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Electronic Message Systems for the U.S. Postal Service

A Report by the
U.S. Postal Service Support Panel
of the
Committee on Telecommunications
Assembly of Engineering
National Research Council

NATIONAL ACADEMY OF SCIENCES
Washington, D.C. 1976

NOTICE

The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the Councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competences and with regard for appropriate balance.

This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

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Preface

Early in 1975, the U. S. Postal Service (USPS) requested that the National Research Council (NRC) undertake a study of electronic message distribution systems in the United States and elsewhere, with the view toward recommending the appropriate research, development, and applications of this new technology for the nation's mail service. To this end, the NRC turned to the Committee on Telecommunications, Assembly of Engineering, which organized the USPS Support Panel to conduct the study.

The panel was asked to emphasize the technologies and applications for electronic message services that would be available in the 1985 to 1990 period. The work statement enumerated seven areas to be covered in the report:

1. A review of the research, development, and applications of communications, electronics, and information technologies as applied to electronic message handling systems;

2. A review of completed studies, including those made by the NRC and USPS, related to potentially promising developments in these technologies (information handling and processing, telecommunication and distribution networks) as they may apply to USPS needs;

3. A review of telecommunications and information processing technologies identified in a survey of industry developments and applications, together with a forecast of user applications of these technologies;

4. A review of foreseeable societal, economic, regulatory, user, and USPS organizational impacts resulting from the introduction of a USPS electronic message system;

5. An on-the-scene survey of innovative postal developmental activities in some technologically advanced countries, relating to communications and information transfer technologies, including advanced electronic message systems;

6. A review of promising communications-information processing technologies and their applications, including electronic fund transfer, that seem worthy of exploration to improve the effectiveness of USPS operations in message handling; and

7. Other related tasks as may be mutually agreed on, subject to the availability of funds.

After preliminary discussions among the panelists and the representatives of the sponsoring agency, the panel put together the following guidelines:

1. The goal of the study is to recommend a course of action to the USPS with regard to the research, development, and applications of communications-information processing technologies and electronic transmission and delivery systems to supplement or partly replace first-class letter mail.

2. Except as it is necessary for understanding and background, the present operational problems and management capacities of the USPS are not to be included in the study. However, the assessment of any technological system in engineering terms includes as pivotal the knowledge and know-how that, taken together, may be called management.

3. The question of how to pay for the new technology is an uncertainty that is not to be considered in this study.

4. Any detailed description of how the technology can or should be implemented by the USPS requires a comprehensive study and understanding of many factors that are beyond the scope of this study. Thus, specific concepts of domestic electronic message services and international telecommunications systems for future use by the USPS are to be omitted from this survey.

During the early deliberations, panel members, either individually or in groups, undertook to identify the technological developments relevant to this study and elaborate the ideas and impacts that are central to the issues. This material was presented in working papers for discussion at panel meetings. The papers treat in detail some of the subjects covered in this report. A selected list of working papers is included at the end of this report. All are on file with the Committee on Telecommunications.

Because electronic postal communications is a complex new technology that will be applied to a ubiquitous old institution, a fair amount of historical material on the U. S. mail has been included as Chapter I, Introduction. Chapter II describes the possible strategies available to the USPS and outlines some management approaches for the USPS if it initiates electronic message services. Chapter III deals with the previous studies on electronic message services and the current USPS research and development activities, then provides the

panel's perceptions of the technologies applicable to electronic message services. Chapter IV describes some existing electronic message systems and delineates the conceptual systems models developed by the panel. Chapter V contains the panel's view of the impacts that are likely to result from the adoption of electronic message service systems. Finally, Chapter VI lists some relevant developments in selected foreign countries and addresses international message systems.

This study was sponsored by the Advanced Mail Systems Development Office, U.S. Postal Service. The panel acknowledges the contributions of William J. Miller and Harold P. Belcher of that Office and their close cooperation throughout this study. The panel also acknowledges the assistance of personnel from other government agencies: Robert C. Powell, Robert Gary, and Cleveland Hopkins, Department of Commerce; Jerry A. Lebo, Defense Communications Agency; Charles C. Joyce, Jr., and Gregg Skall, Office of Telecommunications Policy; Charles Brownstein, National Science Foundation; and Robert Branand, House Committee on Post Office and Civil Service.

The panel appreciates the contributions of other participants, especially Joseph Milano, New York World Trade Center; Leonard J. Rennenkampf, Computer Sciences Corporation; and Jacques Harlow, formerly with Western Union.

Summary

America's mail service has been recognized as an essential public service since before the birth of the republic. In recent years, however, it has been in serious trouble. As the volume of letters and parcels expanded along with the nation's population and economy, delays in deliveries and costs of operation increased alarmingly, causing a rise in hostile criticism and a loss of public confidence. After examining the deteriorating service, the President's Commission on Postal Organization reported in 1968 that the nation's postal system should be operated in accordance with the best business practices, as a federal government corporation in the executive branch.

Accordingly, in 1970 the Congress enacted legislation under which the Post Office Department was abolished the next year, and reorganized as an independent establishment, the U. S. Postal Service (USPS). The legislation required the USPS to function so that revenues and appropriations would cover operating costs, and anticipated that it would be self sustaining by 1984.

The USPS management introduced many new programs to increase efficiency and improve service, including centralized mail processing, express mail, and Mailgram. Despite these actions--and three first-class rate increases since 1971--the USPS, after initially breaking even in 1972, has suffered rising deficits, with costs exceeding revenues plus appropriations from the Congress. To make matters worse, the demand for mail service, once believed by some experts to be inelastic, actually declined in 1975--only the third time this century. The decreased use of the mail possibly was caused by higher postal rates, the nation's twin problems of recession and inflation, and the increasing availability of alternatives such as the telephone, telex, private parcel delivery, a sophisticated variety of facsimile, data, and communications services, and carrier systems for magazines, utility bills, and product samples.

There is cause for concern. In size and complexity, the USPS is surpassed only by a few major commercial enterprises. With more than 700,000 employees and an operating budget in excess of $12 billion, the USPS is one of the largest non-industrial organizations in the nation. However, the USPS operated in fiscal year 1976 with a deficit of $1.2 billion.

Several alternatives have been advanced as possible methods of dealing with this problem. One approach is for the USPS to expand into the new technologies that are now assuming some traditional postal services--namely, electronic systems that have the potential of providing message and data communications and banking transactions. From the time of its formation in 1970, the USPS has been concerned with the promise of electronic message technology. It has commissioned several major studies of the subject--those by General Dynamics, Arthur D. Little, and Philco-Ford, have been completed, and another, a major systems definition and evaluation, is now underway by RCA.

The USPS requested this present study by the National Research Council, which was undertaken by a panel of the Committee on Telecommunications in the Assembly of Engineering. One of the panel's tasks was to recommend the promising future concepts of domestic and international telecommunications systems and equipment that could be used by the USPS for electronic message services in the 1985 to 1990 period. In addition, the panel was asked to review the completed studies of the subject that had been commissioned by the USPS and to examine some of the effects that electronic mail is likely to have on such matters as privacy, economics, and regulation of the telecommunications industry.

Having described the issues as best it can in this brief report and stressed the fundamental importance of clearing up the uncertainties that now exist, this panel recognizes that many of the decisions about the future operation of the nation's mail service are essentially sociopolitical and, therefore, beyond its scope and capability to evaluate.

POSSIBLE APPROACHES

The panel considered two salient strategies the USPS may pursue:

1. Limit the role of the USPS to "business as usual"--the physical handling of letters, circulars, periodicals, and parcels and the sale of postage stamps. This strategy would probably result in mounting costs, decreasing volumes, and continually rising deficits--a pattern that is a "no-win" situation and leads inevitably to a deterioration of services and a dependency on subsidies.

2. Commit the USPS to a future that includes modern telecommunications technology, which has altered human communication more radically than anything since Gutenberg's printing press. This could be achieved by either of the following options:

   a. Develop ventures in cooperation with communications carriers, information processing services, and users, capitalizing on the existing strengths of the USPS.

   b. Provide new electronic services to improve the collection, transmission, distribution, and delivery systems, accepting the fact that this option may

produce policy and competition issues in connection with existing or planned communications carrier offerings.

The panel has reservations about the ability of the USPS to meet the nation's need for a complete mail service in the future if the first strategy is adopted. By maintaining the status quo it is unlikely that the USPS can be run as a modern, self-sustaining enterprise, without continually raising rates or sacrificing service. The postal system is at a turning point. Commercial enterprises are now offering new and innovative electronic message services. Electronic funds transfer systems (EFTS) are in operation and more are planned. Time is running out for the USPS. While it delays its entry into electronic message services, developments by private firms are sure to proceed, possibly foreclosing any opportunities for the USPS to move into the field in any meaningful way.

During this study, the panel often discussed the need for new thinking by the USPS about applications of advanced technologies--the kind of thinking that led the postal service to adopt a succession of new transportation technologies to carry the mail with greater speed, flexibility, and reliability--the steamboat, railroad, automobile, and airplane.

In its review of the studies commissioned by the USPS of electronic message services, the panel found that the reports by General Dynamics, Arthur D. Little, and Philco-Ford, as well as an additional survey of the technology by the Department of Commerce, reached conclusions along the general lines of this examination. The panel was somewhat surprised that the previous studies had made such little impact on the USPS--possibly because Postmasters General had served for relatively short periods in recent years.

It was clear to the panel that if the USPS decides to venture into electronic message technology, it will have to come to grips with very difficult and sophisticated decisions--ones that are enormously different from those it has been accustomed to facing. There are several management approaches that have proved successful in cases where industries have faced major technological changes. These approaches involve management commitment, research and development, systems engineering, in-house control of implementation and operation of complex systems, and demonstration field trials of the proposed new services.

Until now, USPS research and development activities have been generally aimed at improving the physical handling of mail. A change to electronic message services represents a far-reaching transformation of skills and perspectives within the USPS. For the most part, the change would probably be evolutionary, rather than revolutionary, and the technical risks probably relatively low.

Even so, the amount of money required will be considerably more than the USPS presently allocates for research and development activities. While the panel did not produce a cost-benefit analysis or presume to estimate the funds that would need to be applied, it noted that in 1974, research and development in the commercial sector

averaged 3.7 percent of gross revenues for communications industries and 5.2 percent for electrical and electronic industries. By contrast, the USPS devotes less than one-half of 1 percent of its operating budget to research and development of all sorts and even less to R&D pertaining to telecommunications. The panel considers the USPS allocation for R&D to be grossly inadequate to undertake electronic message services with any hope of success.

ELECTRONIC MESSAGE SYSTEMS

The panel reviewed some existing message distribution systems and their related electronics technologies--including the ARPA network, AUTODIN, PLATO, and electronic funds transfer operations. Because the possible configurations of electronic message systems are myriad, the panel found it useful to develop generic conceptual configurations. Accordingly, three generations of electronic message systems were defined. In any system, elements of each of the generations could be in operation simultaneously, but changes from one generation to the next are most likely to occur in an evolutionary way.

Generation I consists of an extension of the present first-class mail stream, with all of it handled physically except for selected links between postal installations. On these links, electronic transmission of information replaces the physical transport of mail.

Generation II calls for electronic input and transmission of information. Hard copy is produced at a postal installation near the recipient and then delivered by a USPS letter carrier in the conventional way. Mailgram is an example of Generation II.

