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AUTHOR	Kay, Peg; And Others	
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ABSTRACT

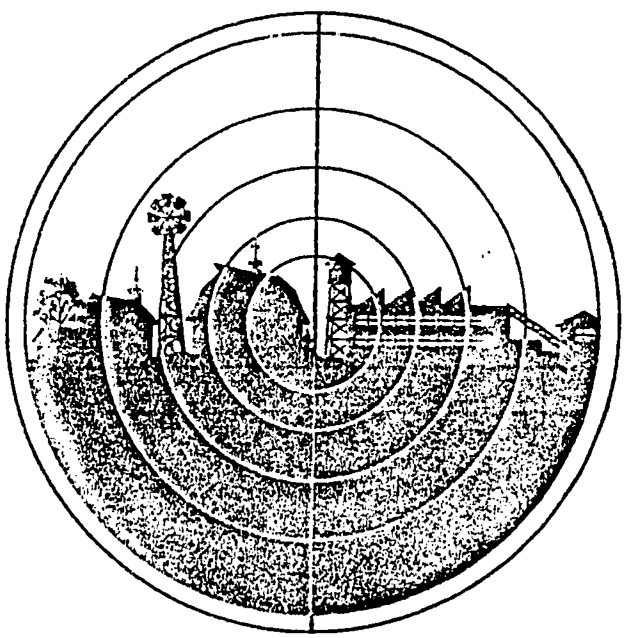
For several years, the Office of Telecommunications Policy has initiated projects investigating the potential of telecommunications as a method for alleviating some of the problems of rural America. In the course of these investigations, a number of insights have been gained relating both to the match between rural problems and telecommunications solutions and to some of the issues involved in service delivery via telecommunications wherever the delivery takes place. Covering some of the issues raised during these investigations, this paper discusses: (1) the rural setting, trends, background, and traditional public services (education, health, public works, public safety, and recreation); (2) some of the alternative technologies (telephone, coaxial cable, radio, video broadcasting, microwave, and satellites); (3) significant characteristics and comparative advantages of cable and local telephone systems; (4) some aspects of the "software problem"; (5) the development of methodology for identifying the communications requirements of localities; and (6) the compilation, codification and analysis of information already available. Several representative studies and demonstrations pertaining to health services, services to the elderly, educational services, public safety, and administrative services are outlined. (NQ)

U.S. Congress

Office of Technology Assessment

Conference on

Communications and Rural America



November 15, 16, and 17, 1976

Washington, D.C.

Communications and Rural America

Purpose

In April 1976, the Office of Technology Assessment (OTA) of the U.S. Congress issued a staff report entitled *The Feasibility and Value of Broadband Communications in Rural Areas*. The purpose of the conference is to extend this effort by:

- Considering a broader range of communications technologies which might be used to meet rural needs.
- Further examining the question of whether system demonstrations aimed at achieving economic viability are needed and if so, identifying the kinds of demonstrations which might be undertaken.
- Further examining whether rural interests have been adequately consiuered in existing Federal communications policy.

The outcome of this effort will be a report incorporating the information and points of view presented at the conference.

Congressional Interest

The conference is being held in response to a request for additional information on rural communications from Senator Herman Talmadge, Chairman of the Senate Agriculture Committee, as approved by the 12 member Technology Assessment Board of the U.S. Congress. Senator Pastore of the Senate Subcommittee on Communications subsequently joined Senator Talmadge in support of the conference. It is intended that the conference will be of value to the U.S. Congress in its deliberations on communications policy.

Conference Dates and Organization

The conference will convene for 3 days, November 15–17, 1976, with about 60 invited participants. For the first 2 days, participants will be equally divided among three panels which will meet in parallel. Each panel will concentrate upon a specific topic addressed in the OTA report as follows:

- Panel 1. Rural Development and Communications.
- Panel 2. Technology, Economics, and Services.
- Panel 3. Federal Policy.

On the third day, participants from all three panels will meet together to exchange and synthesize findings and explicitly address the question of rural system demonstrations.

Cosponsoring Institutions

The National Rural Center is cosponsoring Panel 1 (Rural Development and Communications). The Aspen Institute is cosponsoring Panel 3 (Federal Policy).

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Review of Representative Public Service Experiments as They Apply to Rural Telecommunications

Office of Planning and Policy
OFFICE OF TELECOMMUNICATIONS POLICY

A Staff Research Paper

October, 1976

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Introduction

For the past several years, the Office of Telecommunications Policy has initiated projects investigating the potential of telecommunications as a method for alleviating some of the problems of rural America.[1] In the course of our investigations, a number of insights were gained relating both to the match between rural problems and telecommunications solutions and to some of the issues involved in service delivery via telecommunications wherever the delivery takes place. This paper will discuss some of the issues raised during our research. The intent of the paper is to provide points of departure for this panel's consideration and should not be interpreted as representing a policy position of OTP.*

The first section of the paper briefly describes the rural setting. Section II provides a non-technical description of some of the alternative technologies. Section III outlines several representative studies and demonstrations. Section IV considers some aspects of the "software problem". Section V suggests some potentially useful research initiatives.

Numerous sources within and without the Federal government contributed to the compilation of this report. We would particularly like to thank the Rural Center, the Rehabilitation Services Administration (HEW), the Mitre Corporation, the National Center for Health Services Research (HEW), Practical Concepts Corporation, and numerous offices of the Department of Agriculture for their continuing contributions.

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* This paper was prepared by the Research Office, Office of Planning and Policy.

Principal Author: Peg Kay, Fellow-in-residence, OTP
Kathleen Criner
Marian Dix
Paul Fox

Section I: THE RURAL SETTING

Trends

For the first time in this century, many rural areas are gaining population. Most of this growth is in non-agricultural areas--just over half of the inmigration was to counties adjacent to SMSA's.[1] A number of factors are associated with this developing pattern, e.g., increased employment opportunities in rural areas, the development of retirement communities and a general disenchantment with urban life.[2] Given the nature of these factors, it is not surprising to discover that two age groups dominate the inmigration pattern, i.e., young families in their mid-twenties and thirties, and older retirees. If this trend continues, the dichotomy may have important implications for future service delivery, e.g., one would expect the older people to exert heavy pressure on already strained health facilities; the younger residents could require changes in established educational facilities.

