

INNOVATIONS IN LIBRARY COMMUNICATIONS

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The library stands historically as one of man's most intriguing institutions. It has withstood centuries of neglect. It has been used as a yardstick against which to measure the degree to which a nation or city is civilized or cultured. The library has survived the conqueror's torch, and has persisted through long stretches of history when the annual accumulation of dust on the library shelves exceeded the weight of man's recorded intellectual output for the year. Frequently, the library has stood more as a status symbol or a sterile monument to man's past accomplishments than as a living and dynamic mechanism for the broad, effective dissemination of information and support of all kinds of intellectual endeavor. In short, the library has led a varied, sometimes interesting but most often dull existence over the centuries.

Today there is a new urgency and vitality in the library. Suddenly, the library is at the center of a great national effort to bend computer and communications technologies to better serve the full range of man's intellectual activities. History's dull and colorless container of books has become a glamorous, sought-after thing on which to lavish the most sophisticated technologies of the last quarter century. Our great national libraries, i.e., the Library of Congress, the National Agricultural Library, and the National Library of Medicine, backed by networks of smaller libraries, are in the forefront of the effort to channel technology to the solution of our pressing information problems.

President John F. Kennedy, speaking during National Library Week in April 1961, accurately summarized the current national attitude when he said: "Books and libraries and the will to use them are among the most important tools our nation has to diffuse knowledge and to develop our powers of creative wisdom." Our current developmental efforts are aimed at using technology to make the library a greatly more effective diffuser of knowledge and to turn our library resources into the backbone of a nation-

wide network to handle information in all forms for a variety of purposes.

This paper covers briefly some of the more important trends in library development, and then describes in some detail the programs underway at the National Library of Medicine.

There are unmistakable signs that our current efforts toward improvement of library and information services will lead to the development of a national information network. While technology is only now making nationwide information networks truly practically attainable, the concept of networks and cooperative communications is not new to the library community. For example, the Librarian's Convention in 1853 in New York City produced a strong plea for a system to exchange bibliographic data between governments and a "central agency" on each continent to negotiate such data exchanges. Although some progress has been made toward achieving these and other exchanges over the last century, we are only now reaching a point where we are moving seriously to mobilize our resources and technological skills for an all-out attack on our information interchange and knowledge diffusion problems.

The importance of information networks and libraries as national development objectives was heavily underscored during the last two years:

1. Speaking at the Conference on World Education in Williamsburg, Virginia, October 8, 1967, President Johnson stressed the need for providing the best library facilities in the world through exploitation of communications technology.

2. At the November 7, 1967, signing of the Public Broadcasting Act of 1967, President Johnson, remarking on the probable effects of information networks on the individual citizen, said, "I think we must consider new ways to build a great network for knowledge—not just a broadcast system, but one that employs every means of sending and storing information that the individual can use."

3. In August 1967, President Johnson established the President's Task Force on Communications Policy to conduct an in-depth study of U. S. telecommunications policies and legislation, and to suggest communications policies for the nation in the decade of the 1970's. Here again, the interest was on clearing obstacles to the implementation of national information networks.

Mr. Joseph Becker of EDUCOM, in an article entitled, "Information Network Prospects in the United States" published in the

January 1969 issue of *Library Trends* (XVII, No. 3), has summarized the current situation as follows:

Two developments are responsible for the trend toward greater inter-library cooperation. The first stems from World War II and the increase in government-sponsored research in science and technology. The second is evident in the changes in American education and culture that have occurred over the past decade and which have resulted in corresponding changes in the variety and quantity of published material. . . . Further, expansion of diverse information services in this country has taken place during the past two decades. The Government, for example, has established large-scale mission-oriented information programs at NASA, AEC, and in the Department of Defense, to make the fruits of government research more widely available. In the private sector, on the other hand, the development of discipline-oriented information systems was emphasized. . . . Another phenomenon has been the development of specialized information or analysis centers which serve as scientific middlemen to distill, interpret, and synthesize information in direct support of the working scientist. More and more, these organizations are producing machine-readable files, and efforts are underway to develop computer techniques for cross-accessing these data in order to satisfy a variety of interdisciplinary interests. The fact that the data are machine-readable increases their usefulness, because they are susceptible both to computer processing and to communications transfer.

