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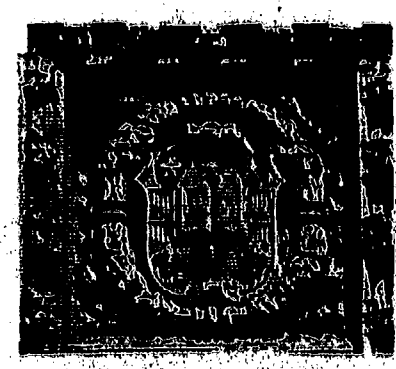
ABSTRACT

As a part of the NASA sponsored program on the application of communication satellites to educational development, a study was made of the utilization of telecommunications by academic and school libraries in the United States and the potential for future utilization by these institutions. The five basic functions performed by all libraries--acquisition, cataloging, storage, retrieval, and circulation control--are identified, and an overview of library cooperation of a general nature not restricted to communication is presented. Applications of telecommunications are then described with respect to interlibrary information interchange and with respect to new uses. School and academic library budgets are discussed, together with the important role played by federal legislation and financial assistance. Current interlibrary communication utilization is described, noting that data communication is potentially an area of considerable value to libraries, but is currently used by only a few. The future of interlibrary communication utilization is projected; medical school libraries are seen as most likely to increase their utilization of data communication in the near future. (JY)



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March, 1972

UTILIZATION OF TELECOMMUNICATIONS BY ACADEMIC AND SCHOOL LIBRARIES IN THE UNITED STATES

Carl A. Niehaus

WASHINGTON UNIVERSITY // ST. LOUIS // MISSOURI 63130

PROGRAM ON APPLICATION OF COMMUNICATIONS SATELLITES
TO EDUCATIONAL DEVELOPMENT

WASHINGTON UNIVERSITY

Memorandum No. 72/1 March, 1972

UTILIZATION OF TELECOMMUNICATIONS

BY ACADEMIC AND SCHOOL LIBRARIES

IN THE UNITED STATES

Carl A. Niehaus

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SUMMARY

Washington University (St. Louis) has undertaken a NASA sponsored program on Application of Communication Satellites to Educational Development. This memorandum has been prepared to provide basic information on the utilization of telecommunications by academic and school libraries in the United States and to examine the potential for future utilization by these educational institutions.

The introduction presents a classification of libraries which defines public, special, academic, and school libraries. The restriction of the report to academic and school libraries and several other restrictions are also discussed.

The second section provides background information concerning libraries. Five basic functions performed by all libraries -- acquisition, cataloging, storage, retrieval, and circulation control -- are identified. Next, an overview of library cooperation of a general nature not restricted to communications is presented. Examples of cooperation by function are treated, including bibliographic, acquisitions, and cataloging cooperation, interlibrary loans, and centralized data processing cooperation. In addition, cooperation between libraries according to type and administrative level is discussed. County and state systems, special and academic library cooperation, and federal libraries and legislation are considered. Applications for telecommunications are then described, both within the framework of traditional interlibrary information interchange and with respect to potential new uses. Finally, school and academic library budgets are discussed, together with the important role played by federal legislation and financial assistance.

In section three, current interlibrary communication utilization is described. Physical transportation of material and information (such as the mail) continues to be an important means by which libraries communicate. Telephone service is beginning to play an increasing role, as is teletype service. In 1971, approximately 8.6 percent of the academic libraries in the United States subscribed to TWX, the switched teletype network operated by Western Union. Telefacsimile utilization appears very limited at present and is discussed in some detail. Radio and television usage is apparently negligible at the present time. Data communication is potentially an area in which considerable growth might occur, but is currently used by very few libraries. However, medical school libraries have begun to utilize data communications and this activity appears likely to expand.

The last section considers the future of interlibrary communication utilization. Research and development related to library telecommunication use does not appear to be widespread. An exception is Project INTREX at the Massachusetts Institute of Technology. While current research may not immediately result in viable library telecommunications applications, INTREX experiments will probably provide a technological foundation upon which future systems can build.

Community antenna television holds the promise of broadband two-way local communication systems, but libraries appear unlikely to become heavy users in the near future unless some formidable obstacles are overcome. Communication satellites similarly provide attractive long distance broadband possibilities. Library experiments using NASA satellites have been conducted and others have been proposed, but routine library utilization at significant levels will probably be negligible over the next five to fifteen years. Significant utilization will hinge upon whether or not economic and operational advantages can be demonstrated, as well upon overcoming certain resistances. Important obstacles to future library telecommunications utilization are high cost; acceptance of the necessity for telecommunications; psychological, traditional, and historical barriers; legal, political, and administrative difficulties; lack of standardization; and problems of intellectual access and of bibliographic organization. The issue of the potential costs and benefits associated with future library telecommunication utilization has received relatively little objective attention and is in need of further study. Finally, a summary of predictions inferred from the literature is presented.

UTILIZATION OF TELECOMMUNICATIONS BY ACADEMIC AND SCHOOL LIBRARIES IN THE UNITED STATES*

1. INTRODUCTION

1.1. Statement of Purpose

The purpose of this memorandum is to assess the extent to which libraries associated with educational institutions in the United States utilize telecommunication systems. The discussion is divided into three sections. First, background information is provided on the functions performed by libraries, an overview of library cooperation of a general nature, and potential applications for telecommunications. In the context established by the first section, current interlibrary telecommunications utilization is then surveyed. Finally, the future of interlibrary communications systems is discussed.

1.2. Types of Libraries

Libraries may be classified according to the nature of their user community and institutional affiliation. A common classification defines four types of libraries -- public, special, academic, and school.

Public libraries are self explanatory. They are almost always local libraries, serving a municipality or a county. Since they must satisfy the requirements of the general public, their collections tend to be very diversified, but of relatively limited depth in any given subject.

Special libraries are those established by corporations, government bodies, professional organizations, etc. Their collections usually cover a quite narrow range of topics extremely thoroughly. Access to special libraries is often limited to members of the organization maintaining them.

Academic libraries include those of universities, colleges, and junior colleges. The extensive demands of their users necessitate collections which are both very broad and very deep.

Libraries in elementary and secondary schools comprise the class of school libraries. They are grouped separately from academic libraries because their needs and the collections they build are fairly distinct.

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1.3. Restrictions of Report

In its fullest sense, a discussion of interlibrary telecommunication systems should properly include all four types of libraries. However, commercial and industrial organizations are among the largest consumers of library communications because of their greater demand and ability to justify the substantial expense. Consequently a general discussion would be disproportionately concerned with such special library networks. The primary emphasis of this report is on education related library communications. Hence, elaborate and sophisticated special library systems such as those of IBM, Bell Laboratories, and General Motors are not considered. In general, utilization by special and public libraries is discussed only when it materially involves academic or school libraries as well. Furthermore, the nearly total lack of references in the literature to telecommunications in school libraries (those serving elementary and secondary education) suggests that the extent of their utilization is negligible. The information presented is therefore largely restricted to academic libraries.

The types of communications considered are also restricted to the extent that systems which are only incidentally related to libraries are ignored. A particular effort has been made to avoid duplicating discussions of areas which have been extensively described in other memoranda in the series. For example, since libraries are often the focal point for multi-media programs in schools and communities, educational television often uses library facilities. Similarly, computer assisted instruction is frequently library related in that the terminal equipment is physically located in the library. Neither of these two applications for communications, nor any others of a similar fringe relationship to libraries, are treated.

A final restriction on the detail of this report is arbitrarily enforced by a general lack of statistics on the entire field of library telecommunication usage. Announcements and descriptions of individual systems abound in the literature, but no thorough national census of the communications usage and requirements of libraries in the United States has ever been compiled. Bystrom summarizes aptly: "The large number of plans, the emphasis of publicity on proposals rather than actual developments, and the fact that many operations today are only demonstrations without a guarantee of viability, make this a difficult field in which to keep assessments current."[1]

2. BACKGROUND

The typical user of a library has very little comprehensive understanding of the complex and interrelated operations which it performs. Indeed, from his standpoint, the only aspect of library operation of interest is its ultimate ability to provide the particular materials sought. Of course, this is as it should be. The ability to successfully make use of library services is usually independent of any knowledge of the mechanism which actually fulfills user requirements.

Consequently, to the average person, a library is simply a place where one hopes to obtain needed materials and check them out quickly with as little interference as possible from the staff. Only a small part of the total library operation is obvious from these encounters. Furthermore, a user attempting to learn more about the overall system often discovers that most relevant books and articles are written by librarians for other librarians, and supply only limited knowledge to the layman.

Two of the next three sections are intended to provide background information to the reader who has only the typical rather vague idea about internal library operations. The first section identifies several very broad functions that libraries perform, and describes each of them briefly. The second section is an overview of library cooperation of a general nature not restricted to communications.

2.1. Functions Performed by Libraries

Every library performs certain specific functions which are unique, due to the varying organization and environment of libraries. Nevertheless, there are general areas of effort common to all libraries, regardless of type, size, or local peculiarities. Five such comprehensive functions are acquisition, cataloging, storage, retrieval, and circulation control.

Acquisition of new materials to add to the collection is a basic function of all libraries. This function involves maintaining a knowledge of the current literature, deciding how the available acquisition resources will be invested, ordering new material, and ensuring that the ordered material is received when needed. A major part of the acquisition function is anticipating user requirements, rather than simply responding to demands as encountered. Obviously, a good deal of accounting and bookkeeping detail is involved, such as preparation of order forms, allocation of funds, clearing invoices and funds, updating order files, and frequently converting between American and foreign currencies when the source is in another country.

Establishing and maintaining a catalog of their collections is another important task that libraries perform. Without a highly efficient scheme or organization to enable a specific work to be located, the collected literature is of very little use. It was realized quite early in American

library history that a standard cataloging system was an absolute requirement for interchange of cataloging data between libraries. The Dewey Decimal System was one of the most successful standards. It has been replaced by a cataloging scheme developed by the Library of Congress. When a new item is acquired, a determination must be made whether it has ever been cataloged before. If it has not, original cataloging must be done and the result entered into the filing system.

To minimize gross duplication of cataloging effort, and to provide a convenient reference to the holdings of other libraries, union lists are published. A union list is a record of the holdings for a group libraries of material of a given type, in a certain field, or on a particular subject; e.g., a catalog in a central city public library that shows which books are in each branch as well as those in the main library. Union lists are discussed more thoroughly in the next section.

Storage of collections is another basic function on which libraries must perform. It entails retaining the materials in a form, and for a length of time, suitable for their intended use. Printed, bound volumes continue to be the dominant form of storage. However, extensive use of microfilmed material is becoming more widely employed, especially for dissertations, newspapers, foreign journals, etc. The time that a document is retained may be infinite if the library is serving as an archive. Most other libraries, however, must resolve document retention problems. When new additions to the collection begin to compete for space in the stacks with existing material, seldom used materials are moved to a secondary storage area. This procedure is referred to as stack thinning. Determining which materials to remove from the primary storage area is a substantial part of the storage function. The criteria for establishing which documents are "seldom used" are relative, and care must be taken to ascertain the proper set to thin.

Retrieval of the stored information in the collection is the basic product of the library. This function consists of providing the user with methods which enable him to find the information he needs. It is only with this aspect of library operation (and with circulation) that the majority of users are familiar. Likewise, the reference staff are generally the only members of the library organization with whom users have personal contact. Since most readers are in fact well acquainted with the retrieval function, it will not be discussed.

Dissemination and control of the circulation of library materials is a fifth universal function. It involves knowledge of user needs, ensuring that he receives what he requests, and making sure that the borrowed items are returned so that others may also make use of them. Most users of libraries have a reasonably good idea of how the traditional circulation control system operates. It should be noted, however, that this function is not completed for an individual transaction until the returned material has been replaced in the collection storage.

2.2. An Overview of Library Cooperation

An understanding of and appreciation for many of the problems connected with increasing utilization of communication by libraries can be enhanced by an awareness of the progress of interlibrary cooperation of a more general nature. A successful telecommunication system will quite probably build on foundations laid by cooperative arrangements already in existence.

A brief history of the development of cooperation between libraries is contained in the following sections. First, cooperation by function is discussed, followed by an overview of developments by type and administrative level. An abundance of papers concerning library cooperation have appeared in the literature. The primary sources for the following sections are Weber and Lynden [2] and Purdy [3].

2.2.1. Cooperation by Function

Many of the functions performed by libraries on an individual basis lend themselves to increased efficiencies and a higher quality result when accomplished by cooperation between a group of libraries. Significant improvements in library service have resulted from joint bibliographic, cataloging, and acquisition activity. Circulation control within a single library has evolved into a formal system for interlibrary loans. Other administrative functions have been successfully centralized by application of cooperative data processing systems. The following sections discuss each of these functional areas of cooperation.

2.2.1.1 Bibliograpnic Cooperation

One of the most important trends fostering interlibrary cooperation has been the development of bibliographic compilations. American libraries have developed resource lists, union lists, bibliographic centers, book catalogs, and union catalogs.

