EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF TELECOMMUNICATIONS MANAGEMENT
WASHINGTON, D.C. 20504

October 31, 1969

Memorandum for Dr. Tom Moore, CEA:

The attached papers are suggested inputs to the Economic Committee Report, per our discussions of October 29, 1969.

Tom.
Tom Olsson

cc: Dr. Whitehead
Dr. Drew

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OFFICE OF TELECOMMUNICATIONS MANAGEMENT
WASHINGTON, D.C. 20504

DRAFT/OLSSON - 10/30/69

Report of the Economic Committee on Domestic Satellites

INTRODUCTION

The United States has the most comprehensive economical and flexible system of telecommunications in the world. This highly developed and valuable resource provides a wide diversity of telephone, telegraph, TELEX, television, radio, facsimile and data exchange services for the nation's private, public and government users. These services are provided through an intricate complex of private and government-owned facilities and systems including: (a) radio and televisinn broadcast stations and receiving sets; (b) an integrated public switched telephone network including common carrier transmission systems (wire, cable and radio); (c) fixed radio network; and (d) mobile radio network (vehicular, aeronautical and maritime). This enormous infrastructure of systems network and institutions is worth an aggregate of over 50 billion dollars and includes more than 110,000,000 telephones, 6700 broadcast stations, several million mobile radio transmitters, 200 million miles of voice equivalent circuits interconnecting virtually every town and city and _____ central offices and toll switching centers in the public telephone network.[1/]

1/ See statistical section of FCC Annual Report to the Congress for representative data on the scope of domestic telecommunications.

The feasibility of long-distance communications via communications satellite in geostationary orbit has been demonstrated and, in fact, such capability is now utilized on an operational basis throughout the facilities of the International Telecommunications Satellite Consortium (INTELSAT).

The potential for providing domestic telecommunications services by the means of satellite communications technology has been under active consideration by many private and government organizations for several years; however, uncertainty exists as to the proper role for an economic viability for satellite communications in domestic applications. This new technology --- the product of great expenditures by the American taxpayer -- could be utilized as an integral part, an extension of, or independently of the existing enormous domestic telecommunications complex.

The Economic Committee is charged with examining those factors having economic relevance in the introduction of satellite communications into the domestic telecommunications environment. The Committee, limited its consideration to the near-term time frame using current state-of-the-art and allocated frequency bands (4 and 6 GHz) available for commercial communications satellites. In this examination, the Committee addressed, in part, the following important policy questions:

-- How should this new technology be organized, utilized and regulated to make the maximum contribution to the total telecommunications resources available to the American people?

-- What are the logical roles for satellite communications which can and should be established on a fully independent basis?

-- Is there an economically viable role for domestic satellite communications independent of the existing common carrier structure?

Report of the

Economic Committee on Domestic Satellites

Add to page 8 before Costs

Government as User of Commercial Telecommunications Services

The United States Government is dependent upon a very wide range of modern telecommunications services in conducting its functions. Within the coterminous 48 states the Government has followed the policy of obtaining commercial services from common carriers to meet its traffic needs wherever possible and only establishing Government-owned facilities to meet special requirements. (See BOB Circular A-76, August 31, 1967, entitled Policies for Acquiring Commercial or Industrial Products and Services for Government Use). Hence, the Government is today by far the largest single customer of common carrier telecommunications services both domestic and international.

Every department and agency of the Government must have ready access to a range of telecommunication services in carrying out its missions assigned by the Congress and the President. Agency operations are supported in varying degrees by telecommunications networks and services. These include networks for national defense, radionavigation, air traffic control, intelligence, weather reporting, law enforcement, agriculture, medical, research and development, recreational education and many others. The networks of the Department of Defense to support the numerous national security functions comprise the bulk of the separate networks. The principal domestic defense networks include the Defense Communications System, Automatic Voice Network (AUTOVON), Automatic

Data Network (AUTODIN) and special-purpose networks. The most important civil Government long-haul networks are those operated by the Department of State, the Department of Transportation/Federal Aviation Administration (FAA), National Aeronautics and Space Administration (NASA), and the Federal Telecommunications System (FTS) within the General Services Administration (GSA). Practically all of the plant comprising these networks is provided by AT&T, the independent telephone companies and WU. A more comprehensive treatment of these Government networks is covered in Tab A.

The scope of the annual leasing of telecommunications facilities and services by the Government can be seen in the following table listing AT&T revenues.

AT&T Revenues From Government

Leased Telecommunications Services

	Government			
	Non-Mil	Mil	Total (1)	Total AT&T Operating Revenues (2)
1950	$14 M	$22 M	$36 M	$3,262 M
1955	23 M	50 M	73 M	5,297 M
1960	46 M	150 M	196 M	7,920 M
1965	120 M	196 M	316 M	11,062 M
1968	155 M	225 M	380 M	14,100 M

(1) Total Domestic and International. The INTERNATIONAL AMOUNT is small e.g. less than $5 M - 1968

(2) Excludes Bell Associated (Southern New England and Cincinnati and Suburban Companies).

The potential market for domestic satellite communications must include the Government departments and agencies. The most probable candidate for leased private line telecommunications services include:

(a) wideband collection and distribution (video, high-speed data and computer to computer real time); (b) alternate routing of point to point telephone, dataphone and telegraph; (c) possible new applications for the Post Office Department, the Department of Transportation and the Department of Defense.