The signs of activity aimed at developing a national information network are apparent everywhere. At the local and regional levels, both individual and cooperative efforts are underway to improve library capabilities and develop modern information systems. At the Federal level, there is great activity aimed at mobilizing and focusing resources, and designing and building the framework to integrate local and regional developments into a coherent nationwide network. In many cases, the Federal government is providing the resources to encourage improvement and support the development of new information and communications facilities and capabilities. In the field of health science, for example, the Federal government is providing funds under a variety of programs including the Regional Medical Program and the medical libraries assistance act. The unfortunate fact of the matter is that there are so many programs and so much activity that we face the danger of being unable to keep track of national priorities, and avoid wasteful duplication. A major object of at least a part of the Federal effort, therefore, is aimed at keeping a proper perspective and visibility over all information network activity. Several councils and national bodies have been formed to perform these functions.

With the foregoing as a crude background or frame of reference, I will now describe what we are doing at the National Library of Medicine to improve communications and information handling in the health sciences field, and to contribute to the building of a national information network. The remainder of the paper will be divided into two parts: 1) A description of the organization set up to plan and oversee the exploitation of information technologies for the health sciences; 2) A description of the conceptual framework being evolved to serve as a vehicle for effecting substantive improvements in information communications.

The National Library of Medicine has become an important focal point of national activity aimed at creating a national information network. NLM has been made a national resource in network activity by a number of actions of both the legislative and the executive branches of the Federal Government. Impetus was provided, for example, by the following statement in the 1965 Report of the President's Commission on Heart Disease, Cancer, and Stroke:

In the generation of health knowledge, the Federal Government has abundantly demonstrated its ability to stimulate and support productive effort without stifling control. It has done so by developing a partnership of federal and non-federal scientific resources in a system which promotes individual freedom and initiative. Similarly in the communication of health knowledge, it can and must develop a partnership whereby scientific and communications skills and resources, both federal and non-federal, work together to transmit the urgent messages upon which health depends.

Congressional leaders concerned with health legislation have repeatedly singled out the National Library of Medicine as a critical resource in developing the capabilities to cope with the glut of information that bears on national health and improvement in the delivery of health care services. In the course of an investigation of HEW in 1966, the House investigating subcommittee stated that NLM should be a central focus for biomedical communications within the Public Health Service and DHEW, and that NLM should establish a research center in biomedical communications. The Congress gave force to the subcommittee's words in the 1967 appropriations act by adding funds to the NLM budget to cover the costs of hiring personnel to go forward with planning for NLM to become a national center for biomedical communications. This resulted directly in the hiring of Dr. Ruth Davis to be the Library's first Associate Director for Research

and Development, and in initiating an intense level of activity in network design and development.

NLM activity has gone forward in two directions—planning a national center for biomedical communications and designing a national biomedical communications network. Both of these endeavors bore fruit in the summer of 1968. Senate Joint Resolution 193, signed by President Johnson on August 3, 1968, established the Lister Hill National Center for Biomedical Communications as an organizational entity of the National Library of Medicine. At about the same time, the Library promulgated a technical development plan setting forth the preliminary structure and concepts of a nationwide Biomedical Communications Network. (This network will be described in detail later in this paper.)

The Lister Hill Center was assigned four basic functions by the Secretary of Health, Education and Welfare:

1. Apply technology to the improvement of biomedical communications.
2. Design, develop, implement, and manage a national Biomedical Communications Network.
3. Serve as a focal point within the Department of Health, Education, and Welfare for the technological aspects of biomedical communications, information systems, and network projects.
4. Represent the Department of Health, Education, and Welfare in the activities of the President's Office of Science and Technology, other Federal agencies, and interagency committees and task forces in areas related to information and communications.

