based organization. NeighborLINE includes information on planning; financing and developing new or rehabilitated housing units; strategies for the conversion of low-income housing units; and shared information from groups participating in a tenant/landlords rights project. It also makes available the city's data bases and

real property files. If mounted on the network, this information could be available to neighborhoods in Los Angeles, Chicago, or Boston.

The change from print to electronic libraries is prompting a significant change in roles for libraries--from ownership to access to information. The prototype digitel libraries envisioned in NREN applications legislation are a beginning. The legislation properly provides for the development of systems software standards and computer technology to make the digitel library possible.

If we are to preserve our intellectual heritage through the digital library, NREN applications bills also need to stimulate the digital conversion of library resources. Philadelphia was the center of printing for the American colonies. The digitization of early Pennsylvania imprints would recreate, for thousands of users, the intellectual materials that gave rise to our democracy and government. The Pennsylvania Public Television Network has an archive of all programming produced by the seven public television stations. It represents the imagery, video and sound ready to be entered into a digital library. This is an example of why libraries need the high capacity the NREN promises. Interactive distance learning, health and medical applications and scientific research also need NREN's higher speeds.

The National Science Foundation has worked diligently to implement its HPCA duties, and to hear and respond to observations and recommendations from a wide range of interested parties. However, it has been given neither clear responsibility nor adequate resources to fully realize the congressional vision. Its solicitation process for the NSFNET backbone appears to be focusing on the technical architecture of the network and on federal research support.

At this stage, continued NSF support of mid-level networks and of the connections program is essential. Connectivity may become a commodity quickly but the other services and values provided by mid-level networks would not be easily replaced. Recently, several productive partnerships have been established between mid-levels and state or regional library networks. The library networks broker technological services on behalf of individual libraries. Library network and mid-level network partnerships may prove particularly helpful in supporting connections for small libraries where technical support and training must come from outside the library.

For libraries to become full partners in the NREN vision requires a public planning process for the national NREN program, a meaningful voice for libraries and other involved constituencies in NREN planning and management, and a government role in assuring to educational institutions and libraries (as publicly supported institutions fostering national goals) a broadly available, high-capacity, affordable, interlinked, network system. We join with others, such as EDUCOM and the Computer Systems Policy Project, in recommending congressional attention to the National Information Infrastructure (NII).

Establishment of an NII Council would be a useful first step. We recommend inclusion of library, education, and public interest representatives on such a body. NII discussions must include voices with actuel experience with the

networks and network information so that the focus on users of information is not lost in the voices of the telecommunications, computing, broadcast, cable and entertainment industries. Further steps could include investigation of establishment of an NII implementation entity. One option which should be considered is a not-for-profit federally-chartered entity.

We also commend to the Subcommittee's attention the Proceedings of the NREN Workshop, Monterey, California, September 16-18, 1992. Supported in part by NSF, this workshop was sponsored by the Computing Research Association, EDUCOM and the IEEE U.S. Activities Board. Representatives of ALA and other library organizations participated and a number of useful recommendations were made related to NREN policy issues.

Congress can further its NREN vision by building components into both new and existing legislation. Congress could add resources to establish network connectivity through many of the current grant programs. This would encourage federal agencies and departments that do not already have connectivity programs to partner with NSF. Congress could, for example, in its pending reauthorization of the Elementary and Secondary Education Act, authorize funding for connectivity for schools and their libraries. The recently reauthorized Higher Education Act in its Title II library programs specifically encourages NREN related projects.

The Library Services and Construction Act already exists as a vehicle for extending connectivity and the information infrastructure to libraries of all types. As little as $20 million per year in new funding through LSCA would provide a major stimulus to additional development. LSCA provides for state-based programs administered by state library agencies, and is thus an existing vehicle which allows for statewide coordination and considerable flexibility to address the differing circumstances and needs throughout the nation for connecting libraries and adding information resources to the network.

Some libraries need higher-level connectivity and bandwidth than others; all will need full network capabilities as use of the network becomes essential, and as multimedia resources become electronically available. Immediate priorities for higher-level library connections will be the key roles played by libraries; as federal or state government information depositories; as key points for public use and access; those serving large populations, or those providing access in areas of little or no connectivity. A library may be the only access for those without an institutional affiliation. Another priority would be the unique resources which libraries will add to the network. Pilot projects such as ours in Pennsylvania demonstrate the value of publicly supported information infrastructure.

Clearly, parts of the congressional NREN vision have yet to receive attention and need more emphasis. Much too small a percentage of the HPCC budget is being used to support the network. Reallocation within the HPCC budget is urgently needed for (1) connecting all levels of education and libraries; (2) making federal and state government information available over the network, especially through the existing federal depository libraries; and (3) education and training programs and an integrated approach to organizing and locating electronic information resources and converting library collections to digital formats.

ALA strongly supports passage of an NREN applications bill which would build on legislation introduced in the last Congress. We recommend that the Subcommittee:

1) expand the education component of an NREN applications bill to include public libraries in their role in support of education and lifelong learning;

2) add a new component to provide high-level connections for key government information depository libraries, and support pilot projects to make federal and state government information available over the network;

3) support, within the digital libraries component, pilot projects in the conversion of library resources to digital formats, development of an integrated approach to organizing and location electronic information resource, and education and training programs.

Resources currently available fall far short of the amount needed to realize the goal of Congress in connecting research, education and libraries at all levels in every state. The network to date is a major success story in that the federal investment has spurred a much larger investment by industry, institutions and other levels of government. A modest reallocation of federal resources in order to provide a stimulus to broader access, better network tools, and practical applications such as literacy and lifelong learning, health care, provision of government information and information which contributes to social and community problem solving and economic development would also spur a larger investment and quicken the development of a National Information Infrastructure.

An NREN applications bill may not need an agency coordinative process which duplicates that in the HPCA, but any new bill should be structured so that federal agencies responsible for both view them as an integrated whole, thus providing a ubiquitous universally acceptable, high-performance information network system to serve the individual agencies, institutions and organization that have a stake in its components.

I also ask you, as a Subcommittee, to give serious consideration to developing this legislation in partnership with appropriate education and government operations committees and subcommittees, in order to leverage the policies, programs and practices that they oversee with those of the NREN program.

Thank you for asking me to join you in the public policy process that is framing and addressing the need for a national information infrastructure to support life and enterprise in the 21st Century.

Mr. BOUCHER. Thank you very much.

Dr. Bender.

Dr. BENDER. Mr. Chairman, I would like to thank you for inviting me to participate in these hearings.

I'm currently the Director of the Ohio Supercomputer Center, a state-funded high performance computing center providing higher education, as well as Ohio industry access and training to high performance computing. I'm also the Director of Academic Computing for the Ohio State University, providing central resources for our teachers, faculty, and staff. But today, I'm representing the Coalition of Academic Supercomputer Centers—CASC—as its Chairman.

The Coalition of Academic Supercomputer Centers was founded in 1989 to provide a forum to encourage federal, state, and local support of high performance computing. Today there are 18 CASC members, five federally funded, three state funded, and 10 university or locally funded. A list of our members is attached to our testimony.

Our members provide the primary share of high performance computing and networking services to the academic community and particularly at the state centers serve as economic development for the local business community. CASC provides a vehicle for our centers to pursue a common agenda using our technology infrastructure and human resources.

Our centers have high performance computing equipment, support infrastructure—for example, visualization and software—distance learning and training, mass storage equipment, and, most important, a human resource knowledge, knowledgeable and experienced in educating, training, and supporting our users.

CASC is now participating in the development of the medicine complex which will bolster a productive, cost-effective partnership among academic high performance computing centers, government, research laboratories, university researchers, and industry. CASC's role in education and the business communities of America has positioned us to be effective to effectively address the challenges of the 21st century.

We have looked at both the questions you raised and are prepared to offer a statement which is a consensus statement of CASC. We held a meeting last Wednesday, and we have been working on it over the network ever since, and the last revision I have we finished up yesterday afternoon. I will summarize our statement.

We recognize the importance of the High Performance Computing Program in seeking to retain the U.S. position in the area of high performance computing and networking technologies. We applaud the Federal Government for committing the investment in HPCC. However, CASC is concerned with the management, the direction, and the funding of the HPPCP.

The role of FCCSET was never intended to manage the HPCCP, and the HPC Advisory Committee has yet to be developed. We note that such a management must be in place to direct and, importantly, to protect our U.S. investment. Also because of the lack of management, unhealthy competition among existing and new activities has developed.

The early implementation of the HPCCP did not envision an explicit complementary role of current national, state, and university investments. In fact, CASC members have seen no increases of funds due to HPCCP for the support of our performance—high-performance computing infrastructure.

Grand Challenge problems research has impacted the federal agencies, higher education, and business, in that order. The impact on federal agencies is to focus Grand Challenge problems on agency missions. Higher education impacts are in the basic, computational, and computer sciences, not the support of the infrastructure, particularly the high performance computing infrastructure.

The primary industrial impact of the HPCCP is on the technology development, not technology utilization. It does not appear that the NSF, which is in the lead—was in the lead of the development of the national high performance and networking infrastructure for education and research—has received funding consistent with the HPCCP planning. CASC recommends that the NSF should receive funding at the targeted levels to maintain and enhance its role in the HPCCP.

Finally, CASC questions how many new federal resources were actually invested in the HPCCP and are very interested in where those resources went.

Summarizing our comments on stimulating applications, we seek recognition by the Congress and the federal agencies. CASC members are already involved in enhancing kindergarten through undergraduate university education via information technologies, providing medical and health care uses of information technology, and we are playing a critical—and are critical players aiding states in economic development by focusing on rapid work force retraining and small and medium business applications.

New legislation is needed to create clear incentives to encourage state and local investments to complement federal investments, and those having already made investments should be encouraged to maintain and enhance their current activities. CASC suggests that HPCCP can be brought to medium and small business, manufacturing, and service industries by expanding the support for the CASC members as they develop the infrastructure and outreach necessary.

Currently, CASC members have many industrial partners. We are serving pharmaceutical, biological, oil, chemical, and the automotive industries. We are working to speed the pace of innovation on more than just Grand Challenge problem research. Applications would focus on getting competitive products to market faster at a lower cost.