The availability of another means of radio communication by satellite technology offers the Government departments and agencies the opportunity to further enhance their networks existing and planned. Such enhancement could include increased versatility, flexibility, diversity and quick reaction capability brought about by the addition of satellite communications in the domestic privately-owned telecommunications complex. A domestic satellite communication network interconnected and integrated, where appropriate, with the terrestrial public telecommunications system and capable of simultaneous coverage of all fifty states and Puerto Rico would add to the capability and emergency restoration potential of the facilities and services leased by the departments and agencies of the Government. To realize these potential benefits in light of the existing uncertainties it seems prudent to proceed with an orderly initial program of domestic satellite communications.

The importance of new and modern telecommunications facilities and services provided by private industry to the Department of Defense was highlighted by the Department in a statement attached to the President's Communications Policy Board Report of March 1951 as follows:

"1. General. The nerve system of National Defense is the sum total of all communications systems that are available, operationally and potentially, for the prosecution of any emergency or war effort. The operational existence of nation-wide systems of rapid voice and record communications in peacetime is indispensable from the standpoint of meeting the wartime requirements of both the Military Services and the civil economy. As the intensity and complexity of warfare continues to increase, correspondingly greater demands will be placed on the communications systems of the nation from the standpoint of both circuit capacity and flexibility of operation. It is, therefore, considered in the vital interest of National Defense that there be maintained within the United States to meet that need, as many nation-wide commercial communications systems as are economically feasible." 1/

The above statement is applicable national policy as reflected in the President's Memorandum establishing the National Communications System (NCS). 2/ If a new commercial satellite communications system is to contribute to enhanced capability of the NCS, it will be necessary that provisions be made to assure interconnection, interoperation and integration, where appropriate, with the terrestrial domestic telecommunications complex.

1/ A Report by the President's Communications Policy Board, "Telecommunications: A Program for Progress," Statement by the Department of Defense of Military Dependence on the Domestic (Commercial) Communications Facilities of the United States. Wash., D. C. March 1951, pg. 227.

2/ White House Memorandum, August 21, 1963 Subject: Establishment of the National Communications System, 28 Federal Register 9413.

TAB A

Background on

Domestic Telecommunications

Extract taken

from

Industrial College of the Armed Forces

Blue Book

"Utilities: Electric Power, Natural Gas and Telecommunications"

1966

PART THREE
TELECOMMUNICATIONS

IX

TELECOMMUNICATIONS IN PEACE AND WAR

The term "telecommunications" refers to any transmission, emission, or reception of signs, signals, writing, images, and sounds or intelligence of any nature by wire, radio, visual or other electromagnetic systems. The communications may be on a point-to-point basis, that is, from one particular geographical location directly to another; for instance, ship-to-shore, or they may be transmissions intended for reception by the general public such as those broadcast by standard broadcast and television stations. All the facilities which make possible rapid communications utilize electrical impulses in some form in conveying information of all sorts throughout the country and to other nations of the world.

Since the dawn of civilization man has directed his imagination and inventive powers to the development of rapid communication between distant places. History is replete with examples of efforts to speed the sending and receipt of messages—through use of relay runners and riders, drums, fire and smoke signals, hide megaphones, flags, pigeons, semaphore systems, and other devices. Yet, until the last century communications remained highly uncertain and very slow. For lack of speedy communications, it will be recalled, Andrew Jackson fought the British at New Orleans on 8 January 1815—15 days after peace had been reached in the War of 1812.

It remained for the development of electricity and electronics in the 19th and 20th centuries, and especially in the past three decades, to achieve almost instantaneous communication of messages on a nationwide and worldwide scale. The wire telephone and telegraph, the submarine cable, radio telegraphy and telephony, and over-the-horizon microwave radio transmission—all these represent milestones on the highway of communication and may be but the forerunners of spectacular developments still to come. Communication through space satellites has already been accomplished, and within this decade they can be expected to play an increasingly important role in extending and improving global communications.

Whatever the medium used, the relay of messages and conversations by electrical energy permeates every facet of modern-day living and is basic to the Nation's prosperity, welfare, and security. Telecommunications aid in the growth of trade, in the production effort of the Nation, and in the enhancement of its influence in world affairs. The use of telecommunications for the health, safety, and enlightenment of the individuals fosters the national welfare. Telecommunications are part of the resources which the Nation uses to safeguard its security against harmful influences, internal or external, and to combat hostile armed forces. Taken as a whole, telecommunications have relationships to the total national interest. There is accordingly a major public interest in ensuring the adequacy and efficiency of telecommunications services.

American imagination and ingenuity have made this country the world leader in telecommunications services, equipment, and operating techniques. The United States, almost alone among the nations of the world, relies on privately owned companies to play the principal role in the country's telecommunications system. Private communications enterprises provide in peacetime for the installation, maintenance, improvement, and expansion of vast communication networks, and for the research and factories which supply them with up-to-date equipment. The communications industry is a pacesetter for the national economy. It not only meets the growing needs created by an expanding economy, but it is one of the major factors in making that growth possible. In emergencies, the communications industry can be counted upon to take up the immediate surge of defense needs and thereafter to provide auxiliary networks, factories to produce equipment of the latest design, and laboratories to create new devices and techniques.