The Lister Hill Center underscores the Federal Government's new sense of responsibility in obtaining the mobilization of technological resources around urgent social problems.

The Lister Hill Center exemplifies the mission-oriented Government facility which the National Academy of Sciences' Committee on Science and Public Policy has cited as the most important invention in the pursuit of modern applied science. The mission-oriented facility derives its effectiveness from three principal sources: 1) Its interdisciplinary nature and its close interaction between research and application; 2) Its methodology for precipitating and organizing coherent efforts around large problems or projects; 3) Its ability to adapt its goals to the mission of the community or agency it supports.

The Lister Hill Center offers to the medical community a sense of mission for those needs and problems which transcend private and regional interests and capabilities and thus become matters of

national concern requiring national instruments to deal with them. The Center offers a technical leadership which can match the world of engineering and technology to the world of medicine. The Center will exercise its leadership through:

- influencing scientific and technical policies and plans to the advantage of biomedical communications;
- effecting technology transfer to match the needs for biomedical communications;
- enabling the medical community to realize the economies of large-scale operations and networks;
- marshalling industrial and technological resources behind the total communications market represented by the medical community;
- formulating and exercising standardization and compatibility policies;
- assisting in the identification of realistic customer needs for communications within the medical community.

The Lister Hill Center has been organized into four branches to handle the work of designing and building improved biomedical communications systems.

1. The *Network Plans and Management Branch* coordinates network planning activities within the Center and provides guidance and assistance to local and regional activities concerned with information and communications projects.

2. The *Research and Development Branch* sponsors and conducts research and development aimed at improving the means of communications in the health sciences. The branch also identifies that technology which is "ripe" for application to biomedical communications.

3. The *Customer Products and Services Development Branch* maintains continuous liaison with the medical community to identify customer needs, and to provide feedback to the Center concerning the community's acceptance of new services and products and its desires to modify these to better serve specific local conditions.

4. The *Network Engineering, Communications, and Operations Branch* formulates engineering and technical solutions to specific biomedical communications problems, directs the development of information and communications systems and supervises the engineering and technical operation of the Biomedical Communications Network.

The Lister Hill Center is staffed with a varied assortment of engineers, mathematicians, physicians, information science special-

ists, and technicians. In its professional manpower composition, the Center bears little resemblance to what one might envision as the conventional library staff. The Lister Hill Center exemplifies the new breed of library staff—a staff dedicated to innovation in library communications.

The Lister Hill Center is actively engaged in designing and developing a nationwide Biomedical Communications Network (BCN) to be the vehicle for bringing computer and communications to bear on the problems of library and information interchange in the medical or health sciences field. We have selected the network as the proper vehicle for improving biomedical communications because we believe that most of the conditions necessary for the success of a network venture already exist. For example, there is an overabundance of local data banks or information collections in the medical community which could serve a much larger population of users if communications facilities existed to connect these users to the information. Similarly, many local information collections are incomplete by themselves but could be greatly improved if the means existed to interconnect a variety of local systems. There simply aren't enough technical resources to enable everyone to proceed alone in the development of new information systems; therefore, we need a mechanism which will permit an effective pooling and sharing of resources. Finally, the growing need for effective interpersonal communications between individuals and groups in the medical community have heightened the demand for a wide variety of communications facilities.

We believe the network is the proper vehicle to satisfy these and a great many other communications needs. By its very nature, the network is ideally suited to point-to-point communications, the interchange and sharing of information resources, interpersonal and group communications, and a disciplined or controlled handling of information in accordance with a predetermined strategy. For these reasons, then, we have chosen the network as our instrument for effecting change and improvement. This selection is consistent with the current state-of-the-art in communications and computer technology; the network is the next logical step in view of the information system developments achieved over the last decade or so.

