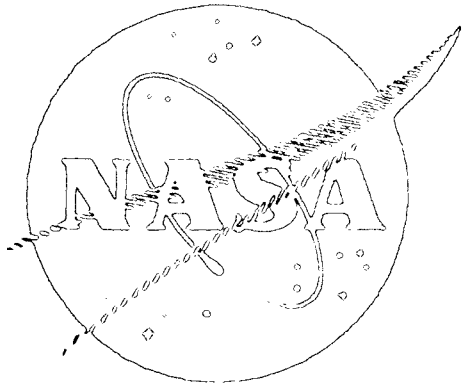
THE NASA ROLE IN MAJOR AREAS OF HUMAN CONCERN

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COMMUNICATION



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THE NASA ROLE

IN MAJOR AREAS OF HUMAN CONCERN:

COMMUNICATION

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PREFACE

Understanding the social significance of America's civilian aeronautics and space effort has become increasingly difficult during the past five years. Whereas the missions of the National Aeronautics and Space Administration once figured prominently in discussions of public issues, increased interest in other national priorities has come to compete with, and often to dominate, concern about those missions. The study which generated this presentation was undertaken to facilitate more thoughtful discussion of NASA's activities by exploring how the achievement of mission objectives has contributed to beneficial changes occurring in six areas of major national interest: communication, transportation, environmental quality, safety, health care and work.

This statement focuses attention on the area of communication. After introducing some of the general factors that have affected progress in this area, NASA program elements are examined to illustrate relevant points of contact. Interpretive steps are taken throughout the statement to show a few of the more important ways people's lives have been affected as a result of the work of NASA and other organizations functioning in this area. The principal documents used and interviews conducted are identified after the conclusion of this statement.

This statement, it should be noted, is incomplete in many respects, primarily because it reflects only a small number of the technical, economic, and social forces affecting American life. Taken as a summary statement, however, it hopefully will provide a useful basis for better understanding NASA's role in the national attempt to develop better communication links among people.

COMMUNICATION: DEVELOPING BETTER LINKS AMONG PEOPLE

In 1940, there were no transistors, no electronic computers, no trans-oceanic telephone cables, no microwave radio relays, and no communication satellites. Even television, now such an integral part of life in most industrialized societies, had not yet reached America's commercial market.[1] Over the last quarter century, however, these technological innovations have been developed and have come to play an indispensable role in much of the world's social and economic activity.

Major telecommunications innovations have occurred in the past quarter century.

Electronic communication networks were born soon after the invention of the telephone in 1876. Today, some 250 million telephone sets operate in a worldwide network which includes ocean cables and communication satellites.[2] Radio and television broadcasting networks provide educational, health, and entertainment services through a billion radio and television sets. And, with the burgeoning application of computers in an ever-widening range of local, national, and international networks, human communication is changing in profound and beneficial ways.

Global communication networks rely on those innovations to provide needed services.

New communication technologies bred out of America's civilian aerospace program have contributed directly and substantially to many advances in human communication. Through a unique series of technical accomplishments involving satellites and computers, NASA and the aerospace community have helped open new horizons in the exchange and use of information in such important areas as international relations, medicine, education, and weather forecasting.

NASA-developed technologies now are used to help provide global communication.

Satellite Communication Networks

Words like Echo, Courier, Telstar, Relay, Syncom, Anik, Early Bird, Intelsat, and ATS are not familiar ones for most Americans, but the phrase "communication satellite" is one that almost every adult would recognize. Millions of Americans watched the television coverage of the Olympic Games in Munich, Germany and Soporo, Japan. Similarly, communication satellites made it possible for people everywhere to witness Neil Armstrong's historic walk on the moon, the events following the deaths of John Kennedy and Martin Luther King, and President Nixon's diplomatic visits to China and Russia.[3]

Communication satellites provide instantaneous television and telephone contacts almost anywhere in the world.