Technology transfer is a key activity of each CASC member. Our efforts can be extended through better definition of the goals of the HPCCP, increased financial support, and greater dissemination of information and expertise developed. This will drive the demand for increased access to high performance computing and networking. Investments must be made to preserve, enhance, and expand our infrastructure. More explicit financial incentives must be given to work with small companies and broaden industrial participation and utilization.

CASC acknowledges the need for an extended research network and the development of a strategy that ensures a powerful and expansive network infrastructure. Our members reach into all levels and many types of industry, and we will provide education and training to all those levels.

The national, state, and university high performance computing centers are a critical resource of the Nation for supporting life and the industrial enterprise of the 21st century.

Thank you.

[The prepared statement of Dr. Bender follows:]

Statement to the

House Science Subcommittee

by

Dr. Charlie Bender,
Chairman,
Coalition of Academic Supercomputing Centers
Director,
Ohio Supercomputing Center

February 2, 1993

Introduction

Mr. Chairman, Members of the Committee, thank you for the opportunity to address you today on issues of vital importance to education, research, and America's competitiveness.

I am Charlie Bender, Director of the Ohio Supercomputing Center, where I have direct responsibility for one of the first State Supercomputing Centers. Created by former Governor Richard Celeste and the state legislature to support researchers at all Ohio post-secondary education institutions, the Ohio Supercomputing Center serves as a base for broad economic development and emerging business needs. I also serve as the Director for Academic Computing at the Ohio State University and have participated as a member of the Advisory Panel for the Office of Technology Assessment report on "High Performance Computing and Networking for Science." Today, I am appearing as the Chairman of the Coalition of Academic Supercomputing Centers.(CASC)

The Coalition of Academic Supercomputing Centers (CASC) was founded in 1987 to provide a forum to encourage Federal, State and University support for High Performance Computing. CASC, with 18 members, includes five national centers, three state centers, and ten university centers. Through the activities of all of our members, we provide the primary share of high performance computing services to the academic community and particularly, at the state centers, serve the economic needs of the small and medium business community.

We see the CASC members as the Nation's computational science educators, the leading infrastructure for technology transfer, and a necessary vehicle for positioning the United States for competitiveness in the 21st century.

CASC provides a common vehicle for the High Performance Computing Centers to pursue a common agenda using our technology base and human resource infrastructure. All Centers have high performance computing equipment and software; support infrastructure including human resources, e.g. mass storage systems, visualization equipment and software, distance learning equipment, and knowledgeable and experienced staffs available to assist users, etc. Our central relationship to the education and business communities of America has positioned us to effectively address the challenges of the 21st Century.

Questions Before The Committee

The High Performance Computing and Communications Program sought to focus Federal investment in the frontiers of computing and computer communications technologies in order to solve some of the Nation's essential problems as well as to maintaining the Nation's competitiveness in the world. The HPCC Program, while driven by that effort and the recognition that close cooperation among Federal Agencies and laboratories, private industry and academe would accelerate significantly the availability and utilization of the next generation of high performance computer and networks to the education and commercial markets as quickly as possible, has had limited success.

The diffused nature of government technology programs remains despite creation of the Federal Coordinating Council for Science Engineering and Technology (FCCSET), which has initiated a planning process but was never intended to manage the HPCC program, thus the HPC Advisory Committee, mandated by PL 102-194, is important to the future of the program for it is expected to provide the information and guidance necessary to better manage the HPCCP.

Early implementation of the High Performance Computing and Communications Program did not envision an explicit, complementary role for current national and state computing infrastructures already serving the high performance computing and communications communities. This has created competition between these existing groups and the new groups envisioned by the Initiative. It also created confusion for potential new external communities that the initiative was seeking to attract, and contributed to an overall sense of poor coordination. This lack of coordination, (despite the creation of the FCCSET) and sense of competition among the players almost ensures a more costly program and a diluted overall effect.

Current budget realities have targeted the new moneys of the Initiative primarily to federal labs and universities. The National Science Foundation's flat budget has resulted in a severely diminished role for NSF despite interest, enthusiasm and support by the staff of CISE. Last year, the Grand Challenges solicitation resulted in several hundred responses received, but only 7 could be funded . Of all the federal agency participants, NSF and NASA (due to support for the Space Station) have received the least funding of all the HPCC Agency participants. At

this rate, NSF can barely afford to maintain its Centers' agreement, let alone provide money for infrastructure to support these projects that have evolved through increased awareness of the overall HPCC Program.

The Grand Challenges needs focusing HPCC R & D are driven by agency missions and their need for a strong underlying science, engineering and technology infrastructure to meet the mission requirements. With these mission requirements as a starting point, it is difficult to see how the goals of the Strategic Priorities will be achieved, since agency missions are rarely focused on such national goals. Thus the HPCC program must be developed in a national as well as Federal context. The real impact of the HPCC program can be brought to medium and small companies, manufacturing and service industries by expansion of the support for the CASC members as they develop the infrastructure and outreach necessary. Currently CASC members have partnerships and are serving pharmaceutical, biotechnology, oil, chemicals and automotive industries, and are working to speed the pace of innovation on more than Grand Challenge problems.

The HPCC is in a unique position to leverage existing federal investments in technology to maximize their contribution to industrial performance. Further cooperation between universities, industries and the government must be encouraged. Consortia involving the CASC members can help firms share risks, pool resources, avoid duplication and make investments that they would not undertake individually. CASC is now participating in developing the MetaCenter concept, which will bolster this productive partnership between the academic high performance computing centers, government, research labs and university researchers and enhance the technology transfer effort.

Recommendations

* The role of the National Science Foundation, as a founding HPCC Program participant and supporter of research and education activities performed by the National, State and University Supercomputing Centers has continued to diminish with decreasing budget support. NSF should receive funding at the targeted levels to maintain and enhance its role in this important effort.

* New legislation is needed to create clear incentives to encourage state investments to complement federal investment, and those states that have already

made investments should be encouraged to maintain and enhance their current activities.

* Recognition by Congress and the federal agencies that the CASC members are already involved in enhancing Kindergarten thru undergraduate University education via Information technologies; providing medical and health care uses of information technologies and are critical players aiding states in economic development by focusing on rapid workforce retraining and small/medium business applications.

* Technology transfer is an integral activity at each of the CASC member Centers. These efforts can be extended through better definition of the goals of the HPCCProgram, increased financial support and greater dissemination of the information and expertise developed. Applications developed at these Centers for supercomputing creates and, in turn, maintains the demand for increased access to and development of supercomputers.

* A well deployed infrastructure is critical to realizing strategic priorities identified in the Information Infrastructure and Technology Act of 1992. Investment must be made if we are to enhance, preserve and expand our infrastructure. More explicit financial incentives must be given to work with small companies and broaden participation beyond the university research community and more players must be involved.

* CASC supports the need for an extended national research network and the development of a strategy that ensures responsiveness and affordable connectivity to a reliable, powerful and expansive infrastructure that increases the returns on government investments in research and education.

Conclusion

CASC members are successfully involved in numerous Grand Challenge activities from weather forecasting, climate modeling and aero-elastic simulation to participation in the gigabit testbed networks. We reach into all levels and many types of industry and we provide education at all levels. The national, state and university supercomputing centers are a critical resource of the nation supporting life and enterprise for the 21st Century.

The Clinton-Gore Administration declared that U.S. technological leadership is a national priority. The new administration considers technology to be the engine of economic growth and is committed to building a 21st century technology infrastructure. Investment in internationally competitive technology, joining the Federal agencies, the universities, and advanced technology resources, will leverage the federal investment in science and technology infrastructure and support a world class competitive business environment.

Thank you Mr. Chairman, that concludes my remarks. I would be happy to answer any questions that you and other members of the Committee may have. CASC is happy to provide additional information on the activities of its members and to answer any questions.

CASC Membership

Cornell Theory Center
National Center for Supercomputing Applications
National Center for Atmospheric Research
Pittsburgh Supercomputing Center
San Diego Supercomputer Center

Ohio Supercomputing Center
North Carolina Supercomputing Center
Minnesota Supercomputing Center

University of Texas System
University of Kentucky
Arizona State University
Utah Supercomputing Center
The University of Georgia
University of Nevada, Las Vegas
Purdue University Computing Center
Texas A & M Supercomputer Center
University of Florida
University of Alaska

Mr. BOUCHER. Thank you very much, Dr. Bender, and we express our thanks to each of the panel members for their discussion this morning.

Mr. Kay, let me begin my questions with you. You have recommended in your testimony that a single federal agency be responsible for managing the program and the follow-on legislation that we will be introducing shortly. You have also recommended that we create a national information infrastructure council, and so you are essentially recommending the creation of two managing entities or advice-giving entities or entities that will have some role in guidance of the follow-on initiative. How do you differentiate their functions, and what responsibilities would you assign to each?

Mr. KAY. Mr. Chairman, I'm not sure that we have necessarily suggested two new entities. With regard to the HPCC—I guess, let me make one point. As the CEO's began work on the National Information Infrastructure about nine or ten months ago, they did an exhaustive discussion with people in the agencies about whether the HPCC program could be broadened to encompass a national information infrastructure. The conclusion of almost everyone we talked to was that that would be a bad idea, that the HPCC program was barely able to do what it was asked to do and it was unfair to broaden its mission to now encompass an NII.

I think it is for that reason that, when we are here this morning, our suggestion to you is that we ought to work on fixing and improving the HPCC program and that when you establish a mission of an NII you ought to do it separately because it is really a different set of issues and a different set of objectives that is being worked on. So, maybe that answers your second question.

With regard to where we see the HPCC program going, we would defer both to your judgment and that of the Administration as to the proper home. That a new entity must be created it is not necessarily the case. I guess our CEOs' position would simply be, there needs to be management and not coordination of the program, and we would defer to those who have better experience and judgment about how to structure the government. We are observing to you that it is currently a coordinated program and it needs to be a managed program. We have no position on where that ought to be and would defer to others.