The earliest national resource list, indexed by subject and describing library collections and catalogs, is William C. Lane and Charles K. Bolton's 1892 Notes on Special Collections in American Libraries. This resource directory has been followed by a large number of similar directories.

The first major national union list was Henry C. Bolton's A Catalogue of Scientific and Technical Periodicals, though this list did not give exact statement of holdings. Following the Bolton list, suggestions for a comprehensive, national list, indicating exact locations, culminated in 1927 with publication of the Union List of Serials in Libraries of the United States and Canada, having entries for 75,000 serial titles and listing holdings for 225 libraries. The third edition of the Union List of Serials..., published in 1965, contains 157,000 entries locating journals in 956 libraries.

In addition to periodical union lists, American libraries have cooperated to produce union lists of newspapers, foreign serial documents, microfilm, and manuscripts. These union lists have all had a pattern of

development similar to that of the Union List of Serials. They have used previous lists in compiling their list, have invited cooperation of large numbers of libraries, have been aided by a foundation grant, have been sponsored by an association, and have received assistance from the Library of Congress.

Union catalogs are an important form of bibliographic cooperation, made possible by uniform cataloging rules and standard sized catalog cards. In 1901, the Library of Congress began building the first national union catalog by collecting cards from government libraries in Washington, D. C. and from the New York Public, Boston Public, Harvard University, the John Crerar Library, and several others. The Union Catalog was arranged in a single author alphabet by 1909 when the contributions of cards from nine libraries had accumulated. In 1927, the American Library Association secured a grant from John D. Rockefeller, Jr. to finance a major expansion of the union catalog.

The first major regional union catalog was organized in 1909 in California incorporating primarily public library catalogs. However, major union catalogs increased sharply in number between 1932 and 1940 when seventeen catalogs were established, many through the assistance of the WPA. A number of these regional catalogs were added to the National Union Catalog so that by 1968 the National Union Catalog contained more than 16,000,000 cards, representing about 10,000,000 titles and editions.

During the 1930's, with the assistance of the WPA, another form of bibliographic cooperation was developed -- the bibliographic center. These centers maintain catalogs for their respective area and serve as centers for the exchange of interlibrary loan information. They have maintained large collections of printed bibliography, including LC catalogs. The centers depend on financial support from their member institutions. The Bibliographic Center for Research, Rocky Mountain Region, Denver, was established in 1934 as a bibliographical collection which would serve the needs of Colorado libraries. The Pacific Northwest Bibliographic Center, Seattle, was founded in 1940 with a Carnegie Grant of $35,000 to the Pacific Northwest Library Association.

Another bibliographic trend has been the increased use of book catalogs. The first printed catalog of an American library was the Harvard College Library catalog published in 1723. The size of the collections and the cost of book catalogs were major factors in deterring more widespread use between the 1980's and the 1950's. One of the most important book catalogs yet published is A Catalog of Books Represented by the Library of Congress Printed Cards Issued to July 31, 1942, published by Edwards Brothers, Inc., of Anr Arbor, Michigan, for the Association of Research Libraries.

In 1956, the Library of Congress began publishing the National Union Catalog in book form. In 1963 the ALA and LC decided to publish the National Union Catalog, prior to 1956, in book form and contracted for its publication. The first volumes of the National Union Catalog Pre-1956 Imprints were published in 1968. There are now over five hundred libraries participating. The publication of this catalog will be a culmination of union catalog development effort.

2.2.1.2 Acquisitions Cooperation

Libraries continue to purchase publications which will serve the needs of their particular community. However, librarians have become better informed of national resources through the aid of union lists, union catalogs, and resource lists, and increased activity in the area of cooperative buying programs, centralized buying programs, exchange arrangements, photocopying of important research material, and shared book storage centers.

The basic idea behind specialization agreements is that certain subject areas are allocated to each library involved in the cooperative effort. Such agreements permit the total acquisition resources of all members to be more efficiently utilized, since gross duplication of acquisitions are eliminated. Examples of specialization agreements date back as early as 1896.

On a local basis, acquisitions specialization was prevalent during the late 1930's and early 1940's. In 1941, the ALA Board of Resources convened a meeting of librarians to undertake a national plan for resources specialization. However, this conference and a similar regional conference in the Pacific Northwest failed to produce any lasting results.

The first nationwide specialization agreement grew out of concern about the feasibility of acquiring European research materials during World War II. In 1942, the Library of Congress sponsored a conference at Farmington, Connecticut. A committee was appointed to develop a plan which later became known as the Farmington Plan. It was designed to acquire at least one copy of each new foreign publication according to a subject scheme, to list it in the National Union Catalog, and make it available for interlibrary loan.

In 1954 Public Law 480 made available surplus agricultural products to soft-currency nations. These countries purchased produce with local currencies which accumulated unspent. In 1961 the Library of Congress sponsored legislation for a plan to acquire publications of India, Pakistan, and the United Arab Republic using unspent local currencies. The Public Law 480 Plan expanded to six countries by 1965 and 1,531,745 items were sent to American libraries. LC maintains overseas selections teams in the countries involved. LC publishes accession lists for these acquisitions and the libraries contribute funds for cataloging.[4]

LC initiated a major centralized acquisitions program in 1965 when Title II C of the Higher Education Act authorized federal funds "for the purpose of 'acquiring, so far as possible, all library materials currently published throughout the world which are of value to scholarship'".[5]

In 1941 a group of Colorado college librarians proposed centralized book buying. However no project resulted until 1967 when a study indicated the feasibility of establishing a centralized processing center for Colorado academic libraries.[6] With the support of a National Science

Foundation grant, the Colorado Academic Libraries Book Processing Center began a one year experiment in 1969. The Center processes book orders, catalogs these books, and physically prepares them for distribution to nine institutions.

Exchange arrangements are another important form of acquisitions cooperation. Library associations have had exchange systems since 1899 when the Medical Library Association established its exchange operation. The Association of College and Reference Libraries (ACRL) established the Periodical Exchange Union in 1940, now called the Duplicate Exchange Union. It functions by circulating lists of duplicates to libraries in the order of the size of their collections.

The most active exchange organization in the world is the US Book Exchange, which succeeded the American Book Center for War Devastated Areas in 1949. Stock is sufficiently large to allow both American and foreign libraries to send and receive duplicates.

Photocopying and cooperative microfilm projects for dissertations, foreign newspapers, official gazettes, and archival materials has been another important development in cooperative acquisitions. A prototype was developed in 1938 when Harvard University secured a grant from the Rockefeller Foundation for the purpose of currently microfilming a number of foreign newspapers, and positive copies were offered for sale to other institutions.

In 1965 a Center for the Coordination of Foreign Manuscript Copying was established at the Library of Congress with a grant from the Council on Library Resources (CLR). It has proved effective as a clearinghouse for microfilm projects since it enables libraries to cooperate in the microfilming of rare manuscripts.

Joint storage facilities provide low cost storage for seldom used materials. In 1941, the Massachusetts legislature chartered the New England Depository Library (NEDL) which opened in 1942 as a storage library owned and operated by eight libraries. In 1949 the Midwest Inter-Library Center in Chicago was incorporated. Now called the Center for Research Libraries, this organization houses, organizes, services, and under certain circumstances, owns infrequently used materials. In 1970, the Center had fifty full and associate members and a collection of approximately 2,750,000.[7] A third storage center, the Hampshire Inter-Library Center, was established in 1951 by Amherst, Mount Holyoke, Smith College, and the University of Massachusetts. This center is primarily a storage center for little-used serials and it has a small acquisitions fund for expensive sets and rarely consulted serials.[8]

Acquisitions cooperation is not possible without strict adherence to specialization agreements which require some monitoring. Even formal agreements do not have to have a binding contractural agreement. The only agreements that are viable are those among consenting parties continually convinced of their merits.

2.2.1.3 Cataloging Cooperation

The general trend in cataloging cooperation has been toward centralized cataloging. Major developments in this area include centralized cataloging and cooperative cataloging.

Centralized cataloging is simply cataloging done by a central agency. The Smithsonian Institution was performing this function as early as 1853. The Library Bureau offered centralized card services to libraries in 1894 and ALA took over these services in 1896. In 1897 R. R. Bowker suggested that the Library of Congress undertake a centralized card service. The ALA Publishing Board and LC reached an agreement in 1901 whereby the latter was to supply printed cards for current books. In 1967-68, the LC Card Service reported that approximately 25,000 libraries, firms, and individuals bought 78,767,377 cards.

Cooperative cataloging is the supplying of copy to a central agency. In 1901 the Library of Congress began receiving copy from other libraries for the printing and distribution of cards. The Library of the Department of Agriculture was the first library to contribute. In 1910 LC asked the libraries receiving LC card sets "on deposit" to supply copy for the card service and about one-third agreed to assist the Library of Congress. A cooperative Cataloging Division was formed at LC in 1932, but recently libraries have submitted copy directly to the National Union Catalog.[9]

Cooperative processing on a local and regional level is on the increase. There has been a large increase in public library regional processing centers since 1958. At most processing centers original cataloging is kept to a minimum and LC proof sheets are used for cataloging.

Another important cataloging development, in the public and school library fields, is the increase of commercial cataloging services. Such service has been available since 1938. In 1958 one firm offered both catalog cards and book preparation and by 1968 over fifty firms were in the commercial cataloging business.[10] This rise can be attributed to government support of library purchases. The majority of firms serve school libraries.

Several significant obstacles have limited the expansion of centralized cataloging. Local cataloging is required when a different edition of a title is owned locally, when the delay for centralized cataloging is unacceptable, and when it is not economically feasible to reproduce a card from a printed book catalog or trade list.

2.2.1.4 Interlibrary Loans

Perhaps the most widely known form of interlibrary cooperation is interlibrary lending. Interlibrary loan (ILL) activity has increased markedly in this century. In 1927, the Library of Congress loaned 3,723 volumes. In 1967 it loaned 258,573 volumes. This increase is typical of libraries in general.

The first recorded note of interlibrary loan agreements in the United States occured in the Library Journal of 1876. In 1917, the ALA Committee on Coordination of College Libraries drew up the first ILL code. This code was revised in 1940, 1952, and 1968. A standard ILL form was adopted in 1951. In 1936 the Library of Congress began the system of circularizing research libraries for material requested but not in LC, and adding information to the National Union Catalog when a copy was found. About 82% of requests are now filled by locating the titles in the National Union Catalog and, for those not found, by circularizing in the "Weekly List of Unlocated Research Books".[11] The National Library of Medicine began its photoduplication service in 1939. By 1956 it decided to treat photoduplication and ILL as a single service. The Library of Congress began an experiment in 1969 with a regional switching center of ILL. The Bibliographic Center for Research, Rocky Mountain Region, Inc., in Denver handled requests via teletype on a regional basis. The requests are switched to the Library of Congress if they cannot be filled regionally.

Interlibrary loan is plagued with a variety of problems. The citations are often inaccurate. Abuse of the privilege occurs fairly often. There is risk of copyright infringement under present laws when a photocopy is sent rather than the original. Increasing demand from a larger and more highly educated user group increases the burden on the national library and the major research libraries.

2.2.1.5 Centralized Data Processing Cooperation

In the past few years, the topic of library automation has received considerable attention. Several hundred libraries are making efforts at utilizing computers and having some successes. The great majority of these applications do not involve innovations in interlibrary cooperation. The very large expense involved has limited most applications to automation of existing techniques.

The primary contribution to cooperation in automation is the result of federal efforts. The dependence of many American libraries on Library of Congress cataloging deterred attempts to automate local catalog operations in recent years. There was great concern among local libraries that an in-house developed catalog data-base would end up being non-standard and incompatible with the format of other libraries. As a result, the Library of Congress began preliminary plans and investigations for a MARC (Machine Readable Cataloging) format in 1964. An initial format was developed and tested in several libraries between 1966 and 1968. A final format was agreed upon by U. S. libraries in 1969.

The MARC format is designed to handle all bibliographic records and to be sufficiently flexible so as to allow a variety of local applications on various hardware configurations. The over-all format conforms with the standards for telecommunication of data promulgated by the United States of America Standards Institute.

Since April, 1969, catalog data for current books in the English language have been available on magnetic tape. Due to the success of MARC, a project to convert all the 1968 and 1969 English language catalog entries into machine-readable form was begun in mid-1969. This program called RECON (for Retrospective Conversion) will also test the possibilities of converting older English and other Roman alphabet publications. Catalog data on English language monographs has recently become available through MARC II tape distribution.

The New England Library Information Network (NELINET) is a regional library automation project, sponsored by the Council on Library Resources and administered by the New England Board of Higher Education. The regional center was organized (in 1967) to provide three primary services to six New England university libraries -- a machine readable catalog data file, catalog data file searching, and the production of catalog cards, book pockets, and book labels. The requests are processed in the central processing center in Cambridge, Massachusetts via telephone lines and the output is mailed to the libraries. MARC is the network's communication standard.

The first major cooperative automation project was the Columbia/Harvard/Yale Medical Library computerization project, begun in 1962. It was the first cooperative on-line information retrieval system among universities. The project was designed to use an on-line system for both production of catalog cards and retrieval of bibliographic information. The project lasted only four years, and was discontinued in 1966.