More overseas communications are now going by satellite than by any other mode of transmission.[4] As a result of the operation of new and improved satellite networks, greater dialogue over international problems has occurred, providing new avenues for understanding and peace among nations. The United States has developed cooperative space communication programs with France, Canada, the United Kingdom, Germany, India and Italy. In addition, two North Atlantic Treaty Organization (NATO) satellites have been launched by the U. S. to provide a means of facilitating political consultation and crisis management among member nations.

Satellite networks contribute to greater international cooperation.

Communication satellites have been used to improve the international exchange of educational information among doctors, students, and teachers. On March 13, 1970, for example, during the 18th International Congress for Post-Graduate Medical Instruction, the astronauts' physician, Dr. Charles Berry and other American doctors from Houston, and San Antonio, Texas, discussed certain aspects of space medicine with some 30,000 doctors in Switzerland, Germany, and Austria via communication satellite.[5]

Educational use of communication satellites has proven quite successful.

Growth in the use of satellites for international communications is related directly to the successful launching and orbiting by NASA of eight generations of satellites. Six of those generations of satellites have been experimental government programs: Echo (1960), Courier (1960), Telstar (1962), Relay (1962), Syncom (1963), and ATS-1 (1966). The two other generations of satellites have been primarily commercial ventures: Intelsat 1-IV (1965 to present) and Anik-1 (1972).[6]

Eight generations of communication satellites have been launched.

Commercial use of communication satellites had it genesis in the Communications Satellite Act of 1962 which authorized the establishment of the Communications Satellite Corporation (COMSAT). COMSAT was given three general objectives: (1) to establish in conjunction with other countries, a worldwide communications network; (2) to improve and broaden communications between countries of the world; and (3) to contribute to world peace and understanding. By mid-1964, COMSAT was financially solvent: half of the financing came from stock purchases by the general public, and the remainder was derived from communications carrier companies.[7]

Commercial interest in communication satellites mushroomed in the early sixties.

With the establishment of the International Telecommunications Satellite (INTELSAT) Consortium in August 1964, the development of a global operational network came one step closer to reality. In the intervening years, INTELSAT has grown from the original 14 to 83 member nations, including the People's Republic of China. The system is being used for telephone traffic, telex, telegraph, and international television. The largest

users of the system are the United States, the United Kingdom, Japan, France, Canada, Germany, Australia, Italy, Spain, Brazil, Argentina, and the Philippines, in that order.[8]

Important as television via satellite has become, however, it represents only a small percentage of all the communications that are occurring via satellite. Telephone traffic among countries accounts for approximately three-fourths of all commercial communication satellite activity; the remaining one-fourth is divided among television, radio, telex, telegraph, and data and facsimile transmissions.[9] The most recent Intelsat IV, launched by NASA in June 1972, can handle from 5,000 to 6,000 two-way telephone conversations under average conditions.[10] The availability of these new telephone links is particularly significant to American-owned multinational corporations which have become an increasingly important factor in the country's balance-of-payments struggle. The emergence of such corporations has been associated directly with expanded jet air travel and international telecommunications service. Communication satellites have helped stimulate their tremendous growth by making trans-oceanic communications less expensive.[11] During the past three years, the cost of a three-minute New York-to-London has dropped from $9.00 to $5.40 in the daytime.[12]

INTELSAT provides 83 nations with high quality communications not previously available.

The primary use of communication satellites to date has been in connection with the development of networks for commercial telecommunications among different nations. It is only within the last five years that serious attention has been given to the use of satellite technology for other purposes, such as health care and education. By means of NASA's Applications Technology Satellite (ATS-1), for example, emergency health services are being brought to areas where few or none existed previously.[13] In Alaska, paramedics and other health care personnel in remote villages recently began using ATS-1 to confer with physicians in larger Alaskan cities regarding emergency medical treatment.[14] This experimental program has been credited with helping save the lives of a young girl suffering acute appendicitis and a middle-aged man injured in a snowmobile accident. Since 1970, 26 Alaskan villages have been linked via satellite networks to schools and hospitals in Fairbanks, Anchorage, and other Alaskan communities.[15]

Experimental satellites provide remote regions with communication services.