We call our network instrument the Biomedical Communications Network or BCN. Through the BCN, the Lister Hill Center is able to apply the benefits of national level planning to the medical

community's information problems. This type of planning allows economies in the allocation of resources, permits a sharing of professional talent, encourages standardization of procedures and communications conventions, and permits a focusing of user needs for presentation to those segments of industry that provide computer and communications hardware. The network mechanism does not restrict or inhibit local action or initiative. On the contrary, our network strategy is aimed at encouraging local activity and providing those facilities which might otherwise be unavailable to the local innovators of library communications.

Viewed in its total context, the BCN has the objective of combining the education process with the information transfer mechanism to achieve improved research, informed decisions on the application of technology, and, most importantly, to contribute to improving the quality of health care services being delivered in the United States.

The Biomedical Communications Network is comprised of four service components and one support component. The service components are: *Library Component*, *Specialized Information Services Component*, *Specialized Educational Services Component*, and *Audio and Audiovisual Services Component*. The fifth or support component is called the *Data Processing and Data Transmission Component*, and is simply a convenient way to refer to all the data processing and communications facilities within the network.

The *Library Component* has the objective to provide conventional library services, i.e., bibliographic data and services and documents, within the network. As might be expected, this component is presently the most advanced of all BCN components. The Library Component, itself a large network of medical library facilities, has the National Library of Medicine (NLM) at its center and features a growing number of regional medical libraries that are being developed and/or improved through funds made available through the national medical libraries assistance act administered by NLM. In addition, a number of decentralized MEDLARS Centers are being interconnected within the Library Component. MEDLARS (Medical Literature Analysis and Retrieval System) is a computer-based system for processing the bibliographic citations to medical journal literature for publication in the monthly *Index Medicus* and a large number of specialized bibliographic tools.

When fully developed, the Library Component, in addition to the National Library of Medicine, regional medical libraries, and

decentralized MEDLARS Centers, will include a large number of access terminals in the library facilities of major hospitals and medical centers. Ultimately, these access terminals will be positioned in local hospital libraries, and possibly in the individual practitioner's office.

The *Specialized Information Services Component* is aimed at providing information services as opposed to the document and bibliographic services of the Library Component. This is probably the least developed of all BCN components; we are only beginning to get deeply involved in the design and development of this component. We believe a national-level "referral center" is a crucial element of this BCN component. This referral center will serve as a point of entry into the BCN for those who lack familiarity with the network and need directory service to guide them to the proper location to have their information needs satisfied. In addition to the directory service, the referral center might also provide hard information of a substantive nature. The Toxicology Information System is a major constituent of this component. Responding to recommendations of the President's Science Advisory Committee, the National Library of Medicine is currently pressing the development of a computer file of information concerning the toxic effects of chemical substances on biological organisms. The Food and Drug Administration, the National Clearinghouse for Poison Control Centers, and a large number of public and private organizations are busily developing chemically oriented information systems which, in time, might be accessible through the BCN. Finally, there are twelve or more Information Analysis Centers in DHEW/Public Health Service which figure importantly in our plans for the Specialized Information Services Component. Examples of these centers are:

- National Center for Health Statistics
- National Center for Radiological Health
- National Center for Urban and Industrial Health
- National Clearinghouse for Mental Health Information
- National Clearinghouse for Poison Control Centers
- NINDB Neurological Information Network
 - Brain Information Service
 - Information Center for Hearing, Speech, and Disorders of Human Communication
 - Parkinson's Disease Information and Research Center
 - Vision Information Center

By direction of NLM's Presidentially appointed Board of Regents,

the *Specialized Educational Services Component* of the BCN is the Lister Hill Center's number one priority for development. This component is aimed at providing the information resources, presentation techniques, and communications facilities needed to improve undergraduate, graduate, and continuing medical education. In addition to developing hard communications capabilities to support medical education, the Lister Hill Center will become a national resource support unit serving all of medical education. In this role, the Center will coordinate the development and distribution of learning resources to satisfy the needs identified by the medical community. It will plan and direct the research and development of equipment and techniques aimed at improving the educational process and enhancing individual learning. Here again one encounters the previously noted network advantages of shared resources and knowledge, a national perspective on needs and capabilities, beneficial standardization, and avoidance of unnecessary duplication.