A second project, the Chicago/Columbia/Stanford Collaborative Library System Development Project (CLSD), was funded by the National Science Foundation to experiment with the feasibility of designing generalized automated systems through cooperative effort on elements of monograph acquisitions systems. This project had a planned life of only 18 months and was concluded in the fall of 1970.

Eleven libraries are currently participating in the State University of New York Biomedical Communications Network (BCN). This network provides a computerized union catalog of textbooks and monographs in a consortium of libraries, lists of journals currently received, bibliographic searches of MEDLARS (Medical Literature Analysis and Retrieval System) tapes, production of subject heading guide cards, current awareness or selective dissemination of information services, and recurring bibliographies. Substantial financing from the State of New York and the support of IBM have enhanced the success of SUNY's BCN.

2.2.2. Cooperation by Type and Administrative Level

2.2.2.1 County Systems

Public library cooperation has developed gradually over many decades. Municipal activity enlarged into county systems, which eventually were centrally coordinated at the state level.

During the last half of the nineteenth century municipal libraries were generally small independent units supported by local taxes. State involvement in extending library services occurred as early as 1890 when Massachusetts created a separate agency for the sole purpose of offering library extension services. However, state agencies were generally not very effective until after the federal Library Services Act of 1956. The county movement produced the most important early cooperative development in the public library field.

The county movement began around 1900 when libraries in Ohio and Maryland were organized for county service. Laws permitting counties to provide county library service had been enacted by 1926 in thirty-one states and the territory of Hawaii. By 1936 forty-five states had plans in which county or regional libraries were a common feature.

A metropolitan, county, or regional system consists of several library units connected by a central administration which attempts to provide services which the individual units find difficult or impossible to provide separately. A major part of the cooperative developments in public libraries can be attributed to the enlargement of administrative units.

Growth of county-level cooperation was encouraged by state financial aid, American Library Association (ALA) studies, and efforts of the Works Progress Administration. The Committee on Library extension of ALA compiled a study in 1926 which recommended that the basis for adequate rural public library service be the county or other large unit. County service demonstrations were sponsored by WPA projects in the thirties and later put on a permanent basis.

Although rural counties have continued to experience growth in library cooperation, metropolitan areas have encountered several obstacles to growth. System development has been hampered by the growth of independent public libraries in suburban areas governed by a variety of political units, by the use of the older central city library, by surburban residents not paying taxes to the city, and unwillingness of the better established municipal libraries to become part of a county system for fear of dissipating their resources.

2.2.2.2 State Systems

The federal Library Services Act (LSA) of 1956 provided the impetus for increased levels of interlibrary cooperation at the state level. Prior to 1956, states possessed neither the incentives nor the coercive power necessary to accomplish this goal. The LSA made federal aid contingent upon development of a state plan by a state library agency.

The Library Services and Construction Act of 1964 (LSCA) has also supported public library development through state agencies. Title III of the LSCA as amended in 1966 specifically encourages states to plan cooperative systems. However, system development has varied greatly from state to state. "As of 1967, nineteen states have no state aid programs; of the remainder, eleven states account for all except a fraction of the total, $34,700,000."[12]

Three states -- Hawaii, Pennsylvania, and New York -- have produced strong, comprehensive statewide systems since 1956. Hawaii's system is state-wide and state-governed. The entire state is included in a network of thirty-four branch libraries using uniform loan regulations and operated from the State Library without local funds. The Pennsylvania state system has a hierarchial system of thirty districts, each with a state supported headquarters library and four regional resource centers. Reference and interlibrary service are filtered to the top. In New York, seven hundred public libraries became part of twenty-two systems between 1946 and 1962. The New York Education Department established a committee in 1960 on Reference and Research Library Resources (3 R's) which recommended a similar hierarchial system: the county systems, nine Reference and Resource councils, three geographical referral centers, and nine subject referral centers, all of which are research libraries. Reference questions and interlibrary loan requests pass through various levels until answered. The State Library supervises the entire system.

2.2.2.3 Special Library Cooperation

Special libraries have cooperated in several ways in order to make the most efficient use of their resources. Larger corporations have developed centralized services for their branch libraries. General Motors Corporation has twenty-two company libraries. However, since 1927 all interlibrary loans have been handled through its central library. Using remote interactive terminals, IBM has a technical processing network based in Poughkeepsie. Smaller corporate libraries have developed arrangements with other corporate libraries. In Minneapolis, six small companies formed a cooperative library association in 1963, coordinated their buying, encouraged interlibrary loans, and discussed mutual problems. The Associated Science Libraries of San Diego, established in 1963, includes corporation libraries, universities and colleges, public libraries, government agencies, and museums.

2.2.2.4 Academic Library Cooperation

Cooperation among academic and research libraries has involved acquisitions, cataloging, interlibrary loans, and automated services. In contrast to municipal, county, state, and special libraries, where the majority of interlibrary cooperation has developed in the past fifteen years, academic and research libraries have had major programs for seventy years, with substantial expansion in types of programs in the past forty years.

An example of an informal arrangement among several institutions is CLUNY, the Cooperating Libraries of Upper New York. Formed in 1931, it included Buffalo University, Colgate University, Grosvenor Library, Hamilton College, Syracuse University, Cornell University, and Union College. This group functioned until 1939 as a clearinghouse for mutual problems and cooperated on a union list of periodicals and the joint purchase of microfilm of early English publications. Three of the original members of CLUNY (Buffalo, Syracuse, and Cornell) are now part of FAUL (Five Associated University Libraries) which has compatibility of computer systems as a chief emphasis.[13]

An example of a formal agreement between independent libraries is the Duke/North Carolina Interlibrary Project. In 1931, Duke University and the University of North Carolina decided upon special collecting areas. With a grant from the General Education Board, the libraries were able to exchange author cards from their catalogs. In 1935 a messenger service was inaugurated. Two more North Carolina institutions joined in 1955 and full borrowing privileges were extended to all members.

A contractual agreement among several libraries is the Joint University Libraries founded in 1938 by Vanderbilt University, George Peabody College, and Scarritt College. Operating under a Joint Board of Trustees, the facility is an independent body, jointly owned and financed by the participants.

The Claremont College library system began in 1931 when a contractual agreement among Claremont College Graduate School, Pamona College, and Scripps College established a joint order and catalog department to serve the three libraries. There is now a common facility, the Honnold Library, constructed in 1952, serving six Claremont Colleges -- Claremont Graduate School, and University Center, Claremont Men's College, Harvey Mudd, Pitzer, Pomona, and Scripps Colleges.

An example of the merger of two or more libraries is the Atlanta Center Trevor Arnett Library in Atlanta, Georgia. Built with a grant from the General Education Board in 1932 it serves six colleges of Atlanta -- Atlanta University, Morehouse College, Spelman College, Morris Brown College, Clark College, and Gammon Technological Seminary.

Another variation of interinstitutional cooperation, unification of research libraries under state control, was pioneered by the Oregon State Board of Higher Education in 1932. The board appointed one director of libraries for the entire state system, established the principal of free circulation among all state institutions, and set up a central order division.

The University of California at Berkeley Author-Title Catalog published in 1963 to share research resources, and the UCLA catalog which followed, were part of the broad program of cooperation among the campuses of the University of California recommended by the All University Faculty Conference and formalized by the Regents in September, 1961. The State University of New York (SUNY), established in 1948, has sixty colleges and centers presently in operation. In 1966, the central SUNY administrative staff drew up a program for library development including the establishment of a university wide communications network, a computer based union catalog for holdings of the entire system, and a processing center for the acquisition, cataloging, and physical preparation of new material.[14]

College and research libraries have also made special arrangements to cooperate with special libraries. Stanford University Libraries established a separate library office in 1958, called the Technical Information Service, now servicing over 300 industrial and commercial firms. Regular members pay for each citation delivered, and the membership provides reading room use, loans, photocopy service,

interlibrary loans from outside Stanford, and the right to recommend purchases. The TIS provides a switching service between a major research library and local special libraries.[15] Massachusetts Institute of Technology also maintains a similar formal program of services with an annual fee.[16]

2.2.2.5 Federal Libraries and Legislation

Library cooperation has resulted from centralized services provided by the "national" libraries, from their efforts to standardize the automation of libraries, and from federal legislation aimed at coordination efforts of libraries.

The Library of Congress (LC), founded in 1800 as a library for the national legislature, now provides significant instances of centralized services for the nation in acquisitions, cataloging, and interlibrary loan. LC began acquiring foreign government documents in 1867 through cooperation in an international exchange program, and took on an aspect of a national library in 1870 when two copies of every work copyrighted in the United States were automatically deposited in the collection. In 1965 LC began acquiring a more comprehensive collection of foreign publications through a cooperative program, the National Program for Acquisitions and Cataloging (NPAC).

The Library of Congress made printed catalog cards available for every book it cataloged after 1901. It also began building a National Union Catalog in 1901.

In addition to its centralized acquisitions and cataloging services, LC maintains a vast interlibrary loan program. According to the annual report of LC, there were one quarter of a million volumes loaned in 1968.

The National Library of Medicine (NLM) was formed from the Army Medical Library by an act of 1956. NLM mechanized its indexing services in 1960, and three years later it began storing these citations on the computer for use in MEDLARS (Medical Literature Analysis and Retrieval System). MEDLARS is a batch processing system which involves the mailing of requests and the printing and shipping of responses. An on-line interactive computer-based system (MEDLINE) using MEDLARS citations has recently been developed.*

The Department of Agriculture Library was designated as a national library in 1962, becoming the National Agricultural Library (NAL). It compiles a comprehensive listing in the Bibliography of Agriculture, and produces Pesticide Documentation, a bi-weekly index of worldwide literature, and related research. Both NLM and NAL have made their catalogs available in book form. In 1967, the first volumes of the Dictionary of the National Agricultural Library, 1862-1965 were published. In 1968 both also began issuing a current book catalog.[17]

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*MEDLINE is discussed in section 3.7.

A Federal Library Committee was formed in 1965, to promote greater cooperation among the federal libraries through formal interlibrary lending arrangements, standards for personnel and management, common procurement procedures, and correlation of resources.

In June, 1967, a National Task Force on Automation and other Cooperative Services was announced by the directors of the three national libraries to establish a national bank of machine readable cataloging and serials data as well as compatability in subject headings and classification schemes used by the three libraries. Several of their recommendations on standardization of automation procedures have already been accepted, including a standard format for communication of bibliographic data, MARC (Machine Readable Cataloging).[18]

National legislation has also played an important role in increasing cooperation. In 1936, the Library Services Division was created in the U.S. Office of Education. The Higher Education Act of 1965 initiated the National Program for Acquisitions and Cataloging which directed the Library of Congress to acquire on a comprehensive basis, currently published foreign scholarly material and to catalog it promptly.[19] The next year President Johnson established a National Advisory Commission on Libraries which recommended the establishment of a Federal Institute of Library and Information Science, which was conceived as being responsible for providing technical direction for the design and implementation of an integrated national library and information system.

2.3. Applications for Telecommunications

As is evident from the preceding section, interlibrary cooperation has a long history and has developed to a level where each library is dependent on an extensive, although informal, network of libraries. The necessity for communication between libraries engaged in cooperative activities is immediately obvious. However, much of the information which is exchanged is in the form of bulk, printed matter. Furthermore, since a good deal of interlibrary cooperation occurs at a local level, the distances which material being delivered must travel are often very short. Non-electronic methods of communication are usually the most suitable for satisfying such requirements, especially when the demand for very rapid transfer of the material is low. The mail, commercial and in-house parcel delivery systems, and direct person-to-person contact are extensively utilized by libraries.

The opportunities for profitable use of telecommunications are nonetheless abundant. The growth of regional associations of libraries has had the effect of increasing the geographic separation between individual members, making communication at once more difficult, slower, and substantially more expensive. At the same time, the expanding demands of users have prompted libraries to develop techniques and abilities which will provide ready access to the aggregate information store of large networks. Efficient control and guidance of networks demands centralization of many management, accounting, and bookkeeping activities, thereby creating requirements for communication of the necessary data inputs from their point of origin to the processing center.

Application of telecommunication can be divided into decentralized and centralized uses. The former is well represented by interlibrary loan and reference activities, while the latter involves uses such as remote bibliographic search and circulation, acquisition, and serials control.

2.3.1. Decentralized Applications

The requirements of interlibrary loan (ILL) operations are particularly well suited to the services provided by telecommunications systems. Telephone and, especially, teletype service have a great potential for application in this area. The speed of transmission is an obvious advantage, as is the availability of two-way communication. Additional speed-ups are realized by completely by-passing in-house mail processing delays. The printed log of all transactions at both ends provided by teletypes is a very valuable record. This feature, together with its far superior ability to precisely and unambiguously transmit citation information, gives the teletype an advantage over the telephone for ILL use, although the latter is still of considerable utility. The role of both services, i.e. telephone and teletype,in libraries is already of significant magnitude, and is discussed in sections 3.2.2. and 3.2.3., respectively.