Generation III is a completely electronic system, in which a hard copy may or may not be produced, depending on whether or not it is required, and the information flows from originator to recipient only in electronic form. Thus, carriers would not deliver letter mail in Generation III. Two main elements are required for Generation III to operate widely:

1. The development of an economical, reliable, and reasonably compact terminal for the individual user, and

2. The utilization of existing distribution networks, or the development of a new distribution network.

About 74 percent of the nation's letter mail originates in the business sector. Government originates another 6 percent. The panel estimates that as much as 30 percent of all government and business mail may be amenable to transmission as electronic messages. Much of this mail is presently produced in computer format, especially monthly accounts, and therefore could be handled in a Generation II system.

Approximately 46 percent of the present mail is received by individuals. The average household, however, receives only around ten pieces of mail per week, of which about six are first-class pieces. The panel observes that this relatively small amount makes it quite improbable that the average household will install a terminal solely

for the receipt of electronic messages and thus move into Generation III anytime in the near future. If a household terminal becomes available for other applications, the marginal cost of adding an electronic message service might be economically acceptable. The panel notes that this view of mail that is amenable to electronic transmission is consistent with views held by post offices in both Canada and Britain. However, these national post and telegraph operations forecast that the portion of electronic messages generated by individuals is likely to be relatively insignificant up to the year 1990.

CONCLUSIONS

The panel concludes that:

1. Technological feasibility does not limit the evolutionary development of electronic message services. Instead, the success or failure of such services depend upon combinations of technical, societal, economic, and regulatory factors. Technologies that are likely to be used in providing an electronic message service within the next 10 to 15 years are already available or in development. Nevertheless, modifications and developments of equipments and software are required to arrive at electronic message systems that are reliable, versatile, and cost-effective.

2. Because several large electronic message distribution systems are already in successful operation, any USPS planning and implementation of electronic message services may benefit from the experiences gained in establishing and operating these existing systems.

3. It is not necessary and may not be desirable that the USPS own and operate a complete message system. Subsystems could be either leased or owned, depending upon specific analyses in each case. Because of the dynamic and evolutionary nature of the network, the entire system will need to be managed by the USPS to be most effective.

4. Electronic message systems offer the potential of replacing as much as one-third of all of today's letter mail, which includes nearly one-half of all first-class mail. Most of the electronic messages will probably be originated by business or government entities. Electronic messages originated by private individuals will probably make up less than 10 percent of the total. Accordingly, the requirement for local letter carrier distribution will not decrease significantly in the near future.

5. Regulatory issues that arise as a result of the implementation of Generations I and II can probably be dealt with under existing procedures. Major difficulties are not expected. However, the implementation of Generation III will undoubtedly raise difficult and complex national policy issues concerning competition and regulation. A court test may be required to settle such issues--or the Congress

may have to take up the matter. Security and privacy implications are inherent in all three Generations and need to be carefully considered.

6. Several other countries, including Canada, the United Kingdom, West Germany, and Japan, are proceeding in varying degrees along lines generally consistant with the conclusions of this panel that present mail processing can be significantly supplemented or replaced by electronic message services.

7. Present and proposed international telecommunications systems are capable of accommodating all presently foreseen requirements for electronic message transmission.

RECOMMENDATIONS

The panel recommends that:

1. Among the alternatives available to the USPS, electronic message services offer an opportunity to reverse the present trend of rising costs, decreasing volumes, and increasing deficits. Electronic message systems are neither a panacea nor a guaranteed solution to the present problems of the postal service, but if a significant portion of today's first-class letter mail is replaced by such systems, the USPS might find it possible to achieve economies.

2. USPS top management needs to adopt a firm and continuing commitment to involvement in the electronic message field. The commitment that is called for is the same type of conviction in the eventual success of the project that was prevalent within the top management of the National Aeronautical and Space Administration (NASA) for the manned space program in the 1960's.

3. USPS management needs to place increased emphasis on planning, research and development, systems engineering, and in-house capability.

4. Some demonstration field trials will be required to develop and test the new systems, as well as to determine the user acceptance of the services. It may be desirable for the USPS to obtain the participation of business users or government agencies in such field trials. It is not certain that present mail patterns can yield good predictions of an electronic message system. The response of prospective users to a demonstration of electronic message services is necessary to decide on wider applications. Not only can user reactions be ascertained in field trials, but the likelihood of developing a more acceptable public service would be enhanced. There are too many factors involved to determine the economic feasibility of the service a priori. It may be that the USPS will not benefit economically until a Generation III system is operating, but Generations I and II need to be in place, at least in prototype, before Generation III is feasible.

5. At the earliest opportunity, the Congress would do well to address the adoption of a policy on electronic message services that best serves the nation. The mail is a matter of national policy, affecting an essential service that has been in the hands of the federal government since its founding. The Congress, therefore, will have to consider the function of the USPS, especially its record in handling the technology of Generations I and II, and the situation with regard to the private communications carriers. The panel recognizes that this is a difficult issue--one that certainly includes complicated social, economic, legal, and political questions. For most countries, electronic communications happens to be a government monopoly, like the postal service. In the U.S., by contrast, it has been a matter of national policy that all electronic communications, except those under military jurisdiction, have been left to private enterprise. Yet any system using the sophisticated Generation III concept would blur today's clear distinction between the mail and the service rendered by the electronic communications common carriers.

CHAPTER I
Introduction

The genius of the American mail system has been demonstrated in the ability to make good use of new ideas and technologies to improve service and reduce costs. This practice began when Benjamin Franklin, upon becoming Deputy Postmaster General of Britain's colonies in North America, carried out "time and motion" studies of the post routes. Franklin revised the carrier rounds, increased the frequency of pickups and deliveries, and initiated mail service among the colonies and as far away as Canada. These changes led to wider use of the mail and to greater postal revenues. From 1771 until the Revolution, the colonial post office sent its annual profit to London, where it was entered into the Royal account with a notation that this was "the first remittance ever made of its kind" (Fuller, 1972).

The framers of the Constitution gave the Congress power to "establish post offices and post roads," which was a powerful force in opening the new nation to settlement and trade, binding it geographically and culturally. In 1792, when the first postal law was enacted, there were only 195 post offices and fewer than 6,000 miles of post roads. By 1832, more than 8,500 post offices and 120,000 miles of post roads were in operation, from New England to New Orleans and the Michigan territory (Scheele, 1970).

The history of the U.S. mail is paralleled by the advances in transportation technology--from horseback and stagecoach to steamboat, railroad, pneumatic tube, automobile, and airplane. As the nation grew in size and complexity, increasingly faster and more reliable methods were needed for handling the mail. Thus, in 1861 the Railway Mail Service was established to facilitate the sorting and processing of mail en route to its destination. Even streetcars were used for this function during one period (Scheele, 1970). With the invention of the automobile came rural free delivery (RFD), an innovation that helped transform the nation's social and economic life. One consequence of RFD was the reduction of the number of post offices from 76,945 in 1901 to 41,102 by 1920; another consequence was the rise of the mail-order business. The Post Office pioneered air transportation, flying its own Curtiss JN4H "Jennies," before World War I, between New York City, Philadelphia, and Washington. In 1920, the Post Office inaugurated daily transcontinental flights, with airborne radio receivers providing the pilots with the latest weather reports (Shamburger, 1964).

Other innovations also affected the service. Stamping and canceling machines, postage meters, and additional techniques of mechanization were adopted or developed especially for the postal service. With the advent of the telegraph in 1837 and the telephone in 1876, there were many who predicted on each occasion that the mail would be virtually replaced. As it turns out, however, these technologies, along with computers, satellites, and other electronic wonders, hold promise of changing and augmenting the mail in fundamental ways.

New technologies for improving or displacing old methods were central to the Kappel Commission report in 1968, the basis upon which the Congress reorganized the nation's postal system in 1970 (President's Commission of Postal Organization, 1968). Since then, the successor to the old Post Office Department, the U. S. Postal Service (USPS), an independent, quasi-private corporation of the executive branch of the federal government, has introduced such new techniques as the Ziptronic device for sorting and routing mail by destination Zip code and Mailgram, a joint venture with Western Union which sends messages electronically for postal carrier delivery the next day. These techniques, in addition to new routing systems and tighter operating procedures, were aimed at increasing reliability and reducing delays and costs. Despite these actions--and despite three rate increases since 1970--the cost of running the USPS continues to rise, criticism of deteriorating services continues to be voiced, and confidence in the service continues to diminish.

Moreover, in 1975 the demand for postal services, long believed by some experts to be inelastic, actually declined. Only the third mail decrease this century, after the depression period of the 1930's and World War II, the reduced demand was possibly the consequence of high rates and the increasing availability of alternative services. More probably, the decrease was a reaction to the nation's economic problems of recession and inflation. As it happens, the volume of mail at the end of 1976 was slightly greater than a year earlier, perhaps because economic conditions improved. Even so, year by year the number of of alternatives to mail increases. These alternatives include the telephone, telex, private parcel delivery, and a sophisticated variety of facsimile, data, and communications services that enable people and businesses to send more messages and pay more bills without using the mail. This state of affairs brings the USPS to a decision point: to embark upon a program of electronic message transmission or not.

This is not the first time that the question of involvement in electronic communications has been raised for the nation's mail service. In 1844, when Samuel F. B. Morse was transmitting news of the Democratic party convention in Baltimore to newspapers in Washington, the Postmaster General and some members of Congress urged that the Post Office Department assume ownership of all telegraph technology in the U. S. The next year the Post Office was put in charge of Morse's experiment, but a Congressional bill to buy Morse's telegraph was never enacted (Fuller, 1972). Later, during World War I, all telegraph and telephone services were placed under the Postmaster General to meet the emergency. After the war, the Post Office recommended keeping the

system as a government operation---as was already the case for Post-Telephone-Telegraph (PTT) systems in Britain, France, and other countries. In response to outcries from the business community and the press, however, the telegraph and telephone were returned to private operation (Scheele, 1970).

In the U.S. today, practically 100 percent of businesses and 94.5 percent of households possess at least one telephone (U.S. Bureau of the Census, 1975). The telephone and the telegraph compete directly with the mail. There are supplementary services for both businesses and individuals, including Mailgram and Faxgram, facsimile and computer terminals, and word processing equipment. One major reason for the expansion into telecommunications is the exponential reduction in costs for electronic components. In 1958, a transistor which performed a standard gate function (similar to an on-off switch) cost about $20. The same function is now performed by an integrated circuit chip segment that costs about one-tenth of a cent and is expected to cost only half that by 1980 (Altman, 1976).

For some time, the USPS has been concerned with the potential of electronics technology for the mail. Thus, the USPS has commissioned four major studies of the subject--three having been completed and the fourth initiated earlier this year by RCA. This study was undertaken by the U. S. Postal Service Support Panel of the National Research Council to review the three previous examinations of electronic mail and to conduct an independent evaluation of the research, development, and applications of today's telecommunications technology as ways of supplementing the existing capabilities of the USPS and/or providing new postal services in the period 1985-1990.

CHAPTER II
Strategy

Recognizing that the nation's mail is an essential public service, the panel identified two salient strategies the USPS may pursue in the future:

1. Limit the role of the USPS to "business as usual"--the physical handling of letters, circulars, periodicals, and parcels and the sale of postage stamps. This strategy would leave the transfer of messages by electronic means to the communications and information processing industries.

