

The National Research and Education Network: An Idea Whose Time Has Come

ABSTRACT: The National Research and Education Network (NREN) is a government sponsored network to consolidate the many regional, national, and international networks that currently exist. A unique aspect of this network is that it is planned to provide communication facilities not only to scientists and faculty, but to the general public as well. Cooperation of industry and the Federal government is of critical importance in this venture since the initial financial outlay for startup will be enormous.

The NREN has been partially implemented through NSFNET. Government legislation has been proposed, but not yet fully implemented to provide funding for this project. The federal government has not yet provided an organized plan for the NREN, but has created objectives for the network and has labelled this agenda the National Information Infrastructure.

Many uses exist for the NREN. Distance learning, cooperative research, life-long learning, and easier access to information are only the beginning. As more people use the network, additional uses will be discovered. Information Systems educators have a chance to introduce their students to the vast amount of information available through the international system of networks and to instruct them in the use of this technology.

Educators need to do their part to encourage legislators to support this endeavor. Educating the public and making their voices heard will help to ensure that the future will bring the kind of information highways needed for the 21st century.

INTRODUCTION

The National Research and Education Network (NREN) is the answer to the needs of many scientists and faculty for a seamless network, connecting researchers with similar interests worldwide. A proliferation of networks and the increasing need to access information has sparked interest in such a network. Vice-President Albert Gore has been instrumental in introducing legislation to fund this project.

The purpose of this paper is to describe the NREN, its origin, and aspects of its implementation. Legislation proposed in relation to the network will be discussed as well as academic uses for this network by IS educators. Finally, sources for funding and a timetable for implementation of such a network will be presented.

Description of the NREN

The NREN is a high-speed, digital network which will join existing regional, national, and international networks. It is the infrastructure for high-speed communication nationwide (1). The NREN is part of the National Information Infrastructure (NII) as defined by the Clinton administration (2). Components of the infrastructure include the physical network, information and software available over the network, and any required support services.

The National Science Foundation Network (NSFNET) is the precursor to the NREN. The NSFNET was established in 1984 to provide high-speed communication among supercomputer centers (3). This network is currently the backbone for the Internet, a collection of over 16,000 networks in 90 countries. The networks which comprise the Internet use the Transmission Control Protocol/Internet Protocol (TCP/IP) communications protocol (4). TCP/IP was originally developed for use on the Advanced Research Projects Agency Network (ARPANET) in 1969, which was the government's first venture into national networking.

As evidence of the demand for an advanced, high-speed network, there has been a 20 to 25 percent monthly increase in usage on NSFNET (1). NSFNET was developed in the 1980's as a backbone network to link supercomputers for research and development. The network is now managed by Merit, Inc. and provides commercial access to the Internet. In addition, the Internet, which connects 1.8 million host computers, has a 7.4% growth rate per month (5). Access to these networks is commonplace in academic environments, and their use is becoming increasingly important in the business world. A seamless method for access to worldwide networks is the ultimate goal of the NII and NREN.

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The need for information exchange extends from the academic and research communities into the commercial arena. Networks that operate on a for-profit basis are seen as essential to the existence of any national network. They are the link for delivery of information to the general public.

Proposed Uses for the NREN

The NREN will allow people in all parts of society to use information technology to communicate more effectively. Time and distance will cease to be major limiting factors in the design and implementation of research projects. The network will provide a way for information to be transformed from one medium to another, possibly even translating from one language to another. Numerous educational applications for the NREN exist. Many institutions will benefit from a connection to the NREN because it will provide access to national networks. The Internet has been inaccessible to many non-research institutions because of the cost of the connection. Having such access may improve instruction at these institutions. IS educators should be particularly interested in such uses of the NREN. It allows them to introduce students to applications of the technology they are learning. Studying the intricacies of the national network can provide a very interesting discovery process

for the students.

Another way to improve instruction is through distance education. Higher education is changing to meet different student requirements as the job market changes, and the demographics at our institutions change. Some traditional 18- to 22-year-old full-time students are being replaced by older, part-time students. For many of the latter, the traditional form of higher education is impractical or impossible because of financial or familial constraints. Many of the older students are gravitating to the IS area to pursue undergraduate or advanced degrees in computer technology in order to improve their job prospects. For these students, distance education can allow them to fit higher education into their schedules.

IS educators usually cannot attend as many conferences and workshops as they would like. Time or financial constraints prevent these educators from meeting face-to-face with their colleagues at other universities. The NREN will provide access to these colleagues and to their research. The network provides a means of disseminating ideas without physically travelling to meetings. Global electronic mail will be available on the NREN. Using this technology may enhance the research possibilities for IS educators.