With regard to this new information infrastructure council, we don't see this at the moment as an implementing entity, we see this as a conversation that needs to take place to create a common vision for the NII and to get us headed in the right direction.

For example, in your earlier panel the question was raised: Where is the FCC's role in all of this? I think our probable first take is, the FCC probably doesn't have a role in the HPCC program as it is currently structured, but as you move to a national information infrastructure clearly it would. The question for such a council would be: What are the appropriate agencies, and which responsibilities would you give each? And it strikes us that a council or commission is the proper forum right now to debate those issues because they are very complicated and that a group of industries and key players in government could come to some closure on those key questions.

Mr. BOUCHER. Well, I think that helps illuminate the suggestion.

Let me ask you this. What you are proposing, I think, is that there be a single federal agency that would have the responsibility for coordinating the follow-on legislation. One of the problems, I think, as a practical matter, that you encounter is that, if you have a single agency that has overall coordinating responsibility, the other agencies tend to think that their role has been somewhat diminished, and it is oftentimes for that reason somewhat more difficult to get them to participate fully, and I think, frankly, the reason that OSTP was given coordinating responsibility for the original High Performance Computing Initiative was for that very reason, that this is an umbrella within the Executive Branch that has the role of advising the President for science policy and coordinating the delivery of that advice to him, and it comes as close as anything to being an umbrella under which all the other agencies can fit and would tend to reduce the natural rivalry that exists within those agencies for control of a program and, for that reason, encourage greater participation.

So what is your comment with regard to that general problem that having OSTP involved at the coordinating level tends to resolve?

Mr. KAY. I guess my observation would be, I think, we have to look at this process in phases, and the phase at which the FCCSET process and OSTP operated to get consensus within the government to get this program up and running, a collegial, nonhierarchical, nonbureaucratic approach, made a lot of sense, and the people who put it together ought to be given tremendous credit for that kind of an informal mechanism at a time when it was appropriate.

We are now moving into a very different phase of the HPCC program in which all of us in the private sector and the Congress are going to be expecting a lot more from the program, and you are going to have to coordinate the HPCC activity with the national information infrastructure.

All the comments you heard on the first panel alluding to the fact that we are not sure what views are, we are not sure what the policies are, derive from the fact that the current program is not in a position right now to meet expectations with regard to clarity of direction and setting time lines for accomplishing goals and being critiqued both by the Congress and the private sector as to whether those time lines are appropriate and whether those goals are being met.

If we are going to get serious about achieving a national information infrastructure, our industry's position is that we are going to have to get much more serious about a very logical, managed approach and that the HPCC program will just have to come into phase with that as well. I guess our observation would be, we know it is difficult, we know there is great bureaucratic concern about budget autonomy and the rest, but we think that you and the agencies ought to work together towards finding some mechanism where single accountability, management, and oversight will be easier than you would currently have with the program as it is now configured.

Mr. BOUCHER. Should we build into the new legislation specific timeframes for accomplishing stated goals?

Mr. KAY. Well, if you don't build those in, you should at least make sure that the agency, or the program develops those, that they bring those to you, and that you have a chance to see them and review them. I'm not sure in this process whether you want to set them, but you certainly should expect, and I think our CEO's have said in their conversations with the Administration, that those ought to be put in place so that both their input, as well as the Congress' input, could be gotten. So I think that that process clearly needs to be done, yes.

Mr. BOUCHER. So keeping the agencies on schedule is more a part of the oversight function than it would be the legislative function, in your opinion—through hearings and other kinds of discussions, we should try to keep them on track rather than set in the legislation specific timeframes they have to meet.

Mr. KAY. I think that you could put in the legislation the fact that you want them to come up with timeframes that they are proposing, and then I think that there should be a general expectation that they be met. So I think the idea of setting the framework of timeframes—our chief technologists have met on this subject and believe that the whole program would be substantially upgraded if those kinds of goals were set and everybody knew what they were and then all of us could come in and tell you from our perspective whether they were or weren't being met.

Mr. BOUCHER. Is your organization prepared to recommend to us specific tasks that can be met within specific timeframes?

I think part of the problem here is that when you are in a research environment, it is very difficult to know what can be expected in terms of producing research results within a given period of time. Are you prepared to make those recommendations to us and state the goals and tell us how quickly they ought to be achieved?

Mr. KAY. Again, I'm not sure that we would suggest that those things be enshrined in legis'ation, per se.

Mr. BOUCHER. I understand, but what you are saying is that the implementing authorities ought to be able to propose to us the projects and the time frames, and what I am asking is, are you prepared to do that? Can you suggest to them what those projects and time frames ought to be?

Mr. KAY. Our 13 CEO's have had the chief technologists of all 13 companies involved in both a critique of the HPCC program, as well as the development of our NII position. I think without going on a limb, I could commit to you that—their interest and desire to stay involved in the process, and I certainly would think that our chief technologists would be in a position to work with government agencies in helping design both the proper subjects and the proper time lines for those activities.

Mr. BOUCHER. All right. That is very helpful. Thank you, Mr. Kay.

Ms. Parker, let me inquire of you: You made a very interesting recommendation that perhaps one of the applications that we target in the follow-on legislation should be the appropriate collection and readying for dissemination of government information. A number of other people have made similar kinds of suggestions, perhaps not in the context of the High Performance Computing Initia-

tive, but have pointed out the fact that we do have archives of information oftentimes collected at great expense and then hardly available to anyone because of the difficulty of obtaining access to it.

In fact, the chief sponsor of the initial high performance computing program, the Vice President, Al Gore, used to say in arguing for this initiative that we had silos of data collected by the Landsat satellite that essentially were sitting there unused today and that one of the principal reasons that we need a network such as this is to make sure that that information gets to people who can use it. So I think it is an intriguing proposal that you have made.

Let me ask you this. Would your formulation be that it is the role of government to assemble and process and put in the proper format the government information and then have private vendors, commercial networks, and the like make that information available to the public for payment of a fee?

Ms. PARKER. Mr. Chairman, I think certainly in terms of the role of government in organizing and getting access to information. But I believe that you will find my colleagues and I believe that government has been collected from a variety of sources, involving a commitment of public funds to pay for that; and, as such, being already supported in terms of public ownership of information. That information can best be mobilized and the return on the public's investment best realized by going out over the kinds of networks as public-based information, hopefully without fees; and certainly, when you look at a wide variety of position statements from the American Library Association, you find us on record as opposed to government charging for information, regardless of whether that is captured through resale to a private vendor, who then does value-added and recoups on the investment, or whether it is use charges placed by government agencies themselves.

Mr. BOUCHER. So you would say that it should be available without charge essentially to anyone who wants it?

Ms. PARKER. I say that, realizing that government sometimes incurs extraordinary costs when a user of information wants in a particular form which may be difficult for government to provide.

Mr. BOUCHER. Okay.

Let me ask you another question. You have recommended in your testimony that as a part of our follow-on initiative for applications that we involve libraries to a greater degree. In the bill that was introduced last year and in the discussions that we have had prior to your testimony today, we have talked about one of the applications that we have in mind being the digitization of material contained in libraries and then the making available to the general public over the network of that information so digitized, and, in fact, there are a variety of different tasks that would have to be performed in order to achieve that goal, including systems for data structures, query language that would enable the public to put in the right request in order to get the information off the digital shelf, how to handle real-time transactions where you have literally millions perhaps of requests coming in simultaneously—how do you handle that? We don't have any comparable system today that would accomplish that result.

Standards and common formats, so that you would have the same kind of digitized format, library by library, around the country. Information displays, where you have a variety of different kinds of information available at once—sound and image and other things—and then how do you protect security for information that is copyrighted and/or for information that involves national security.

So we already have a lot of tasks set before us in terms of achieving this digitization, and we clearly contemplate libraries being a major aspect of the new applications.

Now, given that, do you have any recommendations going beyond that for what role libraries ought to play as we seek new applications?

Ms. PARKER. You have very well articulated the kinds of things that have to be done and the tasks that confront us as we build digital libraries. I think we would extend that by saying it is a time in which we could begin some pilot projects to gain actual experience that would help us in accomplishing those tasks.

Mr. BOUCHER. Okay, that is fine.

Mr. McDonald, let me ask a couple of questions of you. You have recommended that with regard to the health applications of the new HPC initiative that several specific applications be looked at, including computerized patient record and clinical systems, home-based telemedicine, the personal health information system, population data structures, and electronic data interchange, as well as electronic claims processing, all of which, I think we would agree, would advance the delivery of health care substantially.

It is one thing to understand that these are the goals, it is another thing to try to structure legislation that helps us reach those goals, and perhaps you could give us some sense of the kind of R&D projects that we ought to direct be carried out in the legislation in order to help achieve these specific goals that you have set for us.

Mr. MCDONALD. Okay. First of all, the direction of the effort is toward the NLM and types of things that NLM does well now, but there are many other agencies that should be involved in this. The Agency for Health Care Policy and Research is doing very significant work in the outcome of research now.

The ability to aggregate data and then to reflect on that data in terms of the quality of care, is going to be a very important contribution to health care reform, a critical component for example, and the population data structures are not in place today. The Centers for Disease Control also could have the ability to set up almost real-time reflection on endemic disease patterns and epidemics. That does not exist today; that is something they would love to do and is probably appropriate for this project.

One of the great concerns that we have is, the most primitive part of our health care system is that part that allows the public themselves to reflect on their own health and to make more wise decisions about how to utilize the health care system.

I think that if as we build the National Health Information Infrastructure, we do not focus on this portion of the infrastructure, we are losing perhaps the biggest opportunity to reduce costs and improve quality of care and quality of life.

Mr. BOUCHER. Let me just ask you, if you would, to reflect a bit on the kinds of research projects that need to be carried out to which we should refer in the legislation that would help us meet the goals you have stated, which I think we agree are laudable goals, and if you could, within the next 10 days or so, submit to us in writing a statement of the kinds of research projects that we should direct be carried out in order to achieve this application, that would be extremely helpful.

Dr. Bender, you have in your testimony suggested that the High Performance Computing Program to date has suffered from a lack of coordination. Be a little more specific, if you would, about what the problem is, who is responsible for it, and what specifically we ought to be including in the follow-on legislation to improve that condition.