2. Commit the USPS to a future involving the transfer of messages by electronic means, in accordance with either or both of the following options:

   a. Develop ventures in cooperation with communications carriers, information processing services, and users, capitalizing on the existing strengths of the USPS;

   b. Provide new electronic services to improve the collection, transmission, distribution, and delivery systems, accepting the fact that this option may produce policy and competition issues in connection with existing or planned communications carrier offerings.

If the first strategy is adopted, the panel has reservations about the ability of the USPS to overcome the continuing cost increases and volume decreases. Salaries and benefits amounted to nearly 86 percent of the USPS's total operating expenses in 1975, and the proportion is rising steadily. At the present rate, salaries and benefits will total over 87 percent of operating expenses by 1980. Transportation costs, although representing only a small percentage of the total outlay, are also likely to continue upward.

In good economic times, large mail volume often can help overcome a deficit. In 1975, however, mail volume declined by nearly 1 percent from 1974, and the small increase reported in 1976 may be a temporary anomaly. Coupled with rising costs, decreasing volume raises the

specter of a continuing deficit. The announcement of a $15 million operating surplus for the third quarter of 1976 was good news after years of dreary deficits, and this may suggest that the USPS is getting a firmer grip on costs and finding ways to improve productivity. Nevertheless, the panel considers that the acceptance of the first strategy would place the USPS in a "no-win" position, beset on one side by increasing operational costs and on the other by decreasing mail volume. While the USPS has attempted to improve the situation, it is likely that there are few areas remaining in which significant savings may be achieved. The panel, therefore, believes that the use of the first strategy--limiting the USPS role to physical handling of mail--will lead to greater costs and poorer service--conditions that are unacceptable to the nation. The application of electronic technology to the mail service is no panacea, but it does appear to offer the USPS an opportunity to turn away from a course that shows little or no promise of improvement.

RECOMMENDATION

Among the alternatives available to the USPS, electronic message services offer an opportunity to reverse the present trend of rising costs, decreasing volumes, and increasing deficits.

If the USPS decides to adopt electronic message technology, it will have to come to grips with very difficult and complex tasks. Moreover, the USPS will have to master a new technology that is now unfamiliar to it. Because the new service will integrate the complex electronics technology with the presently operating distribution system, the control problem is central for management. There is no exact historical parallel to this, but there are several management approaches that have proved successful in similar situations. This chapter describes some of the approaches that the panel members consider applicable to USPS entry into the electronic message field. Although such management approaches represent the viewpoint of the panel members, several have been supported by other studies that are cited.

COMMITMENT

Studies made for the USPS, and dating from the early 1970's, have reached conclusions along the general lines of this report. Somewhat surprisingly, these have not made an impact on the USPS. Without the commitment of the top management of the USPS to the thrust of this report, the panel is persuaded that its conclusions and recommendations will also be disregarded. The commitment of the USPS top management to electronic message services is the same type of conviction that was required of the top management of the National Aeronautical and Space Administration (NASA) for the manned space program.

One reason for the lack of commitment may be found in the relatively short tenure of Postmasters General in recent years. There have been eight since January 1961, with only one serving more than three years. While commitment by the Postmaster General is essential,

it may not be sufficient. A management commitment to an electronic message service of this magnitude must extend through a ten to fifteen year period. The USPS Board of Governors can help to insure continuity to the commitment. A commitment and adequate allocation of resources by the Board of Governors and the top USPS management will be necessary for a successful venture into electronic message services.

RECOMMENDATION

USPS top management needs to adopt a firm and continuing policy commitment to involvement in the electronic message field.

PLANNING

Top management commitment is often expressed through the preparation and maintenance of a corporate strategic plan. Not a document to be issued and then used only for occasional reference, such a strategic plan needs to be dynamic, concise, and comprehendible so that it can be useful and meaningful at all levels of USPS management. The plan should be stated in no greater detail than necessary to indicate the thrust of management's intentions for the future. Thus, the options would be kept open until the time comes for decision. The plan would enunciate the fundamental objectives of top management. In the case of the USPS concern with electronic message systems, the objectives are now ill-defined and poorly understood. The plan would serve the important purpose of organizing and stating the objectives of the USPS for the new technology.

A well-developed plan may produce results far in excess of the resources expended in its production, since it offers a manifesto with which individuals at all levels can relate their every decision. Most successful businesses are able to articulate definitive answers to the question "What is our business?" and discuss the strategic objectives and plans in a straightforward, but probably proprietary, manner (Drucker, 1974). While the plan itself may be a document of relatively small size, the preparation of the plan is anything but trivial. Considerable amounts of time, money, and competent personnel are required to produce and maintain an effective strategic plan The panel did not presume to estimate the resources required. Such an estimate would require considerable efforts by individuals knowledgable with the USPS organization and procedures. It is emphasized that the maintenance of a strategic plan is equally as important as its initial production. Moreover, the plan needs to be modified as additional data are generated and evaluated, and as conditions change.

RESEARCH AND DEVELOPMENT

Any movement into more complex and sophisticated technology, such as electronic message services, requires that higher status, larger resources, and greater emphasis be given to research and development. Until now, USPS research and development activities have been generally aimed at improving the physical handling of mail. A change to

electronic message services represents a far-reaching transformation of skills and perspectives within the USPS. The panel observed that for the most part, the change would probably be evolutionary, rather than revolutionary, and the technical risks probably relatively low.

Even so, the amount of money required will be considerably more than the USPS presently allocates for research and development activities. While the panel did not produce a cost-benefit analysis or presume to estimate the funds that would need to be applied, it noted that in 1974 the average research and development operations, as percentages of gross revenues, amounted to 3.7 percent for communications industries and 5.2 percent for electrical and electronic industries (Standard and Poor's The Outlook, August 18, 1975). American Telephone & Telegraph Corporation (AT&T) budgets about 2 percent of gross revenues to R&D. By contrast, the USPS devotes less than one-half of 1 percent of its operating budget to research and development of all sorts and even less to R&D pertaining to telecommunications. The panel considers the USPS allocation for R&D to be grossly inadequate to undertake electronic message services with any hope of success.

In this connection, the panel notes that the time and cost for R&D activities are habitually underestimated in all industries. For instance, a study of proprietory drug firms showed that the average R&D expenditures were greater than estimates by a factor of 2.11 and that the average time taken to complete the work was greater than estimates by a factor of 2.95 (Mansfield, 1971).

Furthermore, the importance of technical inputs to the highly complex electronic message system argues for increased visibility of the USPS R&D effort. The relationships existing among individual development projects and the various decision points in the strategic plan need to be well understood by top management, in order to provide for the effective implementation of developmental results. Since the strategic plan is required to be dynamic, reflecting situation changes as well as developmental results, the information exchange between top management and the research and development activity will be extremely important.

SYSTEMS ENGINEERING

A case similar to that made for research and development activities can be made for systems engineering. The term "systems engineering" represents a discipline so complex and broad that it defies a simple or rigorous definition. Most managers and technicians operating successfully in highly technical areas accept as nearly axiomatic the premise that the application of systems engineering is mandatory to success. As an official at Bell Telephone Laboratories once put it:

> Because of its critical position in the highly integrated Bell System, Bell Labs also engages in another line of activity that has no clearly identified counterpart in military R&D. For this

> activity, we use the general term "systems engineering" although with a meaning that is broader than that in common usage. A more definite term would probably be "systems and development planning", for the thrust of this activity is to plan the applications of technology and the deployment of Bell Labs' development resources for their best use in pursuit of our primary goals: enlarging the scope of, and improving the performance and economy of, communication services (McMillan, October 1975).

The system engineering process is especially important to electronic message services, mainly because these services must be carefully fitted into an already existing socioeconomic and regulatory complex. Although in many systems the user can be controlled, trained, or educated to conform to the system, in this case it is the system that will be required to make nearly all the adaptations. The organizational element that performs the systems engineering function must meet two significant criteria: basic policy factors are critical in most of the phases of systems engineering, and the specific activity must interface with all operating, planning, and support elements of the USPS. As a result, it is clear that the systems engineering element in the USPS needs to be placed in a key organizational position, with visibility and access to top management. The panel considers the NASA manned space flight program an example of successful systems engineering that the USPS could well replicate.

IN-HOUSE CAPABILITIES

The panel understands that increases in funding for such activities as systems engineering and research and development are always difficult to attain and especially difficult when an organization is experiencing a deficit that totaled $1.2 billion in fiscal 1976. Nonetheless, a significant investment will be required if the USPS decides to enter the electronic message field. At one panel meeting, William J. Miller, of the USPS Advanced Mail Systems Division, estimated that only about one-quarter to one-third of all of the USPS R&D is presently done in-house, at the R&D Laboratory in Rockville, Maryland.

The panel considers it imperative that the USPS maintain the functions of system integration and overall system management in-house. In stating this, the panel recognizes that outside contractual efforts are proper and appropriate for dealing with such problems as equipment modifications. Outside contractual efforts may also be used, at least until an in-house capability is developed, to address such tasks as systems studies. The establishment and maintenance of an in-house systems engineering capability will facilitate the development and maintenance of specialized knowledge for the USPS, and also ensure that new techniques and services are utilized where appropriate within the overall postal system. It is not good engineering or business practice for only a few in-house people to be knowledgeable about large contracts.

IMPLEMENTATION PHASES

The identification of phases that occur in the implementation of an electronic message service is necessarily somewhat arbitrary. The panel considers that the following phases are general enough to cover most situations and that these phases represent the actions necessary for the successful development of a complex system.

1. Conceptualize specific services, assuming communications objectives that support USPS policy and national policy.

2. Design and build tentative prototype systems, providing for the conceptualized specific services.

3. Conduct experimental field trials to test the technical, economic, and marketing concepts that are involved in the specific service.

4. Evaluate the field trials and revise the conceptualized phases.

User reaction to electronic message services is one of the key elements to success, and user reaction cannot be determined without field trials. A large majority of the panel urges that field trials be made as the most effective means of learning more about user reaction to and acceptance of electronic message services. Because a controlled environment may be best for such trials, it may be appropriate for government agencies or business users to take part in the field tests.

RECOMMENDATION

USPS management needs to place increased emphasis on planning, research and development, systems engineering, and in-house capability. Some demonstration field trials will be required to develop and test systems definitions, especially with regard to user acceptance of the services. It may be desirable that the USPS obtain the participation of business users or government agencies in the field trials.

CHAPTER III
Technologies

In the course of this study, four studies previously conducted for the USPS were reviewed.

The first, completed in 1970, was the General Dynamics "Study of Electronic Mail" (General Dynamics, 1970), which began with an evaluation of applicable technology, described the relevant current postal operating procedures and facilities, delineated various methods for handling and transmitting mail electronically, then furnished a design and specification for an experimental electronic message system that called for a laboratory-type system to be built and operated by Post Office personnel. The General Dynamics study concluded that a nationwide electronic mail handling system is technically feasible and recommended a system design study and several specific equipment or subsystem programs.

In 1973, a study by Philco-Ford examined the performance and cost aspects of an electronic mail handling subsystem to convert graphic inputs and letter mail to digital forms, process these for transmission, and re-convert the data to hard copy at a destination terminal (Philco-Ford, 1973). After considering eight alternative conversion subsystems, the Philco-Ford team found that although a wide range of service quality was covered, the costs of the operation varied only over a narrow range.