Another important decentralized application for telecommunications is reference service. The inherently long response time of communication via mail is prohibitive for effective use in this area, due to the question and answer nature of reference work. For the same reasons that the teletype is superior to the telephone for ILL applications, it is similarly more useful when applied in this way. Detailed bibliographic information and lengthy, involved citations can be quickly and clearly transmitted in response to reference questions. In many instances, reference use neatly complements interlibrary loan capabilities as a tool for discovering unsuspected resources in a distant library which appear to be highly applicable to the subject being researched and are subsequently borrowed via ILL.

2.3.2. Centralized Applications

One of the most tantalizing and glamorous uses for telecommunications is in support of systems which permit a remote user to access a central catalog and perform his own bibliographic search. A vast amount of literature has been produced on this topic. Many writers describe future libraries with thousands of remote, interactive computer terminals, located in homes and offices as well as in libraries in the network. While the technology to support such systems is quite likely now available, it appears to be generally agreed that the cost would be very high for at least the near future. Less monumental, but nevertheless highly sophisticated, systems have been developed already, notably by special libraries with large demands and matching budgets. The National Aeronautics and Space Administration's RECON (REmote CONsole) system went into service on an experimental basis in February, 1969. It has been expanded to include all NASA centers in a network linked by leased telephone lines to the NASA Scientific and Technical Information Facility at College Park, Maryland. Utilizing cathode ray tube (CRT) terminals with custom-designed

keyboards, RECON provides users with access to the central bibliographic file. The SUNY Biomedical Communication Network (BCN)[20] is another system currently providing remote bibliographic search capability. Although affiliated with the State University of New York, it is a medical, and hence special, library system. The terminals are typewriter-like devices (IBM 2740's) rather than CRT's.

Other forms of centralized processing to which telecommunications may be applied are shared cataloging and catalog card production, circulation control, acquisition control, and serials control. These functions are unquestionably less exciting to users than conducting bibliographic searches on a remote terminal. They are nevertheless applications where telecommunication systems can have a considerable impact on library cooperation. Centralized cataloging capabilities which depend on the mail for interlibrary communication often are not fully utilized because the delay entailed is unacceptable. Local cataloging is performed instead. Clearly, even one-directional telecommunications between the individual libraries and the central cataloging facility would substantially improve the performance of such a system. The benefits of a two way link would be greater still. In addition to rapid transmission of cataloging questions or copy to the central facility, replies could also be immediate. In sophisticated systems catalog cards, book pockets, and spine labels could also be generated centrally and immediately transmitted to libraries for remote printing.

Circulation control systems using short, local communication links (often simply in-house coaxial cable) are already in existence in many libraries. When materials are borrowed, the transaction is immediately recorded in a central computer file. A laminated plastic library card with borrower identification punched into it is inserted into a special purpose terminal device. An abbreviated alphanumeric keyboard is used to transmit information about the documents. In addition to the multiple intermediate manual actions which are eliminated by such a system, a record of the loan is automatically available in machine processable form for report generation.

Acquisition control and serials control systems can benefit from telecommunications in basically the same ways as has been described for cataloging and circulation control applications. The centralization of accounting and bookkeeping functions inherently requires a means of transmitting information between the points of origin of the data and the central facility.

2.4. Library Budgets

2.4.1. School Libraries

Expenditures for libraries in elementary and schools are difficult to assess on a national basis. The National Center for Educational Statistics of the U.S. Office of Education gathers data and publishes statistics on virtually all aspects of education in America, but school

library expenditures are not thoroughly reported. An extraordinarily detailed tabulation was published in 1964 covering the 1960-61 academic year.[22] This was the only year that such a comprehensive report was made. In the annual accounting of current expenditures by local educational agencies for free public elementary and secondary school, no library expense data are provided at all. State-level summaries provide very limited information. Only expenditures for library books and for the salaries of librarians are itemized, and these figures are incomplete due to variations in accounting procedures among the states.

As a result of the lack of accurate data, no history of spending for elementary and secondary school libraries exists, and thus it is impossible to extrapolate about future trends. A very rough idea of expenditures can be obtained by comparing figures from the most recent year for which complete data is available (1960-61) with the partial statistics pieced together from a recent year. In 1960-61, total library expenditures, including librarians' salaries, materials, binding and supplies, amounted to $210,081,520. In 1967-68, reported spending for library books and librarians' salaries was approximately $376,842,000.[23]

Additional expense data can be gleaned from the annual reports of the Elementary and Secondary Education Act of 1965, Title II. This act provides direct federal assistance for the acquisition of school library resources, as well as textbooks and other instructional materials. The third annual report for fiscal year 1968 indicates that for 45.3 million public and private school pupils (92% of those eligible) a total of $171.4 million was spent for school library resources, of which $82.2 million was provided by ESEA Title II.[24] It should be noted that these figures also represent only a portion of the total expenditures for school libraries since they do not include salaries, capital investments, etc., and since they do not include all schools in the United States.

2.4.2. Academic Libraries

The United States Office of Education published a highly detailed and precise statistical report on American academic libraries in 1970.[25] Between fall 1964 and fall 1968, enrollment rose by about 92 percent (3,600,000 to 7,000,000). However, total library operating expenditures increased 270 percent or almost three times as rapidly as enrollment during the same period ($137,000,000 to $510,000,000). Expenditures for books and other library materials rose even more dramatically, specifically, 370 percent ($41,000,000 to $189,000,000).

Two major reasons for this huge increase in library expenditures are federal financial support and inflation. The ability of academic libraries to sustain such sharp spending increases is heavily dependent on continued assistance from the federal government. Federal legislation and financial support is discussed in the following section.

Expenditures by university libraries exceeded those of all other types of academic libraries combined during the eight year period covered by the report. Public and private university libraries spent over $257,000,000

TABLE 1

SUMMARY OF COLLEGE AND UNIVERSITY LIBRARY STATISTICS FOR ACADEMIC YEARS 1961 - 1970

AGGREGATE UNITED STATES*

Item	1961-62	1962-63	1963-64	1964-65	1965-66†	1966-67†	1967-68†	1968-69	1969-70†	1970-71
Total Expenditures in millions (excludes capital outlay)	$183.7	$213	$246	$276	$320	$366	$416	$510	$550	$600
Number of libraries	1985	2075	2140	2175	2207	2252	2300	2370	2500	2600
Number of students (millions)	3.9	4.3	4.8	5.3	5.9	6.4	7.0	7.3	7.6	8.2
Expenditures per student	$47.13	$50.95	$51.25	$52.75	$54.23	$57.03	$59.29	$69.86	$72.36	$73.17
Expenditures as a percentage of total education and general expenditures	3.1	3.2	3.3	3.3	3.3	3.6	3.7	3.7	3.8	3.8

*Adapted from [26]

†Estimated.

during 1967-1968, while all other academic institutions (four year colleges and junior colleges) spent approximately $252,000,000 on their libraries.

California and New York academic library expenditures were substantially greater than of those of all other states during 1967-1968, with collective spending of $60,000,000 and $56,000,000 respectively. Pennsylvania was a distant third with $29,500,000 total expenditures.

Table 1 presents a summary of selected college and university library statistics for the academic years 1961-62 to 1970-71 for the aggregate United States. The reader should observe that a number of these data are estimates.

2.4.3. Federal Legislation and Financial Assistance

Various pieces of federal legislation supporting libraries have been referred to in preceding sections. There is no question that federal money has been a dominant factor in the expansion of library services in general and the utilization of telecommunications in particular. The Higher Education Act of 1965, PL89-329, under Title II A provides funds for "combinations of institutions of higher education which need special assistance in establishing and strengthening joint use facilities".

In the amendment to the act in 1968, Title VIII, "Networks for Knowledge" was added "To encourage colleges and universities to share to an optimal extent, through cooperative arrangements, their technical and other educational and administrative facilities and resources and in order to test and demonstrate the effectiveness and efficiency of a variety of arrangements". Eligible projects include "joint use of facilities such as classrooms, libraries or laboratories, access to specialized library collections through preparation of interinstitutional catalogs and through development of systems and preparation of suitable media for electronic or other rapid transmission of materials". Unfortunately, funds have never been appropriated to implement this legislation.

The Elementary and Secondary Education Act, Title II requires in its regulations that state plans include some provision for coordination between school libraries and public library programs at both state and local levels.[27] Financial aid for school libraries is also provided, as mentioned earlier.

The most significant encouragement to interlibrary cooperation came with the addition of Title III to the Library Services and Construction Act (LSCA) of 1966, although statewide planning for library development really began in most states with the passage of the original Library Services Act of 1956 which provided funds to the states contingent upon a plan for the improvement and extension of public library services. Under the Library Services Act and its successor, the LSCA, public library systems were established in most states, and became the nuclei of subsequent third generation library organization.

Title III of LSCA provides funds to the states to "establish and maintain local, regional, state, or interstate networks of libraries for systematic and effective coordination of the resources of school, public, academic, and special libraries or special information centers". Funds are to be spent according to a plan devised by the state library agency with the help of an advisory council representative of all library interests in the state. Projects are not required to be statewide, but most involve more than a single library type. Funds can be spent for equipment, personnel, and leasing of space, but cannot be used for the purchase of library material. The act requires that federal funds be matched on a equal basis with state or local funds, although Congress later resolved to suspend the matching requirement through June, 1968. LSCA is scheduled to continue until at least 1975.

The first appropriation under Title III was made by Congress in 1967. The act authorizes appropriations of 5 million dollars in 1967, 7.5 million in 1968, 10 million in 1969, 12.5 million in 1970, and 15 million in 1971. However, actual appropriations have never enabled more than a basic grant of approximately $40,000 to each state. This sum, when matched at the minimum level as is common in most states, cannot support the massive programs that would be needed to make all the library resources of any state available to all its citizens.

In spite of its minimal funding, Title III has resulted in many worth while achievements. Of the 56 states and territories, 52 submitted annual programs for fiscal year 1970 under Title III, obligating $2,079,126 of $2,281,000 appropriated. Various significant program activities were included. Some plans provided for the identification and location of library resources available in a state or region. Others scheduled establishment or expansion of interlibrary loan and reference networks to include all types of libraries and information centers and, in some states, regional medical libraries and State Technical Services Act information centers. Still others planned expansion or establishment of processing centers using modern technology and equipment. Finally, coordination of the acquisition of materials among types of libraries within a geographic area was to be developed according to other programs.

After an initial planning year and two full years of operation, the program has aided in the creation of 45 interlibrary networks and centers serving 904 libraries. Thirty-five Title III supported telecommunications networks now connect 800 libraries, and 14 technical processing centers available to 300 libraries have been established.[28] Unfortunately, no data on the break down of these libraries by type are available, so the number of academic and school libraries involved is unknown.

3. CURRENT INTERLIBRARY COMMUNICATION

The communication requirements of American libraries are met in a variety of ways and by a variety of media. The following sections discuss the roles of mail, telephone, teletype, telefacsimile, television, and radio in libraries. When applicable, an historical perspective on a medium's use is also provided.

3.1. Mail

As it has in the past, mail service of some form continues to be a dominant means for delivery of material and exchange of information between libraries. The U.S. Postal Service, of course, receives the great majority of libraries' business. However, some libraries have considered using bus or truck delivery rather than conventional mail. Others utilize local commercial delivery service for faster delivery in urban areas. Connecticut has employed LSCA Title III funds to maintain an in-house truck delivery system. Many of New York's 3-R systems (see section 2.2.2.2) deliver materials to member libraries by eitner truck or parcel delivery.

The most commonly voiced complaint about conventional mail as a means of communication between libraries is that it is quite slow. For example, the time elapsed between a patron's original ILL request and receipt of the requested document has been observed to range from one to several weeks. Critics of mail service have pointed to the greatly increased volume of mail handled in the U.S. and the ensuing bottlenecks, slowdowns, and general deterioration of service as reasons for utilizing an alternative means of communication.

Based on complaints that libraries were encountering long delays in delivery of material, Michigan made a careful study of mail service a few years ago as part of a preliminary study before contracting with a private delivery service.[29] The results revealed that most of the delays were occurring in the State Library itself and in the borrowing library. Material delayed overnight, over a weekend in the library shipping room, material bottlenecked in the charging operation and other similar slowdowns accounted for much of the delivery time. The post office in Michigan was in fact making deliveries most of the time within twenty-four hours throughout the state.

3.2. Telephone

Long distance telephone service is an important means of communication between libraries. It is often supported by the Bell System's Wide Area Telephone Service (WATS). A number of library WATS systems are known to be in use. However, no data on subscribers is made available by the Bell System, so the involvement of academic and school libraries in such networks is not accurately known.

Most states have WATS lines connecting the state capital with various key points in the state. In some cases, a dedicated library system is provided. The State Library acts as the switching and bibliographic

center for the system, and in some states, assumes the cost of the telephone lines. When a dedicated network is not available, library communication traffic competes for time with that of other state agencies. In either network configuration, the most common utilization is for interlibrary loan and reference service.

The majority of current long distance telephone utilization is built around state-level networks. A few states, such as Michigan, Arkansas, and Mississippi, have chosen to use the telephone as the sole communication device for interlibrary loan (ILL) and reference. Other state library systems using long distance telephone service include those of Texas, Washington, Iowa, North Carolina, and Georgia.