Beginning in January 1973, Canadians living in the remote areas of the Yukon, the Northwest territories, and the wilderness north of the arctic circle came into closer contact with southern cities near the U. S. border. Anik-1, a satellite launched for Telesat Canada by NASA last November, provides dependable and up-to-the-minute radio, television, and telephone service to hundreds of small communities that previously depended on shortwave radio service. Besides providing a means of improving emergency news and health services, Canada hopes that this new domestic satellite communications network will pave the way for further land settlement and resource development.[16]

Canada's Anik-1 has substantially improved communication with outlying communities.

In 1974, another experimental broadcast satellite, ATS-F, will lift off from Cape Kennedy. One of its missions will be to provide a telecomunnication link for a series of educational experiments to be conducted to the United States, India and Brazil.[17] In this country, the satellite will relay in-service instructional information to teachers and students in areas such as the Rocky Mountain States and Alaska. Subsequently, the satellite will be used to beam Indian-originated instructional television programs to persons in an estimated 5,000 villages in India to contribute to state family planning goals to improve agricultural practices and to contribute to national integration. Similar experimental uses are under consideration in Brazil, where officials are hoping to reach some 30 million people via ATS-F.

ATS-F will relay instructional information to the U. S., India and Brazil.

As new applications of communication satellites are developed, national and international information exchange will continue its course of evolution and expansion. Considering just the applications that already exist in the areas of defense, health, education, safety, and home entertainment, however, satellite technology has become a significant force for beneficial change.

Computer-Based Information Services

Americans and others in much of the rest of the world are generating more information and more paper with each passing year. The magnitude of the paper storm alone can be seen from a few isolated examples. As recently as six years ago, federal offices maintained files for more than 165,000,000 social security recipients, 160,000,000 fingerprints, and 93,000,000,000 tax returns; approximately 15,000,000,000 checks pass through the nation's banks each year, with each check being handled from 5 to 7 times; approximately 30,000 technical journals published more than 2,000,000 articles per year throughout the world in over 50 languages; the federal government produced 25 billion pieces of paper per year at a cost of about $4 billion annually; and some magazine publishers had combined mailing lists of up to 40,000,000 subscribers.[18] These files of information either didn't exist or were significantly smaller twenty years ago. Without question, processing information in these and thousands of other areas has required the use of new tools and techniques as well as the restructuring of organizations.

An avalanche of data and records has forced the development of new information processsing tools and techniques.

Given increasing quantities of information, the constant demand for accuracy, and the general need to increase productivity, there has been a steady development of techniques for the mechanization and automation of information processing, storage and retrieval activities. In a matter of just two decades, people in governmental, commercial and academic institutions have moved from a point where they didn't use computers at all

Computers are among the most powerful tools currently used.

to one where many areas of human activity are supported by computers.[19] Banks, for instance, are linked together or otherwise operated via computers; so, too, are hotels, airlines, telephone companies, television and radio services, and stock exchanges. According to the American Federation of Information Processing Societies, there were only 10 or 15 computers at work in the U. S. in 1950; by 1972, there were approximately 88,000. By 1975, investment in computers will total more than $33 billion.[20]

Growth in the use of computerized information services has been fed by technological advances that have made computer-based information services better and cheaper each year. Ways have been found to substantially increase the speed of large control processors; dramatic improvements have computers; and a greater diversity in applications has been found ranging from simple clerical operations to assistance in major management decisions. Fundamentally, the use of computers in an ever-widening series of information systems is helping people perform a variety of tasks better while relieving them of much boring, routine human activity.

Once remote from daily routine, computers now affect almost everyone's lives.

By its very nature, NASA has been a catalyst in the integration of computers into interactive communication systems. Computers of great capacity and speed have been developed to monitor space missions in real-time, to perform pre-launch checkout functions automatically, to simulate aircraft and spacecraft operations, to manage inventories, to control document collections, to compute the direction and velocity of planetary movements, and to model global weather patterns.

Computers have played a crucial role in NASA mission accomplishments.