In 1973, Arthur D. Little, Inc., undertook a study to identify those areas of research, engineering, and technology that would offer the greatest promise as building blocks for a detailed system-design effort (Arthur D. Little, 1974). The report concluded that the design, development, and construction of an electronic message handling system, while formidable tasks, are technically feasible. The study noted that detailed assessments of some devices and concepts were not rewarding because of the lack of a detailed system design.

Another report, "Study of Satellite Frequency Requirements for the U.S. Postal Service Electronic Mail System" (U.S. Department of Commerce, 1974), recommends that certain frequencies in the radio-spectrum now allocated government (20/30 GHz) and non-government (11/14 GHz) uses should be set aside for satellite transmission of postal messages. The report concludes that technology has not imposed any limits on proceeding with electronic message services, and that the USPS has a wide range of options to explore. It recommends market-

acceptability testing of proposed electronic message services to provide information that would be essential to the development of system design requirements.

Members of the panel reviewed these four studies and determined that the conclusions are generally in line with those reached by this study; the Philco-Ford report describes a system that has been conceptualized by this panel as a Generation I system for the USPS (see page 31). The panel decided that the Arthur D. Little report merited a full discussion because of its nature, scope, and conclusions. At points in this report, therefore, there are references to the Arthur D. Little study.

The panel was seriously concerned that, although the four studies had recommended actions leading to the production of a system design, the USPS had taken apparently few actions to pursue such a design.

USPS RESEARCH & DEVELOPMENT ACTIVITIES

The USPS is presently engaged in several activities that involve electronic message services. One of the largest of these is a $2 million, two-year effort for a definition and evaluation study of electronic message service systems (EMSS), awarded in April 1976 to the RCA Corporation. Other USPS agreements with the Institute for Telecommunications Sciences and the National Bureau of Standards call for technical and network modeling support for the USPS EMSS program. Another contract requires Arthur D. Little, Inc., to provide continual technological investigations, applications, and assessment in support of the EMSS program. In addition, Pitney-Bowes, Inc., is developing an experimental model of a high-speed printing and paper-handling system for the same program. Still other USPS activities include studies by the Naval Electronic Laboratory Center to provide supporting services for the development of electronic scanning devices and related equipments; Arthur D. Little to define and create industrial demand for advanced electro-optical components and systems; and Quantum Science Corporation to study electronic funds, text, and graphic transfer cystems. Finally, proposals are being evaluated for the exploratory development of a scanner subsystem.

TERMINAL TECHNOLOGIES

Input device technologies include direct digital input (from keyboard, computer, or recording media), line-scan input for analog or digital transmission, and optical character recognition. The output device technologies include devices to convert information from electronic form to either hard copy or transient display.

Direct digital input presents no significant technological difficulties, although there are format and procedural standards yet to be determined. Line-scan input technology has generally been somewhat constrained by the need to utilize portions of the existing telephone system, with the result that the available bandwidth is a limiting factor. Most of today's facsimile transceivers require about four minutes for the transmission of a standard-size page. Although this

period is acceptable for some applications, higher speeds are clearly desirable, if only to reduce transmission costs. A number of companies are now producing facsimile terminals that transmit at considerably faster rates, and one manufacturer produces a terminal that transmits a standard 8-1/2 x 11 inch page in 35 seconds. The reproduced copy, in this high-speed mode, exhibits a vertical resolution of 67 lines per inch, which is wholly adequate to reproduce typescript. The greater speed is attained by the use of a coding algorithm that accommodates transmission to the amount of blank space on the transmitted document. Another facsimile set transmits a standard page in two minutes and reproduces the document on plain, untreated paper. If slower speeds are acceptable, there are available vertical resolutions as great as 200 lines per inch, sufficient to reproduce 4-point type, which is only 0.05 inches high. Obviously, greater capabilities require greater capital investments (Administrative Management magazine, January 1976). The limiting factor in fascimile transmission has been the cost of availabile transmission facilities, not the line-scan technology itself. For comparison, the standard broadcast television signal consists of 30 complete line-scan pictures (at low vertical resolution) per second.

The development of optical character recognition (OCR) equipment has received considerable attention in recent years. The idea is attractive: recapture key strokes without human intervention. Characters are dissected and resolved, with the results then compared to stored patterns for decisions (IBM presentation to USPS Support Panel, G. N. Gaebelein, February 13, 1976). While the panel considers the OCR concept to be sound, operating equipment suffers from several handicaps. For one thing, the equipment is quite expensive. For another, specific type fonts are required, and even then the error rates are high. What's more, there is no redundancy, the basis for error correction, inherent in the process. OCR equipment is bound to improve, of course, but it is not clear that the problems of initial cost and operational errors can be overcome. This is not to say that OCR should be discounted completely. There are probably many applications where OCR equipment can be used efficiently, but it is doubtful that OCR inputs will significantly replace facsimile and direct digital inputs.

Output devices can be divided into those that produce hard copy and those that produce a transitory display. Each type has its place in an electronic message system. Hard copy requirements demand the use of printers. Impact printers, characterized by ingenious designs of electro-mechanical elements, operate at 10-55 characters per second (cps) for single-element printers, through 50-155 cps for wire-matrix printers, up to 300 cps for continuous-belt printers and 2300 cps for chain-link printers. Non-impact printers include thermal (100 cps), electro-erosion (240 cps), ink-jet (500 cps), and electro-photographic (15,000 cps). Maintenance problems exist in mechanical printers, and in general the problems increase at higher speeds. It is noted that progress in the development of printers continues at a fairly rapid rate (IBM presentation to USPS Support Panel, J. C. Tamulis, February 13, 1976).

If hard copy is not always required or desired, electronic display is an alternative. For full-page display, there are only two principal choices at present. These are the plasma panel and specialized cathode ray tubes (CRT), such as the deformographic storage display tube (DSDT). Some plasma panels are electrically constrained to a 7 x 9 dot character matrix, thus capable of reproducing only previously programmed alphanumeric information, while other plasma panels are 512 x 512 electrically unconstrained grids. Each register point is sustained at a 30KHz rate, so that the panel acts as its own storage medium. Such panels will need to be competitive with the cost of CRT's. While this objective has not yet been attained, the reliability of the plasma panel is much greater than the CRT. Several years of field experience have demonstrated only trivial failures. Plasma panels are limited in size (by line delineations and production yields) to about 273 square inches.

In a DSDT, a dielectric screen replaces the CRT phosphor screen. Retaining a given charge until commanded to change, the DSDT also acts as a storage device. A deformographic film over the dielectric screen is affected by the charge, and the image that is formed on the film is externally illuminated. A key problem in this device is the relatively high-energy beam required to charge the dielectric screen. Because the DSDT is still in the development stage, information is not yet available for establishing the market demand and production costs.

Television receivers, which are in more widespread use (98 percent of households) than telephones (94 percent of households), are often considered as display devices for home terminals. Although the use of television receivers is certainly possible, modifications to TV sets would be required to obtain the higher resolution necessary for satisfactory alphanumeric presentation (Alvin E. Nashman, quoted in The Washington Star, April 10, 1976). The present costs for more specialized terminals are considered too high for acceptability in the home. However, initial calculations by one of the panel members suggests that the present costs may decrease by an order of magnitude, making home ownership of such terminals to be clearly acceptable (Presentation to the USPS Support Panel, Guy Fougere, March 4, 1976).

TRANSMISSION

Transmission can be characterized as either narrow-band or broad-band. Narrow-band is most commonly used for telephone service, nominally 3KHz. At first, all transmission systems were first narrow-band, initially twisted or open-wire pair. It was soon realized that several narrow-band channels could be merged effectively into a wide-band channel. Advances continue to take place in wide-band transmission, utilizing co-axial cable, microwave relay, wave-guide, satellite, and optical fibers. Co-axial cables, now the lifeline of the cable TV industry, first were used to provide long-haul common carrier links. Traditionally, cables have served for transmission between points of communications, such as the telegraph and telephone links under the Atlantic, or for a broadcast service, as in cable TV. There are some who argue that this wide-band technology is the tidal

wave of the future. But, to this panel at least, to see present wide-band technology as a direct replacement for the switched narrow-band telephone network is to indulge in speculation that focuses on only a portion of a complex system.

Improvements in transmission technologies are not likely to offer major opportunities for cost reductions in this portion of an electronic message system, since current capabilities are completely adequate to fulfill all foreseen requirements in any one of several ways. The configuration that will be used will be chosen on the basis of cost effectiveness, and will depend primarily upon the scale of the system application.

At present, satellites are economically competitive with other communications systems only when the ground stations are located more than about 500 miles apart. By the late 1980's, however, satellite circuits may be cost-effective, compared to terrestrial systems, at distances of only about 50 miles. Advances in communications satellite design and space shuttle vehicles are likely to reduce the cost of satellite communications systems. Satellites offer unique characteristics that can be exploited for an electronic message system. Such characteristics include extreme flexibility, both for operational use and system evolution. The USPS is unlikely to become directly involved in satellite development and operation; the evolving commercial offerings of high bit-rate digital service between major cities would appear to be adequate for transmission in field trials and initial system development.

An exciting development in communications transmissions is the use of optical fibers. This relatively new medium promises to provide digital-data transmission rates at millions or billions of bits per second, while, at the same time, eliminating frequency assignment and interference problems and reducing susceptibility to interceptions. Problems relating to fiber and cable production, ancillary modules, and cable installation and maintenance are beginning to appear. If these problems can be solved, fiber optics undoubtedly will become a powerful competitor to all other wide-band transmission media in many applications.

SWITCHING

Switching may be characterized as either circuit switching or message switching. Circuit switching connects segments in tandem, until a through-path is established between the user and recipient of a message. Once the circuit connection is established, user-to-user service is provided without delay. Message switching enables messages to be sent, either in whole or in blocks of characters or bits. This service is also known as "store and forward," since the messages or blocks are temporarily stored at intermediate positions in the network. Packet switching is a special case where the relatively small blocks or packets of the same message may take different routes and are reassembled only at the recipient's terminal.

The switching machines of a sophisticated electronic message system will undoubtedly include a component that is essentially a

digital computer. Messages are held temporarily in a magnetic storage device--generally a drum or disc, but sometimes a tape or core memory. In addition to store-and-forward message processing, the computer switches perform such functions as the interpretation of complex addresses and handling instructions; message transmission by priority; translations of code, speed, and format between senders and receivers; record keeping for protection, accounting, and retrieval purposes; and data processing based on message content or message header information. The increasing availability of inexpensive microprocessors now permits the consideration of new switching concepts. Networks employing distributed switching capabilities are being designed and tested. The switches are the heart of any message system, and the USPS needs to actively maintain an awareness of developments in the field.

STORAGE

In addition to the temporary storage of messages, storage capacity will also be required to control data flow, network configurations, and system operations. Memory techniques that offer the potential of high-density storage at low cost include magnetic domain devices, charge transfer devices, transverse and helical recording on magnetic tape, electron-beam writing on thermoplastic or silver halide film, and laser-beam writing on metalized plastic film (Arthur D. Little, 1974). Many additional developments are taking place continuously in this field.