Whether the trend will continue is not entirely clear. Clawson[3] has pointed out that only recently have annual population data become available. Previously, analyses were perforce based on the ten year population census. The apparent inmigration to rural areas may simply reflect a normal, but hitherto unnoticed, perturbation in a long-term trend of outmigration. The U. S. Department of Agriculture computer model showed inconclusive results, suggesting that "further changes in rural-urban balance can be anticipated during the late 1970's".[4]

There are several factors that could lead to a slowing, or reversal, of the rural inmigration trend. First, the energy crisis which spurred much of the increased employment opportunities in rural areas rich in coal and other energy resources may ultimately be responsible for a decline in rural employment should cheap-fuel dependent agricultural industry become depressed and/or if increased transportation costs make continued dispersion of industry too expensive.[5]

Second, a sizable proportion of rural inmigration has been to counties where a senior state college is located. Some evidence suggests that this inmigration trend has slowed along with the leveling off or drop in college enrollment rates.[6]

Third, concern for the well-being of their children often motivates young families to move to smaller communities. The decline in America's birthrate could diminish that incentive.[7]

Fourth, migrating former urbanites have tended to bring their established living patterns with them, often disturbing the environmental balance of their adopted communities. For instance, the "greening" of Arizona with eastern-style lawns and plants has brought the pollen pollution in that one-time haven for asthma sufferers almost to the level of the East Coast.[8] Several targets of inmigration have reported depletions of energy and water resources as air conditioners and lawn sprinklers accompany the inmigrants.[9]

Finally, indications of a rising rural crime rate may take some of the bloom off the bucolic peach.[10]

Note that the above discussion does not question the reality of rural needs. Those needs have been well documented and, indeed, the Rural Development Act of 1972 commits the country to efforts "to make rural America a better place to live and work."[11] Rather, the discussion addresses the nature of the trend, e.g., is it in fact long term? if so, will it continue in the same geographic directions? The uncertainty of the trend's nature has implications for telecommunications system design and suggests that if comprehensive systems are built, they should be based on current need but should include flexible growth potential.

Background[12]

During the discussion of trends, it was noted that just over half of the rural inmigration was to areas adjacent to SMSA's. This highlights a definitional question--where does "urban" leave off and "rural" begin? At the edges, at least, the distinction between the two is blurred. There is, however, no difficulty in recognizing the difference between types of rural areas.

East of the Mississippi, the rural dweller typically lives within 50 miles of an urban center. Insofar as public service needs are concerned, the problems are those of scale. In such low density areas it is difficult to aggregate enough population to support public services locally, although it is feasible, if not convenient, to travel to an urban center for such services as health or education. In the Far West, however, people often live beyond 300 miles of an SMSA. The problems here are not only of scale, but distance. It may simply be infeasible to travel that far for basic services.

In either case, it is more expensive on a unit basis to provide certain public services to low density areas. In addition, such areas normally have fewer resources with which to pay for them. Thus, while the nature of the problem may differ both between and within the two types of rural areas, there is nonetheless some level of need for more economical delivery of traditional public services. Whether, to what extent, and by what means the needs can be satisfied, depend in large measure on the factors of scale and distance. In the event that a telecommunications sytems demonstration approach is taken, the systems design, including the mix of technologies use, will (or should) differ sharply across the selected sites.

The remainder of this section will list the "traditional" public services referred to above and will highlight some of the "traditional" problems associated with them in rural areas. The following section will describe some of the technological alternatives that can be applied.

Traditional Public Services[12]

A. Education

Rural communities often spend as much as 80% of their public money for education. School district consolidation has been a common solution to the problems of scale posed by low density areas. That is, the population base needed to support a varied curriculum and adequate plant are aggregated from a fairly wide geographic area. Consolidation, however, does not solve the problems of distance common in the Far West. In some cases, the size of geographic area necessary to attain sufficient aggregation may simply be infeasible. In Rainey's words, "How long a service road are you willing to build to assure that one family can get its children to school throughout the winter?".[13] As energy costs increase, the answer is apt to be, "Very short". Even in areas where consolidation is feasible, educators are beginning to question its wisdom, in terms of economy, educational effectiveness, and community cohesion. Telecommunications alternatives are being considered with growing interest.[14]

B. Health[15]

The basic problem is that primary care physicians (and other primary health care providers) are scarce resources in rural communities. Several factors contribute to this. First, rural doctors work longer and [illegible] than their urban counterparts. [illegible] [illegible] that the cost of running a rural practice is higher,[illegible] [illegible], most physicians are specialists who may or may not double as "primary care"* doctors, but who, not unreasonably, prefer to utilize their special training at least some of the time. Very often, specialization requires the facilities of a sophisticated medical center or at least of a modest hospital. However, in most cases, a hospital of less than 50 beds cannot support necessary facilities and equipment. Many rural areas cannot support a 50 bed hospital. Thus, the inability to support secondary or tertiary care facilities is a contributing cause of the basic problem, i.e., the shortage of even primary health care in rural areas.

C. Public Works

This includes such things as water, sewers, lighting, streets, and highways. Many of the problems of public works services cannot conceivably be amenable to telecommunications solutions except for such marginal operations as meter reading or application form facsimile transmission. Highways, however, can be analyzed in terms of the transportation-communication trade-offs. To repeat Dr. Rainey's question, "How long a service road are you willing to build...?".

E. Public Safety

The rising rural crime rate has been referred to previously.[10] One of the critical lacks in coping with this growing problem is adequate police training. The village policeman does not often have the training necessary to deal with inmigrating city crime. Training is also a problem for traditionally volunteer rural fire departments. In this case, time spent on training is not "company time" but is taken from other activities.

F. Recreation

Public sector intervention in the provision and control of recreational facilities--particularly in the form of Federal, state, and local parks--is a widely recognized phenomenon. What is, perhaps, less widely recognized is government involvement with television as a recreational activity. Certainly, government control of the amount and content of permissible advertising on broadcast television is similar to government control of the type and number of permissible

*Primary care is defined as "first contact" care which does not require referral to a specialist.

[illegible] of the parks. The provision and control of the "recreational facility" of broadcast television to rural areas, however, has been something less than even handed. In fact, most of the 9% of the U.S. households that can receive fewer than three TV channels, are located in rural areas.[17] The seriousness of this problem is increased because the broadcast "recreational facility" is the same medium that is the prime carrier of information to the American people. The importance of television as an information medium is magnified in rural areas which tend to be underserved by print media.

Section II: TECHNOLOGIES

Numerous technologies are available for rural communications. Principally, they are telephone, coaxial cable, radio, video broadcasting, microwave, and satellites. Further improvements can be expected in existing microwave and satellite technologies and in one as-yet unproven area--fiber optics.

The telephone system, while the oldest technology discussed, offers perhaps more new practical uses than any other technology. This is because our perception of the telephone has been far too limited. A telephone system can do a great deal more than simply carry telephone conversations. The key to more versatile use of the phone system is a wider range of terminal equipment. With appropriate terminal equipment the phone system can easily transmit all forms of digital data, printed material (facsimile), still images (slow-scan video), and many forms of remote instrument readings, e.g., remote EKG's. The ability to transmit still images with slow-scan video equipment is particularly important because many of the applications for which closed circuit television have been proposed do not really need full-motion. A reexamination of these proposals suggest that most of the medical and educational applications need only the ability to transmit still pictures. Even voice communications can be made more useful. With appropriate equipment, audio teleconferencing has been shown to be a suitable substitute for some travel. The availability and relatively low cost of the phone system are its two most significant advantages.