The variety of special aerospace jobs performed by computers in the past decade of space has grown richer each year. In Project Mercury, ground-based computers were used solely to determine booster cut-off conditions. In Apollo, by contrast, computers continuously calculated the flight path to the moon and back; provided essential information on the best lunar descent approach; recorded and analyzed thousands of bits of information from the spacecraft to detect any signs of trouble; and, at the same time, monitored the well-being of the crew.

Once the computing equipment and necessary programs were developed to meet these and other NASA requirements, both Agency personnel and computer contractors sought ways of using the systems to help solve information handling problems in socially important problem areas such as transportation, health, education, energy and law enforcement. The experience of just a few aerospace computer contractors illustrate the rich variety of ways these transfers have occurred.

Many nonaerospace uses of computer technology developed for NASA have been found.

One contractor, Sanders Associates of Nashua, New Hampshire, successfully developed the Saturn V Operational Display System for the large-

scale RCA 110A digital computers used in seven installations at Kennedy Spacecraft Center and Marshall Space Flight Center. Twenty-eight of these systems have since been delivered to government agencies and commercial firms, both domestic and foreign. Under the name CLINI-CALL, the Sanders system has been of special usefulness in the medical community where it automatically stores, retrieves, and verifies patient data; in addition, it provides management information on legal matters, statistical summaries, inventories of supplies. The Mayo Clinic installed a CLINI-CALL system in 1971 to manage admissions and accounting data; the system enabled the Clinic to bring a seven-year backlog of these records up-to-date in 30 days. Kaiser Memorial Hospital in San Francisco and Walter Reed Hospital in the District of Columbia also have installed the system.[21]

The Saturn V Operational Display System is used in 28 nonaerospace organizations.

Persons working in such areas as education, defense, atomic energy and transportation have become increasingly involved in attempts to develop communication networks that streamline the processes of acquiring, storing and disseminating documentary information. Numerous procedures and services based on current technological developments are being used to link together dozens, and in some instances, hundreds of geographically dispersed institutions in ways that handle the escalating volume and diversity of materials without a corresponding escalation in cost. According to information scientist Dr. Roger Summit of the Lockheed Palo Alto Research Laboratory, NASA created the first major market for a Lockheed-developed computerized information system called DIALOG. Under contract, Lockheed modified DIALOG to NASA requirements to produce the NASA/RECON ("remote console") system. This system quickly and easily enables aerospace engineers and scientists to identify potentially useful information in a collection of approximately one million documents. Following NASA's successful large-scale use of this interactive communication retrieval system, various versions of NASA/RECON and Lockheed's DIALOG have been adapted for use by other government agencies, including the National Library of Medicine, the Defense Communication Agency, the Federal Mediation and Conciliation Service, the Department of Justice, and the Department of Health, Education and Welfare.[22]

The approach used by NASA to handle its scientific and technical literature has since become a model used in information systems operated by many nonaerospace government agencies.

Power and water needs in the United States are increasing at phenomenal rates. As a result, requirements for efficient and automatic energy control, transmission, distribution, and monitoring are becoming critical. Recent power black-outs and brown-outs in the northeastern part of the country underline this point. Characteristic of computerized information networks under development to meet those needs are the efforts of North American Rockwell's Information Systems Company (NARISCO). NARISCO was formed in 1969 as an offshoot of North American Rockwell's Space and Information Systems Division. Since its formation, NARISCO has designed and integrated the

The electric power industry employs computerized information networks developed by aerospace contractors.

complete computer monitoring and control system for the Philadelphia Electric Company's electricity distribution grid; developed a master plan for water quality control in the San Francisco Bay-Delta region; and provided management and engineering consulting services for the Ontario Hydro's Richview System Control Center.[23]

Another area of need, and one that is a current focus of computer network development efforts, is that of improved communication among law enforcement agencies. General Electric, which developed computer information systems technology for classified projects and the Apollo Program, has worked closely with the U. S. Department of Justice to develop the National Criminal Justice Reference Service. This service provides law enforcement officials in all 50 states with a controlled information reference source on such matters as wanted criminals, drug abuse, and hijacking. In addition to criminal records, the reference services include publications, books, tape libraries, and other documentation materials from thousands of government and private sources.[24]

The new National Criminal Justice Reference Service was developed partly by an aerospace information contractor.