SOFTWARE

One of the key areas - and one which cannot be over-emphasized in support of electronic message services - is the development of complex and sophisticated programming systems for operation under real-time, high-volume conditions. A tremendous effort will be required for a nationwide system of electronic message services, whether these are installed and operated as part of the postal system or as a commercial network. While the magnitude of such an effort is now appreciated by more and more people with expertise in the field, there is a tendency to underestimate such essential elements as developmental lead times, documentation procedures, the multiplicity of required subprograms, and system diagnosis and repair. For the USPS to do the job well, it will need to utilize all the experience that has been accumulated by others in similar projects. The system architecture for electronic message services is crucial, because early decisions in systems structure and design can determine the potential for advances in software without necessarily modifying the hardware already in use.

NETWORK CONTROL

A functioning network requires more than terminals, transmission facilities, and switches. The brain of the system is network control. Network control involves actions such as the prioritization of demands for service, the assignment of equipments, routes, and transmission

channels, and the monitoring of component performance and service quality. These actions are taken to optimize the network performance, in accordance with previously-selected parameters. Such optimizing parameters are developed according to the objectives which the system is required to satisfy. User satisfaction is one parameter that must be present in all communications systems. There is considerable research and development activity in the network control area at present.

CONCLUSION

The panel concludes that technological feasibility does not limit the evolutionary development of electronic message services. Instead, the success or failure of such services depends upon combinations of technical, societal, economic, and regulatory factors. Technologies that are likely to be used in providing an electronic message service within the next 10 to 15 years are already available or in development. Nevertheless, modifications and developments of equipment and software are required to arrive at electronic message systems which are reliable, versatile, and cost-effective.

CHAPTER IV
Systems

There are several electronic message service systems in existence. Some have been created by the user, by purchasing or leasing terminals, leasing communications channels, and providing network control. This technique requires considerable resources, and may be the most effective when quick responsiveness is of paramount importance. Many commercial organizations now offer message services that require varying degrees of user involvement in technical aspects, such as network control functions and protocol. The panel did not attempt to make a survey of such systems, which include airline reservation networks, commercial facsimile services, and Infonet. Nevertheless, after reviewing a few of the existing systems, the panel agreed that the experience gained in the planning, implementation, and operation of these systems would be applicable to a USPS electronic message service.

AUTODIN NETWORK

One of the most sophisticated large-scale networks in operation is the Department of Defense Automatic Digital Network (AUTODIN). The AUTODIN system consists of 18 multi-million dollar computer switches and more than 1,350 terminals. Considerable effort was expended to attain high message and system reliability, which is achieved by the use of parity checks, controlled environments for the switches, and hardware redundancy. As a result, the probability of a misrouted message is less than one in 10 million. The probability of a character error being generated in a switch and transmitted undetected is one in 100 trillion. Specialized military requirements include a precedence system which interrupts the transmission of relatively routine traffic to allow the delivery of important messages. AUTODIN provides for sophisticated security of all messages. To meet such specialized requirements, more complex hardware and software have been used, with, not surprisingly, increased costs. Many of these specialized features would not be required for a USPS network. AUTODIN currently handles over 30 million messages per month - an average message consisting of some 3,000 characters. User satisfaction with AUTODIN is extremely high (Defense Communications Agency, 1973).

ARPA NETWORK

A second Department of Defense information network is the Advanced Research Projects Agency (ARPA) Network. The ARPA network uses packet-switching techniques and was designed to provide a resource sharing capability among computer research installations widely distributed geographically. Implemented in 1969, management control was transferred to the Defense Communications Agency in 1975. The ARPAnet now serves some 90 host computers, and consists of some 58 Interface Message Processors (IMP) and Terminal Interface Processors (TIP). Packets of up to 1,000 bits are exchanged between computer stations, with a 0.5 second response time. The present ARPAnet traffic is about 8 million packets per month. Ruggedly built, the IMP/TIP hardware maintains a mean time of approximately 10,000 hours between failures. The IMP's are connected with 50 kilobit per second leased lines (Becker, 1973).

ADVANCED RECORD SYSTEM

In 1964, the Advanced Record System (ARS) was established by the General Services Administration to provide civil federal government departments and agencies with a general purpose record-data telecommunications system to meet agency requirements on both a day-to-day and emergency basis. To meet the major design objectives of reliability, flexibility, versatility, and economy of operation, the ARS utilizes a combination of circuit switching and message switching. The circuit switching is an automatic direct-dialing system and includes 28 district switching centers and 3 trunk switching centers. The message system includes 2 message switching centers and provides store-and-forward message relay, code and speed conversion between dissimilar terminals, multiple address transmission, and interconnection with the AUTODIN network. During 1975, the ARS served 2,500 stations, with a total usage of over 100,000 hours per month.

PLATO

Another example of an operating network is the Programmed Logic for Automatic Teaching Operation (PLATO) system. Designed for computer-assisted instruction, the PLATO system offers, as an ancillary service, the storage and delivery of messages between subscribers. Supported by more than $15 million in federal funds and nearly the same from state, university, and other sources, the PLATO system has been recently offered for commercial use (Bitzer et al, 1973).

SERVICES

The first telegraph message on record was sent in 1838 (Carlson, 1975). Telegraph service expanded almost everywhere until it was overtaken and replaced by telephone. In addition to the telegraph, Telex and TWX services are now readily available. Recent entries into message service include Graphnet's Faxgram, a facsimile-transmission

service, and Western Union's Mailgram. Initiated in 1970, Mailgram utilizes electronic entry, switching, and transmission to a USPS installation, where a hard copy is produced and entered into the conventional mail stream for delivery by letter carrier. From a modest beginning of 370,000 Mailgrams in 1970, its use has increased to about 24 million in 1975 (Presentation to USPS Support Panel, James J. Johnson, September 11, 1975).

Data communications services also are available. The Telenet Communications Corporation, using experience gained in the implementation and operation of the ARPA Network, now offers the service to a 60-city network.

Another class of service is offered by manufacturers of word-processing or text-editing equipment for use in publishing and other businesses. This consists of stand-alone text-editing systems that also are capable of communicating directly with similar equipment at other locations, using standard dial-up or dedicated telephone service. In most cases, control and supervisory functions are performed by the users.

As such equipments become more widespread, there will be tendencies to use them for messages to additional addressees. Commercial companies are planning services that will automatically perform conversions in modulation, protocol, codes, and speeds, to allow direct communication among previously incompatible facsimile and alphanumeric terminals, including word-processing equipment. This recent development emphasizes that electronic message systems hold great promise of public and private benefits and indicates that new service developments will be made available in the future.

ELECTRONIC FUNDS TRANSFER

Another large subset of electronic message systems concerns financial transactions--preauthorized payments, large dollar transfers, credit authorization, point of sale services, and teller functions. Taken collectively, this has come to be known as electronic funds transfer systems (EFTS). Since approximately 70 percent of the present first-class letter mail consists of financial transactions, the USPS interest in this subject is profound.

The American Banking Association began to study EFTS in 1968. Some systems were first implemented in 1972. Since then, many additional systems have come on-line. One, introduced in 1974 in Lincoln, Nebraska, linked the city's First Federal Savings and Loan Association with local Hinky Dinky supermarkets. Remote teller terminals at the stores dramatically gained new accounts and increased savings deposits, but also raised basic problems of regulation and competition. Similar remote terminal installations are now operating in Seattle, Washington, and are planned for several other locations. Sometimes these systems are in conflict with existing state laws or regulations. Thus, interstate banking operations, such as Citibank N.A., of New York, have experienced far greater regulatory problems than those banks that operate within a single state. Nevertheless, Citibank has invested about $100 million in electronic systems and now

has installed more than 7,500 basic terminals, leasing some 17,000 point-to-point common carrier lines in New York City alone (Gerald M. Walker, Electronics, July 24, 1976, and Presentation to USPS Support Panel, John S. Reed, September 11, 1976). Citibank's total investment probably represents 5-10 percent of the investment by the entire banking industry, indicating an industry investment on the order of $1 billion (Frank M. Curran, American Bankers Assn., May 25, 1976). Another problem raised by electronic funds transfer is that the system can be interpreted as branch-banking, a system that is forbidden in some states. An important point is that most of the present EFT systems have been developed and are operated by only one bank or group. While the potential for interconnection and operation as a system exists, the pace of development and implementation is so rapid that there is likely to be little room for any maneuvering within a few years.

The U.S. financial transaction market totaled $84.5 billion in 1972, and this is expected to grow to more than $108 billion by 1980. Perhaps as much as 70 percent of this market is amenable to electronic transfer (Arthur D. Little, 1975). The role of the USPS in EFT is anything but clear. It is to be expected that any hint of USPS competition with the banking community would be met with cries of outrage. One of the largest movers of funds, however, is the U.S. Government. If the USPS could offer an EFT service to the government agencies only, it might be significantly cost-effective. At any rate, such options should be kept open at this time.

CONCEPTUAL MODELS

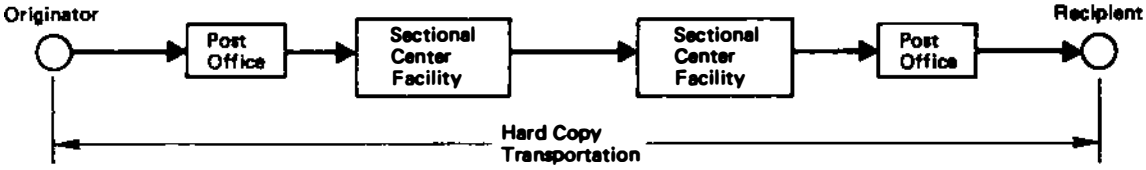
The possible configurations of electronic message service systems are practically infinite. The panel found it necessary to formulate a set of conceptual models, to permit discussions based on commonly understood baselines. The panel developed three models of electronic message systems, designating these as Generations I, II, and III. Although the use of the term generations suggests a natural sequence, the panel would like to point out that elements of all generations could be in operation at any given time, according to the specific requirements and conditions. The models were designed to be only as detailed as necessary to emphasize the major differences among the specific generations.

Thus, Generation I and II both would use electronic transmission for some segments and physical delivery to the recipient, while Generation III would be wholly electronic. In Generation I, the USPS would retain complete control of the system and its relationship with the user interfaces would remain unchanged. In Generation II, the relationship with the originating user changes, and in Generation III the interface is different for both the originator and recipient.

All three models are based on a simplified functional version of the present mail stream (Figure 1). In the present mail system, all messages, letters, or information are transported from the originator to the recipient in the form of a printed or written record on an intrinsic medium, such as paper. These media, bearing the recorded

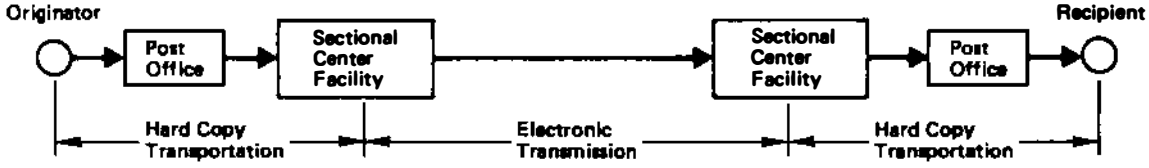
The Conventional Mail Stream

Figure 1



information, are commonly called "hard copies." Each hard copy is collected, sent to a USPS Sectional Center Facility (SCF) for sorting, transported to and sorted at additional SCF's or post offices, and delivered by a letter carrier. The number of sortings is a function of the specific origin and destination, but may be as high as seven. This model of the present mail stream may be imprecise in detail, but it serves the purpose of developing models for the various generations.