Coaxial cables can carry large amounts of information. Current cable systems can carry thirty to forty television channels through one cable. With this large capacity the potential exists for a wide variety of services. The disadvantage is that these systems cost at least $3,000 a mile (usually more). Unless there are enough services to financially support the system, it may not be feasible to build cable systems in rural areas where relatively few users must support the systems.

There are two ways to broadcast television signals so that they are receivable by normal television sets. The first is over a conventional television station. The cost and limitations on the total number of stations (because of frequency scarcities) limit the usefulness of this technique. Translators which are low power, inexpensive broadcast relay stations provide an effective way of delivering television service to areas which do not now receive adequate off-air service.

Current FCC regulations forbid using translators to originate programming (except for very brief advertisements).

Radio communications are important for rural communications in two ways. The first is to provide mobile communications. The second is to provide communications to remote areas where telephone service is either nonexistent or inadequate. In all cases the potential use of radio, as with the telephone system, extends far beyond voice communications.[1]

Microwave provides line-of-sight communications between specially equipped locations. Microwave systems can carry large capacities including television signals. Three microwave services are designed to economically transmit television signals from one central location to many different locations within a ten to thirty mile radius. Instructional Television Fixed Service (ITFS) is for educational, cultural, and governmental use. Multipoint distribution service (MDS) is a common carrier service intended to be used by a wide variety of users. At present MDS only serves metropolitan areas. Cable Antenna Relay Service (CARS) is for use by cable systems to carry programming between parts of a cable system. Other microwave equipment using frequencies assigned to common carriers and industrial users is designed for connecting two points. This equipment, unlike that used in the first three microwave systems mentioned, is capable of relaying signals over long distance.

Current satellite systems in regular service require expensive terminals. Terminals capable of only receiving signals, not transmitting them, cost around $100,000. Terminals capable of transmitting signals cost significantly more. While some improvements will be possible in the next few years, satellite terminals will still be expensive units unsuitable for individual use.

The next decade will probably see three significant technical developments. First, improved microwave technology should permit greater overall capacity. Unfortunately, the new systems will also require shorter distances between repeaters, limiting their use in rural areas.

Second, Direct Broadcast Satellites, i.e., satellites capable of transmitting directly to the home, will probably be economically as well as technically feasible within the next decade. This may be a method of delivering regional television service to rural areas which are now inadequately served.

Third, use of a new technology, fiber optics (the transmission of information on light beams through tiny glass fibers) will probably emerge. Potentially, the significant advantages of glass fibers to rural communications is low loss (i.e., the signal loses strength over distance at a lower rate) and the ability to carry huge amounts of information. The low loss property would be particularly valuable in rural areas because of the large distances involved. While the theoretical capacity of a fiber is huge, there are a great many technical problems that must be solved before this capacity can actually be utilized. In addition, large capacities are significant only when a demand for them is present. As a result, fiber optic use in rural areas faces many of the same problems facing coaxial cable. Because of this factor and the large number of unsolved engineering problems, it is unlikely that fiber optics will have a significant impact on rural communications for many years to come.

It seems that the most obvious rural need is the delivery of one-way broadcast services which, assuming the removal of FCC restrictions, can most efficiently be accomplished through the use of a "hybrid" system of conventional cable for population centers combined with translator service for outlying areas. The position has been set forth at length, elsewhere.[2,3]

Translators, however, serve only as broadcast relay stations. And, in the context of one-way broadcast delivery, cable also serves primarily as a distributor of broadcast services. Unlike translators, however, cable can serve as a primary carrier, as well as a relay.

In the context of a comprehensive telecommunications system, it is necessary to look to primary carriers. In considering local origination--a major factor in a comprehensive system--the preeminent available technologies are cable and telephone. The remainder of this section will therefore describe the salient characteristics of each in more detail. Bear in mind, however, that neither of these technologies alone will solve the problem of one-way broadcast reception and that even in the context of this discussion, both cable and telephone will usually have to rely on some over-the-air lines to cover long distances.

Significant Characteristics of Cable and Local Telephone Systems

Capacity is the rate at which information can be transmitted. Most portions of the telephone system are narrowband, having a capacity below that necessary to transmit a full motion video signal. Cable systems are broadband; that is, they have the capacity to carry at least one full motion video signal.

A telephone channel is the capacity that telephone companies can uniformly deliver between any two points. One channel carries a telephone conversation. It can also carry individual still pictures. The greater the detail required, the longer it takes to send. A single telephone voice channel on the dial-up service can also carry digital data--up to 2,400 bits of information per second.

A television channel can carry the equivalent of about 1,000 telephone channels of audio. It can carry one full motion picture; it can carry thirty still pictures per second; and it can carry over four million bits of information per second (digital data).

It should be pointed out that the full capacity of the telephone system to carry audio, still video, and digital data is currently in commercial use. The full audio and digital capacity of cable systems are still in the experimental or theoretical stage of development.

Multiplexing is the method by which multiple communications are carried on a single facility without interference. Space division multiplexing (SDM) is accomplished by spatially separating the lines over which the signals are carried. This is the type of multiplexing generally used by local telephone systems. Frequency division multiplexing (FDM) is accomplished by putting different communications on different frequencies. An example is broadcasting where different stations are on different frequencies (or channel assignments). Receivers are tuned to specific frequencies to get the desired communication. Time division multiplexing (TDM) is accomplished by using a communication path for different purposes at different times. An example is the sequential transmission of TV programs. Using modern electronics, it is possible to share a facility many times a second so that each user monopolizes only a fraction of a second at a time. TDM is used for polling.

Direction in a cable system refers to whether the signal is being carried from the headend (the electronic equipment located at the start of a cable system) to another point in the system (downstream) or from some point in the system to the headend (upstream). Separate equipment is needed to handle upstream communication. This distinction is irrelevant to telephone systems which are essentially symmetrical. (See Figures 1 and 2.)