An issue relevant to teaching is the rate of change of information. This is particularly true in the Information Systems area. Trying to stay current with technology is often the most time consuming activity in an IS faculty member's day. In order to keep up with changes, faster dissemination of information is needed. Learning should be an on-going process for both faculty and students. The lifelong learner will be the one who succeeds, not the one who leaves learning behind when he/she receives a college degree.

Another use for the NREN is its capability to establish the collaboratory as a viable research tool (10). This concept involves communication among people working in all fields and disciplines. A collaboratory allows many people access to an electronic version of a laboratory, in which the location of those participating in the experiments is unimportant. A benefit of this research environment is an increased growth rate in fields which up to this time had little involvement in information technology.

The IS educator can expand the idea of the collaboratory into an environment in which industry and academia cooperate in

sharing data. Research and consultation are high priorities with IS educators. These activities are crucial to staying current with the changes in technology that are occurring in the business world. The NREN can be a pipeline of information between educators and industry, a benefit to both in times of rapidly changing technology.

Finally, new technology offers new tools for teaching and learning. The classroom environment in which the lecturer stands at the front of the room is no longer the only option. Sound and image can be stored and replayed from remote sites, making instruction more interesting and challenging for students (11). IS educators have always been ahead of other faculty in using the available technology to teach, and the new network adds another tool to be used in teaching students about the availability of information worldwide.

Beneficiaries of the NREN

Communication networks such as NSFNET have traditionally been used by scientists and faculty. Research networks were established back in the late 1960s with ARPANET to serve the needs of these users. The revolutionary idea behind the NREN is that the sponsors see it serving scientists, faculty and the general public (12). All 50 states will have high-capacity access to the network. The connection may provide information on education, entertainment, banking, shopping, newspapers, and possibly even jobs. Access to the network is planned initially through schools, museums, public libraries and universities. Eventually fiber optic cable may be run to each home in the country to facilitate usage of the network.

The possibility of providing the wealth of information to the general public adds a new dimension to life-long learning. Educational uses for the NREN will be developed as the network grows. Every house that has a computer and a telephone can become a classroom, just as every home with a television can now receive educational programming and college courses. The home computer provides the advantage that connection to the NREN will provide access to international networks, expanding education into the global marketplace.

Implementation of the NREN

One component of the successful implementation of the NREN was thought to be the establishment of nationwide Integrated Services Digital Network (ISDN). The speed available on ISDN would have facilitated the high-speed data transfer which is an

ultimate goal of the NREN. Roadblocks existed to the acceptance of ISDN, however. Reluctance to ISDN was strong in business, since the installation of ISDN is quite expensive and existing data transmission lines were adequate for today's needs. Future expansion will need transmission lines which are faster and have the capacity to send more data than that available on current ISDN lines.

Even without the cost of implementing ISDN, estimates of the cost of the project run between \$50 billion and \$100 billion (2). The majority of the funding is expected to come from the private sector, with the government providing \$1 to \$2 billion. Most of the existing networks were funded by institutional or national sponsors with usage at no cost to users. Use of the networks was encouraged with no financial burden on the users. Budget cutbacks at the state and local levels have caused individual institutions to become involved in the funding of these networks. But even the financial help provided by governmental and educational institutions will not be enough to fund the NREN. The large price-tag on the NREN means that the government will need private sector help to implement the network.

The first contract under the government's NREN program was awarded to Sprint Corporation in August of 1992 (6). This was a \$50 million contract for Asynchronous Transfer Mode (ATM) services for a 45 million bit per second network. Initially use of the service was to be by the Department of Energy and the National Aeronautics and Space Administration (NASA). Unfortunately, the contract was rescinded by the General Accounting Office (GAO) (7). Sprint continues to be involved in the NII Test bed project to study high-speed technology (2).

The Internet provides a way to link individual networks, so its part in the new network is crucial. In order for the NREN to be successful, the capabilities of the Internet need to be improved (8). Improved technical coordination and management will be needed, with involvement from industry, the government and the academic community.

Legislation Affecting the NREN

A number of pieces of legislation have been proposed in support of the NREN. Vice-President Gore, in his capacity as a senator, was a staunch advocate of this legislation, and introduced many of the bills to the Senate in 1988. Gore is still very

involved in the government's plan to launch the NII. Although none of these resolutions has passed, the groundwork has been laid for the national network.