GENERATION I

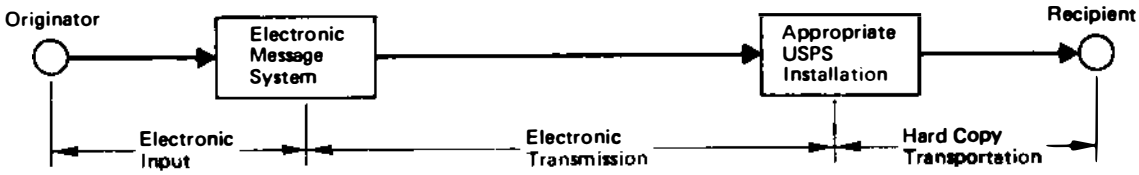


The Generation I Concept

Figure 2

Generation I (Figure 2) substitutes electronic transmission of information for a portion of the mail stream. Functionally, this is analogous to the World War II "V-mail" service, in which a letter was photographed and reduced to microfilm which was transported to an overseas location for reproduction. Today's technology enables letters or messages to be converted to electronic signals for transmission and reconversion to hard copy. The USPS has initiated development projects in this area, involving techniques of conversion by facsimile, transmission, and paper handling.

GENERATION II



The Generation II Concept

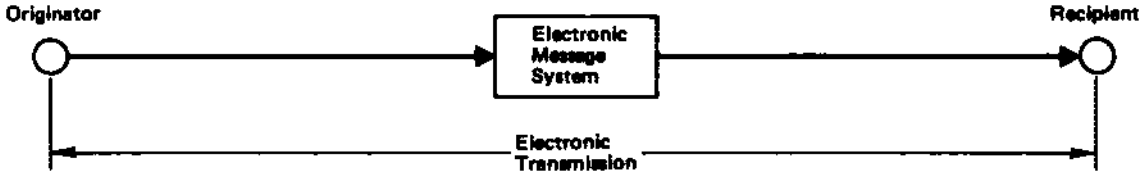
Figure 3

In Generation II (Figure 3), information enters the mail stream at a postal installation close to the recipient. Prior to the production of a hard copy at this postal installation, the information exists in electronic form, possibly with a concurrent hard copy for local record purposes. All transmission and sorting is electronic. An example of Generation II is Mailgram, developed jointly by Western Union and the USPS. Mailgrams may originate at a terminal (Telex, TRW, or InfoCom), at a computer (direct or via a Western Union office), by a toll telephone call, by acoustically-coupled terminals (facsimile, word-processors, or teletypewriters), or across-the-counter at a public telegraph office. Once entered into the system, the information is switched and transmitted electronically to a post office near the addressee, and a hard copy is produced. The hard copy is put into an envelope by USPS personnel and dropped into the conventional mail stream for delivery.

The conceptual model of Generation II suggests telecommunication services similar to Mailgram, with electronic inputs entered directly at a postal installation near the originator. It is estimated that 80 percent of all letter mail originated by government and 40 percent originated by business (about one-third of all letter mail) would yield to input in electronic form. Moreover, approximately 86 percent of the business revenues in the U.S. are generated by only 10 percent of the corporations. The panel has assumed that the volume of business mail bears some correlation with the size of the business; therefore the mail volume is probably sufficiently concentrated to make electronic inputs practical and economic. Those most likely to use electronic mail services first include banks, utilities, department stores, oil companies, insurance companies, and credit card companies. There are indications that transmission costs in the Generation II system will probably be an insignificant portion of the total eventual cost (Presentation to USPS Support Panel, Jacques Harlow, March 4, 1976).

For Generation III (Figure 4) electronic means are used to deliver the information directly to the recipient's place of business or residence, where a hard copy may or may not be produced. The panel envisions that, as Generation II service grows, addressees will receive an increasing proportion of their mail in the form of messages that have been transmitted electronically and converted to hard copy for delivery.

GENERATION III



The Generation III Concept

Figure 4

Looking beyond this, it will become feasible to replace physical delivery by electronic delivery for each individual recipient, depending upon the specific circumstances. Two main elements are required for Generation III to operate widely:

1. The development of an economical, reliable, and reasonably compact terminal for the individual user, and

2. The utilization of existing distribution networks or the development of a new distribution network.

The technology for the terminal has been described in Chapter III, where it was concluded that existing basic technology is adequate to produce a terminal, once the specific requirements, market acceptability, and economic factors are known. The panel observes that these unknowns cannot be calculated in advance, but need to be determined by experimental field trials.

LOCAL DISTRIBUTION NETWORKS

The local distribution network extends from the local postal installation or electronic concentration point to the office or residence of the recipient. There are several candidates for the local distribution networks. About 94 percent of the U.S. households have at least one telephone, and each of these local lines is used only a very small portion of the time. Even a household with one or more teenagers experiences some periods of telephone idleness. Practically 100 percent of U.S. businesses have a telephone. Businesses receiving large quantities of messages may decide to install an additional line dedicated to electronic message services.

The existing telephone system is thus an operating network already in place, capable of addressing individuals who constitute nearly the entire population of the U.S. Clearly, the addition of interfaces and conversion devices to accommodate an entirely new class of service is an engineering problem of some magnitude. While it is technically feasible, there remains the problem of accomplishing this economically and without disrupting the business and social life of the

community. It seems safe to say that the high density portions of the network are generally more flexible than the access lines; therefore, the characteristics of the terminal will exercise a strong influence on the design of the entire system. The system may be designed for multiple purposes, with the delivery of electronic messages only one of its roles. The addition of other capabilities will be reflected in the modification of the requirement parameters for both the terminals and the system as a whole.

An alternative distribution network would be one similar to the narrow-band telephone system, but consisting of wide-band transmission links. The wide-band links could be co-axial cables similar to those used by cable TV systems. In 1974, cable TV systems served about 13 percent of U.S. households (U.S. Bureau of the Census, 1975), and at present the cables pass near another 10 percent or so. The expansion of such systems to cover every household, plus their integration into a common system, would obviously be very expensive and could raise major regulatory questions. If glass-fiber optical transmission develops as predicted, the cost may be less, but still considerable.

The benefits derived from a wide-band system are primarily in the increased rate of information transmission. The availability of low-cost wide-band lines also permits the use of less expensive multiplex systems (trading off bandwidth for cost), thereby providing narrow-band circuits at a cost less than if the circuits were derived from narrow-band systems. An example is the AT&T "N" carrier system, developed at the end of World War II, which used double side-band modulation. Replacing the "K" carrier system, which used single side-band modulation, the wider-band multiplex equipment was considerably less expensive.

Because the average household has little foreseeable demand for large volume time-sensitive information, the increased capacity probably cannot justify the additional costs of wide-band compared to the existing narrow-band telephone network. A detailed economic analysis would be required to compare the two distribution alternatives in specific cases. It is probable that some high-volume business users could justify the use of wide-band local distribution, especially if transmission facilities were already available. Concepts adaptable to individual users will be different for wide-band than for narrow-band networks and might utilize time or frequency division techniques rather than circuit switching.

A COMPLETE SYSTEM

While the complete electronic message system would have elements of all three conceptual models operating at any specified time, the specific service is most likely to depend upon the circumstances and needs of the business or residential user. Circumstances and needs change. So does technology. All three elements are bound to make any electronic message system extremely dynamic. This alone is an impressive argument for the USPS managing the entire system, since Generations I and II use the USPS physical delivery system as presently constituted.

RELATIONSHIP WITH PRESENT MAIL

About 74 percent of the nation's letter mail originates in the business sector. Government originates another 6 percent. The panel estimates that as much as 30 percent of all government and business mail may be amenable to transmissions as electronic messages. Much of this mail is presently produced in computer format, especially monthly accounts, and therefore could be handled in a Generation II system.

Approximately 46 percent of the present mail is received by individuals (Presentation to USPS Support Panel, Harold P. Belcher, September 11, 1975). The average household, however, receives only around ten pieces of mail per week, of which about six are first-class pieces (USPS Market Research Division, November 1974). The panel observes that this relatively small amount makes it quite improbable that the average household will install a terminal solely for the receipt of electronic messages and thus move into Generation III anywhere in the near future. If a household terminal becomes available for other applications, the marginal cost of adding an electronic message service might be economically acceptable. The panel notes that this view of mail amenable to electronic transmission is consistent with views held by post offices in both Canada and Britain. These national post and telegraph organizations state that the portion of electronic messages generated by individuals is likely to be relatively insignificant.

CONCLUSIONS

Therefore. the panel concludes that:

1. Because several large electronic message distribution systems are already in successful operation, any USPS planning and implementation of electronic message services may benefit from the experiences gained in establishing and operating such existing systems.

2. It is not necessary and may not be desirable for the USPS to own and operate a complete message system. Subsystems could be either leased or owned, depending upon specific analyses in each case. But because of the dynamic and evolutionary nature of the configurations, the entire system will need to be managed by the USPS to be most effective.

3. Electronic message systems offer the potential of replacing as much as one-third of all of today's letter mail, which includes nearly one-half of the first-class mail. Most of the electronic messages will probably be originated by business or government entities. Electronic messages originated by private individuals will probably make up only a very small portion (less than 10 percent) of the total. Accordingly, the requirement for local physical distribution of mail will not decrease significantly in the near term.

CHAPTER V
Impacts

REGULATORY

Arguments can be made against USPS involvement in any way with electronic transmission of information. One argument rests on the definitions of "mail", "correspondence", and "letter". It holds that if the physical letter has been reduced to electronic coding for electromagnetic transmission, the resulting service may be called many things, but not mail, and, therefore, the USPS has no constitutional or congressional mandate to become involved in electronic message services. This argument was used in the 1840's and after World War I in wresting control of electronic communications from the Post Office (Scheele, 1970). The opposing argument, advocating USPS involvement in electronic message services, is based largely on the 1970 Act, which contains several provisions supporting the application of new technologies to increase the benefits the nation derives from the operation of the mail service:

- "The Postal Service shall . . . provide prompt, reliable, and efficient services to patrons . . . " 39 U.S.C. 101(a)
- ". . . the Postal Service shall give the highest consideration to the requirement for the most expeditious collection, transportation, and delivery of important letter mail." 39 U.S.C. 101(e)
- ". . . the Postal Service shall receive, transmit, and deliver . . . written and printed matter . . . and provide such other services incidental thereto as it finds appropriate to its functions and in the public interest." 39 U.S.C. 403(a)
- ". . . the Postal Service shall have the following specific powers . . . (1) to provide for the collection, handling, transportation, delivery, forwarding, returning, and holding of mail . . . " 39 U.S.C. 404(1)

- ". . . (6) to provide, establish, change, or abolish special non-postal or similar services . . . " 39 U.S.C. 404(6). The record of the legislation reveals that it was specifically contemplated that the USPS would develop "new services responsive to the evolving needs of the United States." H.R. Rep. No. 91-1104, 91st Congr., 2d Sess. 9 (1970)

- "The Postal Service shall promote modern and efficient operations and should refrain from . . . engaging in any practice . . . which restricts the use of new equipment or devices which may reduce the cost or improve the quality of postal services . . . " 39 U.S.C. 2010. See also 39 U.S.C. 101(g), 401(5), 403(b), 404(3).