The Georgia Library Information Network uses both inward and outward WATS service to connect 37 regional public library systems, 9 special libraries, 24 universities, colleges and junior colleges, and the union catalog at Emory University Library with the Public Library Services Unit of the State Department of Education.[30] In Georgia, the Public Library Services Unit performs many of the functions performed by state libraries in other states. The network has been in operation since 1969, and supports ILL and ready reference.

Perhaps the most widely publicized use of telephones for interlibrary communications is the "hot line" project in Michigan. In the original project, 24 public library systems were linked to the State Library in order to transact interlibrary loans. Later, the 27 Community Colleges of the state were included as well. The State Library telephones all public library system headquarters every working day at the same hour to receive ILL requests which cannot be filled in the region. School libraries enter the network through their local public library. Plans have been made to include direct calls to the reference departments of each of the state's four-year college libraries. The original design goal was for the State Library to service all requests in twenty-four hours or less, and to refer those not available in the state library's collection to the other resource libraries in the state and outside if necessary. In the present system, requests that cannot be filled by the State Library are sent to an office in the University of Michigan Library staffed with Hot Line personnel and equipped with photoduplication equipment.

The hot line has several advantages over teletype service, the chief rival of the telephone in interlibrary telecommunication. One is that during the same daily telephone call, a report can be given on the previous day's requests and questions can be quickly clarified on substitutions, subject requests, etc. Another major advantage is that the hot line helps to get a network started quickly with maximum volume, since initiative is not left with the local library to use the network.

The primary disadvantage of the hot line, and of telephone networks in general, is that it is more costly than systems using teletypes in terms of personnel, since a teletypewriter can operate unmanned. A less significant but frequently troublesome problem is the lack of audio clarity and preciseness when lengthy bibliographic information is communicated. Unless some citations are spelled character-for-character,

the chance for confusion and misunderstanding is great, especially when clerical rather than professional staff man the telephone.

3.3. Teletype

Teleprinters, commonly referred to as teletypewriters or simply teletypes, are by far the most common means of telecommunication used by libraries. They are widely used to support interlibrary loan and reference service, for augmenting holdings on a reciprocal basis and querying union catalogs, and for general communication with other libraries as well as internal communication. Some libraries use teletypes to transmit bibliographic data for cataloging, and still others utilize teletype service as part of their circulation control system.

The teletype is particularly well suited for library use. It offers libraries many of the same advantages as telephone service, namely speed of transmission, expanded resources, and an increased range of library services. Furthermore, the simultaneous written record at both ends inherent in teletype operation provides clarity of foreign languages, precise citations, and the ability to use codes with a far lower transmission and understanding error rate than is possible over a telephone. The addition of a paper tape punch and reader to the basic machine allows a message to be typed off line as slowly and carefully as necessary to ensure correctness without tying up a line. When an error-free paper tape is completed, the message may be then transmitted at the maximum machine speed. This procedure simultaneously greatly increases message accuracy and (for switched networks) minimizes line costs. The tape created may also be saved for retransmission at a later time. Finally, the availability of unattended operation with a limited answerback capability allows twenty-four hour service at a substantial savings in personnel costs.

Teletype service is supported by either leased lines or switched networks. Voice grade lines are almost always used for both types of service. In a leased line system, members of a network may communicate only with others also wired into the closed circuit, and the cost of the line is fixed rather than being a function of the amount that it is used. In a switched network, any given teletype has access to all other teletypes served by the network, usually via common carrier telephone lines. Connection with another teletype is accomplished by means of a dial-up mechanism. This system is known as TWX in the United States and Telex in other countries.

Libraries have used teletypewriters since at least 1927, when a closed-circuit system was installed in the Philadelphia Free Library to provide communication between stacks and the circulation area.[39] The first installation connecting two libraries was made between Milwaukee and Racine, Wisconsin.[32] Teletype service proved to be less expensive than telephone calls for serving the Racine patrons whose needs could not be satisfied locally. Michigan established the first teletype network in 1951. When the State Library was destroyed by a fire, a TWX system linking the Detroit Public Library, the University of Michigan Library, and Grand Rapids Public Library with the State Library, provided interim service. The network was abandoned

when teletype charges were increased.[32] The Library of Congress installed TWX in 1952, thereby enhancing the utility of installations in local libraries. During the nineteen fifties, a number of state systems were created. A 1959 survey reported 24 libraries using TWX, and a subsequent 1964 survey revealed an increase to 65 library users.[32] Note that both figures include libraries of all types, not just academic and school libraries.

At the present time, leased line systems are known to exist, such as Maryland's network connecting all the county library systems in the state with the Enoch Pratt Free Library.[32] However, the extent of national utilization of leased line teletype networks is not released by the common carriers. Western Union offers TWX service in the United States, and they publish a national directory of subscribers similar to a telephone book. The 1971 TWX directory classified section (the "yellow pages") lists 225 academic library subscribers out of a total of 499 library subscribers of all types.[33] Figure 1 indicates the distribution of these academic library TWX subscribers in the United States. Since there were approximately 2,600 academic libraries in the 1970-71 academic year[26], about 8.6% were TWX subscribers. This is a slight increase from 6.5% in 1968 when 154[34] out of 2,370[26] academic libraries were subscribers.

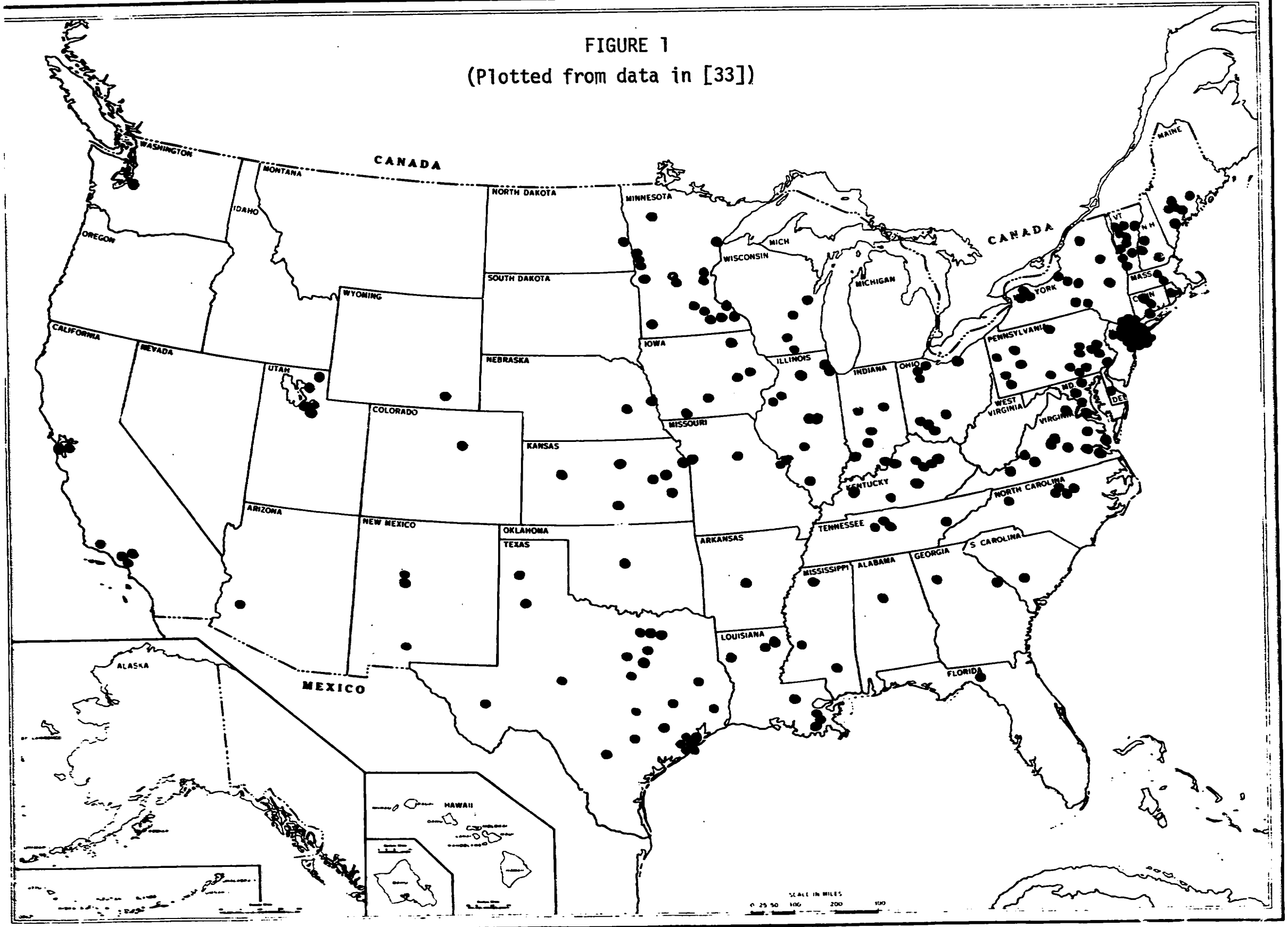
Of course, it is quite likely that in a number of instances libraries may be sharing teletypes supported by TWX service with other agencies. If the other agencies pay for the line, the TWX directory will not reveal such library utilization. The inferred level of academic library TWX use presented above may therefore be regarded as a lower bound on the actual use.

Many interlibrary teletype networks are currently operational in the United States. The majority are intrastate systems, since the LSCA Title III funds which provided the impetus for their establishment are administered at the state level to support state-wide systems. For the same reason, many existing networks are largely public library oriented. However, academic libraries are included in most networks in one way or another. In some states, most or all of the state university or college libraries are linked together. Almost every system includes at least the main campus of the state university as a back up resource library for referrals of requests that cannot be serviced by the State Library. Among the more prominent academic library networks utilizing teletype are those of California, Texas Washington, Pennsylvania, Minnesota, New York, Kentucky, and Ohio. The New England Library Information Network (NELINET) is one of very few which formally links the academic libraries of a number of states, namely, Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.

Evaluation of teletype use is just now beginning to occur in a systematic way. It is possible that analyses have been prepared for internal distribution in some systems, but published reports of the effectiveness, cost, and other operational parameters of teletype networks are very rare indeed. One of the first evaluation studies is the analysis of the Oklahoma Teletypewriter Interlibrary System (OTIS),[35] which uses TWX to link the various regions of the state

FIGURE 1

(Plotted from data in [33])



with Oklahoma's five resource libraries -- the Tulsa and Oklahoma City-County Public Libraries, the two State University Libraries, and the State Library. In an analysis of the first eighteen months of OTIS operation, the study estimated the unit cost of the network, both to the resource libraries and to TWX center libraries, its benefits in terms of user satisfaction, (success in locating and supplying material and turn around time), and the extent to which the network achieved fringe benefits such as the fostering of better development and use of local library resources and broader coordination between libraries of various types on a state and local level. The study revealed that access to wider resources brought people in to the local public libraries who had never used them before and universally encouraged the selection of a higher level of material in the local libraries. The study also documented that the strongest libraries in the state made the greatest use of the network. The public library systems accounted for more than one third of the networks requests. The two university libraries accounted for nineteen percent of the traffic. This evidence tends to cast some doubt on the concept that a network tends to operate primarily for the benefit of the weak library.

Evaluations of teletype networks in Texas[36] and Minnesota[37] also have been recently published. Analysis of a number of such objective studies of library teletype utilization will be necessary before a clear picture of their performance parameters and demands on the telecommunication link is established.

3.4. Telefacsimile

A great deal of interest has been generated in the possibility of using telefacsimile systems in libraries for the rapid transmission of library materials. In addition to being dramatically faster than a teletypewriter for sending text (assuming a broad bandwidth circuit and a high scan rate), it has the additional advantage of being able to send pictorial or graphic information. An important implication of the latter feature is that most type faces, not generally reducible to machine-readable form, may be transmitted, including non-Roman alphabets. In another report in this series,[62] Ohlman has discussed the role of facsimile as an alternative to physical distribution of educational materials in general.

Far from being a recent technological innovation, facsimile transmission can be traced back to as early as 1842.[38] In that year an electrochemical recording telegraph was invented by Alexander Bain, a Scottish physicist. The scanner was a pendulum swinging across metallic type with which electrical contact activated a synchronized remote swinging pendulum. The receiving device produced a brown stain by passing an electric current through chemically treated paper, a technique very similar to that used by several modern devices. However, faster, less complicated and more versatile equipment, notably the teletypewriter, were developed and Bain's invention never became popular.