Methods of access refer to the ways in which users are interconnected. Point-to-point switched systems (telephone systems) make a separate path between two (or more) users who

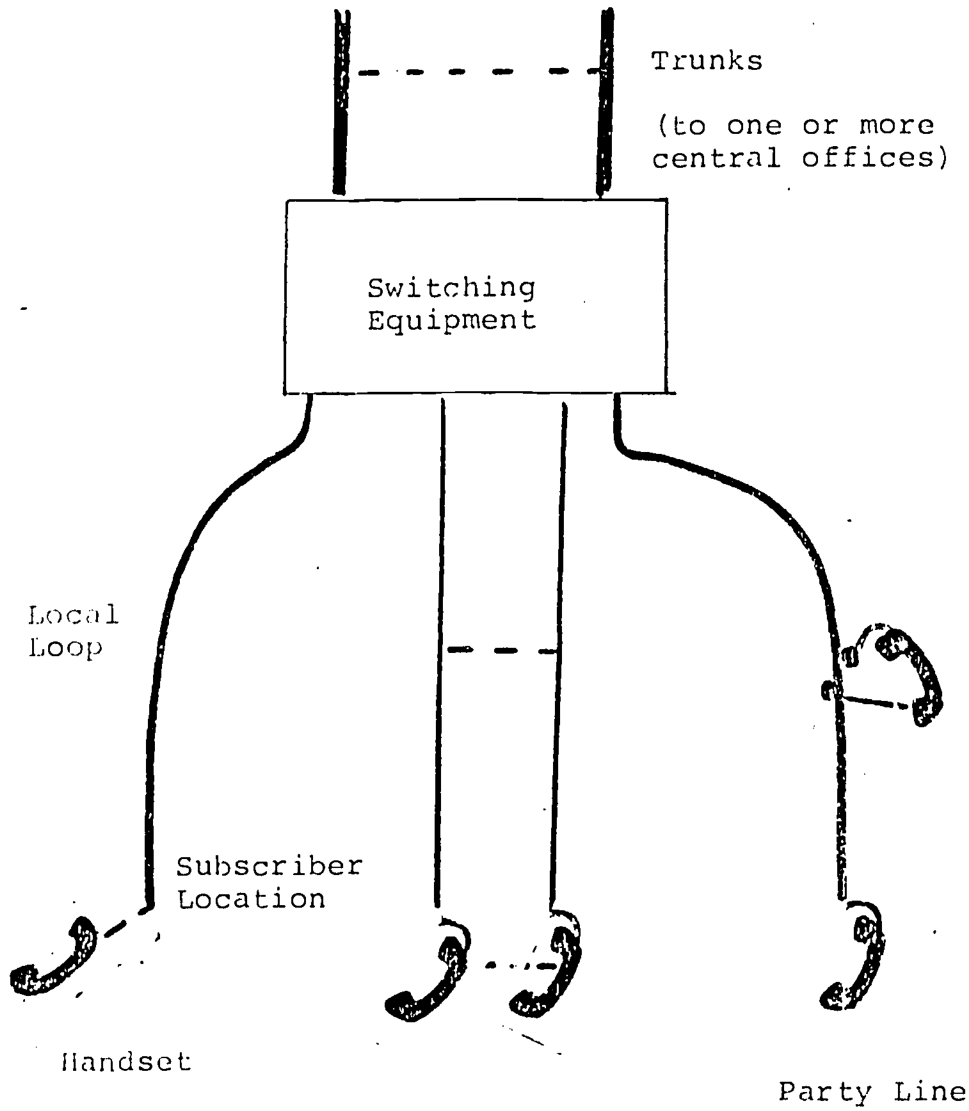

Figure 1

Telephone System

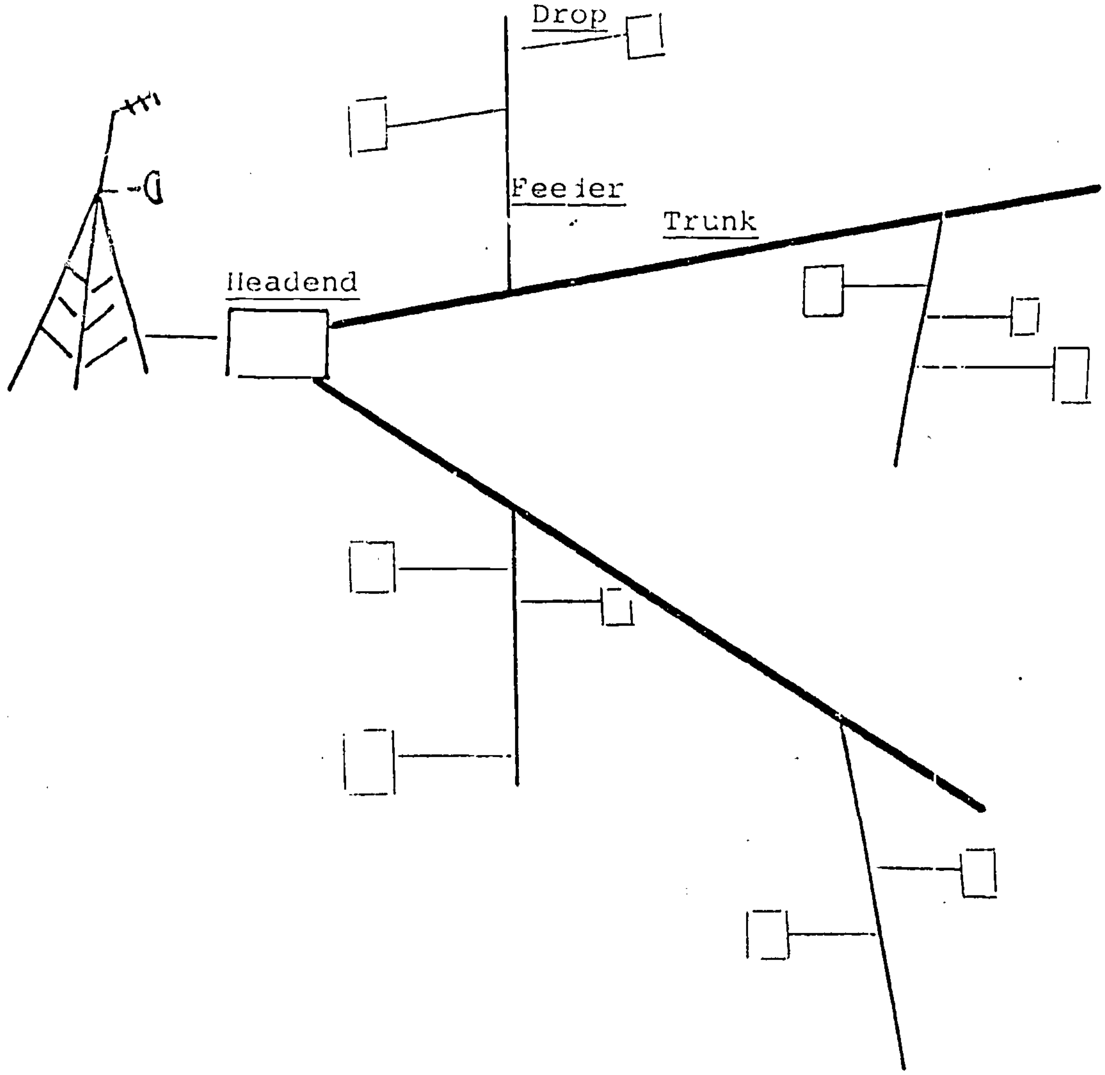

Figure 2

Cable System (Tree and Branch)

want to communicate. It is difficult, using this type of system, to quickly set up brief connections to and from a large number of locations (e.g., for polling purposes). Conference calls are, of course, possible, but become less attractive as large numbers of conferees are added, both because of cost and the interruption of service to other subscribers. Multiple access (cable) systems are giant party lines in which everyone is connected to everyone else. This is an extremely efficient system for one-to-many ("broadcast" type) uses and for all types of polling. Dedicated lines, possible on both narrowband and broad systems, are direct connections among specified users. Figure 3 shows some typical examples of crosses between methods of access with broad- and narrowband capacities.