As the nerve system of our economy, official and private business relations, public welfare, diplomatic relations, and national defense, telecommunications systems must be considered as indispensable instruments of national policy. It is not enough for the Government to regulate our communications systems and prevent the abuses that stem from monopolies; it must also be alert to the problems of the industry and must be prepared to promote and support measures necessary to insure the continued strength of the telecommunications system as a whole.

The Federal Government has a number of basic roles in the telecommunications field. It must control, as well as promote, private industry in the public interest; and it must use telecommunications for the accomplishment of agency missions. Regulation of private telecommunications is exercised by an independent agency, the Federal Communications Commission (FCC), while the management of Government telecommunications is primarily the responsibility of the Chief Executive, who has delegated his responsibilities with certain limitations by Executive Order and memorandum to the Director of Telecommunications Management. The pattern of government agencies concerned with telecommunications is complex, and coordination of the entire structure has not been easy. The dual control over the radio spectrum—with the FCC assigning frequencies for non-government purposes and the President (through a Director of Telecommunications Management assisted by an Interdepartment Radio Advisory Committee) assigning frequencies to government stations—has been characterized by a former Director of Telecommunications Management in the Executive Office of the President as "a potential administrative nightmare." [1]

While drawing heavily on common carriers for service, the military and civil agencies of the Government have built up extensive communications networks of their own. The Government's telecommunications assets, largely military-owned, are valued at $2.5 billion in original cost; and about $1 billion a year is required to operate these assets. And yet it is only in the last few years that steps have been taken to achieve some measure of cohesion in the national telecommunications community. The present accent on improved and integrated management reflects recognition of the fact that in this age of the H-bomb and recurring crises, telecommunications is all the more now the central pathway over which the impulses of national policy, decision and control must travel.

The Nation's stake in telecommunications is thus extremely large. The electromagnetic spectrum space is finite and must be shared with other nations; and unless adequate plans are made in advance, the United States can find itself severely handicapped in negotiating at international conferences for frequency allocations. In the face of increasing pressure on the radio spectrum, the Government's own frequency management must seek to reconcile conflicting interests with due regard for the most essential needs and the effective use of the various forms of communications. The Government must insure that its own telecommunications networks are efficiently managed and are fully responsive to the needs of crisis. It must make certain that its controls and operations do not impair the irreplaceable service which the industry renders to the public. As telecommunications transcends agency lines and jurisdictions, the Government must see to it that all agency efforts in this field are coordinated and related to the full range of national objectives, policies, and programs.

[1] Irvin Stewart, "Telecommunications Management: The Strategy of Organizational Location," *Public Administration Review* (September, 1953), p. 150.

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NON-FEDERAL TELECOMMUNICATIONS

The Nation's non-Federal telecommunications system provides a wide variety of services. These are normally grouped into three major categories: (1) common carrier services including both domestic and overseas telephone and telegraph service; (2) safety and special services involving use of radio for marine, aviation, industrial, land transportation, public safety, citizens, amateur and disaster services; and (3) broadcast services by radio and television. To these must be added a sizeable supporting communications equipment industry and the development of a satellite communications system.

COMMON CARRIER SERVICES

The commcn carriers in the telecommunications field, that is, those companies that hold themselves ready to provide communications service to all customers, are made up of the Bell System and about 2,700 independent telephone companies; the Western Union Telegraph Company; and a group of international cable and radio companies. The combined assets of these companies are estimated at over $28 billion. The companies employ more than 1 million men and women. All segments of the industry have kept pace with progress in electronics technology, and this is reflected in their services, equipment, and operating techniques.

THE TELEPHONE SYSTEM

Since 1876, when Alexander Graham Bell transmitted the first complete sentence heard over a wire, the expansion of telephone communication has been rapid. The number of telephones in service in the United States rose from 2,600 at the end of 1876 to over 86 million in mid-1964. The United States has more than half of the world's total, and it leads all nations in standards of performance. Daily telephone conversations in this country average nearly 330 million. Most telephones are now dial-operated. In some places there is touchtone or push-button calling; and picturephone service, enabling users to view each other while they converse, is now in use at specified public stations. The placement of lines underground, automatic switching, new types of instruments, the reduction of unsatisfactory transmission and reception, use of coaxial cables and microwave systems to relay radio and television programs, the extension of service to ships, planes, trains and motor vehicles, and the introduction of transoceanic telephone cables—these are further illustrations of the progress that is being made in this mode of communication. In addition to their principal exchange and toll message services, the telephone companies provide extensive private-line telephone and teletypewriter circuits on a lease or rental basis.

The telephone industry of the United States is generally described in two groupings: the Bell System and the independents. For all intents and purposes the Bell System stands in a monopolistic position in the telephone field. It operates more than 80 percent of the telephone facilities and earns about 90 percent of the operating revenues. In fiscal 1964 the Bell System had a net investment of $22.1 billion, its operating revenues approximated $10 billion, and its earnings reached $1.7 billion.[1] The System consists of a group of closely integrated companies, as follows:

(1) *The American Telephone and Telegraph Company,* the parent body, whose general staff coordinates the activities of the rest of the System. Its Long Lines Department owns and operates the lines, cables and other plant which provide the service between the territories served by the associated Bell companies and the adjoining independent companies.