Experimental facsimile equipment was not installed by telephone and telegraph companies in the United States until about World War I. Short wave radio facsimile was soon established throughout the world, primarily for making news photographs more speedily available. The cond World War spurred additional developments and facsimile transmission has since then been widely used by the news media for photographs and newspaper stories, by government agencies, particularly for rapid transmission of weather charts, and by Western Union for sending its typewritten messages. Some newspapers, notably the Wall Street Journal, are type-set in one city and printed by high speed facsimile in another.[40, 32]

The first library demonstration of facsimile transmission was in 1948, when a RCA system called Ultrafax[41] was used to transmit the 1047 microfilmed pages of Gone With the Wind from Washington's Wardman Park Hotel to the Library of Congress, five miles away, in 2 minutes and 21 seconds. The system, the first to use a cathode ray scanner, transmitted the image by microwave, and received it on another cathode ray tube, from which either a videotape or a hard copy could be made. The received image was first recorded on fast-acting film which was developed very quickly. RCA predicted a variety of sophisticated uses for Ultrafax; but, although it worked very well, it was apparently abandoned, probably due to high cost.

The Atomic Energy Commission developed and briefly tested a prototype facsimile system in 1952 which achieved a resolution of 150 lines per inch (adequate to render 6-point type legible in the facsimile copy) and a very satisfactory rate of speed using broadband transmission. The system used a cathode ray flying-spot scanner to read a page and electrolytic paper to reproduce the image. It's most important feature was the use of a flat-bed scanner which made it possible to transmit directly from a book or other bound volume. No commercially available device with this capability has been marketed in the nearly twenty years since the AEC device was tested.[32, 41]

During the nineteen fifties, facsimile transmission became increasingly utilized by industry and government, as mentioned earlier,but library experiments were not conducted again until the early sixties. A proposal to the Council on Library Resources in 1961 for a library facsimile experiment in the Boston area was considered, but ultimately turned down because of high costs and the short distances involved.[42] A facsimile link between the Franklin Institute Library in Philadelphia and the nearby General Electric plant at Valley Forge was established in 1963. Although successful from a technical standpoint, the system was abandoned because of apprehension about copyright violation.[43]

In 1965 the Council on Library Resources made a grant to the University of Nevada for a thirty-day experimental test of a new facsimile system then under development by the Magnavox Research Laboratories. The Xerox Corporation had contracted to market the equipment, which was variously known as Magnafax, the Xerox-Magnavox Telecopier, the Xerox Magnafax Telecopier, and more recently as the Xerox Telecopier. The device is a compact, relatively low cost, slow-scan transceiver. Early production models were used in the experiment, which was designed to evaluate the feasibility of transmitting printed pages between libraries as a faster

alternative to sending Xerox copies by mail in response to a mailed request. The Reno and Las Vegas campus libraries of the University of Nevada and the Davis campus of the University of California were linked by voice grade lines in the test. The results[44] indicated that the system was indeed feasible and convenient for routine interlibrary use, provided that the equipment has both improved readability and consistency of copy quality. Transceiving time for a ten page document took about one hour, resulting in costly long distance telephone charges. The average total elapsed time for completion of requests was about four hours. The quality of copies was deemed adequate for most library materials when the machines worked properly. The test equipment was out of order more than a third of the time. Total operating cost for a ten page transaction was approximately $9.85.

Another Council on Library Resources grant sponsored an experiment at the Library Research Institute of the University of California in 1967 using the Xerox LDX (Long Distance Xerox), a much larger, faster, and more expensive system than the telecopier. Library speed and definition requirements were generally satisfied by the LDX system. Although costs did not greatly exceed original estimates, both system turnaround time and demand for service were disappointing.[40]

The Hawaii State Library System installed four Stewart-Warner dictaphone transmitting and receiving stations in 1966 on Oahu and three of the other Hawaiian Islands. Transmission of material by facsimile was especially attractive to Hawaiian libraries. It seemed to be an ideal answer to their frequent need to transmit Chinese, Japanese, and other non-Roman alphabets. In addition, their pecular geographic isolation results in most mail being flown or sent by boat, making it either expensive or slower than land mail. However, primarily because of unsatisfactory equipment performance, the Hawaii system was discontinued in the autumn of 1967.[40, 32]

Perhaps the best known experiment with facsimile transmission was conducted by the New York State Library. Its FACTS pilot project was initiated in January, 1967, using Stewart-Warner and Alden equipment, and connecting the New York State Library, the New York Public Library, Cornell University Library, Buffalo and Erie County Public Library, and Rochester Public Library. Eventually twenty-five research libraries were scheduled to be linked. Original plans called for users to be charged 25¢ per page and limited to receiving a maximum of twelve pages for any one transaction. A hierachical referral system called for requests to be first teletyped from the originating local library to the nearest library having a facsimile device, then to the State library if still unfulfilled, and finally to the system at large if necessary.

After consideration of the recommendations in a report of Nelson Associates, Inc.[45] FACTS was discontinued in March, 1968. It had grown to include fifteen libraries and in fourteen months of operation had satisfied 4,265 of almost 5,000 requests. However, the report recommended against continuation of the network because costs were too high, equipment unsatisfactory, public demand for the service disappointing, and total transaction time too great to justify the use of rapid and expensive transmission equipment.

The South Carolina State Library conducted experiments with Xerox Magnavox Telecopiers in April, 1967, connecting the State Library in Columbia, the Greenville Public Library, and Charleston Public Library. A variety of library materials were transmitted, although the system was used primarily for sending interlibrary loan requests. South Carolina's report is more generally favorable to the equipment than was that of the University of Nevada.[46]

According to Heron[40], as of January, 1969, at least two operational systems using facsimile transmission were known to be in existence. One is the Pennsylvania State University network. A pilot system began in February, 1967, using the Xerox Telecopier in three installations. An analysis of the first five months of operation, at relatively low volume, indicated high unit cost. Despite the findings of the study, the university has expanded the system so that each of the twenty branch campuses and the main campus now has access through facsimile to the resources of other libraries in the network.[40]

Another reported library facsimile system is the San Francisco Public Library Bay Area Reference Center (BARC). This system, established in 1968 and federally supported, connects the main San Francisco Public Library and seven other public libraries. Xerox Telecopiers are utilized.[47]

It is clear from this survey of attempts, both successful and otherwise, to utilize telefacsimile in libraries, that several significant problems have been repeatedly encountered. A fundamental difficulty is the equipment itself, which was not designed with library needs in mind. Morehouse observes that using commercially available facsimile devices in a library environment is "something like using an electric dishwasher to wash our clothes".[48] Most equipment priced in a range that libraries can afford has been designed for business letters and forms, mostly typewritten. The definition of such devices, while adequate for elite type, is often far too gross for many library materials, particularly scientific journals and other technical documents. In pure textual documents, whole words may be decipherable even if individual characters are not. Separate letters may not be identified with any certainty, but a group of them may be clearly identified as a word with the aid of context. On the other hand, technical documents frequently contain small characters and symbols that must be independently identifiable. Another serious drawback of contemporary equipment is its inability to copy directly from bound volumes. Legibility of the transmitted copy frequently suffers since it is necessary to transmit from a local copy of the original. Staff members of the FACTS experiment complained that they often sent illegible copy because they were working from faint or low contrast copies.[45] Furthermore, the necessity of making an intermediate copy of every page transmitted is a disadvantage in and of itself, since it increases both the turnaround time and cost of every transaction. Even if a book scanner is devised, experiments with automatic page turners have not been encouraging.

Relatively low user demand for service where it was made available is another problem of facsimile systems. Librarians often "assume that there is an insatiable demand for faster service and quick, ready access to the resources of other libraries".[48] Experience seems to indicate that this is not always the case, especially when the service is relatively

expensive. Consequently there is often a chicken-and-egg situation in which unit transaction costs would be low if only enough volume existed, but patrons are waiting until the cost goes down before they use the facsimile service.

The rather substantial expense of telefacsimile systems is thus perhaps the single greatest obstacle to increased library utilization. Morehouse states that a cost of less than $1.00 per page is quite rare.[48] Few libraries can afford to absorb the entire cost of facsimile service at that high a price. And it also appears that few users are prepared to pay what is often many times the price of an entire document for copies of just a few pages. Under certain circumstances it may be possible to obtain a required publication more economically and about as quickly by purchasing it outright rather than by utilizing a library telefacsimile system.

One of the major components of the high cost of facsimile transmission is the communication link. The expense of the transmitting, receiving, and possibly modem devices is not inconsequential, but it is fixed and consequently is not affected by the distance separating equipment installations. To achieve both high resolution and high speed, big systems like the Xerox LDX require broadband circuits. Even operating at maximum capacity, the expense of such circuits adds a substantial per copy cost overhead when transmission distances are not relatively short. Libraries could, of course, utilize voice grade service and still obtain a high resolution, but at the expense of greatly increasing transmission time per document. Conventional message facsimile systems, operating at 96 scan lines per inch, can transmit an 8-1/2" x 11" page in about six minutes. A resolution of 160 lines per inch (generally considered satisfactory for library purposes) would boost transmission time over a voice grade line to ten minutes for one page. This is unacceptably long for the majority of potential library facsimile patrons.

A final difficulty libraries have been faced with in their attempts to use telefacsimile is the fear of copyright violation. Publishers are already nervous about direct copying equipment now available and regard remote reproduction of copyrighted texts as an additional threat to library property rights. The wide use of copying equipment in educational institutions has been one of the issues which has delayed the passage of a new copyright law in the United States Senate.

3.5. Radio and Television

The current utilization of both radio and television for interlibrary communication is negligible. In Missouri, the Ozark Pioneer Library Association, a group of six regional public libraries, has a library radio network for interlibrary loan and reference service.[30] However, no academic or school library use of radio communication is mentioned in the literature.

Libraries have been interested in television for some time, but mostly in terms of presenting book talks and other library-related programs on educational television stations. Uses of this nature (ETV)

and their communication requirements have been extensively described by another memorandum in this series[49] and are not discussed in this report.

Two experiments at the University of Virginia designed to help resolve some of the difficulties with interlibrary communication using television were sponsored by the Council on Library Resources in 1958. As part of an investigation of the feasibility of remote consultation of card catalogs via closed circuit TV, a card-turning device had to be designed which would feed and turn cards for the camera. The mechanisms developed were not sufficiently reliable to do the job efficiently. In another experiment in the Manchester College (England) Library, a one-way closed circuit TV link was installed between the main library and an on-campus branch. The receiving end was equipped with a TV monitor, a book moving device for remote handling of the document being viewed, and an intercom. The page turning apparatus proved to be less efficient than a staff member turning pages. Also the use of the system over longer distances was deemed infeasible because of the high cost of the required common carrier broadband circuits.[50]

The Natrona County Public Library (NCPL) in Casper, Wyoming, experimented briefly in the spring of 1970 with a video reference service on a local CATV channel. In the pilot project, viewers phoned in their questions and watched the reference staff find and relay the answers on camera. NCPL, the largest library system in the state, hopes to broadcast the service on a regular basis and to expand it to a statewide network.[30]

The entire library community is very interested in the growing field of Community Antenna Television (CATV). Broadcast television is not at present economically feasible for interlibrary communication use, and furthermore it does not permit two way communication. However, the FCC has announced its intentions to require cable operators to provide the possibility of two way communication which libraries, among others, could use for facsimile reproduction, information retrieval, computer to computer communications, and other purposes. In another area, FCC rulings on the share of a cable system's capacity which must be reserved for non-commercial users may favorably affect the utilization of television communications by libraries. This subject will be discussed in more detail in section 4.3.

3.6. Data Communications

Although it has not been explicitly mentioned until this point, the heart of many centralized applications for telecommunications is a computer. Interlibrary loan, reference, and other decentralized functions using a telecommunications system would no doubt benefit from the services of computers, but could perform quite well in their absence. However, the fundamental technology which supports remote bibliographic searching and other similar applications is data processing.

A discussion of library communication utilization should therefore consider the subject of data communications. The technical aspects of this topic are beyond the scope of this report, but have been thoroughly considered and extensively described in another memorandum in this series.[21]

The small number of references in the literature suggests that there are very few currently operational library systems which exploit interlibrary data communication. As mentioned in 2.2.1.5, the New England Library Information Network (NELINET) and the State University of New York Biomedical Communications Network (BCN) are important exceptions. Another more recent project is the Ohio College Library Center (OCLC),[60, 61] a non-profit organization located on the Ohio State University campus. The OCLC is designed to offer increased library services to faculty and students of member institutions at reduced costs and to promote the development of a national computer-based bibliographic network.

Grants from the U.S. Department of Health, Education, and Welfare and the Council on Library Resources are funding the development of several on-line systems. A shared cataloging system became operational in August, 1971. Users access the central data base through a specially designed graphics terminal and may enter new cataloging information as well as retrieving existing data.

The next project being developed is an on-line remote catalog access and circulation control system. Users will not use display terminals directly, but will telephone operators at strategically located centers who will perform the searches. Eventually, a catalog access system is planned in which users may conduct their own searches from remote terminals.