Dr. BENDER. I pretty well agree with Mr. Kay in his position that after we got FCCSET moving it was a fairly collegiate activity, and yet there is quite a lot of money being spent, and the management, real management of those resources, hasn't really appeared to us. In fact, it is somewhat difficult to figure out how many new resources were actually put into the High Performance Computing Initiative. We heard $150 million for the first year. Has that accountability been laid out? We haven't seen it. And so we feel that within OSTP is fine, but a tighter management of the overall program with accountability, which doesn't seem to be there right now.

Mr. BOUCHER. So your concern is just seeing where the dollars went and trying to get a broader understanding of how that money is being expended.

Dr. BENDER. That is right.

Mr. BOUCHER. Okay. What about the pace of the work so far? Do you have any general comments on that?

Dr. BENDER. Not as a coalition.

Mr. BOUCHER. All right.

Well, I want to thank these witnesses for answering these questions, and you are not excused just yet. Let me recognize the gentleman from Texas, Mr. Johnson.

Mr. JOHNSON. Mr. Chairman, thank you. I think you have very adequately—more than adequately—addressed the problem, and I appreciate the questions you did ask and the responses we got, and I'll refrain from further questions at this time and yield back my time.

Mr. BOUCHER. Thank you very much, Mr. Johnson.

I would like to express on behalf of the Subcommittee our thanks to this panel for the thoughtful preparation of your comments and your presence here this morning to answer our questions and to offer you the opportunity to offer additional suggestions to us within the period of about the next 10 days to two weeks.

We intend to structure and introduce at the end of that time frame the follow-on legislation that will provide for the applications, and you have got a window there of a bit of time when you can help us structure that, and we would appreciate your additional help and your additional guidance.

We also, during the course of this year, and next year will hold additional hearings to assess the progress of the High Performance

Computing Initiative and to provide oversight as that implementation goes forward, and so it is not a one-time opportunity that you have to educate us and to offer suggestions, and we will welcome your continued contributions to that process.

Having said that, and with the Subcommittee's thanks, this hearing is adjourned.

[Whereupon, at 12 noon, the Subcommittee was adjourned.]

APPENDIX

Statement of

Stanley J. Kabala

Vice President--Data Communications

AT&T Business Communications Services

on behalf of

AT&T

submitted to the

Subcommitee on Science

Committee on Science, Space and Technology

U.S. House of Representatives

in conjunction with its hearings on

High Performance Computing and Communications

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February 2, 1993

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EXECUTIVE SUMMARY

AT&T recognizes the need for a national high performance computing and communications network to serve major federal, industrial and academic research laboratories and supercomputer centers. The High Performance Computing Act of 1991 has helped bring this goal closer to reality. Investment in high performance computing and communications will enhance the nation's critical research and development capabilities, especially at the generic, pre-competitive level. Federal support has helped leverage private investment in the development of this specialized but critical segment of the overall National Information Infrastructure (NII). Given our nation's urgent need to reform education and health care, and to achieve global manufacturing competitiveness, AT&T also favors study of demonstration applications in these areas.

The NII is rapidly becoming a ubiquitous network of networks, including common carriers, other commercial providers, and privately owned systems, distinct and varied. but all closely interconnected, interoperable and widely accessible. The NII includes various information appliances; local, exchange and long distance communications services; centralized information and computing resources; and people interacting at all levels, at any time and virtually any place.

Throughout this century, the U.S. has achieved and maintained uncontested worldwide leadership in computing, communications, and information services. The U.S. government generally has sought to promote robust competition wherever possible in these industries. Largely as a result of intense competition in most markets, the NII is already well established, and is rapidly expanding and evolving.

The high performance computing and communications initiative is devoted primarily to solving the "Grand Challenges" of nature and physics, where the national interest is apparent. The National Research and Education Network (NREN) segment of the initiative enables industry and academia to cooperate in testbed studies of gigabit-speed applications and networking.

Another component of NREN, NSFNET, functions as the backbone of the Internet -- a nationwide data network composed of various regional and local networks, intended to serve the research and education communities. NSF has noted that the model of the government-subsidized NSFNET as a generic transit provider for the Internet is breaking down. The NSF is to be applauded for recognizing the need to change current policy and move all routine (i.e., not supercomputer related) research and education traffic and all commercial traffic off the NSFNET to commercial providers. Any appropriate subsidies should be directed to end users to alleviate any hardship resulting from this transfer.

AT&T looks forward to working with the new Administration, Congress and the private sector to further the objectives of high performance computing and communications and to advance the evolution of a truly competitive National Information Infrastructure.

INTRODUCTION

My name is Stanley J. Kabala and I am Vice President-Data Communications in AT&T's Business Communications Services organization. I am pleased to have the opportunity to present my own and AT&T's views on the High Performance Computing Act of 1991 and on the legislation proposed in both houses of Congress in 1992 to expand federal efforts in applications technologies, high performance computing, and high-speed networking.

AT&T SUPPORTS THE HIGH PERFORMANCE COMPUTING AND COMMUNICATIONS INITIATIVE

AT&T recognizes the need for a national high performance computing and communications network to serve major federal, industrial and academic research laboratories and supercomputer centers. The High Performance Computing Act of 1991 has been effective in advancing the nation toward such a network in a timely manner. AT&T also favors government support for research to promote technological applications that would extend to universities, colleges and schools, libraries, hospitals and medical institutions throughout the nation. It is our view that the demonstrations of such applications, as contemplated in the 1992 legislative proposal, are well chosen.. Nevertheless, they do not necessarily fall within the parameters of high performance computing and communications and must be more carefully delineated. Given our nation's need to reform education and health care, these areas require the attention and energy of both the public and private sectors.

AT&T believes the high performance computing and communications network is a relatively small but integral part of the broader National Information Infrastructure (NII). It is important to understand the relationship between the two.

AT&T'S VIEW OF THE NATIONAL INFORMATION INFRASTRUCTURE

AT&T believes that the National Information Infrastructure is a fundamental yet rich and diversified resource for the United States' success in the 21st century. Unlike most other industrialized nations, the U.S. government has generally sought to promote the evolution of the NII by fostering robust competition wherever possible in the communications and information industries. And largely as a result of intense competition in most markets, the NII is already well-established. In this competitive environment, with continued technological change and greatly increasing computing, communications, and information demands, the NII is rapidly expanding and evolving.

The NII comprises a broad array of computing, communications and information technologies and services, set in motion, directed, controlled and utilized by people everywhere. The NII includes:

- information appliances in homes, offices, automobiles and briefcases, providing voice, data, image, video and multimedia communications to anyone, anywhere, any time;
- local communications services, within an office or on a campus; metropolitan/exchange services within a local community; long distance services, to another community or state; or international services, anywhere in the world;
- centralized information and computing and communications resources, such as databases, digital libraries, interactive voice, messaging and answering systems; and
- people with wide-ranging resources interacting with the system at all levels.

Since the invention of the telegraph and the telephone more than a century ago and the advent of the electronic computer after World War II, the U.S. has maintained uncontested worldwide leadership in communications and information technologies. With sound government policies in place, the U.S. free enterprise system will sustain and advance our leadership role in communications and information into the foreseeable future.

As it evolves, the communications portion of the NII will become a ubiquitous network of networks, including common carriers, other commercial providers and privately-owned systems, distinct and varied but all closely interconnected, interoperable and widely accessible. People everywhere should have access to the NII whenever they want, in many different ways, for many different purposes. The NII will comprise a variety of services and technologies for homes, hospitals, schools, libraries, businesses, and government offices throughout the nation and, via wireless technologies, almost anywhere. The services provided over the NII should be reliable; the communications and information transmitted, private and secure; the information devices, varied and diverse.

The NII already serves a broad and diverse array of customer needs -- applications which vary greatly in terms of quality, performance, features and price. The wide variations in telephone sets, computer terminals, personal communicators, and data networking options will surely continue to expand, but interconnectivity and interoperability, particularly in data systems and information resources must be improved, and the interfaces that machines present to humans must be enhanced greatly so that all citizens can use the NII easily.

As the High Performance Computing Act of 1991 has demonstrated, the federal government has a crucial role to play in supporting leading-edge, pre-competitive technological research and testing for the high performance computing and communications network. The new Administration has appropriately suggested that government act as a catalyst for evolution of the NII in this way.

HIGH PERFORMANCE COMPUTING AND COMMUNICATIONS

The high performance computing and communications network is an essential part of the NII, connecting research laboratories and supercomputer centers -- some of the most advanced and sophisticated users and devices -- with links that process and translate enormous communications and information streams -- voice, data, graphics, video and multimedia. This highly specialized but critical segment of the NII will comprise the highest capacity transmission, intricate signaling and switching, and powerful supercomputers, all integrated through a unique architecture, and both systems and human management.

Continued emphasis on high performance computing and communications could greatly strengthen and enhance our nation's overall research and development capabilities, particularly at the generic, pre-competitive level, where costs are especially high and where practical, useful applications are still far off. It is here that government, in association with commercial and academic partners, can leverage investments, initiate synergies, "prime the pump," as it were, to move the creative energy and capital of the American free enterprise system into action. The 1991 Act is, in fact, implemented as a partnership among federal agencies (DARPA, NSF, DOE, NASA, HHS/NIH, DOC/NOAA, EPA, DOC/NIST) and other organizations, and leveraged by participation of industry and academia.

Further research in high performance computing and communications could also speed technological innovation, facilitate transfer of defense technologies to commercial uses, and speed commercial applications for new technologies generally. Such changes are critically important for an increasing number of U. S. companies, including many small businesses, who are now competing in a global marketplace, instead of the local or national arena they knew in the past.

As a leader in both telecommunications and computing services, AT&T is committed to providing and sustaining a state-of-the-art infrastructure to support high performance computing and communications. In the forefront of experimental technologies, AT&T is currently funding and managing the Experimental University Network Program (XUNET), which includes experimental work in very high speed data networking. Two XUNET links, connecting three XUNET Asynchronous Transfer Mode (ATM) switches, are being upgraded to 622Mbps and will be available for scientific and technical research by July, 1993.