(2) *Twenty "Associated Companies,"* the principal operating companies which provide telephone services and facilities within their respective territories.

(3) *Western Electric Company,* which manufactures supplies and repairs the great bulk of the telephone equipment and materials used by the operating companies, and does most of the installation of central office equipment for the Bell System.

(4) *Bell Telephone Laboratories, Inc.,* which conducts fundamental research and basic development of new apparatus and new systems and carries the development up to the manufacturing specifications.

The integrated organization and the central management of long-haul operations have been the key factors in the Bell System's efficiency and progress.[2]

At the beginning of the 20th century, the non-Bell companies owned almost half of the telephones in the country; today they are down to about 18 percent of the total. The number of independents has also fallen off considerably. On the eve of World War II they numbered about 6,400, many quite small, some large. Mergers and consolidations have reduced the number to less than 2,700. These independents serve about 16 million of the Nation's telephones, and they accounted for over $1 billion total operating revenues of the domestic industry in fiscal 1964. They are spread through various parts of the country. Like the Bell companies, each has a franchise to operate within a specified area;

[1] Federal Communications Commission, *30th Anniversary Report for the Fiscal Year 1964* (Washington: U.S. Government Printing Office, 1964), pp. 6–7.

[2] American Telephone and Telegraph Company, *Annual Report—1964* (New York: 1964).

and there is no real competition between companies in any one locality. All have operating agreements with the Bell System for the interchange of traffic.

The Bell and independent companies together thus blanket the entire United States with a network of interconnecting telephone circuits. The possession of this extensive communications system is one of the Nation's best assets. The system has enormous flexibility to provide for urgent demands not readily foreseen and to maintain essential services in the event of destruction of certain sections of intercity routes. The companies are familiar with the means to restore quickly facilities damaged by such disasters as storms, floods, and fires. They have long had an intimate association with the national defense. In past mobilizations the industry was called upon for many important defense undertakings—developing new tools of war; producing large quantities of urgently needed equipment; providing plant and equipment for military use; operating schools and training members of the Armed Forces in the communications specialties. In the cold war years, Bell System facilities and personnel have been heavily involved in the design of warning and communication systems, missile, submarine cable and other special defense projects. The companies have participated with the civil authorities in Operation Alert exercises simulating widespread nuclear bombing, activating disaster centers, evaluating the effects of damage to communications, and setting up re-routing facilities to restore service for all essential needs.

The telephone industry provides a fine example of a public service cooperating with defense agencies and taking the lead in preparing for a possible nuclear attack.[3] As additional circuits have been required for growth, dispersal considerations have bulked large in the industry's plans. Vast amounts of equipment and supplies, spread throughout the Nation in factories, supply depots, and in transit, are available for regular and emergency calls. The men and women of the industry represent a reservoir of widely dispersed and trained personnel ready to meet any emergency in communications. By-pass and express routes have been constructed to avoid target areas and protect all services. Storage batteries and standard power generating sets at each point make the express and by-pass offices independent in case of failure of commercial electric power. Some new main routes have been put completely underground, and new above-ground buildings at key junctions and terminal points are equipped for fallout protection. Emergency radio equipment, portable and mounted on trucks, is scattered around the country for bridging the gap when toll routes are interrupted. Portable towers and microwave equipment are available for quick service in the event of destruction of

[3] Charles C. Duncan, *Communications and Defense*, Lecture L58–116 (Washington: U.S. Industrial College of the Armed Forces, 3 March 1958). Reprinted from *Bell Telephone Magazine*, Spring, 1958.

radio relay stations. Advances have been made in providing automatic equipment to restore circuits, to start emergency power generating units, and to handle the nationwide switching of telephone calls without the use of operators or maintenance men—measures particularly important under conditions of nuclear bombing and radioactive fallout. Steps have also been taken for protection against sabotage and espionage. Portions of a 4,000-mile transcontinental system, with the cable and all amplifiers underground, have been placed in service. Skirting all major and possible target areas, this "hardened route" is designed to withstand natural disasters, floods, hurricanes, tornados, and even nuclear blasts short of a direct hit. Though much remains to be done, the telephone system of this Nation is perhaps better prepared for emergencies that any other major utility, indeed any other giant of industry. It has become an integral part of the defense system of the United States, and its capacity for survival, recuperation, and rehabilitation is of the utmost importance.

THE TELEGRAPH SYSTEM

The principle of the electromagnetic telegraph was developed by a university professor, Samuel F. B. Morse. In 1835 Morse proved that signals could be transmitted by wire. Congress in 1843 voted $30,000 to construct an experimental telegraph line between Baltimore and Washington, D.C., and members of Congress early in the following year witnessed the sending and receipt of messages over a part of that line. Some 50 telegraph companies were in operation in various parts of the country in 1851. That year saw the start of a corporate body now known as the Western Union Telegraph Company. It grew rapidly, built the first transcontinental telegraph line in 1861, and within several years it acquired control over many of its competitors. In the process of absorption and merger of smaller companies, two principal domestic carriers emerged—Western Union and the Postal Telegraph Company. On the recommendation of the FCC and with the authorization of Congress, the two were consolidated into the Western Union Telegraph Company late in 1943, with the proviso that Western Union divest itself of its connections with international cable or radiotelegraph companies—an action finally consummated in 1963.