- The USPS shall ". . . have all other powers incidental, necessary, or appropriate to the carrying on of its functions or the exercise of its specific powers." 39 U.S.C. 401(10)

These citations would seem to support a dual approach to the USPS authority to engage in electronic message services: (1) that this is simply a modern and efficient way to accomplish its mission; or (2) that this is a "new special and similar service" that it may institute. Significantly, the USPS can point to its present use of mechanization and electronics and its experimental facsimile mail program. There has been no outcry from the Congress, the public, or the press against the use of such technology to improve the mail service.

Perhaps a court test is needed to settle the issue definitively. Even if such a test would result in a decision supporting the USPS in the use of electronic message systems, as some Panel members believe, the courts are still likely to leave to the Congress the difficult issues of national policy and business competition raised by an electronic message service. Stated differently, the courts might well decide, pragmatically, that if the USPS is to be left in its present condition, the matter is up to the Congress, not the judiciary, in light of the broad powers that appear to have been granted in the enabling act of 1970.

This is likely to be the case for electronic message services where there is hard copy output to be delivered over the present postal routes, which is what would happen in Generations I and II. In Generation III, however, in which the message appears only in electronic form until it reaches the office or residence of the recipient, where hard copy may or may not be produced, it can be argued that there is no "mail" in the traditional sense of the word and that the USPS should not be involved.

For most countries, electronic communications happens to be a government monopoly, like the postal service. In the U.S., by contrast, it is a matter of national policy that all electronic communications, except those under military jurisdiction, are left to private

enterprise. Yet any system using the sophisticated Generation III concept would blur the historic distinction between the mail and the service rendered by the communications common carriers, like AT&T, RCA, and Western Union, to name just three. Thus, a contentious legal issue is likely to appear as to the authority of the USPS to provide Generation III services. While the panel discussed this issue, it reached no conclusions or recommendations regarding it for this report.

Notwithstanding, the panel urges the congress at the earliest opportunity, to address a matter considered important: the adoption of a policy on electronic message services that best serves the nation. It is clear that this is a matter of national policy, affecting an essential service that has been in the hands of the federal government since its founding. The Congress, therefore, will have to consider the function of the USPS, especially its record in handling the technology of Generations I and II, and the situation with regard to the private communications carriers. The panel recognizes that this is a difficult issue--one that certainly includes complicated social, economic, legal and political questions.

Related to these are other significant policy issues raised by the emergence of electronic communications as the nation's mail. The issues would arise whether the USPS were to implement the Generation III system alone or, as is more likely, the USPS were to exercise control of a message system that uses elements operated by the common carriers. In the latter event, there are concerns about the indirect regulation of the USPS by the Federal Communications Commission (FCC). Created by the Communications Act of 1934, the FCC is charged with the interstate regulation of all electronic communications, including rate structures and radiospectrum assignments. It exercises no jurisdiction over postal services. However, it regulates the carrier traffic that the USPS uses now in Mailgram and Faxgram and that which the USPS might use in electronic communications in the future. A question regarding this was addressed in a 1971 controversy over an experimental facsimile mail service and was, in effect, "finessed" by an agreement to amend the tariff to provide a specific exemption for the new USPS operation. Other uncertainties, such as the authority of the Postal Rate Commission to act in matters concerning electronic messages, are bound to appear when the distinction between postal and common carrier services grows more and more fuzzy.

If the USPS embarks upon the electronic message service, the most probable scenario would call for policy and regulatory issues to be considered on an ad hoc basis as they arise. Issues concerning the Generation III no doubt will be based on the progress the USPS makes in entering Generations I and II. If the USPS has been successful in these hybrid systems, the Congress, business and the public may be more confident of USPS involvement in Generation III. Another scenario is that the Congress, recognizing the conflict between the policies embodied in the Communications Act of 1934 and the 1970 Postal Reorganization Act, will enact clarifying legislation. In this connection, it would be useful if joint hearings of the appropriate Congressional committees were held to examine and help to resolve the inevitable problems.

SYSTEM SECURITY

Electronic message systems need to be given protection from outside detrimental influences. Security in this sense includes all measures taken to assure the operation and safety of the overall system that provides the service. Dangers or threats to the system include normal equipment failure, natural disasters and accidents, and attempts to sabotage or penetrate the system. Complete security is never technically attainable and certainly never economically feasible. Available resources will have to be applied to protect against the threats that are perceived as most dangerous. System security provides a number of benefits. Security is necessary for a reliable system and represents protection for the system's resources and reputation and its public acceptance. Security is also a prerequisite for privacy.

PRIVACY

A key element to public acceptance and confidence in the use of electronic message services is the public perception of the privacy afforded by the system. Privacy may be defined as the right of the individual or organization to control what is done with information that is collected about the individual or organization. A message sent electronically is subject to casual inspection by communications and post office operating personnel in the performance of their duties. The volume of messages and the fact that messages must be handled rapidly mitigate this type of privacy violation, but the possibility is always present, as indeed it is with conventional mail. A knowledgeable individual with access to the system could probably gain access to any specific message if its existence were known or suspected. Realizing this, the originator of electronic messages who is unwilling to risk either casual or intentional interception of his message would be well advised to utilize another service. Users of V-mail during World War II faced this same problem. It is experienced today by users of telegrams, cablegrams, Mailgrams, telex and other electronic services. Originators of a message that requires confidentiality as well as speed have to trade off one consideration or use a security code. It would probably be prohibitively expensive and operationally complicated to design a completely private system with safeguards against casual or intentional interception.

There is, therefore, an apparent need for legislation to prohibit the unauthorized use of information obtained by any type of interception (for example, see 47 U.S.C. 605, or 1968 Omnibus Crime Act, PL 93-51). The "Big Brother" aspect of electronic message services would need to receive attention if the public comes to perceive that financial transactions and personal messages could be used by the government to, for instance, detect tax evasion. If the public suspects that such message data are being intercepted, public acceptance and confidence are likely to wither and development of an electronic mail system could be slowed considerably. Thus, the issue of privacy needs to be carefully considered by policymakers, and could be dealt with during experimental field trials.

ECONOMIC

An electronic message system will not be established unless it can be operated economically. Besides cost, the reasons for using such a system include speed and convenience. Other means for rapid communications now exist, so it is not surprising that a USPS survey shows that only a small portion of first-class letter mail is, according to the recipients, time sensitive. This survey indicated that about 10 percent of the mail delivered on any given day was actually required that day. Only 1 percent of the letters arrived late and caused some inconvenience, and half of these were mailed late (Report by USPS Market Research Division, "The Household Mailstream: 1974 and 1972 Compared," November 1974). Cost, therefore, seems to be the force driving an originator to select an electronic message service over conventional mail. Convenience may also be a consideration of some magnitude, but, in general, is not the factor that drives the selection.

The cost of a message sent electronically is difficult to predict, since it is a function of the specific system used. Costs of communications and information processing equipment continue to decrease. Several communications firms now advertise "electronic mail" and claim costs competitive with the present mail service. If USPS costs increase further, these commercial firms should find it even easier to compete.

Once a significant portion of the first-class letter mail is replaced by an electronic message service, the USPS might find it possible to effect economies in the delivery of the rest of the conventional mail. Assuming that time-sensitive material would be sent electronically, the USPS would have more flexibility with respect to the frequency of deliveries of other classes of mail to businesses and residences.

USPS ORGANIZATION

The internal organization of the USPS could conceivably be affected by USPS entry into the electronic message service field. However, the panel did not presume to recommend specific organizational structures, realizing that these are functions of many factors other than those examined in the course of this study. A look at the problem indicates that approaches found effective in industry and in the military in similar situations would include the establishment of a project manager office within the USPS Headquarters.

COOPERATION WITH INDUSTRY

Mailgram is an example of cooperation between the USPS and a commercial communications enterprise. The panel recognizes that additional areas of cooperation are appropriate and suggests that the Generation II model offers many opportunities for cooperation. For instance, as an experimental field trial, the USPS could demonstrate the delivery of a utility company's bills in computer-generated format,

either by direct input to a Generation II system or by physical delivery of a tape or some other format containing the information. This would be a "start small" approach, providing valuable experience at relatively small cost. Some of the panel members observe that USPS initiatives in this area will probably receive sympathetic attention from businesses.

Definitive economic analyses will be required when specific network configurations are being considered. Preliminary general analysis indicates that transmission costs alone will be small (Presentation to USPS Support Panel, Jacques Harlow, March 4, 1976). An expanded cost analysis, to estimate the total cost per message, is more difficult, but the panel considered reasonable the estimate of ten cents per page made by the Canada Post Offfice (Canada Post presentation to USPS Support Panel, Terence Simms, December 4, 1975). Many businesses that are adversely affected by the rising cost for postal services, may welcome a service which delivers messages at this price. Attractive bonuses of an electronic message system include features such as speed, reliability, ease of multiple distribution, ease of message retrieval, and ease of record keeping.

CONCLUSION

The panel concludes that issues of regulation and legislation arising from the USPS's implementation of electronic message services of the Generation I or Generation II type can probably be dealt with under existing processes. Major difficulties are not expected. However, any USPS implementation of Generation III services will undoubtedly raise difficult and complex national policy issues concerning competition and regulation. Security and privacy implications are inherent in all three generations and need to be carefully considered.

CHAPTER VI
International Aspects

Some members of the panel who were abroad on other business in the period of this study extended their visits in order to contact postal or telecommunications officials in Belgium, Japan, the United Kingdom, and West Germany, and from the Organization for Economic Cooperation and Development (OECD) in Paris. Moreover, some panel meetings were attended by officials from the post offices of Canada and Britain. Additional material was gathered by the panelists and staff of this study.

CANADA

The Canada Postal Act, essentially unchanged since 1800, constrains the Canada Post (CP), in considering electronic mail, to a system that produces hard copy for delivery by letter carrier. This results in a proposed system that has features similar to those of the Generation I and the Generation II concepts. The CP has designed a nationwide system consisting of 26 concentration and switching centers, at a preliminary cost estimate of $75 million. Some panel members doubt that the system can be installed for that amount. The Canada Post had planned a Pilot Electronic Mail System, consisting of switching centers at Ottawa, Toronto, and Montreal, but this experimental system has been delayed because of funding limitations (Canada Post presentation to USPS Support Panel, Terence Simms, December 4, 1975 and March 11, 1976). The proposed system is expected to take at least ten years to implement. It is estimated that two-thirds of the present mail volume will continue to be handled by conventional physical distribution and that a fully electronic system (similar to Generation III) will not be needed until after 1990 (Hitech Canada Ltd. report, April 1975). In connection with the proposed system, the CP Marketing Department commissioned a survey of potential high-volume users of an electronic mail system. The respondents perceived several difficulties associated with the concept of electronic mail, including the absence of corporate logos and graphics, the inability to enclose inserts and return-addressed envelopes, and the security aspects, particularly when financial transactions are involved (Survey by Paul R. Crocker & Associates, Inc., October 1975).

UNITED KINGDOM

The British Post Office (BPO) operates both postal and telecommunications services. The BPO plans to use the telecommunications facilities to transmit mail electronically. This corresponds roughly to the Generation I concept. The BPO has made preliminary studies of advanced concepts (BPO presentation to USPS Support Panel, Frank Lawson, December 5, 1976). It has an operating Postfax system which provides facsimile service at the rate of 6 minutes per page, between 24 selected locations. A recipient may pick up his facsimile-transmitted document at the Post Office or it will be delivered for an extra charge. Among the possible reasons given by the BPO for the disappointingly low usage of Postfax is that the system was introduced with little publicity. Another reason is the relatively good service provided by the regular mail. A letter mailed prior to 6:00 p.m. is practically assured of next-day delivery to any part of the United Kingdom.