The upgraded XUNET network is an integral part of the BLANCA gigabit testbed sanctioned by the Corporation for Network Initiatives (CNRI). CNRI administers four separate gigabit testbeds on behalf of the NSF and DARPA. Research scientists and engineers from AT&T Bell Labs and various other university and government laboratories are already performing experiments on the current, coast-to-coast 45Mbps XUNET ATM network.

Recently, AT&T announced plans to move aggressively in offering ATM service commercially, collaborating with customers and other industry leaders. These partnerships will accelerate availability of ATM-based networking solutions; AT&T expects to begin with switch, network, and customer applications testing by year end and to offer controlled introduction of ATM services during the first half of 1994. Initially the network will support speeds of 45Mbps, evolving to higher speeds as customer applications demand.

Also, AT&T is participating in a five-year cooperative agreement with the NSF to provide directory and database services to NSFNET and NREN users. Directory services are critical to NREN users, bringing together computer services, communications and information services. These services will eventually become an essential component of the evolving NII.

HIGH PERFORMANCE COMPUTING AND COMMUNICATIONS AND THE GRAND CHALLENGES

High performance computing and communications is driven by the recognition that creative applications of advanced computing and communications power will help in solving a wide range of scientific and engineering "Grand Challenges" -- some of the profound mysteries of nature and secrets of physics, the environment and human nature, whose solutions are vital to our nation's economic well-being and to human progress.

More accurate weather prediction and better understanding of global atmospheric and climatic changes, for example, might help prevent some of the catastrophic losses of life and property experienced in so many states last fall as a result of Hurricane Andrew and subsequent tornadoes. Research in this area could also lead to a deeper understanding of global warming and how it could be prevented.

Efforts, already under way, to map the human genome system could help pinpoint genetic conditions precisely, and perhaps lead toward prevention or remedy of many presently baffling diseases and illnesses. There are many other examples of applications that will have fundamental and far-reaching consequences for the American people, helping and enriching us in our everyday lives.

THE HIGH PERFORMANCE COMPUTING ACT OF 1991 HAS BEEN EFFECTIVE

The High Performance Computing Act of 1991 has resulted in significant new activities on several fronts. New funding has been provided through different government agencies for various groups, research centers and consortia, focusing particularly on Grand Challenges applications. Progress is reported also in new software applications and in scalable high performance systems.

The federal government should continue to spur development of the national high performance computing and communications network toward research efforts that best serve national interests and, under the 1991 Act, such efforts are already under way. The four pre-production testbeds for new technologies and applications, for computer and

network interworking, and for testing of ways to design products that customers will find simple and easy to use are promising objectives

Research funds should be directed toward development of critical pre-competitive technologies and applications, with the active collaboration of both large and small companies in the computer, communications and information industries. The focus for such research efforts should be on those technologies where commercial applications appear promising but too distant to warrant investment by the private sector alone.

Over many years, particularly through the federal laboratories, government has sustained a large defense research effort, and continues to do so. To capitalize on its investment and to make the most of federal research under the High Performance Computing Act of 1991, important attention should be given to technology transfer and dual-use technologies. This is particularly so during this time of transition for many of these laboratories.

The benefits of a national initiative in high performance computing and communications go well beyond accelerating innovation and technology transfer. As noted in a recent report of the Computer Systems Policy Project (CSPP), an association of 13 U. S. computer companies, including AT&T, the federal government's high performance computing and communications initiative can help spark the nation's economy, create jobs for American workers and give US. companies an edge to better compete internationally.

One of the key components of the high performance computing and communications initiative is the National Research and Education Network (NREN). The NREN concept reflects a goal of interconnecting research centers at major universities and supercomputing centers, to create a national networking resource for university, government, and industry researchers. Such a resource is deemed necessary to effectively

address the Grand Challenges. NREN has an R&D component through which industry and academia cooperate in test bed studies of gigabit-speed applications and networking.

The NREN also includes several national agency backbone networks, and we will focus briefly on one of those, NSFNET, which is funded through the National Science Foundation. NSFNET is the backbone of the Internet, a nationwide data network composed of various regional and local networks. The Internet furnishes electronic mail, file transfer, and remote log-in services to users, many of whom are directly involved in research and education. Originally conceived as a tool for researchers, the Internet is now rapidly expanding to serve commercial users, while the backbone still receives direct government subsidies. Third-party commercial information-services providers are also connecting to the Internet at an increasing rate.

A 1992 study led by Robert Aiken at the National Science Foundation notes: "...the model of NSFNET as a generic transit provider for the Internet is breaking down. Commercial network providers now offer inter-regional connectivity for traffic which does not comply to the NSF AUP...." The study further indicates that the NSF expects that, over time, network subscribers will increasingly bear their own costs as network connections become available from commercial telecommunications providers.

The NSF is to be applauded for recognizing the need to change current policy and for outlining a plan for such change. An NSF official has said that as soon as it is technically feasible to do so (when initial development of policy-based routing is completed), all routine (i.e., not supercomputer application related) research and education traffic and all commercial traffic will be moved from the NSFNET to commercial providers. Any appropriate subsidies should be provided to end users to alleviate any hardship resulting from this transfer.

In our view, the subsidy transition should be effected in a timely manner, and connections to the new NSF-subsidized very high speed backbone network services (VBNS) should be effectively limited to the four supercomputer centers mentioned.

The legislation introduced in the House and Senate last year, already reintroduced as part of a larger bill in the Senate this year and being considered for introduction by members of this Subcommittee and the parent Committee, extends the thrust of this initiative to demonstration applications beyond the original high performance computing legislation. The proposed legislation would support limited demonstrations in education, health care, libraries and manufacturing.

In our view, enhanced funding for these demonstration applications, while not high performance computing and communications, is nonetheless important to the future of NII. These demonstration applications can test areas such as network scalability, security of information, privacy considerations, integrity and robustness of networks and databases, simplified human-computer interfaces, interoperability standards, etc. This is a valuable use of government funds and we support it. It is critical, however, to add some additional context to these plans, particularly relative to the respective and joint roles of government and industry.

Federal policies play a crucial role in fostering a truly competitive NII environment, responsive to the needs of customers and the nation. The government itself can play several significant roles as:

- Leader - creating a vision for the nation and defining the national challenge;
- Innovator - investing in pre-competitive technologies and applications, and

supporting technology transfer;

- Motivator - providing incentives to industry to invest in research and development;
- Administrator - effectively administering government-controlled resources (such as spectrum) to enable and promote competition in the marketplace;
- Enlightened Regulator - limiting and focusing regulatory measures so as to open all possible markets to competition -- particularly promoting competition at all levels in the telecommunications industry -- and eliminating unnecessary regulatory requirements which inhibit free-market competition;
- Facilitator - supporting the adoption of industry-developed interoperability standards;
- Protector of Innovation - setting limits on liability in targeted areas;
- Participant - supporting the inclusion of appropriate government information in databases and digital libraries; and
- Wise Funder - directing appropriate subsidies to end-users who can freely select services from the marketplace.

AT&T stands ready to work with the new Administration, Congress and the private sector to further the objectives of high performance computing and communications initiative and to advance the evolution of a truly competitive National Information Infrastructure.

ASSOCIATION OF RESEARCH LIBRARIES

Statement of the Association of Research Libraries
to the
Subcommittee on Science
Committee on Science, Space and Technology
for the Hearing Record of February 2, 1993
Regarding the High-Performance Computing Act of 1991

The Association of Research Libraries is a not-for-profit organization representing 119 public and private research libraries in the United States and Canada. The membership of ARL is actively involved in the provision of information resources -- including those that are unique, to the research and education community. ARL programs and services promote equitable access to, and effective use of knowledge in support of teaching, research, scholarship, and community service.

Implementation of the goals and programs as set forth in the High-Performance Computing Act of 1991 (HPCA of 1991) will have profound effects on the nature and operation of research libraries, thus research and scholarship in the years ahead. The work of this Subcommittee in providing oversight to this critically important endeavor is to be commended. How the HPCA of 1991 is implemented, and in particular, section 102, relating to the establishment of the National Research and Education Network (NREN) is integrally linked to how researchers, scholars, and citizens will communicate, conduct research, and participate in our democratic form of government in the future.

This statement will focus on three NREN-related issues before the Subcommittee including:

- selected activities in research libraries that reflect the changing nature of communication and the research needs of users;
- characteristics and information policy issues relating to digital libraries; and
- possible new directions and research projects for federal agencies to consider during the implementation of the HPCA of 1991.

There are a host of activities underway which are defining, redirecting, and providing a new appreciation for how the research and education communities will benefit from and utilize network-based information resources in the future. Research libraries have taken a leadership role in stimulating and promoting networked-based initiatives to advance access to information resources in support of research and education. Libraries are participants in numerous experiments and pilot programs that demonstrate the utility of high capacity networks for the exchange and use of information for all disciplines.

*This statement is based in part on joint ARL/Computing Research Association statements and position papers on related issues.

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This participation is based on the fundamental premise that research libraries with other partners in the research and education community, federal, and private sector have a role and responsibility in the building and evolution of the NREN and the national information infrastructure.

Selected Networked Based Activities in Research Libraries

ARL recently conducted a survey to provide a snapshot of ARL libraries activities considered key elements of a research library of the future including digital libraries that are elements of the virtual library -- electronic document delivery, electronic journals, full text database access, network access, and the like. The virtual library refers to the research library of the future, the library without walls where users will have access to resources without regard for physical or geographic location. The survey found that a large number of institutions are making "notable commitments to electronic networked systems and services." For example, 85% of the respondents are using or developing electronic document delivery services and 66% are providing access to electronic full text.

The speed with which research libraries are incorporating aspects of the virtual library into their operations can be attributed to numerous factors -- new opportunities and services resulting from computer and telecommunications investments and programs, changing user information needs and requirements, increasing reliance upon electronic resources, shrinking budgets, the rising cost of journals, and more.