Western Union thus has almost a complete monopoly of the domestic telegraph business. There remain a few independent companies, but they are small and mostly serve railroads or particular industries in limited areas. Western Union's telegraph service affords a means of rapid communication where a written record of messages is essential. Though the service is used for messages of a social or personal nature, it finds its greatest application in modern business, particularly in brokerage and banking, in newspaper and news services, and in the work of large companies with widely separated factories, branch offices, customers or suppliers. Along with various classes of service offered to the public, Western Union furnishes private line and other special telegraph services.

Although Western Union is a natural economic monopoly, it has met with strong competition from other forms of communication. Increased use of long-distance telephone service, the development of air mail service, the Bell System's extensive operation of a teletypewriter exchange service (TWX), and its leasing of private-line telegraph circuits superimposed on telephone wires—all these have made inroads on Western Union's domestic message telegraph business. For more than a quarter century, Western Union experienced economic difficulties, and there was doubt that it would survive its 100th anniversary in 1951.

Application of new technology and improved management, along with greater general business activity, over the ensuing years saw a thorough rejuvenation of Western Union. The industry executed a large-scale modernization and plant expansion program to provide improved quality and greater variety of service. In 1950 Western Union completed the construction of 15 strategically located reperforator switching centers for the automatic and semiautomatic relay of telegrams between cities. It has been building a transcontinental microwave beam system capable of handling all forms of communications at high speeds, in large volume, and relatively immune to interruptions due to storm damage and electrical interference. Progress in the development of facilities for transmitting and recording facsimile reproductions of printed, typed or written copy has given Western Union new means for better serving the public.

Western Union has vastly expanded its operations in leasing private wire and facsimile systems to industrial and governmental users and tailoring special equipment to customer needs. It has installed the world's largest digital data-communications system (AUTODIN) for the military services, and will provide the Advanced Record System portion of the Federal Telecommunications System linking all civilian agencies of the Government under the management of the General Services Administration. Western Union's most rapidly growing service percentage wise is TELEX, a dial-operated customer-to-customer teleprinter exchange service somewhat similar to the Bell System's TWX service, with 9,800 subscribers yielding revenues of $7.7 million in 1963. An increasing number of business users are now equipped with the DESKFAX, a compact facsimile telegraph machine which speeds the delivery and pickup of telegrams.

The following financial and operating data on its domestic landline operations in 1963 reflect Western Union's vigorous state:

Table III. Western Union Landline Operations—1963

Book cost of plant (as of 31 December)	$596.6	million
Message revenues	176.7	do.
Teleprinter exchange service revenues	7.7	do.
Leased-circuit revenues	84.7	do.
Total operating revenues	286.8	do.
Net operating revenues	20.2	do.
Net income before Federal income tax	20.9	do.*

* Western Union's net income in 1962 was $10.4 million. The increase for 1963 is attributable in large part to the fact that a tax credit of $8,250,000 arising from the loss on the sale of the ocean-cable system was tabulated as an extraordinary income credit of the landline system; *see* FCC, *30th Anniversary Report*, p. 125.

Its public message volume, while falling off, is still substantial, with 104.2 million (including domestic transmission of 11.6 million transoceanic and marine) messages handled in 1963; and domestic public messages remain Western Union's biggest revenue producer. The company's new high of $286.8 million of gross landline operating revenue, reached in 1963, reflects sizeable increases in TELEX and private-line services.

Like the Bell System, Western Union in past mobilizations handled a vast number of special projects for war purposes. It provides an immediate source of know-how and facilities to meet defense needs. Its research and development have contributed to the solution of many military communications problems. And its special circuit facilities and equipment are basic to the operations of the military and civil agencies of the Government and of many large defense-related industries. No less than the telephone system, the domestic telegraph system represents a vital element of the Nation's economic well-being and security.

INTERNATIONAL COMMUNICATIONS

Looking beyond the domestic scene, telecommunications services by means of submarine cables and radio span the globe. These commercial networks convey the messages, conversations and pictures that give direction and support to the Nation's foreign trade. They contribute vitally to the conduct of defense and diplomacy and to the protection of life at sea and in the air. And as we shall see, international communications by the long-established telegraph and telephone systems will be shortly supplemented by communication satellites in orbit around the earth. Though Samuel Morse also pioneered in submarine telegraphy, it was Cyrus W. Field who made the submarine cable practical. After many disappointments, transoceanic cable service became a reality in 1866, when America and Europe were finally linked by two cables.

Other ocean cable lines followed. Western Union International, Inc. (which succeeded Western Union in rendering its internatioal telegraph services upon the divestment of its cable holdings in 1963) and eight other companies constitute America's international telegraph carriers. These carriers have advanced the total operating revenues of the industry to a new high of $97.8 million in the calendar year 1963. The following financial and operating statistics reflect the continuing strong demand for these carriers' services:

Table IV. International Telegraph Carriers—1963

Types of service	*Messages handled (in millions)*	*Revenue (in millions)*
Domestic	53.069[a]	$ 3.3[b]
Transoceanic	25.5	56.2[c]
Marine	1.1	2.3
Teleprinter exchange service	------	13.7
Leased circuit	------	12.1
Total operating	------	97.8
Net operating	------	12.7

Book cost of plant as of 31 December: $153.5 million.