	Broadband	Narrowband
Point to point	"Picturephone"® Individual or small group full motion video contacts	Most telephone systems Individual or small group voice/data/"slow scan" video contacts
Multiple access	Cable systems Mass distribution of video information	Telegraph loop Mass acquisition/ distribution of data/voice

Figure 3

Comparative Advantages

Cable is capable of carrying full motion video in two directions. It is capable of very high speed digital data transmission. Using cable, it is easy to arrange large conferences, and it is easy to poll.

The supreme advantage of the telephone is that it is ubiquitous. Much off-the-shelf equipment is available. There is easy point-to-point access. The engineering for pilot projects is often easier than on cable. And it is relatively cheap.

Section III: REPRESENTATIVE STUDIES AND DEMONSTRATIONS

There has been a plethora of demonstrations of, and studies about, the delivery of public services via telecommunications.[1] This section will discuss a representative sample.

Health Services

A. Canadian Experiments

A series of experiments is being conducted in Canada, comparing the efficacy of various telecommunications systems to assist in primary health care.[2,3,4] Results of the first three phases of the project (which included a same-building remote hook-up and, in Phase III a three-mile remote between an urban community health center and a three-mile distant hospital) indicate that the accuracy of medical diagnoses do not appear to be significantly different when performed by a physically present M.D., via two-way color TV, two-way black and white TV, or hands-free telephone. Nor is there any significant difference in the time it takes to diagnose. (A nurse was physically present with the patient whenever remote diagnoses were made). Attitudinal measures were inconclusive. The final phase will extend the research to a remote rural area. The Canadian experiments were "laboratory" tests, and the results have not yet been verified in the field.

B. National Center for Health Services Research Program[5]

In 1972, the Division of Health Care Information Systems and Technology (DHCIST) initiated a systematic program designed to test three general hypotheses[6]: (1) technology can facilitate functional aggregation of dispersed health-care resources, (2) technology can redistribute health care personnel from areas of abundance to areas of scarcity, and (3) technology can mitigate the depersonalization of the health care system.

Table 1, reprinted from Rockoff's January, 1975, article, shows the initial round of experiments.[7]

The program's strategy was to initially explore, through experiments, demonstrations, and studies, a wide range of technologies, later narrowing the focus of investigation as results came in.

TABLE I

…ARY OF TWO-WAY VISUAL TELECOMMUNICATION PROJECTS INITIATED IN JUNE 1972 TO EXPLORE THE UTILITY OF THIS TECHNOLOGY IN HEALTH-SERVICES DELIVERY

Institution	Title	Principal Investigator and Contract Number	Technology	Locale
…is Mental Healt… …ules	Picturephone Network for the Illinois Department of Mental Health Medical Center Complex/Community Mental Health Program	Dr. Lester H. Rudy Medical Center Complex 1601 W. Taylor Street Chicago, Ill. 60612 HSM 110-72-381	Picturephone	Urban
Case Western Reserve University	An Experiment in Using Two-Way Wide-Band Audio, Visual, and Data Communications Over a Laser Link to Permit an Anesthesiologist to Supervise a Nurse Anesthetist	Dr. J. S. Gravenstein Department of Anesthesiology School of Medicine Case Western Reserve University 2040 Adelbert Road Cleveland, Ohio 44106 HSM 110-72-383	Laser One-way color, one-way black and white Remote controls	Urban
Cambridge Hospital	Evaluation of a Video-Augmented Consultation System Between Physician Extenders at Neighborhood Health Clinics and Physicians at a Community Hospital	Dr. Gordon T. Moore The Cambridge Hospital 1493 Cambridge Street Cambridge, Mass. 02139 HSM 110-72-384	Microwave Black and white	Urban
Bethany Brethren	Picturephone and Cable for Visual Communication and Transmission of Medical Records in the Bethany Garfield Community Health Care Network	Mr. Vernon Showalter Bethany Brethren Hospital 3420 W. Van Buren Street Chicago, Ill. 60624 HSM 110-72-385	Picturephone Cable; video discs Black and white	Urban
Lakeview Clinic	Bidirectional Cable Television System to Support a Rural Group Practice	Dr. Jon Wempner Lakeview Clinic 609 West First Waconia, Minn. 55387 HSM 110-72-386	Cable Portable video carts Black and white	Semirural
Dartmouth Medical School	Two-Way Television to Support Physician Extenders in Dermatology and Speech Therapy	Dr. Dean Seibert Department of Community Medicine Dartmouth Medical School Hanover, N. H. 03755 HSM 110-72-387	Microwave One-way color, one-way black and white	Rural
Mt. Sinai School of Medicine	Bidirectional Video Communication and Facsimile Reproduction Links Between a Housing Project Pediatric Clinic and the Mount Sinai Medical Center	Dr. Carter Marshall Department of Community Medicine Mt. Sinai School of Medicine 17 East 96th Street, Room 1A New York, N. Y. 10029 HSM 110-72-382	Cable Black and white	Urban

The DHCIST approach has essentially been "experimental". The program has not adopted a rigorous hypothesis-testing methodology, but rather has relied on extensive field demonstrations to build an accumulating body of knowledge. Thus, results cited should be interpreted as probablistic statements, not verified fact.

The first hypothesis (functional aggregation) virtually grew out of the desperation of rural areas (see Section I, Traditional Services). Costs for health care increase as the skill level of experts and complexity of facilities increase. Thus, a functional aggregation of dispersed health-care resources would have two positive effects. First, by avoiding unnecessary transfers to costly secondary and tertiary care facilities, costs would be held down. Second, by facilitating necessary transfers, the quality of care would go up. The impact of telecommunications on unnecessary transfers was demonstrated at the Mt. Sinai site (see Table I) which showed positive results. The impact of telecommunications on necessary transfers was shown in Broken Bow, Nebraska, where slow-scan (still pictures) video was used to transmit a patient's x-rays over telephone lines from Broken Bow to the University of Nebraska Medical Center in Omaha. On the advice of the specialist, the patient was immediately (and necessarily) transferred to the more complete facility.