The vision of the electronic library as stated by Meredith Eutler (Dean and Director of Libraries) and Timothy Lance, (Associate Vice President for Information Systems and Technology) University at Albany, State University of New York, is compelling. "Our goal is a technologically advanced, flexible facility bringing together all of the University's information resources, and enhancing the capabilities of each. It will offer every member of the University and the community a powerful, user-friendly environment in which information may be created, stored and distributed electronically, accessed in multiple formats easily. Planning for the electronic library assumes a wide-band national research network and regional and campus networks, all operating at speeds beyond those currently achieved."

Examples of existing projects that will be accessible to users of such a facility include the following:

•The North Carolina State University Digitized Document Transmission Project is a national research initiative that utilizes the Internet for the transmission of digitized texts and images. Scanned images are transmitted to libraries, researchers' workstations, and agricultural extension offices. Collaborating on this project are 14 land-grant university libraries in 11 states.

•A joint project between the Iowa State University Library, University of Wisconsin, the University of Minnesota, and Indiana University seeks to enhance access to resources via the Internet in the interdisciplinary area of biotechnology. This

project was developed to address the increasing reliance by researchers on the Internet to communicate and access needed resources yet the existing network environment does not support effective access.

•The Electronic Text Center and On-line Archive of Electronic Texts at the Alderman Library, University of Virginia is an example of a networked-based initiative that seeks to address the information needs of selected users or disciplines. One goal of the Center is " to help create a new broad-base user community within the humanities at Virginia. The initial set of on-line texts includes the new Oxford English Dictionary; the entire corpus of Old English writings; selected Library of America titles, several versions of Shakespeare's complete works; hundreds of other various languages (chiefly from the Oxford and the Cambridge text Archives); and the currently released parts of two massive databases from Chadwyck-Healey: J-P Migne's Patrologia Latina, and the English Poetry Full-text database, comprised of the complete works of 1,350 English poets from AD 600 to 1900." One goal of the Center is to provide a model for other institutions interested in establishing new facilities for teaching and learning.

•PENPages, a computer-based information service, is available 7 days a week without fee to the offices and staff of the Cooperative Extension Program in 67 Pennsylvania counties, to farmers, businesses, schools and members of the Pennsylvania State University community. Information included in PENPages includes consumer education, food safety, forest resources, nutrition, pesticide education, plant pathology, water quality, commodities prices, and plant pests alerts.

•The Economic Development Information Network or EDIN, a collaborative effort between Pennsylvania State University, the Pennsylvania State Data Center, and the Institute for State and Regional Affairs, provides access to bulletins and new releases, issues of *Commerce Business Daily*, directories of economic development centers and agencies, database files pertaining to demographic and economic data, and more.

•University Libraries at Virginia Polytechnic and State University publish two electronic journals and the North Carolina State University Library publishes *Postmodern Culture*, a scholarly, refereed electronic journal produced by English faculty on campus.

Information Policies and Digital Libraries

These projects provide a sense of the changes that are occurring in how people use information in a network environment and also give rise to a host of information policy issues that will require consideration as virtual and digital libraries are created and utilized. The projects described contain many common characteristics. First, be it for a specific discipline or for entire communities, they were designed with the goal of improving the user's access to resources, utilizing information technologies in an innovative manner with an emphasis on ease of use. Second, these projects are designed with the recognition that digital libraries are substantially different and are an *extension* of existing libraries and library functions.

Characteristics of digital libraries that represent this new extension include:

•size -- the total of all printed knowledge is doubling every eight years and many research databases dwarf past information collection;

•manipulatable -- the use of an electronic digital format means that data of any kind can be potentially communicated, analyzed, manipulated, and copied with ease;

•mixed media -- the digital library will consist of multiple forms and formats of information including images, sounds, texts, computer programs, or quantitative data;

•distributed -- the digital library is not a single entity, database, in a specific geographic location. Instead it consists of resources that are constantly changing and available on a distributed basis. The evolution of the digital library and its distributed nature are fundamental characteristics relating to the value of the digital library to the user;

•accessibility and interactivity -- digital libraries will be accessible to new communities, a wider-range of users, and this in turn, increases the value of the digital library through the availability of new research and new knowledge. This latter point refers to the interactivity between the user and digital library.

Creation of digital libraries will likely exacerbate a number of existing information management and policy issues and will require additional research to resolve problems that may thwart progress. Many if not all of the information policy issues requiring attention are not new. Instead, the nature of the technologies either exacerbates existing tensions (e.g copyright) or presents new questions and opportunities to rethink existing practices. These issues range from the need to develop standards and protocols as they affect the usability of electronic media to copyright and intellectual property issues in a network environment.

For example, the success of digital libraries will be determined by the ability of the researcher to easily make use of a host of resources located in a variety of settings. This will require the development of standards, common formats, and controls that will permit the user to identify, locate, and access needed resources in a consistent fashion. Managing network access to electronic resources calls for the development of new standards by librarians working together with research users, and information scientists to fully realize the benefits of digital libraries. Addressing these pressing issues in a coordinated fashion will be necessary.

There are many ongoing federal activities that may act as points of departure. One such approach is the "life cycle " concept to information in which consistent standards are employed from the creation of a datafile to ensure conformity of structure and access. A federal effort, the draft national spatial data standard is illustrative. The goal is to set a common spatial data standard that will be employed by government agencies at all levels and by private and other public entities. If successful, researchers will be able to identify and utilize data in a common format regardless of discipline. In a digital library environment, the benefits to the

researcher are enormous. This federal effort may be one to emulate in other arenas to evaluate its usefulness and applicability to other disciplines.

Standards and protocols will also be needed for those users of digital libraries who may lack the needed skills to effectively utilize the networked environment and who may not have a librarian to call upon. As in today's environment, librarians will be both intermediaries as well as facilitators -- ensuring that communications and access channels for users are available without barriers, either technological or financial. The creation of digital libraries will not diminish the role of libraries. Instead, the growth of information and the need to provide more user-friendly pathways will require additional support. Pathways to accommodate the differing skills levels and an infrastructure that includes support services, training materials, workshops, help lines, and the development of documentation will be essential. Some facets of the recent NSF National Information Services contracts will begin to address these issues.

Other information policy issues that require consideration in a digital library environment include issues relating to freedom of expression, intellectual property, access, privacy and confidentiality, security concerns that include the integrity and reliability of the data resources, and the preservation and archiving of data resources.

Libraries are constantly faced with defending the right to the freedom of inquiry and expression. The key elements to freedom of expression include the right of access to information and the role of government in assuring broad and equitable access to information; the right to confidentiality of access that refers to the assurance that a user's information needs and uses are private and are treated with confidentiality; and the right to expression of ideas which can in an electronic environment, either be enhanced or restricted depending upon how the technology is utilized.

Although there are technological solutions that can *promote* privacy protections, reliance upon technologies is not sufficient. Principles governing uses of the network should be formulated and network practices clearly articulated. An appropriate starting point are current library principles and practices such as in the Library Bill of Rights and policies relating to confidentiality of library records.

Security issues entail both ensuring both the "safety" of the physical network and the integrity and reliability of the resources available through the digital libraries. Projects such as the Knowledge Management System (Mathiason and Lucier) are designed to constantly change and reflect the most current research and evaluation data. Researchers comment online to research findings and the "text" is changed accordingly. In this environment manipulation of the information is a fundamental element of the research process, but it also poses questions regarding the ability to change data and thus potentially challenge the reliability and integrity of the database.

Copyright issues have always required a thoughtful, carefully balanced, and mediated review with the introduction of new technologies. The extraordinary growth and use of networks in such a short span of time has placed new pressures

on the intellectual property system, and may require revision to existing law or practices at some point in the future. The ease with which one can make digital copies of an article or datafile is the chief concern. The vision of the digital library, access to the content of resources without regard for location and format, has fueled a sense in some that there is an immediate need for a recasting or rethinking of the copyright law. But it is too soon. The concept of digital libraries and in fact, the experience in many pilots and networked-base projects, is that the Internet/NREN signals that new formulas, (e.g. new electronic journal publishing ventures), arrangements, and relationships will emerge. More time and experimentation are needed so that these projects can flourish -- many are already demonstrating new uses, opportunities, and challenges of the changing system of scholarly communication.

In the current environment, there is a broad public consensus among users and publishers that there should continue to be protection of copyrighted materials. There is also an appreciation that a robust market for networked information and resources is fundamental to the success of the NREN and the evolving national information infrastructure. The challenge will be to determine at what point the concept of digital libraries has become a "reality," and modifications to existing law may be appropriate.

And finally, recent Court decisions relating to access and availability of government electronic records, underscore the need for rules and regulations that govern their preservation and disposition. Building in archival and preservation concerns to existing network projects will be important.

Central to current activities and creation of digital libraries is the availability of and access to a high-speed, high-capacity network. In the past year, the National Science Foundation has through the recent awarding of contracts for information services and the upcoming NSFNET backbone solicitation, advanced the goals of the HCPA of 1991 by extending the capacities and capabilities of the NSFNET. These NSF activities are noteworthy and merit both support and additional attention. Providing additional support, both through appropriations and oversight, will serve the broad national goals as defined in the HPCA of 1991 and lead the way to the national information infrastructure.

Possible Directions and New Applications

To realize the goals of the HPCA of 1991 and the creation and utilization of electronic libraries, several new directions or increased emphasis on current programs could be considered.

First, the government could stimulate the development of electronic databases that support research and education, and support the development of sophisticated data management and searching software that will make the software accessible and usable by the research and education communities.

Information takes many forms; numbers, text, sounds and images; and, in some cases, a properly integrated database could potentially contain a multiplicity of

forms and media. Some of the databases are very large and growing rapidly, containing many trillions of items of information. To make it available via the network can be a significant research and development problem, involving the creation of new data structures, memory technology, standards, and searching techniques.

Much of this research data is Federally owned or controlled, making it ideal material for experimental projects. Furthermore, since the data is in the public domain, intellectual property problems will not interfere with or confound the research results. Finally, with the increasing use and reliance upon information technologies by federal agencies, it will be important to provide an additional dissemination channel for effective, equitable, and timely access to federal information resources.