Number of employees at end of October: 9,968.

[a] Represents domestic-classification messages (primarily Canadian and Mexican).

[b] Includes revenues of 2 ocean-cable carriers and the radiotelegraph carriers from the domestic transmission of transoceanic and marine messages outside of points of entry or departure in the United States, and revenues from domestic classification messages (primarily Canadian and Mexican).

[c] Radiotelegraph transoceanic message revenues of All America Cables & Radio, Inc.—$1.6 million—are not included.

Source: FCC, *30th Anniversary Report*, p. 126.

The international telegraph cable industry has been highly competitive. The American companies compete not only with each other but with foreign companies. Moreover, the cable lines have encountered stiff competition from companies which provide transoceanic radiotelegraph and radiotelephone communications. The advent of radio paved the way for the development of wireless communication—first by telegraph and then by telephone. At the close of the 19th century Guglielmo Marconi gave practical demonstration of the feasibility of radio communication. Radio signaling was first used commercially in ship-to-shore and ship-to-ship communication. Recognition of the importance of marine communication and encouragement by the Government led to the formation of radiotelegraph and telephone companies in the early 1900's. Today point-to-point radiotelegraph circuits link the United States with practically every part of the world, and about 180 countries and overseas points are within voice contact with this country.

Crowding of the high-frequency bands used for international radio communication and the susceptibility of the radio circuits to fading, noise conditions, jamming and other disturbance brought renewed

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interest in submarine cable systems. The first transatlantic telephone cable was opened in 1956, and three others have since been added. The FCC has authorized the major international carriers—the American Telephone and Telegraph Co., Mackay Radio & Telegraph Co., Press Wireless, Inc., RCA Communications, Inc., and Western Union International, Inc.—to construct and operate a fifth cable which connects New Jersey and France; it was placed in service in 1965. There has been continued expansion of the Pacific submarine telephone cable network of the U.S. companies, with a second cable between California and Hawaii and cables between Hawaii and Guam and Japan. On 18 June 1964 President Johnson formally opened telephone cable service between the United States and Japan. A cable between Guam and the Philippines is also planned, as well as extensions connecting the Pacific network to other points and foreign cable systems beyond Guam. Long-range plans call for a cable extending from Panama down the west coast of South America to Chile, across Chile to Argentina, and up the east coast to Brazil. An additional cable is planned in the Caribbean area, between Florida and the Virgin Islands, extending from the latter point to Venezuela. Some of the Virgin Islands cable circuits will be extended to Puerto Rico via microwave facilities. Most of these cables constitute joint undertakings by one or more U.S. carriers and foreign communication entities. All present and future telephone cables are or will be used also for telegraph service.[4]

As indicated, the international telegraph industry is now in a strong financial position. Its net operating revenues in 1963 were 23.9 percent over those in 1962, reflecting sizeable advances in TELEX and leased-circuit services to customers. Total operating revenues from overseas telephone services, including the leasing of channels for alternate voice and nonvoice use, also showed an upward trend. In 1963 they totaled $65.5 million, an increase of 11.5 percent over the previous year. The word volume of overseas telegraph traffic in 1963 exceeded 660 million, and outbound and inbound telephone calls between the U.S. and overseas points totaled more than 4.5 million during that calendar year.

SAFETY AND SPECIAL RADIO SERVICES

Apart from its role in common carrier and broadcasting operations, radio has some 40 different types of applications which the FCC categorizes as "Safety and Special Radio Services." These aid business and individuals, expedite movement of vehicles on land, further navigation on water and in the air, contribute to the protection of life and property, and serve a variety of other uses. These uses include the most extensive and fastest growing classes of radio operations today. In the 30 years

[4] FCC, *30th Anniversary Report*, pp. 8, 15, 121.

of the FCC's existence (1934–1964), the licensees in the safety and special radio services categories increased from less than 50,000 to more than 1.4 million. Nearly 5 million mobile and land (or fixed) transmitters are presently in operation for these uses. Technological advances and greater knowledge concerning the potential of the radio spectrum have made it possible to accommodate this tremendous expansion of the safety and special radio services at a reasonable cost to users.[5]

The marine radio services are among the oldest of the safety services. They include the use of radio aboard ships and at coastal stations. These marine stations satisfy safety requirements prescribed by law and international agreement. In 1937 Congress made radiotelegraph installations mandatory on large oceangoing vessels. Under legislation enacted in 1956, vessels of any size carrying more than six passengers for hire in U.S. tidewaters must be radiotelephone-equipped for added safety. The marine stations provide additional services such as aids to navigation and commerce and public correspondence.

Like the marine services, aviation radio services were in existence prior to the creation of the FCC. They include stations aboard aircraft (private as well as commercial passenger and cargo planes) and at ground stations serving them. These provide communications required by law and deemed necessary for the protection of life and property, and they are also used for navigation, operational control, and business and private correspondence.