Evidence supporting the second hypothesis (redistribution of health care personnel) was obtained in the (still operating) Dartmouth project (see Table I) which explored the uses of interactive television for speech therapy and dermatology. This hypothesis will be tested more fully, both as part of the planned program (on Block Island, Rhode Island)[8] and serendipitously (in Playas Lake, New Mexico)[9].

The Block Island experiment will connect a doctor's office on the island to a mainland hospital. Augmented narrowband (slow-scan) will be the technology used.

The Playas Lake trial grew directly from the needs imposed by industrial inmigration to a rural area. The Phelps-Dodge Company recently built a copper smelting plant in the New Mexico desert town of Playas Lake. The company also built a "company town" for its employees. The nearest doctor, however, was 110 miles by road in Silver City. A telemedicine system (designed by The Mitre Corporation under subcontract to the University of New Mexico) consisting to two-way microwave (blace and white

TV) and supplemental narrowband, was installed. It connects a physician group practice facility in Silver City with a clinic in Playas Lake. The clinic, staffed by one nurse practitioner, a physicians assistant, and a technician, handles five or six consultations a day. The system became operational in January, 1976.

The third hypothesis (mitigation of depersonalization) is being examined in a current experiment in Cleveland where a small inner-city hospital is connected by two-way television to the University Hospitals of Case-Western Reserve. Here, consulting pediatricians "visit" each infant daily in the newborn nursery and discuss any problems with the nurses. A similar method is used in the intensive care unit. The Mt. Sinai site also produced evidence supporting this hypothesis.

As results of the experiments and demonstrations came in, Mitre was asked to analyze them and apply what was learned to a study that would investigate combinations of physician extenders and telecommunications technologies, for the purpose of arriving at optimal rural health care delivery systems. Mitre's conclusions were that (1) telecommunications links between satellite clinics and central facilities can reduce costs, (2) narrowband technologies offer more preferable cost-benefit mixes than broadband, and (3) augmented (slow-scan) narrowband systems are optimal when health care systems are considered by themselves.[10]

Both Rockoff (DHCIST) and Bennett (Mitre) cautioned that the favorable cost balance could tip to broadband if health services were to be one of several users of a comprehensive broadband system. Mitre projections indicate that the balance shifts at the point where other users pay slightly more than half of the system costs. An additional policy issue is involved, since it may be advantageous from the viewpoint of the community as a whole to use the less economical broadband system for health services if, in so doing, other public services reap counter-balancing benefits, e.g., otherwise infeasible educational services might be made available through the system. An additional consideration, the ubiquity of telephone service, should also be taken into consideration, Rockoff noted. This could be a crucial factor in telecommunications delivery of health services.

In addition, Rockoff expressed concern over the reliability of the antiquated telephone equipment which is used in some rural areas, noting that the five percent of the country that does not receive adequate phone service is scattered throughout rural areas. The Department of Agriculture's experiences with its pilot financial management program (see Administrative Services, below) will tell us something about that.

Fockoff has also pointed out[5] that should National Health Insurance become a reality, data transmission requirements in the health field will multiply.

Many of the results of the DHCIST program appear to be generalizable to other service areas. The opportunity to apply the knowledge gained should not be lost. (See Section V, below.)

Services to the Elderly

A promising demonstration of services for the elderly is taking place in Reading, Pennsylvania, under the sponsorship of the National Science Foundation. A consortium of New York University, Berks TV Cable Company, Berks County Senior Citizens Council, and the Reading Housing Authority proposed to explore the process of communications as it develops through teleconferencing. Reading's elderly population is serving as the prototype group. A multi-purpose senior citizens center and two public apartment complexes for the elderly were interconnected with two-way video equipment. Other locations, e.g., the mayor's office, are added on an *ad hoc* basis as needed. The programming is planned and produced by the elderly. Participants are the elderly themselves, service providers, and members of public and quasi-public agencies. In addition, 124 converters have been placed in the homes of elderly people, so that they might watch the programs on a midband channel.

As of September, 1976, reports from the project staff can only be described as "ecstatic".[12] A March, 1976, survey of 84 of the home viewers disclosed that 70% of them watched the program at least once a week. (Four remotes are presented four days a week.) Because of the high viewership, the programs are now being cablecast systemwide, that is, on a regular channel that does not require a converter for reception. Project Coordinator Connell reported that "in-person attendance at the cablecasts has not been overwhelming, a steady 40-60 per cablecast. But people are 'meeting on the system'. Occasionally, a home-watcher will drop in to meet the active participants--they usually say something like, 'I feel like I know you and I had to say hello in person.' The effect on some of the participants has been amazing.

One particularly bitter, old woman has just blossomed since she started participating."

Apart from the standard presentations on such subjects as food stamps and social security, the project offers yoga lessons, sing-alongs, and a series on "What happens when your spouse gets sick?".

Early technical problems, mostly with the audio, have been solved. There have been no equipment failures.

The project is now preparing for the end of the demonstration phase and transition to community control. A new Board, which includes representatives from several local banks, the City of Reading, the University of Pennsylvania, along with several elderly citizens, has already begun to take control of some aspects of the system.

Given the rise of retirement communities in rural areas, the Reading project is of particular interest-- both from the aspect of its impact on the elderly and its transition to community control.

Educational Services

The field of education has not produced the set of coherent results that are available for health. This is probably due, at least in part, to the Office of Education funding proposals that involve telecommunications rather than programs to investigate telecommunications. As a result, projects do not build on accumulated knowledge, negative results are regarded as "failures" to be swept under the file cabinet, and the mistakes of one project are, for lack of information, repeated by others.

Educational uses of telecommunications have been detailed at length elsewhere.[13] We will here report on some representative projects that have either not been frequently cited or that we have recent information about.

A. In-School Use

The Irvine (California) Unified School District initiated its Video Communications Project in 1974. It now encompasses twelve of the fourteen schools in the district. The University of California, Irvine, also on the interactive cable system, shares some of its extracurricular activities with the public schools. The system uses inexpensive black and white equipment, often operated by students, cablecasting on two midband channels. Each location has two television receivers tuned to the two midband channels, so that each location can see the two on-line participants. When called on for input by the teacher, a location "punches in" its modulator and appears on one of the sets as a participant. The teacher remains on the other screen. The system is used both for classroom instruction and for such activites as chess and debates.

B. College-to-High School

A particularly pertinent project is one just initiated by Kutztown State College. The history of the project is of some interest. In 1971, the Carnegie Commission on Higher Education published its report, "Less Time--More Options," in which it recommended that, in order to reduce educational costs, baccalaureate degree programs be shortened by one year. The recommendation was not embraced by the educational community which seemed to feel, not unreasonably, that a three year B.A. was not the same as a four year B.A.