The BPO points with pride to its Giro operation, a postal banking service. Giro offers a convenient, widely available method of transferring funds and could easily lead the BPO into EFT systems (Letter from Guy Fougere to panel executive secretary, October 22, 1975). In addition, the BPO is now conducting a field test of a Viewdata system. Viewdata consists of a vision receiver (either a special Viewdata unit or unmodified domestic TV receiver with a Viewdata adapter) which connects to a data center by use of the present telephone lines. The receiver acts as a computer terminal, providing interactive services to the user (BPO report, "Evidence to the Government Enquiry into the Future of Broadcasting," December 1974). The progress of the field tests will be of interest to those involved in the development of home terminals.

BELGIUM

One official of the Belgium Post Office stated that approximately 80 percent of the nation's postal transactions involve postal savings accounts. The research and development activities of the Belgium Post Office are held to be underfunded, and the Post Office relies heavily upon support from commercial organizations. This policy apparently has been successful, since Belgium is generally considered in the forefront of innovative postal automation (Presentation to the USPS Support Panel, John S. Reed, September 11, 1975).

WEST GERMANY

In the Federal Republic of Germany, several electronic message system studies have been conducted by the Bundespost and by commercial organizations. The conclusions reached by Bundespost are significantly less optimistic than those of the commercial organizations. Like their counterparts in the United Kingdom, Bundespost planners consider that the development of an electronic message service is handicapped by the next-day delivery of conventional domestic mail. It is estimated that

about 22 percent of today's letter mail could be transmitted via an electronic message system in West Germany.

The Bundespost has conceived of a service involving both facsimile and alphanumeric transmission, with facsimile being the more expensive. Either system is thought of as Generation I. Although current mail service is good, costs are rising and volume is dropping. What's more, telegram traffic is decreasing steadily. The Bundespost also operates a Giro banking system, with business growing at 16 percent per year (Letter from Guy Fougere to panel executive secretary, November 20, 1975).

Early in 1976, a report by the Federal Ministry of Posts and Telecommunications ("Electronic Mail, Bonn, 1976) described electronic mail systems with concepts found in both Generations II and III. It concluded that electronic mail can be realized by means of the technology available today, but that terminals need to be developed further. The report noted that electronic mail will be used by private householders only if it offers lower charges or more convenience. Speed is not a major determinant since 95 percent of all letters are now delivered the following day.

One West German commercial concept was described by Standard Elektrik Lorenz AG in 1975 ("Text and Document Communication, Stuttgart, June, 1975). This concept envisions a combination of conventional letter post, electronic letter post, and an integrated communications service. The electronic letter post is functionally similar to Generation II service, and the integrated communications system is functionally similar to Generation III. Complete electronic delivery is proposed for business organizations only. Private users, the company claimed, will continue to receive mail by carrier delivery.

ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT (OECD)

Officials of the OECD are working on conceptual models of information flow within a community. They note that even in the countries where postal and telecommunications services are combined administratively, little interaction takes place at the operational and planning levels. Major deterrents to progress towards an international electronic message service are seen to include agreements for such elements as communications protocols, address formats, switching devices, and procedures for input-output storage. Although the ongoing work at OECD may not have immediate or direct bearing on electronic message service, it will probably be relevant in the future (Letter from Guy Fougere to panel executive secretary, December 16, 1975).

JAPAN

Japan is reported to be introducing an electronic message system that is similar to Generation I and consists of low cost, readily available facsimile equipment. Utilizing the existing telephone distribution system, the service will at first be utilized by the Japanese government. If successful, the service will be expanded to business

and the public (Presentation to USPS Support Panel, H. M. Watson, September 11, 1975). In addition, Japan is interested in establishing a service similar to Mailgram and has sent several managers and engineers to the U.S. to study the operation (Conversation between panel executive secretary and Mr. Tadao Tateno, First Secretary, Embassy of Japan, May 13, 1976).

TRANSMISSION AND MESSAGE SYSTEMS

In June 1976, the continental U.S. had approximately 7,000 telephone circuits in overseas operation, including about 1,300 circuits to Hawaii and Puerto Rico. Roughly 40 percent of these were by cable, 53 percent by satellite, and 7 percent by other facilities. Cable circuits provide channel bandwidths from 200 to 2700 cycles, while satellite circuits cover the range of 300 to 3400 cycles. The INTELSAT system, of which the U.S. is a member, serves 80 countries and territories via some 8,000 two-way telephone circuits, over 500 paths.

In addition to conventional telephone circuits carrying digital data at speeds of up to 9.6 kbps, INTELSAT can furnish 50 kbps, or 1.5 mbps digital data circuits. Tests have shown that digital rates up to 60 mbps can be transmitted over each of the repeaters of the presently used Intelsat IV (12 repeaters) or Intelsat IV-A (20 repeaters) series of satellites. Field trials are being organized for TDMA (time division multiple access) transmissions among a number of countries in the Atlantic region, and this equipment will work at 60 mbps. Plans are being discussed to initiate the Intelsat V series of satellites, each of which will have 12,500 two-way telephone circuits and will incorporate frequency re-use by means of multiple beams, dual polarization, and operation in the 11/14 GHz band. Still higher capacity satellites are under consideration, including operation with digital bit rates of 120 mbps.

During the second half of 1976, the latest transatlantic cable (TAT-6), with 4,000 telephone circuits, was put into service. In addition, a cable with about four times more capacity is being worked on (Letter from Sidney Metzger to panel executive secretary, June 8, 1976). Based on what is known of EMS and its international transmission needs, it appears that these can readily be accommodated by the present and future transoceanic systems.

Worldfax is a high-speed facsimile system, capable of transmitting a page in less than a minute, planned to operate between New York, London, Brussels, and Tokyo. The New York World Trade Center has selected a commercial communications company as the operator of the system, but is encountering some delay in negotiations for operations at the locations overseas. Initial operation is expected by the Fall of 1976. Market surveys suggest that the service, costing about $5.00 per page, will be a success. Facsimile was selected to preclude formating difficulties and to allow the continued use of current forms (Presentation to USPS Support Panel, Joseph Milano, March 11, 1976).

Several communications companies presently offer international service. A recent development is the adoption of a standard protocol for interfacing host computers and data terminals with any

packet-switched network. This protocol, already adopted by carriers in the U.S., Canada, France, and the United Kingdom, is expected to be approved by the International Telegraph and Telephone Consultative Committee (CCITT) in October 1976. This protocol, providing virtual circuit channels between subscribers, promises increased availability and flexibility for both domestic and international traffic (Hovey, Data Communications, May/June 1976).

CONCLUSIONS

The panel concludes that:

1. Several other countries, including Canada, the United Kingdom, West Germany, and Japan, are proceeding in varying degrees along lines generally consistent with the conclusion of this panel that present mail processing can be significantly supplemented or replaced by electronic message services.

2. Present and planned international telecommunications systems are capable of accommodating all foreseen requirements for electronic message transmission.

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Shamburger, Page. (1964) Tracks Across the Sky: The Story of the Pioneers of the U. S. Air Mail. Philadelphia and New York: J. B. Lippincott & Co.

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Glossary

The following definitions were used by the panel during the deliberations which led to this report. The Roman numeral in parantheses refers to the source listed on page 50.

HARD COPY

A tangible, printed copy of a message, such as that obtained from a teletypewriter. (I)

MESSAGE

A communication in writing, in speech, or by signals. (II)

An ordered selection of an agreed set of symbols for the purpose of communicating information. (III)

An arbitrary amount of information whose beginning and end are defined or implied. (IV)

MESSAGE DELIVERY SYSTEM

A system which accepts messages from an originator and delivers these messages to the recipient or recipients. (V)

ELECTRONIC MESSAGE DISTRIBUTION SYSTEM

A system which distributes messages from an originator to one or more recipients, utilizing transmission of electrical signals in lieu of physical transportation of a recording medium, in one or more segments of the system. (V)

LOCAL ELECTRONIC MESSAGE DISTRIBUTION SYSTEM

A message system in which the originator and the recipient of a message are physically situated within an analytically-positioned circle of 150-mile diameter. (V)

SYSTEM

An integrated whole even though composed of diverse, interacting, specialized structures and subjunctions. Notes: (1) Any system has a number of objectives and the weights placed on them may differ widely from system to system. (2) A system performs a function not possible with any of the individual parts. Complexity of the combination is implied. (IV)

SYSTEMS ENGINEERING

(1) A method of engineering analysis whereby all the elements in a system, including the process itself, are considered. (III)

(2) "When we mean to build
We first survey the plot, then draw the model; And when we
see the figure of the house,
Then must we rate the cost of the erection."

Shakespeare, "King Henry IV", Part 2, Act 1, Scene 3, Line 4.

(3) ...An integrated approach to the synthesis of entire systems designed to perform various tasks in, what is expected to be, the most efficient possible manner.

...An approach which views an entire system of components as an entity rather than simply as an assembly of individual parts; i.e., a system in which each component is designed to fit properly with the other components rather than to function by itself. (VI)

SOURCES

(I) Emerson C. Smith, "Glossary of Communications", Telephony Publishing Corp., Chicago. Ill.

(II) Webster's New Collegiate Dictionary. G. & C. Merriam Co., Springfield, Massachusetts, 1974.

(III) Radio Shack Dictionary of Electronics, Howard W. Sams & Co., Inc., Indianapolis, Indiana, 1974.

(IV) IEEE Standard Dictionary of Electrical and Electronics Terms, John Wiley & Sons, New York, 1972.

(V) USPS Support Panel, Washington, D.C., 1975-76.

(VI) Dommasch, D. O., and C. W. Laudeman, "Principles Underlying System Engineering", Pitman Publishing Corp., New York, 1962.

Working Papers

As part of the panel deliberations, individuals produced several working papers pertaining to various aspects and implications of electronic message services. The papers listed below constitute a set of selected working papers which address in greater detail some of the subject matter dealt with in the report. These sets are available, in limited quantity, from the Committee on Telecommunications, National Research Council.

Reference	Title	Author
PSP-11	BUSINESS PLANNING	Elmendorf
PSP-14	SOCIAL AND ECONOMIC DEVELOPMENTS AFFECTING EMS	Nashman
PSP-17	CONSIDERATION OF SATELLITE COMMUNICATIONS IN THE 50 TO 150-MILE RANGE FOR THE PERIOD 1985-1990	Metzger
PSP-19	REGULATORY IMPLICATIONS	Geller
PSP-29	THE SYSTEM APPROACH IMPERATIVE	Nashman
PSP-31	THE POST OFFICE: BUSINESS OPPORTUNITIES AND TECHNOLOGY FOR THE 1980's	Watson
PSP-33	COOPERATION OR COMPETITION WITH BUSINESS	Strassburg
PSP-39	INDUSTRY - POST OFFICE COOPERATION IN THE EMS AREA	Geller
PSP-40	GENERATION III EMS SYSTEMS	Nashman
PSP-41	TERMINALS IN THE 1986-1990 ERA	Fougere
PSP-45	ELECTRONIC MAIL - LARGE VOLUME ORIGINATION BY BUSINESS AND GOVERNMENT	Harlow