A series of major development and demonstration projects aimed at creating information resources to be accessible to the research and education community over the NREN is needed. These could also include projects that promote the use and dissemination of federal information resources via the Internet.

These projects would focus on experiments involving a broader community of users and a broader range of applications drawn from research, education, public health, and public information. They should also concentrate on leading edge, gigabit-speed communication services and on the use of high-end, but commercially attainable technology to provide innovative new information services. Finally, these projects would include a broad range of information resources and datafiles to experiment with the utility of distributing different datafiles over the NREN and Internet. It will be important to test and evaluate which datafiles and databases may or may not be suitable (with existing technologies) to network distribution. It may be more effective for example to ship a tape of remote sensing data in lieu of network distribution for reasons of size and structure.

The projects would have the combined goals of:
- providing new, sophisticated user services on the NREN;
-developing new technologies for managing and searching electronic information;
- demonstrating the benefits of such services to the larger public;
-evaluating the capacities of the Network for disseminating differing types and sizes of datafiles.
-experimenting and evaluating archival and preservation needs in an electronic environment.

Examples of projects might include:
• Create National Information Centers (NICs) for environmental resources, agriculture, and geographic spatial data.

• Fund multimedia projects that explore provision of electronic access to collections and materials generally inaccessible in the past, but of high research value, including photographs, drawings, films, archival data, sound recordings, spatial data, sound recordings, written manuscripts, and more.

• Promote among Federal agencies the use of NREN as a general gateway to their electronic information dissemination projects, datafiles, and bulletin boards, and develop the necessary indexes and inquiry tools to encourage access.

Second, despite its rapidly growing popularity as evidenced by the growth of use, principally among scientific researchers, the NREN remains a challenging technology to use for non-experts, particularly as they try to move beyond e-mail applications. Furthermore, as more resources are put online, in part due to projects such as those suggested previously, the Network will become more complex and will be accessed by users who are less sophisticated technically.

It will be critically important that the NSF with the Department of Education support programs that are aimed at all levels, from elementary school to adult and are intended to help librarians, educators, and users alike, make effective use of the information resources on the network.

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February 12, 1993

The Honorable Rick Boucher
Chairman, Subcommittee on Science
Committee on Science, Space, and Technology
U. S. House of Representatives
Washington, D. C. 20515

Dear Chairman Boucher:

In response to your gracious invitation to witnesses at the February 2, 1993 hearing on high performance computing and networking, I am writing to provide additional information and more specific recommendations for the hearing record.

First, you asked about the pricing of government information, and about the role of the private sector in the dissemination of federal government information. ALA believes that the federal government has an affirmative obligation to disseminate government information in usable forms through existing depository library programs for free public access, and beyond these, for the government to make its information available at no more than the incremental cost of distribution.

The private sector can play an important and useful role in taking publicly available government information, adding value, and creating marketable products and services. However, ALA believes it is not in the public interest for government agencies to enter into exclusive arrangements with private sector entities for the dissemination of agency information collected and organized at taxpayer expense. Pricing geared to secondary distributors instead of the needs of end users, cream skimming of marketable information, contractor copyright of government databases, lack of stability of vendors, and a lack of incentives for preservation and archiving are among the problems which can result.

For additional information on this subject, I have enclosed a Resolution on the Right to Federal Government Information, adopted by the ALA Council on January 27, 1993.

I am pleased to provide more specific information concerning our recommendations for an NREN applications bill, building on last year's Information Infrastructure and Technology Act.

1) We recommend a new section: Applications for Government Information. Suggested language, background, and rationale are provided in an enclosure.

2) We recommend a modification to the Applications for Education section in order to make clear that pilot projects for primary and secondary schools may include:

- projects which involve school and public library cooperation;
- state level projects involving state departments of education and state library agencies; and
- projects in which public libraries use the network for support of students and school-related activities.

3) We recommend a modification to the Applications for Libraries section to specify that the development of digital libraries include:

- pilot projects in the conversion of library resources to digital formats;
- education and training programs; and
- development of an integrated approach to organizing and locating electronic information resources.

ALA has also collaborated with organizations addressing related issues in more detail. We commend to your attention the supplemental comments or statements for the record of the Association of Research Libraries, the Computing Research Association, and EDUCOM.

It was a pleasure to appear before the Subcommittee on February 2, and I thank you for the opportunity to elaborate on my testimony.

Sincerely,

Sara A. Parker/CCH

Sara A. Parker
Commissioner of Libraries
Pennsylvania Department of Education
Representing the
American Library Association

SAP/pm

Enclosures (2)

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RESOLUTION ON THE RIGHT TO FEDERAL GOVERNMENT INFORMATION

WHEREAS, A democratic society depends on equal, ready, timely, and equitable access to government information, regardless of format; and

WHEREAS, In the past decade, a combination of specific policy decisions, interpretations, and implementation of the Paperwork Reduction Act and other statutes; OMB Circular No. A-130; and agency budget cuts have significantly limited public access to government information; and

WHEREAS, These government policies and actions have resulted in privatization and commercialization of information dissemination by government agencies, curtailment of government collection of statistics and technical data, excessive use of security classification and restrictions on access to unclassified information, restraints on scientific communication through export controls, narrow interpretations of the Freedom of Information Act, and unwarranted government secrecy; and

WHEREAS, The American Library Association has a long record of action in support of public access to information collected, compiled, producedj and disseminated by the government of the United States; now, therefore, be it

RESOLVED, That the American Library Association urge the President of the United States and Congress to take immediate action to:

- affirm a policy that ensures equal, ready, timely, and equitable access to information, regardless of physical form or characteristics, by and about the United States government;

- disseminate government information in whatever format is most appropriate, most cost effective, most timely, and most useful for government agencies, libraries, and the general public, including through an electronic gateway at the Government Printing Office;

- ensure that the government collect, compile, coordinate, maintain, and disseminate accurate and timely statistics in consistent categories to enhance the economic, educational, scientific, technological, social, and cultural welfare of the public;

- ensure that standardized, comprehensive, up-to-date bibliographic locator tools for government publications, records, and databases are widely available through nationally recognized databases and library networks, as well as in print formats, so that the public can identify needed government information;

- strengthen the Depository Library Program, particularly by including electronic formats and online access;

- ensure that government information products and services include indexes, software, and documentation needed to facilitate their usefulness;

- limit the price of government information products and services to no more than the incremental costs of distribution, and exclude the cost of collecting, organizing, storing, and preserving government information;

- prohibit copyright of all works of the United States government, and prohibit any royalty-like fees for redissemination of government information;

- recognize that electronic records are covered under the Freedom of Information Act (FOIA), and require agencies to make reasonable efforts to provide records in the format requested;

- grant no FOIA exemption to agencies for national security, law enforcement, or financial-institution purposes unless proof is provided for demonstrable harm that outweighs the public interest in disclosure;

- impose FOIA fees only on those requestors who seek information solely for private commercial uses, and automatically grant FOIA fee waivers to libraries, educational institutions, nonprofit researchers, authors, public interest groups, and depositories of public records;

- ensure that agencies comply with the ten-day statutory response time limit for FOIA requests;

- reduce drastically the scope of secrecy within the federal government by reviewing all forms of security classification in the agencies of the government, instituting a systematic declassification system to ensure future public access, and prohibiting restrictions on public use of government information solely on the basis that it is sensitive but unclassified;

- appoint a blue ribbon commission to recommend changes in federal policies that were promulgated during the cold war and that inhibit the free flow of ideas;

- protect the privacy rights of individuals and groups from unwarranted government intrusion;

- ensure that federal information systems include provisions for archiving and eventual public access; and make special efforts to archive and preserve current electronic systems which may lack these features;

- designate federal library operations as inherently governmental functions and remove them from the OMB list of commercial activities;

- appoint federal officials who support and promote policies that ensure public access to government information—especially in the National Archives, the Office of Management and Budget Office of Information and Regulatory Affairs (OIRA), the Justice Department offices with jurisdiction over FOIA, and the Government Printing Office;

and, be it further

RESOLVED, That the American Library Association send copies of this resolution to William Jefferson Clinton, President of the United States, and the Members of Congress.

Adopted by the Council of the
American Library Association
Denver, Colorado
January 27, 1993
(Council Document #27.3)

RECOMMENDATION FOR NEW SECTION
IN NREN APPLICATIONS BILL

APPLICATIONS FOR GOVERNMENT INFORMATION

(a) The National Science Foundation and other appropriate agencies shall provide for the development of high-performance computing and high-speed networking technology for the purpose of providing timely, equitable, and efficient public access to federal, state, and local government information. Such applications shall include but not be limited to the following:

(1) Pilot projects that connect government information depository libraries to the Internet and the National Research and Education Network to aid in development of software, hardware, and training materials needed to enable use of networks for--

(A) access to federal government information and databases increasingly available only in electronic formats;

(B) access to state or local government information;

(C) access to related resources which enhance use of government information; and

(D) linkages among government information depository libraries and other libraries and institutions to enhance use of government information;

(2) Pilot projects that use technology to increase access to and effective use of government information and databases for support of research and education, economic development, and an informed citizenry; and

(3) Pilot projects that use technology to increase access to government information and foster community networking in rural areas.

(b) There are authorized to be appropriated to the National Science Foundation for the purposes of this section, $10,000,000 for fiscal year 1994, $20,000,000 for fiscal year 1995, and $30,000,000 for fiscal year 1996.

BACKGROUND FOR NEW SECTION

To serve agency missions and public purposes, governments at all levels collect, organize, and disseminate enormous amounts of information which comprises a valuable national resource. Government information is absolutely basic to research in every field, as well as for education and training, economic development, social well-being, use by government entities other than the agency producing the information, and full participation by citizens in a democratic government. From census data to geographic information systems, from weather data to information on crops, from industry statistics and marketing information to medical and scientific databases, from laws, regulations and RFPs to the latest legislative developments, government information is essential to the workings of modern U.S. society.

Much government information formerly published in print formats is now available only in electronic form. Some types of government information such as tabular data and statistics, can be

most usable in electronic formats. Time sensitive government information can be most efficiently disseminated in online form. The NREN should be a primary mechanism which the federal government uses to provide access to and delivery of federal information, and this flow should be integrated with networked public information arising from the activities of state and local government.