Members of the Cable Television Information Center staff concluded that telecommunications solutions could be applied to the problem and developed the concept of cablecasting college classes to distant high schools. Using two-way video, accelerated students in the high schools could join the college classes, receiving both high school and college credit and thereby arriving in college with credits already in the bank. CTIC took the concept to Vice President Dodson Dreisbach of Kutztown State College--a school that had a fine internal cable system, excellent relations with its feeder high schools, a vigorous administration, and was about to acquire a two-way microwave link to the cable system in Reading.

Within two years, Dreisbach had cleared the institutional hurdles, a course (in oceanography) had been prepared, and cablecasting was begun in September, 1976. Two schools on the Reading system share the microwave channel to KSC. A third school in Kutztown has a direct two-way cable link.

The technology, which has seen previous uses, is working well. The unknowns are the course and the students--there are 50 students in the live college class joined by seven cable students at the three high schools. KSC regards the program as a continuing experiment and expects to spend several semesters learning and gradually building the curriculum.

This application obviously has great relevance to rural districts, both because of its potential for reducing local college costs and because it can be generalized to other applications of remote educational delivery.

C. The OTA report described the Rand-Spartanburg Technical College High School Equivalency project in Spartanburg, S.C. The following includes more recent information.[14] Substantively, the project offers high school education to adults. Classes are conducted by a teacher located at the cable system studio. Ten students were given interactive terminals in their homes. Using the terminals, the students could send eight digitally encoded messages to the teacher, i.e., "I understand", "I don't understand", "Slow down", "Give an example", "Ask a question", "Visuals are unclear", and "Technical problems". The eighth message is the "Here" answer to the roll call. Preliminary results regarding both the technology and the educational quality are encouraging. The initial pilot class is complete, and regular classes have begun. Early and unofficial returns indicate that cable students do as well as classroom students.

Like the Kutztown experiment, Spartanburg is of obvious interest to rural areas. One caveat has developed from the Spartanburg effort. The original experimental design called for random assignment of students to cable and classroom. However, a sufficient number of students who live in the cabled area of Spartanburg was not available, and random assignment was therefore not possible. An examination of the cable path suggests a reason for this. Much of the less affluent section of town was not cabled. Rural areas (like urban areas) contemplating the use of telecommunications for public service delivery had best make sure that their target groups can receive the service.

C. Education for the Handicapped

The Bureau of Education for Handicapped (BEH) funded a project in Amerst, New York, that uses interactive telecommunications to deliver educational material to severely handicapped children (ages 4-21) at home and in residential centers. The project is being carried out by the Regents of the University of the State of New York and The Mitre Corporation.

Six mid- and superband channels are used to deliver TV signals downstream to 50 receivers located in 40 homes and two residential centers. Digital upstream return is activated by typing on a "menu" keyboard and uses standard lines.

During the past year, downstream programming has expanded from "mostly game playing" to a curriculum that includes high school equivalency courses, a math program, reading, and language arts. Appropriate courses are added as they are discovered among available software (see Section IV) or developed by the project.

Molly Richardson, of the project office, reported that this "individual call up" kind of education is particularly suited to the needs of the handicapped who seem to use it in sporadic, but intense, bursts. The only reported problems concern the monopolizing of the home TV and telephone facilities by the students. Extra TV sets and private phone lines are not uncommon.[15]

Public Safety

Probably the most elaborate public safety telecommunications network in the country is the institutional network developed by the Philadelphia Police Department. A dual trunk system, each trunk has thirty-four downstream and four upstream channels. As reported by the Cable Television Information Center in July, 1976, the network connects the main police headquarters, city hall, and nine divisional headquarters. Twelve more districts were to be connected. The system serves the following purposes:

1. Training. The Police Academy presents regular training material both for patrolmen and detectives.

2. Administration. News and special reports (e.g., missing persons) are transmitted.

3. Arraignments. Suspects are interviewed in the district by court personnel located in city hall. This substitutes for suspects being taken, by two policemen, to city hall in a wagon. Department personnel estimate that the saving in police time will amount to about $800,000 annually. This is a court-approved experimental application. A future decision will determine whether it can legally replace face-to-face arraignment.

4. Fingerprint transmission. Permits decentralized identification of arrestees.

5. Document facsimile transmission. Uses a custom-made $14,000 terminal; transmits an 8" x 11" document in 40 seconds.

6. Staff meetings. Permits decentralized meetings in which the chief inspector can see the divisional inspectors; all inspectors can receive full audio.

7. Legal Counseling. The District Attorney's office advises police as to constitutionality of search, seizure, and arrest procedures; screens out some cases based on constitutionality and sufficiency of evidence.

8. Management information.[16]

This application is of interest not only because of its public safety uses, but because of the number of ways the system is used--e.g., for one-way "broadcast" type transmission, two-way video, digital data, and facsimile transmission.

Another project relevant to rural needs is the Michigan State University experiment in firefighter training in Rockford, Illinois (sponsored by NSF). Scheduled to become operational in January, 1977, the curriculum (developed at MSU for this project) will be delivered to the station houses using three technologies: 1) one-way video with digital response, 2) one-way video with mail response, and 3) video-cassettes with mail response. This investigation of the relative merits of technologies makes the project especially interesting.

Administrative Services

The Farmers Home Administration is engaged in a pilot project that may help answer some of the questions about the reliability of rural telephone systems. In recent years, the portfolio of Farmers Home Administration has vastly expanded. The pilot project is an attempt to stay on top of its management. The project began with eight terminals placed in field offices. The terminals are linked to the central office in St. Louis by dedicated phone lines. Digital data is fed directly to the St. Louis computer. Ten more lines have recently been added.

Farmers Home Administration personnel report that they are not yet in position to do a cost-benefit analysis of the project, but initial impressions are very positive.

There were some technical problems with two of the eight original phone lines. One line was replaced when problems with the step-by-step switch developed. The spokesman was not sure what the other problem was, but thought it was similar. In January, 1978, Farmers Home Administration intends to expand its network to a four-state area, using multi-drops rather than than dedicated lines.

Department of Agriculture personnel anticipate some problems with the phone lines when the multi-drop system is installed. They do not anticipate anything that cannot be cured.

Section IV: SOFTWARE

One of the more persistent worries about the success potential of telecommunication systems is the "lack of software". On inspection, the "problem" would seem to be exaggerated.

Perhaps the most obvious fact is that for most uses, prepackaged software is not a factor. Health service uses, for instance, usually consist of some kind of spontaneous conversation and the electronic transmission of an x-ray, EKG, or the like. Public safety uses that encompass fingerprint and facsimile transmission, staff meetings, and arraignments have no software requirements.

Another class of expected use of telecommunications systems--the accessing of computers--either does not require software or, for programming, has an established bank of it available.