Critically ill heart patients already are benefitting from the need to keep check on the effects of space travel on an astronaut's heart activity and blood flow. Scientists at NASA's Ames Research Center and Stanford University Medical Center in California, as well as at the Lewis Research Center in Ohio have developed a computer technique designed to aid in diagnosing heart disease.[25] By means of a computer, X-ray movies of a patient's heart chamber are developed, permitting the heart to be studied as it beats, and making it possible to identify dead spots in the heart wall, stretched heart muscles, and other malfunctions. The new technique is being used in twelve American hospitals. In a related development, doctors at Cleveland's St. Vincent Charity Hospital are using a small, inexpensive computer developed at Lewis Research Center to monitor continuously all changes in the blood pressure and cardiac output of heart patients.

Some of the most important operational problems associated with computers revolve around the development and use of programs, or "software," describing what calculations are to be performed. To the extent that previously developed programs can be reused, with or without modification, the cost of computer operations can be reduced. The Computer Software Management Center (COSMIC), located at the University of Georgia, was established by NASA to offer computer users the many programs developed for the Agency's needs. In serving as a central clearinghouse for computer programs and related documentation developed by NASA and its contractors, COSMIC maintains an inventory of items that are potentially valuable in a wide range of commercial and educational settings.[26]

NASA-developed computer programs are available at minimal cost.

COSMIC has established a firm base of support in the industrial, educational, and business communities with more than 20,000 items disseminated to date. Since program development costs originally were borne by NASA, software packages can be acquired for the cost of

reproduction and distribution. The Department of Defense (DOD) recently joined NASA in this effort by agreeing to make available to the public, through COSMIC, certain programs developed originally for DOD requirements.

In briefly tracing these NASA contributions to the development and use of computer systems, it is important to recognize that the specific contributions cited represent only a small portion of those that have occurred. Furthermore, their long-term value lies not so much in the fact that widely scattered individuals have benefitted from their use; rather, it is that those contributions have interacted with innovations occurring in other fields and disciplines to produce a major revolution in the alternatives available for dealing with society's growing information needs.

Developing International Communication Links

That genuine improvements in the quality of human communication have occurred in the past decade is immediately obvious to anyone who understands the beneficial changes that stem from the use of communication satellites and computer-based information services. Untreated here, however, has been the fact that many human communication activities have benefitted from other NASA programs which, on the surface, have nothing to do with communication technology.

Other NASA programs have fostered better human communications.

By creating information bases in socially important problem areas, the Agency has made it possible for new communication networks to form and flourish for the welfare of mankind. The recently inaugurated Earth Resources Technology Satellite program illustrates this point. Thousands of managers, scientists and engineers from federal, state, and local governments, private companies, and some 40 foreign countries from an informal network, international in scale, that is now studying, processing and using information generated in this earth observation program. Since NASA's successful launching of ERTS-1 last July, the satellite has acquired imagery data useful in inventorying the earth's vegetation and forests; measuring the condition of the soil and its ability to store water; cataloging surface rocks and mineral formations; charting currents and other phenomena in the oceans; establishing the sources and spread of certain pollutants; and improving the mapping of the earth.

The Earth Resources Technology Satellite Program links together thousands of people throughout the world.

NASA's Meteorological Satellite Program also illustrates the fact that the very establishment of specific missions can trigger a whole new range of beneficial communication activities. The Agency successfully launched the first satellite devoted exclusively to meteorology on April 1, 1960. This early success marked the beginning of what has become an international cooperative effort, involving over 50 countries, to develop and use satellites in weather forecasting.

Similarly, NASA's Meteorological Satellite Program embodies an international cooperative effort.

By using satellites and high-speed computers, meteorologists now can forecast up to 72 hours into the future and can cover the entire globe, compared to 24-hour predictions for a portion of the Northern Hemisphere in 1955.

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