The Center is working very hard in the education area. Through a variety of formal and informal arrangements and contracts, our efforts are being closely coordinated with and guided by the Association of American Medical Colleges, individual medical schools, and a large number of physicians and educators interested in medical education. We even have some informal contacts with an Office of Economic Opportunity group that is studying the role of biomedical communications in improving health care in remote and/or depressed areas through better continuing education of the geographically isolated physician, and health education of the isolated or disadvantaged population.

The *Audio and Audiovisual Services Component*, centered on NLM's National Medical Audiovisual Center in Atlanta, Georgia, is to be a national resource supporting the medical community with audio and audiovisual materials and services. In addition to its role as a distributor of materials, this component will provide advice and assistance to medical community activities in the development and use of audiovisual materials, the formulation of new techniques, and research into new methods of exploiting multimedia technologies.

The *Data Processing and Data Transmission Component* is the technological backbone of the network, and contains the data processing centers and data transmission facilities which support the foregoing BCN service components..

The preceding paragraphs are a general description of the over-

all concept of a nationwide Biomedical Communications Network. The Lister Hill Center is moving on several fronts to refine the concept, formulate detailed systems designs, schedule developments, and commence the implementation of network operational segments. The Center's efforts span a broad spectrum of well-understood technologies as well as some which are not yet fully understood. In this latter category, we include satellite communications which appear to offer great promise for some applications but which are not yet fully proven in terms of cost-effectiveness for domestic applications of the kind needed in the BCN. For these reasons, the Lister Hill Center has become a principal advocate of a pilot or demonstration program which will permit experimentation with satellite communications. In this and other efforts, the Center is being assisted by a number of contractors who are collecting and analyzing information on the environment and user needs, and recommending courses of action to be followed.

The Lister Hill Center is currently engaged in making the transition from the network planning and design stage to the network development and implementation stage. The transition is being accomplished through the development of a prototype or initial network which will permit experimentation with existing systems and provide a factual base for proceeding with full network development. The prototype network development involves experimentation in three basic areas:

1. *Dial Access Systems.* Here we are interested in systematically exploring the reasonably straightforward technology associated with audio message systems accessed by direct dial telephone. The Wisconsin Dial Access System at the University of Wisconsin Medical School and the University of Missouri Experimental Audio Message Center are the two systems with which we are currently working. The Wisconsin system is attended or manned whereas the Missouri system is unattended or automated. We are interested in extending the audience having access to the systems and then systematically observing how the two systems function relative to each other, and determining the extent to which the dial access technology can be reasonably extended.

2. *On-line Computer Systems.* This effort involves experimentation with various on-line time-sharing computer systems to acquaint the medical community with the capabilities already available and to encourage the community to identify the specific ways in which the computer can be applied to its information and communications problems. We have established in NLM a Remote

Information Systems Center containing the terminal equipment which enables the staffs of the Center and NLM to have access to and use a large number of time-sharing computers.

3. *Video Experiments.* The Center's efforts here are aimed at extending video or television technology into parts of the medical community that do not now use it. Candidate systems for study are the Community Medical Television System in Atlanta, Georgia, and an ETV system like the one in Los Angeles.

In summary, this paper has described in modest detail the program of the National Library of Medicine. It would be difficult to overestimate the potential impact of this program on the library and the development of nationwide information networks. NLM's Lister Hill National Center for Biomedical Communications and its efforts toward building a nationwide Biomedical Communications Network are clear evidence of the existing innovations now taking place in library communications.