Land transportation services provide for the use of radio by railroads, the trucking industry, interstate and local bus companies, taxicabs, and emergency-road service vehicles. These services facilitate transportation of passengers and freight through increased efficiency and economy. Radar is used in conjunction with radio in some applications. It is used in railroad yards, for example, for automatic control of various operations. Railroads are operating an increasing number of microwave systems to promote efficiency and safety in train movement and maintenance control. Though the land transportation services account for less than 15,000 station authorizations, these represent the use of nearly 400,000 transmitters. That is because various systems, like taxicab, bus and truck, have many radio-directed vehicles.

The industrial services are among the largest of the Safety and Special Radio Services, with more than 1.1 million transmitters in operation in mid-1964. Along with the specified industrial groupings, other business functions such as farming and ranching, mining, heavy construction, land surveying and nongovernment weather forecasting are

[5] A breakdown of the authorizations for each of the 7 major classes of service, by number of stations and transmitters, is shown in Table V.

Table V. Stations and Transmitters in Safety and Special Radio Services, 30 June 1964

Class of station	Stations	Transmitters		
		Land or fixed	Mobile	Total
Citizens	*682,307*	14,000	2,183,302	*2,197,302*
Amateur and disaster	*280,818*	289,338	----------	*289,338*
Amateur	264,007	256,086	----------	256,086
Disaster	372	372	----------	372
RACES	16,439	32,880	----------	32,880
Aviation services	*107,557*	17,696	154,967	*172,663*
Aeronautical & fixed group	5,128	8,205	----------	8,205
Aircraft group	84,110	----------	134,576	134,576
Aviation auxiliary group	672	336	3,158	3,494
Av. radionavigation land	414	538	----------	538
Civil Air Patrol	17,233	8,617	17,233	25,850
Industrial services	*124,347*	106,921	1,054.584	*1,161,505*
Business	62,048	37.229	434.336	471,565
Forest products	2.596	2.596	23,364	25,960
Industrial radiolocation	386	232	772	1,004
Manufacturers	1.179	1,415	27,117	28,532
Motion picture	54	54	918	972
Petroleum	9,660	23.184	67.620	90,804
Power	14,521	11,617	159.731	171,348
Relay press	211	190	2.700	2,890
Special industrial	32,876	29,588	312,322	341,910
Telephone maintenance	816	816	25,704	26,520
Land transportation services	*14,815*	18.203	378,008	*396,211*
Automobile emergency	1.406	1.325	12.900	14,225
Interurban passenger (motor carrier)	84	67	756	823
Interurban property (motor carrier)	2,857	3,137	47,900	51,037
Urban passenger (motor carrier)	134	106	3,216	3,322
Urban property (motor carrier)	677	510	13.540	14,050
Railroad	4,664	4,328	139,920	144,248
Taxicab	4,993	8,730	159.776	168,506
Marine services	*161,593*	4,402	191,268	*195,670*
Alaskan group	1.558	3.428	----------	3.428
Coastal group	498	797	----------	797
Fixed (marine)	97	97	----------	97
Marine radiodetermination land	50	80	----------	80
Ship group	159,390	----------	191,268	191,268
Public safety services	*47,389*	45,372	464,428	*509,800*
Fire	9,496	8.546	104.456	113.002
Forestry conservation	4,042	6,063	32,336	38,399
Highway maintenance	5,416	4.874	48.744	53,618
Local government	6,255	5.630	62.550	68,180
Police	16.605	14,945	199.260	214,205
Special emergency	5,558	5.280	16,674	21,954
State guard	17	34	408	442
Grand totals	1,418.826	495,932	4,426,557	4,922,489

Source: Federal Communications Commission, *30th Anniversary Report for the Fiscal Year 1964*, pp. 99–100.

also included. These radio services are a basic aid to commerce and industry. They represent a new tool in economic management.

The public safety services provide radio communication to help meet emergency conditions and to aid in the administration of local government and municipal activities relating primarily to the public welfare.

Police, fire, local government and other public safety agencies hold almost 47,500 authorizations for the operation of about 510,000 transmitters. In recent years these radio services have been expanded to include physicians, veterinarians and school buses in remote areas; most hospitals, ambulances and rescue vehicles; lifesaving beach patrols; disaster relief organizations; and individuals living in isolated locations.

Personalized use of radio is reflected in the Amateur and Citizens Radio Services. Although a comparative newcomer, first authorized in 1949, citizens radio has become by far the largest and fastest growing single service, with 682,307 stations authorized and some 2.2 million transmitters in use by mid-1964. Citizens radio is used for a great variety of short-range personal and occupational communication needs, including signaling and remote control of devices. In some areas local civil defense agencies are organizing this service into an emergency communications system similar to the RACES amateurs, described below. At the same time, the enlargement of this service has aggravated the enforcement problems for the FCC. These result from the fact that many individuals enjoying the privilege are unskilled in radio operation and tend to ignore the rules and regulations concerning this service.

Radio "hams" or amateurs date back almost as far as radio itself. Amateur service provides a hobby for young and old, and is a means for obtaining experience in radio operation. Amateur and disaster service is the second largest in terms of licensees. Public service is the keynote of these radio operations. They have been of considerable assistance in storms, floods and other local emergencies, and they are being organized to play their part should a national emergency occur. A total of 16,439 stations operating 32,880 transmitters are in the Radio Amateur Civil Emergency Service (RACES) for the performance of emergency communications services. Empowered to function in peace as well as in war, RACES furnishes an essential public service.