Despite the reduction in the unit cost of cataloging which OCLC's catalog system provides, membership has dropped from 54 in February 1970[61] to 49 as of December, 1971.[60]

Medical school libraries appear to offer the most promise at present for developing data communication networks. Medical research continues to be generously funded at a time when other academic areas are contending with shrinking budgets, and medical school libraries are correspondingly wealthier than their general, main-library counterparts. Furthermore, the extremely high rate and volume of publication in the medical literature, together with the speed with which information becomes obsolete, generate a clear requirement for library services which can provide unusually powerful access capabilities. In a recent seminar at Washington University, Dr. Estelle Brodman, Librarian and Professor of Medical History, Washington University Medical School Library, emphasized the necessity of powerful data processing capabilities in meeting the demands of medical research. She suggested that most medical school libraries are unable to afford on their own the computing systems required, and that networks of such libraries could possibly combine their resources and share a large central facility. While such a cooperative arrangement could conceivably operate in a batch mode (involving no data communication), Dr. Brodman left no doubt that an interactive system would be preferred.

3.7. Medical School Libraries: MEDLINE

From the standpoint of both user popularity and genuine usefulness, one of the most significant services which telecommunications can help provide is an on-line interactive bibliographic search capability. Bibliographic data stored in the files of a central computing facility can be made available to distant users. These users may perform searches for documents pertinent to a given subject with far greater ease than is possible with traditional printed bibliographic materials.

Academic libraries do not appear to be utilizing such systems to a significant extent. The substantial expense of the computing facilities required has perhaps been one of the biggest obstacles to use. Furthermore, cooperative efforts designed to involve a large number of institutions and so distribute the costs of the system seem to have had difficulty both getting started and surviving once established.

An important exception to the general low utilization of interactive bibliographic search systems is the MEDLINE system. MEDLINE provides medical school libraries with the capability to perform on-line searches of the bibliography of medical journals contained in the Abridged Index Medicus (AIM). The system was created and is maintained by the National Library of Medicine (NLM). Probably the single most important factor contributing to its widespread use is that it is paid for entirely by the NLM. The only cost to a medical school library is the expense of a terminal facility (typically a teletype) which is relatively inexpensive.* In addition, since many medical school libraries already have a teletype connected to TWX, obtaining MEDLINE service often involves no expense at all.

In response to a user's request, MEDLINE returns bibliographic references to pertinent medical journal articles. The author(s), title, journal name, volume and issue, inclusive pages, publication date, and key subjects are given for each document reference. Only the reference data are provided; no abstracts or summaries are supplied.

The current system is capable of serving as many as 30 simultaneous users. It is available Monday through Friday from 10:00 a.m. to 2:00 p.m. EST. MEDLINE is designed to be eventually available to all medical school libraries who wish to utilize it.

The NLM has been involved with providing enhanced bibliographic services to the medical profession for a number of years. MEDLINE has been developed from several earlier systems. The first operational NLM service providing automated bibliographic searches was the Medical Literature Analysis and Retrieval System (MEDLARS). MEDLARS is a batch system where requests are physically delivered to a central computer. Many search requests are pooled together and each is serviced by examination of the entire MEDLARS data base of bibliographic information stored on magnetic tape. References to documents relevant to the request are printed and the report is finally delivered to the requestor.

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*The Washington University Medical School Library spends $77.50 per month for TWX service.

MEDLARS, although an ambitious sophisticated, and well-financed project, has several serious flaws. Perhaps its greatest drawback is the substantial time lag between the formulation of a request and the delivery of the response. Since physical transportation is involved, and since the requests must be pooled together at the computing facility, the response time may be several weeks. This is intolerably long for urgent requests, and is long enough to discourage routine use. Secondly, search requests are sometimes inadequately precise, resulting in a response which indicates perhaps several thousand relevant documents. Clearly, such a response is useless. The requestor must then try to narrow his request by a more precise subject definition and try again, hoping that the newly formed request is neither too specific (resulting in no relevant documents) nor once again too general (resulting in another huge, unusable bibliography).

NLM recognized the flaws inherent in MEDLARS and realized that an interactive system would solve many of its problems. To investigate the feasibility of such a system and to gain operational experience, an experiment was conducted using the MEDLARS data base and System Development Corporation (SDC) computing facilities. The trial system was known as AIM-TWX (Abridged Index Medicus-TWX). Experience gained from the AIM-TWX project suggested that an on-line interactive bibliographic search system utilizing the MEDLARS data base was indeed feasible. The current MEDLINE system was designed as an operational successor to AIM-TWX.

4. FUTURE INTERLIBRARY COMMUNICATION UTILIZATION

In a paper presented at the Airlie House Conference on Interlibrary Communications and Information Networks in October, 1970, John Bystrom summarized the prospects for future interlibrary communication utilization:

> "There is as yet no library strategy for the development and use of statewide telecommunication systems and urban cable systems or for international exchange by satellite. The use to which libraries will put these telecommunications systems is a matter of conjecture."[1]

Accurate estimates of telecommunication utilization during the next few years are very difficult to provide. A great many current projects are experimental, almost wholly dependent on federal funds, and do not reflect any permanency of use. Detailed plans of systems under development are virtually nonexistent. Few clear trends are apparent from an overview of contemporary library communication usage, and those areas that do appear likely to expand (such as teletypewriter and long distance telephone utilization) are associated with quite modest circuit requirements.

The goal of this section therefore is to discuss the status of several important areas which will probably have a significant affect on future library communication use, rather than to present a consensus of authorities on the matter. Indeed, no such accord seems to exist. The roles of research and development, the burgeoning CATV industry and communications satellites in influencing future library utilization are considered in the following discussions. Finally, the major obstacles to greater communication use are identified and a summary of predictions is presented.

4.1. Research and Development

Experiments and research designed to advance the state of the art in library telecommunications use are not particularly abundant. Nevertheless, efforts do continue, primarily because of grants made available by federal legislation, particularly LSCA Title III, and private organizations, most notably the Council on Library Resources and the American Library Association. A substantial share of the emphasis of such sponsoring agencies, and a corresponding amount of grant money, is allocated to research dealing with problems of centralized processing systems. For example, in the fourteenth annual report of the Council on Library Resources, for the period ending June 30, 1970,[51] it was observed that the average library will never be able to "go it alone" in some aspects of the new technology--for example, automation. The investment required to benefit from emerging national machine readable data bases, like the Library of Congress MARC data, is far beyond the individual budgeting capacity of any but the very largest libraries. The report noted that there is a growing agreement that the only possible solution to the dilemma, expecially for medium and small libraries, is to join into local, state, or regional consortia to pool assets and resources. Because such consortia are very expensive and complex, and will not develop easily, CLR is considering funding the most promising developments. This stress on the data processing aspect of

centralized library communication systems is typical of the philosophy of many agencies sponsoring research in library technology utilization.

The most comprehensive research in the application of technology to libraries is the Massachusetts Institute of Technology's Project INTREX (Information Transfer Experiments). The original objective of these experiments was "to provide a design for evolution of a large university library into a new information transfer system that could become operational in the decade beginning in 1970".[52] The orientation of Project INTREX stresses extensions of the state of the art rather than applications. In the introduction to the Semiannual Activity Report (September, 1970 - March, 1971),[63] Overhage predicts that many problems faced by libraries today will be solved by combination of both organizational and technological innovations. Organizational advances to encourage resource sharing and "networking" will be supported both by the microfilming, duplication, and computing facilities of individual libraries and by existing interlibrary technology, such as telephone and teletype communications, facsimile transmission, and data processing services that utilize centralized bibliographic resources. However, Overhage emphasizes:

> "In contrast with these near-term contributions of new technology toward economic and organizational ends, the technological thrust of Project INTREX is directed toward a more distant and ambitious goal. The objective of Project INTREX is to extend man's intellectual reach by giving him control over his access to information. In pursuit of this objective, we are seeking to improve the efficiency of catalog searches by utilizing interactive computing techniques, and to provide rapid access to full-text displays by utilizing microfilm storage and facsimile transmission."

The experimental program pursued "combines the exploitation of on-line computer technology with the modernization of some current library procedures, with emphasis on the former". Access to bibliographic material, documents, and data banks is the main problem addressed. The experiments relating to the access function deal with a "Model Library" project, an augmented catalog, text access, network integration, fact retrieval, console technology,interaction languages, and various miscellaneous library functions.

The "Model Library" project provides an environment for the performance of the INTREX experiments, as well as yielding operational experience in setting up and running a pilot system with real users.

The augmented catalog experiment involves the establishment of a catalog as a data base in digital form on an on-line computer system. It is augmented in content, depth, and connectivity, and covers books, journal articles, reviews, technical reports, theses, pamphlets, conference proceedings, etc. Experiments deal with bibliographic search; selection, acquisition, circulation, and other library operations; selective dissemination; and browsing.

In the text access experiment, the problems considered are related to the delivery or display of documents to the user versus having them ready when he calls for them. Project INTREX examines the relative merits of alternatives with regard to cost and effectiveness.

The network integration experiment is concerned with exploration of plans for the integration of university libraries into a national network of information centers. The interaction of a computer-based university information transfer system with the information systems of organizations such as NASA and the National Library of Medicine is being investigated. Methods of resource sharing and the interchange of bibliographic, indexing, and abstracting information are also being considered.

The emphasis of the fact retrieval experiment is on the retrieval and assembly of facts rather than documents. Advanced systems for automatic question answering are to be developed. Comparison of the techniques developed with traditional book-based methods are planned.

The ultimate feasibility of the systems and techniques developed as part of INTREX in a real world situation is no doubt given consideration. But many of its most important developments with respect to future library telecommunications utilization are built around in-house coaxial cable transmission over very short distances (a mile or less). Consequently extremely large bandwidths are used to provide reasonable transmission time for many applications where a very large volume of information is sent. While the equipment used may indeed be relatively low priced, the communications circuit, if leased from a common carrier, would be very expensive for libraries separated by several hundred miles. As an example, one of the best publicized activities of INTREX is the text access experiment. It was recognized very early that digital store of full text in a computer memory would be prohibitively expensive. The experiment began investigating various aspects of remote display of text stored in microform using a computer for identification and scanning display of microforms for facsimile transmission to receiving stations. In a recently proposed system,[53] a user enters a request for a document through the augmented catalog console. Output appears as a transient display on a storage display unit at a terminal or as hard copy in the form of microfilm from a film output terminal. A computer queues requests and controls the operation of a random access microfiche text storage device. The bandwidth required for one second transmission via a one-fourth mile coaxial cable to the film output terminal is approximately two megahertz according to this reference, presumably for one page of text from the microfiche. Even with educational institution discounts, the lease cost of a circuit of that capacity would be extremely high over all but very short distances.

Even within the MIT community, there seems to be some disagreement concerning the advent of on-line storage of text for use in a document/text access system. William Locke, director of libraries for MIT since 1956, cites both storage and transmission costs as formidable obstacles to actual operational library systems.[54] Although he does not discuss microfiche storage as is used by the INTREX project, Locke concludes that the cost of magnetic digital storage, on tape or disk, is at least two orders of magnitude greater than shelf storage for books. To provide a feel for the trememdous cost of high bandwidth circuits when it is

necessary to send really huge amounts of information over long distances, Locke cites a comparison of the cost of chartering a Boeing 707 and loading it with microfilm with that of using Telpak D to transmit the same number of bits from New York to Los Angeles. The aircraft charter is $10,000, while Telpak D is about $2,700,000. Of course, attempting to compare physical delivery with electronic transmission of information is a bit like adding apples and oranges. Furthermore, the comparison cited by Locke ignores matters such as how the information was put into microform, in what electronic form the library materials to be transmitted are in, and several other issues which materially affect the costs involved. Ohlman[63] discusses the counter arguments to Locke's example in considerable detail. Even though the two techniques are not really directly comparable, the example illustrates Locke's point that full text transmission will necessarily be an expensive proposition. Concerning the role of on-line text access in libraries in the near future, he flatly concludes that "anybody who talks about storing any number of books, even off line, is off his head".

Project INTREX will no doubt provide important basic research on which future applications of technology in libraries may be based. A good many of these applications will unquestionably need a high capacity telecommunications system. However, it is very doubtful whether the results and technology developed by INTREX to date will affect actual library communication utilization in the near future.

4.2. Community Antenna Television

As has been previously mentioned, libraries and the educational community in general have been taking a close look at the present and potential applications of CATV. No currently operational library systems utilizing CATV have been reported in the literature, but numerous potential uses exist. If a library had access to a channel, either on a dedicated or a shared basis, it could deliver children's story hours, book talks, and programs taking place in the library to every home connected to the cable system. Special programs for specialized audiences, such as the disadvantaged, teenagers, church and community groups could be generated. However, utilization of this nature is obviously more closely related with educational and instructional television than it is with libraries as such.