DEPOSITORY LIBRARY PROGRAMS

The federal depository library program is a system of 1,400 depository libraries, including state libraries, those at land grant institutions, law school libraries, libraries of federal agencies and military academies, certain state court libraries, and public, academic, research, and other libraries designated by Congress in each state and congressional district. Administered by the Government Printing Office, the program was established by Congress and dates back to the nineteenth century. GPO distributes government information at no cost to designated libraries to ensure that (with certain specified exceptions) all government publications are widely available for the free use of the general public.

In return, depository libraries commit to house, organize, provide free access for the general public, and assist the public to use government information. Libraries provide the staff, reference services, cataloging, shelving or other storage equipment, binding, reading and copying equipment for microforms; and more recently, computers and computer workstations, staff and training to help the public use information in electronic formats.

The Association of Research Libraries recently conducted a survey of its 93 U.S. depository members. The survey found that each regional depository library invested approximately $305,000, and each selective library provided an estimated $280,000 in FY 1991-92 in support of the federal depository library program. These figures do not include facilities management, overhead, or storage costs. The 21 regional libraries responding answered on average more than 26,000 reference questions and circulated more than 19,000 items to other libraries in their states. Five libraries reported circulating an average of 44,000 items per year.

Regional depositories (currently 53, approximately one per state) must receive and retain all non-classified government information available via the depository program, and assume additional responsibilities within their region for interlibrary loan and reference and other assistance. Selective depositories may choose certain classes of information to receive, depending upon the needs of their user communities.

The GPO Depository Library Program provides for a convenient, equitable, widely dispersed system for public access to government information collected, organized, and disseminated at taxpayer expense. Government information of public interest should be disseminated through this long-standing system by whatever means the information is publicly disseminated by a government agency. Beyond providing for public access through depository programs, government information should be available in usable form at no

more than the incremental cost of distribution to users, institutions, and the private sector.

Other federal agencies operate specialized depository library systems; examples include the Environmental Protection Agency, the Nuclear Regulatory Commission, and the Patent and Trademark Office. Depository libraries are intensive users of and customers for other federal information dissemination mechanisms, such as the Commerce Department's National Technical Information Service. In addition, depository libraries purchase additional copies of heavily used government information materials, and purchase from the private sector value-added versions of certain government information, and indexing tools and other products and services which enhance access to government information.

RATIONALE

Applications for government information in the proposed legislation would carry out an explicit provision of the High-Performance Computing Act, which states in section 101(a)(2)(E) that the National High-Performance Computing Program shall "provide for improved dissemination of Federal agency data and electronic information." Further, OSTP is given responsibilities in coordinating the activities of appropriate agencies and departments to promote the development of information services that could be provided over the network, including "data bases of unclassified Federal scientific data." H. Rept. 102-66, Part 1, elaborated:

> The intention is that both federally generated, unclassified data bases, as well as data bases and services from private sector sources be included...
>
> The types of unclassified federal data bases available on NREN are not specified in the bill except for scientific data bases, which in general are intended to be accessible. The bill neither requires nor forbids any agency or department to develop or disseminate to the public any particular information product or service. The Committee expects information services to be provided by agencies in accordance with applicable federal statutes, regulations and directives governing information dissemination activities. (pp. 23-24)

The NREN was established by the HPCA to provide access to computer and information resources. The information resources of federal, state, and local government agencies should be among the first resources to be made available. A logical and affordable place to start is to link the mechanism--the NREN--to the existing partnership between the federal government and depository libraries for public access to government information.

INTENDED RESULTS

The intent of the proposed new section is to extend to key depository libraries the NSF Connections Program which supports first-year start-up costs for full node network connections. First priority might be given to those regional depository libraries which are not yet connected, and to depositories in areas with little connectivity. Such increased connectivity for depository

libraries would dovetail nicely with other recent or pending activities such as the NTIS FedWorld pilot project for electronic access to federal bulletin boards, and the GPO WINDO/Gateway/Access legislation for federal database access.

Since electronic government information could theoretically be accessible from any point, why libraries? Among the reasons: libraries provide access sites for those who do not otherwise have the equipment or connectivity; libraries provide professional assistance for those who need personal help with equipment, software, use of information resources, or with navigating the network; libraries are sources of and developers of information resources which may be used in conjunction with government information; libraries are the connections between electronic information and hard-copy resources; and libraries are the training centers for the "electronic citizenry."

Pilot projects would foster creativity in solutions to the challenge of developing more efficient dissemination mechanisms and fostering use of government information in the electronic networked environment. Such projects should be planned for replicability and for use as models; implications of many projects would be expected to extend beyond government information. Examples of possible projects: Exploration of new kinds of electronic networked assistance by regional depository libraries to other libraries and users of government information in a state or region; models of how state government information could be widely disseminated within a state and shared by other states; development of improved software for community and civic networking to serve the needs of urban, and of rural and sparsely populated areas; development of a network of computerized community information and referral, social services, employment and training services, and commerce and business information files maintained by public libraries.

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February 12, 1993

February 2, 1993

Congressman Rick Boucher, Chairman
Subcommittee on Science, Space and Technology
U. S. House of Representatives
Room 2320
Rayburn House Office Building
Washington, DC 20515

Dear Congressman Boucher and Committee members,

Thank you for the opportunity to submit this written testimony on the federal High Performance Computing Program (HPC). I represent two organizations very concerned about the need for involvement of K-12 education in the HPC's National Research and Education Network (NREN) initiative. These organizations are the Consortium for School Networking (CoSN) and the Texas Education Network (TENET).

The CoSN is a non-profit institutional membership organization chartered to promote the use of national and international electronic networks as a means to support school reform efforts and garner resources for K-12 educators and students. Its membership includes State Departments of Education, school districts, professional educational organizations, universities, state and regional networks, NSF regional networks, and members of the private sector. The Consortium supports the use of computer networks to help educators and students use information and communications resources to increase their productivity, professional competence, and opportunities for learning and collaboration.

The Texas Education Network (TENET) is an Internet-based, state funded computer network linking more than 18,000 K-12 educators in the state of Texas. The network reaches more 90% of 1,058 school districts which serve the 3.2 million students in Texas. TENET, designed and operated by The University of Texas at Austin for the Texas Education Agency, was the result of strategic planning for a communications infrastructure to support needs of K-12 education and the desire of the Texas State Legislature to be responsive to those needs. TENET and the Texas Higher Education Network (THEnet)

have created a synergy among other government agencies resulting in desire for additional connectivity while realizing significant cost savings for the state. It has enabled collaboration among all sectors of the government including health care and education agencies.

The NREN initiative has already been the catalysis of greater collaboration between government entities -- both state and federal. However, absent from the initiative has been a clear, inclusive structure which facilitates broader participation and input from multiple sectors of the community. In addition, funding levels for the current fiscal year have not been sufficient to see the connectivity include the broader population of the educational community.

By establishing the NREN, researchers, educators, students, scientist and community members will have access to a wealth of resources as they collaborate with each other. The school environment is an amazingly self-contained, isolated one. It is has a culture which limits interaction between students and teachers in different classes and grade levels. The classroom has historically isolated teachers who infrequently interact with their colleagues within the same campus and with other adults outside the building. Wide area networks like the NREN can break down the classroom walls, giving students and teachers access to resources both within and outside the educational system not available to them before. For example, in Texas at Fredricksburg Middle School, children are learning how science lessons apply to the real world. Kirk Beckendorf, a middle school teacher, commented that about 20 scientist agreed to communicate with his students and answer their questions via e-mail. He said, "This has been very successful, you can literally see the students self esteem and interest in science expand when they receive a personal reply to their question from a scientist."

The Information Infrastructure and Technology Act introduced in the 102nd Congress offered the potential to develop more inclusive applications. As new legislation is drafted we urge you provide the necessary monetary and legislative support which will enable the K-12 community to be included. It is imperative that the barriers, issues, and needs which concern this community be considered. Clearly, there exist a need to align federal, state, local and private sector resources to achieve a national communications infrastructure. These resources should target models that exhibit interoperability and demonstrate the ability to scale as the larger segments of the population begin to integrate information technologies in their workplace.

The K-12 community has traditionally not been a consumer of communications technologies. This is due in part to a number of barriers that were present. These barriers include the lack of access to phone lines and computing equipment, numerous standards and protocols, cost and price structures that were not consistent with the needs of education, the lack of

training and support, and the lack of an intuitive user interface. What is more important, there was a lack of an understanding of the benefits of telecomputing to K-12 education. Historically technology has been introduced without consideration given to the educational outcomes. Even where there has been statewide support, the absence of understanding the educational benefit has been a major barrier to acceptance and use. Kurt Steinhaus of the New Mexico Department of Education recently noted, "My theory is that the lack of access has to do with the whole concept of systemic change. The introduction of new technology in isolation is not acceptable."

A National Information Infrastructure designed with a comprehensive approach is imperative to the success and early adoption. The success seen in the rapid growth of the Texas Education Network exemplified the State' commitment and investment of leveraging state and local moneys. Moreover, this network has been open to the needs of the entire community supporting K-12 education. My colleagues in other states such as Virginia, California, New York, and Florida have witnessed similar growth as they have adopted the Internet as a common standard. Extrapolating from what has happened at the state level, there is a need for a clear systemic approach to the design and implementation of the National Information Infrastructure.

The Consortium for School Networking and the Texas Education Network believe that the federal government role is to provide pilot money to expand network models that will addresses the issue of how to scaling or grow the network, provide a means for coordination of policy issues and standards, and establish a growth path were we can move from isolated, scattered efforts to a true National Information Infrastructure.

In this effort Congress has a pivotal role to play in addressing these issues. These early hearings by the 103rd Legislature recognizes how important this issue is. We support the efforts that your committee has taken to initiate this hearing and hope to offer assistance in the future.

Sincerely,

Connie Stout

Connie Stout
Director of the Texas Education Network
Chairperson of the Consortium for School Networking

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