If there is a software problem, it concerns educational material. Given rural needs, this could limit the effectiveness of a telecommunication system, since it cuts across several substantive uses, e.g., police and firefighter training, medical continuing education. It should be noted, however, that even educational applications do not universally require software. Of the four educational projects described in the preceding section, only one, the Amherst, New York, project for the handicapped, relies on it. The others could conceivably use prepackaged software but, in general, they depend on spontaneity for their success.

Narrowing still further, there does not seem to be a lack of recognized quality software in the area of general education. The productions of Children's Television Workshop, the National Geographic Society series, such as "The Ascent of Man" or "Civilization"--all have been and continue to be used as classroom tools with or without the aid of a telecommunication system. The problem appears to be, then, in the area of prepackaged software developed for specialized audiences.

Even here, the problem does not seem to be in the amount of material available but in locating it and obtaining a reliable pre-assessment of its worth. In other words, how can you find it and how do you know what you are getting?

The Mitre Corporation has just completed a national survey for the Rehabilitation Services Administration (RSA) of DHEW. The purpose of the survey was to locate and classify vocational rehabilitation software.[1] The specifics of the investigation will be available shortly from RSA. However, some of the more general conclusions are of interest here.

Apart from its own state-by-state compilation of the non-print holdings of the state vocational rehabilitation agencies, Mitre identified a number of available catalogs--both general and pertinent to vocational rehabilitation.

Hoye and Wang,[2] for instance, regularly update their index to Computer Assisted Instruction (CAI) material. The index contains several thousand entries, including vocational rehabilitation subjects, e.g., finger spelling, and high school equivalency lessons. Most of the material can be used with telephone accessed computers, such as those used by the Amherst project. The index identifies the target group, states the level of user knowledge needed, and tells how much each entry has been used.

Information on non-CAI educational software is much more dispersed. NTIS and Great Plains disseminate general catalogs. The National Audiovisual Center distributes a catalog of all films and tapes available from the United States Government. The Cable Television Information Center publicat on, Local Government Uses of Cable Television[3] lists two dozen potential suppliers of material suitable for use by local governments. In general, however, locating an appropriate catalog may require almost as much prior knowledge as locating a specific set of materials.

Further, once the catalogs are located, it is extremely difficult to identify a fruitful tree in the forest of semi-evaluated material. The evaluation problem is not uniform across all subjects. The Mental Health Materials Center, for instance, lists all media material, including print. It describes the intended audience for the material, the comprehension level required, plus a general evaluation which seems to be adequate.

In most fields, accurate descriptions of the technical quality of the tapes or films are available. Content evaluations are spotty for understandable reasons. Educational material is usually based on some pedagogical theory. There is no general agreement on pedagogy. (For example, what is the "right way" to teach a paraplegic to get out of bed?) Thus, distributors either tend to eschew content evaluation or else weight it in favor of their own biases. It should be pointed out, though, that the same problem exists with educational print material, and readers have managed to live with it.

Section V: RESEARCH INITIATIVES

Two obvious research requirements are evident from the preceding discussions. First is the development of a methodology for identifying the communications requirements of localities. Second is the compilation, codification and analysis of information already available. This section will discuss each in turn.

Methodology for Identifying Communications Requirements

By this, we do not mean a service needs assessment. Localities are able to perceive their own substantive needs and, indeed, there is every indication that innovations inspired by needs designated as such by "outsiders" are rarely adopted by the community in question.[1]

Many localities, however, are not sufficiently familiar with the technology to recognize which elements of their perceived needs are amenable to telecommunications solutions or to select among the technologies available. It should be noted that the match between needs and appropriate technological treatment should provide the rationale for the telecommunications system in any given locale.

Some work has already been done in this area. Maxine Rockoff, for instance, has constructed a table distinguishing among technical, human, content, attitudinal, and other variables in the design considerations for visual telecommunications events.[2] The Cable Television Information Center has developed a local government departmental communications needs questionnaire.[3] The Program Evaluation Group of the Urban Institute is developing a methodology for tracing both the actual and desired flow of information through an organization.[4]

The proposed research initiative, which attempts to apply some of the principles suggested in the work cited above, is currently underway at OTP. The first phase is scheduled for completion in this calendar year.

Compilation of Previous Research and Demonstrations

As pointed out in Section III, the efforts of the Federal government in the collection, application, and dissemination of information about telecommunications are not uniform. They range from the model program in progress at DHCIST to one-shot demonstrations whose results are not easily appraised. There is something to be learned from almost all of these projects--including the ones that have been written off as failures by their sponsors.

In fairness, it should be recognized that research and demonstration projects have inherent risks. Inevitably, some will fail. These failures are subject to a great deal of criticism. It is too much to expect that the funders will advertise their failures. Unfortunately, the result is that the lesson may be paid for several times. Thus, while the proposed search will be extremely difficult, it is necessary if we are to build on accumulated knowledge.

Literally hundreds of demonstrations have been carried out and research reports written on aspects of delivering services via telecommunications. One report contained a bibliography of over one hundred publications dealing with social service delivery (excluding health and in-school education) on cable television alone.[5]

There are additional barriers to the search. Reporting procedures for Federally funded programs, for instance, often record content information but not method of delivery. This causes extreme difficulty in identifying even significant telecommunications efforts. Also, many projects--probably a majority--originate in the states, municipalities, or with private or quasi-public organizations. However, as the social services report cited above demonstrates, a search such as we suggest can be accomplished with reasonable success.

Once the projects are identified, results should be analyzed for generalizability. For instance, paraprofessionals have been utilized, with varying degrees of success, in many telecommunications projects. Several of the DCHIST demonstrations used them. Project FEATT, a program that trains parents to train their severely handicapped children, uses paraprofessionals. The SALEM project, which delivered adult basic education to rural areas, used them. Has the accumulated experience taught us anything universal about the appropriate use of paraprofessionals in conjunction with telecommunications?

Serious problems will almost certainly arise in cross comparisons of projects which were done under a variety of conditions with varying degrees of rigor. One would not expect a research project of this nature to provide uniformly hard, incontrovertible information. One would expect, however, that a certain amount of hard data would emerge along with a great deal of "folk wisdom" which would provide useful first approximation guidance for the design of rural telecommunications systems.

Much of human endeavor consists of a search for perfect knowledge. The fact that this ideal is unattainable does not mean that we shouldn't use the often imperfect knowledge that we have acquired. That is the underlying rationale for the program recommended.

FOOTNOTES

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10. See, for instance, San Francisco Chronicle, Aug. 3, 1976, article on California crime statistics (Del Norte County crime rate up 80% from '71-'75, Humboldt County up 75%, Lake County up 58.5%, San Francisco down 2%) and New York Times. Aug. 1, 1976, article on New Jersey showing that over the last five years, the largest crime increase has been in rural areas. Nationally, the FBI Uniform Crime Report showed crime in rural areas up 21% in the first quarter of '75 v. the first quarter of '74. The national rate of increase was 18%.

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