The particular significance of CATV to libraries and their future telecommunications utilization is as a means for interconnecting libraries themselves, in addition to simply connecting users to libraries. All kinds of information can be transmitted, e.g., facsimile, pictures, drawings, maps, voice communication. The additional possibility of two-way communication would permit an even greater number of library applications. A partial list of possible uses has been suggested by the Federal Communications Commission:

> "It has been suggested that the expanding multichannel capacity of cable systems could be utilized to provide a variety of new communications services to homes and businesses within a community, in addition to services now commonly

offered such as time, weather, news, stock exchange ticker, etc. While we shall not attempt an all inclusive listing, some of the predicted services include: facsimile reproduction of newspapers, magazines, documents, etc.; electronic mail delivery; merchandising; business concern links to branch offices, primary customers, or suppliers; access to computers: e.g. man-to-computer communications in the nature of inquiry and response (credit checks, airlines reservations, branch banking, etc.) information retrieval (library and other reference material, etc.) and computer-to-computer communications: the furtherance of various governmental programs on a federal, state and municipal level, e.g., employment services and manpower utilization, special communications systems to reach particular neighborhoods or ethnic groups within a community, and for municipal surveillance of public areas for protection against crime,fire detection, control of air pollution and traffic; various educational and training programs, e.g., job and literacy training, preschool programs in the nature of "Project Headstart", and to enable professional groups such as doctors to keep abreast of developments in their fields; and the provision of a low-cost outlet for political candidates, advertisers, amateur expression (e.g., community drama groups) and for other moderately funded organizations or persons desiring access to the community or a particular segment of the community."[55]

The potential applications for library CATV utilization among those enumerated by the FCC are both obvious and quite numerous. Many in the library profession believe that CATV will become the single most important means of interlibrary communication. In addition to selective information distribution, both catalog and text access systems are visualized. Two-way communication could be implemented on a basic level using a telephone as an input device. More elaborate schemes might provide hard copy in addition to the transient TV image. Storage of information received on a small videotape recorder and equipment to store and hold still pictures are frequently mentioned sophistications. Ultimately, library CATV communications may support interactive systems in which a user could request, read, respond to, and alter information via a light pen and an interactive graphics terminal.

The eventual introduction of two-way communication capability is almost a certainty. The FCC has stated that it plans to require that new systems be designed to accomodate two-way communications for those subscribers who want them. However, the availability of such channels to noncommercial users in general, and to libraries in particular, is really the key to realizing the potential of CATV. Simply the existence of extensive cable systems capable of supporting elaborate information transfer uses will be of rhetorical interest to libraries if they cannot afford the service, or if there are insufficient channels to meet the demands of any but commercial patrons. Hearings presently in progress before the FCC will influence this aspect of CATV development to a considerable extent. Testimony has been given by many interested parties, asking that the FCC require CATV operators to allocate some

of their distribution capacity for educational and instructional purposes. The Joint Council of Educational Telecommunications, and others, have suggested that twenty percent of the spectrum space on CATV systems, old and new, large and small, should be made available without charge for broadly educational uses, including not only television but eventually computer assisted instruction, facsimile transmission, and the like. The Canadian government now requires that cable operators make available at least one channel to local authorities for educational and instructional purposes. In the United States, a number of cities and towns have CATV systems which offer local educational organizations free access to one or more channels.

When the technological and economic problems have been solved, there will still remain some important obstacles to future library cable system utilization. Unless copyright issues can be resolved, applications which are technically possible and economically feasible may nevertheless be illegal. And unless libraries actively participate in franchise negotiations for new systems, their interests will almost certainly not be represented in franchises which may run for years with terms that cannot be changed. In the past, the educational community has often not presented its case in time or in sufficient force to gain concessions. It is possible that by similar inaction libraries may fail to secure an oppourtunity to utilize CATV to maximum advantage.

4.3. Communications Satellites

Communications satellites offer a means by which broadband communications capability could be distributed throughout the United States. While high capacity cable telecommunication systems have tremendous potential application in large centers of population, their use for long distance transmission is severely restricted by technological limitations and would be enormously expensive in any case. The President's Task Force on Communication Policy concluded that application of cable telecommunications to the nation as a whole was financially out of the question. It has been estimated that capital outlay for systems serving New York City alone will exceed one billion dollars.[1]

The ability of satellites to act as broadband signal repeaters providing coverage over a very large area results in several particularly important advantages. Probably the most important of these is that the factor of distance is separated from the cost of transmission between interconnected points. It is possible to establish communication with areas of the world previously unserved because of geographic, economic, or political factors. Because of a satellite's relatively short life span, it can be designed for current special requirements and can be adapted to respond to a changing user environment. Point-to-point connection of communicating users is possible, allowing a degree of independence from existing common carrier facilities. Considerable economies can be achieved by sufficiently high volume, and costs per circuit would become small.

Efficient use of a communication satellite demands a relatively high use factor to permit the low charges inherent in the system. Naturally, one of the biggest potential users of a satellites is a television network.

Television requires a very large number of circuits, and no demand has to develop. Both the broadcasting station and receiving location have an obvious need sufficient to warrant the investment in ground terminal facilities. However, the circuit demand of libraries produces no such attraction at present.

Future demand will hinge to large extent on federal telecommunication policies. In recent years, libraries have been encouraged by various indications that the federal government might provide support for library use of communication satellites. At the Conference on World Education in October, 1967, President Johnson predicted outstanding library facilities being made available anyplace in the world through development of existing technology. Later that same year, at the signing of the Public Broadcasting Act in November, 1967, he pictured "a great network for knowledge" which would utilize "every means of sending and storing information that the individual can use".[56] The President's Task Force on Communications Policy considered, among other issues, a federal posture regarding domestic communications satellites. However, their report indicated that data and experience on which to base recommendations was insufficient. To develop such information, they recommended a demonstration satellite program which stressed the importance of a wide range of uses (e.g., the Biomedical Communications Network proposed by the National Library of Medicine) as well as emphasizing broadcast television utilization.

The Nixon administration has advocated an "open sky" policy to the Federal Communications Commission. A basic premise of the policy is that any entity that can demonstrate fiscal and technical capability should be permitted to enter the domestic satellite field. Furthermore, the distribution of high speed data as required by a national library and information network receives as much emphasis as the network needs of television broadcasting.

Experiments demonstrating the utility of communications satellites for interlibrary information exchange have already been conducted. The National Aeronautics and Space Administration has launched a series of Applications Technology Satellites for research purposes, beginning with ATS-1 in 1966. This satellite, in equatorial orbit over the Pacific Ocean, was made available for telecommunications demonstrations in 1969.

The Lister Hill Center at the National Library of Medicine (NLM) conducted an experiment in April, 1970. A conference call via ATS-1 linked medical centers at NLM, the University of Alaska, the University of Wisconsin, and Stanford University. Voice communications to assist practicing physicians in remote areas, a feature NLM plans to use in its Biomedical Communications Network, was tested. Additional experiments with EKG and facsimile transmissions and with slow scan television are planned.

The University of Hawaii has proposed to NASA that an international consortium of Pacific Basin universities and other educational agencies be interconnected by means of a communications satellite for the exchange of resources in a wide number of areas. Linking of libraries to transmit reference questions by voice with possible use of facsimile is proposed. Pacific libraries include three which are copyright depositories and national libraries of record for their countries.[1]

Routine operational use of communication satellites by libraries in the United States will probably not develop in the immediate future. Consequently, academic and school library utilization is likely to be even farther down the road. But with favorable federal policy and the experience gained from pilot systems of special libraries, such as the NLM, it is reasonable to assume that nationwide academic library communication networks linked via satellite will ultimately be established. There does not, however, appear to be anything resembling a consensus regarding when such utilization will be introduced.

4.4. Obstacles to Utilization

Specific problems impeding increased use of specific modes of telecommunication have already been mentioned in the discussions of individual topics. It is possible to identify in addition certain quite general difficulties which are repeatedly cited in the literature.

Foremost among the general obstacles is expense. Library budgets are already stretched in many instances. Any sizable innovation carries with it incremental costs that require additional appropriations. New revenue must be found rather than existing funds reallocated. Unfortunately, libraries often simply cannot afford such innovations. Libraries can not do much about the cost of terminal hardware* and supporting software, but the reduction or elimination of communications rates for educational users, and hence for libraries, would almost certainly spur utilization. It is probable that both rate reductions and direct federal and state financial support will be required to generate a significant volume of library telecommunications traffic.

A general acceptance of the necessity of elaborate interlibrary communications systems will also have to develop before utilization can substantially increase. Often it is tacitly assumed that everyone is in agreement on at least the point that libraries should utilize telecommunications to the extent that is possible to do so. There are those in the library community with reservations, however. The chapter on "Library and Information Center Management" in the 1970 Annual Review of Information Science and Technology cites a paper presented by Dan Lacy at the University of Chicago's 1968 conference, Library Networks: Promise and Performance. It is observed that although Mr. Lacy "agrees with the value of cooperative acquisition, he concludes that transmission of material from a library to a user is more expensive than expected, that it will play less of a role than predicted, and that the primary library service will continue to be that of bringing material physically together in the library. He states that it is more efficient to bring the scholar to the collection than it is to move collections piecemeal to the scholar". [57]

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*The costs of terminals are, of course, important in assessing the costs and benefits of educational telecommunications systems. Some relevant data on terminal costs and cost trends are presented by Singh and Morgan[21] and Ohlman.[62]

Various psychological, traditional, and historical barriers also tend to obstruct increased levels of library communication use. Some libraries are simply unwilling to experiment. Others may be willing, but do not innovate due to inertia and indifference. Small libraries often fear loss of local autonomy. Large libraries fear being overused and undercompensated. Both are naturally concerned about retaining the ability to serve their local patrons. Frequently telecommunications system plans are stalled because of a lack of adequate knowledge of user needs and the unpredictability of demands on the proposed communications links. Lack of local information and experience is sometimes negatively reinforced by unawareness of successful efforts elsewhere in the United States.

Legal, political, and administrative difficulties often thwart libraries in their attempts to plan and implement communication systems. The fear of copyright violations impedes growth of document transmission applications. Cooperative efforts involving libraries supported by different agencies must contend with a maze of varying local regulations, policies, funding schemes, and accounting procedures.

Widely differing standards among libraries complicate efforts to communicate. There are often minor local differences in forms, catalog cards, cataloging codes, statistics, and professional standards. Procedures and operational conventions are sometimes incompatible. The Library of Congress has made important contributions to library standardization, particularly with the introduction of its MARC system for serials and MARC II system for monographs, both of which conform to American National Standards Institute standard format for the interchange of bibliographic information on magnetic tape. However, myriad other formats remain incompatible and as such seriously hamper increased communications.

Problems of intellectual access to documents and data and of bibliographic organization will continue to impose severe limits on information retrieval applications in libraries. In a statement of the principal issues of concern at the 1970 Conference on Interlibrary Communications and Information Networks, Raynard Swank declared that this issue is:

> "...the really unique, gut problem of any library or information service. The communications and computer technologies for information network development are already at hand, but the logical means of organizing the information resource for discriminating access are not. The intellectual problems far outweigh the technological."[58]

Mr. Swank noted that impressive progress has been made toward developing automated retrieval systems with highly sophisticated interactive capabilities designed to permit varying search strategies, browsing, and other features of traditional manual schemes. However, he concludes that:

> "...there are still big bottlenecks in the logic of the structure of very large files and in the programs for reorganizing stored information in response to the differing and changing needs of users. ... Major new insights into the logical problems of information organization will be required before the network capabilities of electric signal transmission can be fully exploited."[58]

One of the leading spokesmen for the cause of advancing the use of telecommunications between educational agencies is Joseph Becker, vice-president of the Interuniversity Education Council (EDUCOM). He has summarized the obstacles to library communication utilization as follows:

> "Before telecommunications can be applied effectively to interlibrary functions and services, many non-technical problems have to be solved. Librarians must answer questions such as: How shall we organize our libraries to make optimum use of the advantage of telecommunications? What segment of our information resources and daily library business should flow over these lines? Will our users accept machines as intermediates in the information exchange process? How can the copyright principle be safeguarded if libraries expand their interinstitutional communications? And, of course, how do we measure cost/effectiveness before moving ahead with an operating program?"[59]

4.5. Summary of Predictions

The exact nature of future library telecommunication utilization is a matter of conjecture, as is the channel capacity that will be required. In general terms, increased use of long distance telephone and both local and long distance teletype service is likely. These devices are well suited to the basic functions of libraries and will continue to be the dominant means of interlibrary communications for at least the immediate future and possibly for some time to come.

Facsimile transmission is attractive to libraries, but the technology at the right price is not quite here. There would be a greater use of telefacsimile if communication costs could be reduced. This might occur because of lower rates, development of equipment requiring a smaller bandwidth, or both.

Broad bandwidth applications, supported locally by cable systems and nationally by communications satellites, have tremendous potential but will not materially contribute to library telecommunications traffic until some formidable obstacles are surmounted.

Medical school libraries appear to offer the most promise for developing systems which utilize data communications. Unlike many general purpose academic libraries, they have both a more clearly established demand and a greater ability to sustain the expense involved.

Whatever the form and extent of future library communication, library networking will have to conform largely to available transmission facilities. Its growth will depend on the extent to which new telecommunication facilities are constructed for general use. The magnitude of traffic which libraries have to offer will probably not be sufficient in itself to warrant large scale independent telecommunication systems, such as is required in ETV broadcasting. Nor will it significantly affect patterns of communication facilities development in the United States.

A basic feature of library communication development should be the ability to take maximum advantage of a telecommunication environment created by policies and practices outside library operations. Libraries should be prepared to seize opportunities as they present themselves. Emphasis should be placed on pooling resources with other educational agencies for joint exploitation of telecommunications facilities and symbiotic cooperation with major communications users.

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