THE BILLS PRESENTED WERE (7):

S.1067	National High Performance Computing Act of 1989 (original version)
S.1067	National High Performance Computing Act of 1990 (second version)
S.1067	National High Performance Computing Act of 1990 (third version)
S.272	National High Performance Computing Act of 1991
H.R.3131	National High Performance Computing Technology Act of 1989
H.R.4329	American Technology Preeminence Act of 1990
S.1976	Department of Energy High-Performance Computing Act of 1989 (original version)
S.1976	Department of Energy High-Performance Computing Act of 1990 (second version)
S.343	Department of Energy High-Performance Computing Act of 1991

The debate over the NREN continues in the government. Who will have authority, where the funding will come from, what agencies will be involved, and the government's role in the nationwide network are issues to be resolved. For details on these pieces of legislation, see (9).

Timetable for the NREN

The growth of the NREN has been described in terms of the Four Stages of EDP Growth Model described by Richard L. Nolan and Cyrus F. Gibson in 1974 (1). The four stage model begins when networks were established, some 20 years after the introduction of the computer.

The first stage of NREN growth consists of network development in the 1970s. The networks available at that time were ARPANET, BITNET, and CSNET (BITNET and CSNET were combined into the Corporation for Research and Education Networking (CREN) in 1989). A majority of the problems which exist today with incompatibility exist because the data communications industry grew up in an atmosphere of competition, rather than one of monopoly (as in the case of voice communication). The lack of standards has resulted in the wide variety of manufacturers and types of networks, many of which

cannot talk to one another.

The second stage of growth of the NREN began in 1985 and continues today. This stage is characterized by 14 regional networks, NSFNET, and state and local networks. Many mature networks are now available and the technology is stable.

The year 2000 is seen as the advent of the third stage of growth. Reduced or controlled growth of the network occurs at that point. The NREN will be an established, worldwide research and education network by the turn of the century.

The final stage is seen as occurring in 2015. This is the mature stage, when the NREN becomes a public network.

CONCLUSION

The National Research and Education Network is the dream of many educators and researchers. It will provide much needed interconnection between a variety of networks, and access to those who have been excluded from national networks in the past.

The road to achieving a project of this size will not be easy. Lean economic times may cause the full implementation of the network to be postponed. But that is not necessarily a bad omen. Technological changes occur at such a fast pace, that a six month or one year delay may result in an improved network.

We must not be impatient. The need for the network is great, and it has much support. The academic community can band together and approach its government representatives, lobbying for passage of legislation to make this network a reality. As in any other matter of government intervention, the people need to make their voices heard in order to see some action occur. Our responsibility as educators is to see that information about the new network is disseminated and that our voices are heard in Washington, D.C.

REFERENCES

- Hall, S. C., "The Four Stages of National Research and Education Network Growth", *EDUCOM Review*, Spring 1991, pp. 18-25.
- Wilson, T. and Lindstrom, A., "Industry Backs Gov't Plan for Data Highway", *Communications Week*, September 20, 1993, pp. 1, 90.
- Bishop, A. P., "The National Research and Education Network (NREN): Promise

of a New Information Environment, *ERIC Digest*, Nov. 1990, EDO-IR-90-4.

- Lynch, D. and Rose, M. T., *Internet System Handbook*, Addison Wesley, 1993, p. 12.
- Robinson, B. "Internet's Business Degree", *Information Week*, August 30, 1993, pp. 17,18
- Messmer, E., "First NREN Award Will Vault Sprint to Forefront of ATM", *Network World*, August 24, 1992, pp. 1, 54.
- Messmer, E., "The GAO Overturns Energy Dept. NREN Award to Sprint", *Network World*, April 5, 1993, p. 2.
- Massey, W. E., "NSF's Role in the National Research and Education Network", *EDUCOM Review*, Summer 1991, pp. 34-36.
- McClure, C. R., A. P. Bishop, P. Doty, H. Rosenbaum, *The National Research and Education Network (NREN): Research and Policy Perspectives*, Ablex Publishing Corp., 1991, pp. 15-16.
- Wulf, W. A., "Government's Role in the National Network", *EDUCOM Review*, Summer 1989, pp. 22-26.
- Rogers, S. M., "Educational Applications of the NREN", *EDUCOM Review*, Summer 1990, pp. 25-29.
- Weingarten, F., "Five Steps to NREN Enlightenment", *EDUCOM Review*, Spring 1991, pp. 26-30.

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