Technological developments in recent years have brought reductions in the size, weight, cost, and learning time of much of the equipment used in the safety and special radio services; and the equipment has become more versatile, reliable, and efficient. The FCC has been giving close study to the problem of finding added frequencies to accommodate the mounting operations in this field. Tighter technical standards, narrow channel spacing, and other devices have made it possible to extend greatly this radio usage despite the limited spectrum space available for these services. In their normal usage, these services are an integral part of the Nation's system which promotes the public welfare and supports a dynamic economy. The incorporation of various categories of these services into current disaster control and civil defense plans will increase the effectiveness of emergency communications.

BROADCAST SERVICES

The radio broadcasting industry had its practical beginnings in the early 1920's. In the relatively short span of 45 years it has grown from an experimental novelty to one of the giants of the American economy. In 1963 the investment in tangible property of the four nationwide radio networks (American Broadcasting Company, Columbia Broadcasting System, Mutual Broadcasting System, and National Broadcasting Company), their 19 owned and operated radio stations, and 3,813 other stations totaled $479.5 million in original cost. In 1963 the investment in tangible property of the three TV networks and their owned and operated TV stations totaled $723.1 million. And this investment is small compared with the American public's investment in radio and television receiving equipment. The radio and television industry reported broadcast revenues of $2.3 billion (radio, $681.1 million, TV, $1.6 billion) in 1963. Total industry expenses that year approximated $1.9 billion, leaving profits (before Federal income tax) of $398.1 million.[6]

Broadcast station growth has been spectacular. In 1935 there were slightly more than 600 authorized radio stations—all AM (amplitude modulation) operated; frequency modulation (FM) and TV were still in the experimental stage. By mid-1964 there were a total of 17,231 broadcast authorizations. A breakdown by different classes of broadcast services follows:

Table VI. Broadcast Authorizations—30 June 1964

Class	
Commercial AM	4,061
Commercial TV	668
TV translators and boosters	1,913
Educational TV	107
Instructional TV fixed	4
Auxiliary	1,559
Experimental TV	28
Commercial FM	1,371
Educational FM	257
International	3
Remote pickup	7,020
Studio-transmitter link	121
Developmental	6
Low-power auxiliary (cueing)	113
Total	17,231

Source: *Ibid.*, p. 78.

A substantial part of the work of the FCC has been the vigorous enforcement of the legislation and of its own rules and regulations to insure

[6] FCC, *30th Anniversary Report*, p. 82.

that broadcast service licensees fulfill their obligation to serve the public interest, convenience, and necessity.

The Nation is served by three types of broadcast stations—AM, FM, and TV. Though there were many early experimental audio transmissions, it was not until after World War I that regular AM broadcasting began. Initially, radio broadcasting was localized. Today, through use of telephone lines, coaxial cables, microwave and other relay means, it is possible to send the same program over many stations simultaneously.

A patent on frequency modulation was first issued in 1902, but its advantages for broadcasting were not developed until shortly before World War II. Regular FM broadcasting, educational as well as commercial, began in 1941. FM stations began subsidiary "background music" service to business and other customers in 1955. Stereophonic programing to the public was started in 1961.

The beginning of visual radio has been traced back to 1884 when Nipkow, a German, patented a scanning desk for transmitting pictures by wireless. After extensive experimentation, regular television broadcast service was inaugurated on a small scale immediately prior to World War II. The war inhibited commercial development of what was essentially an amusement industry, but after the war TV's progress was rapid. Only 6 stations were in operation at the war's end; by mid-1964 the number of commercial TV authorizations had climbed to 668. In 1946, only 8,000 homes had TV sets; today an estimated 60 million sets are in use. Color TV, long a subject of study and experimentation, is now a reality, and since 1961, color receiving sets have been introduced into the market on a large scale. Non-commercial educational TV broadcast services, nonexistent as late as 1952, have since been making rapid strides. Subscription-TV transmission is under test.

The radio and television broadcasting industry is dominated by the four large nationwide networks, but includes several regional networks and a relatively large number of stations without network affiliation. Though the FCC has sought to check the concentration of control of stations, network provision of programs sponsors has exerted a contrary attraction. About one-third of the radio stations and nearly all of the TV stations are affiliated with one of the major networks and make use of some or all of its programs. Of the $2.3 billion broadcast revenues reported for 1963, the nationwide networks (with their owned and operated stations) accounted for $889.3 million (radio, $69 million, TV, $820.3 million). Their income (before Federal income tax) was $142.1 million (radio, $5.9 million; TV, $136.2 million)—approximately one-third of the total profits of the industry.

The operation and growth of the broadcast industry are almost wholly financed by advertisers. As a rule, some 10 to 15 percent of each commercial program is allotted to advertising announcements; and the broadcasting companies' compensation is in proportion to the estimated value of the advertising service which they render. This value is directly affected by the degree to which the broadcast company is believed to attract the public. The greater the number of listeners a station has, the greater is the estimated value of the service it renders to advertisers. This value depends upon the character of the programs, the licensed power of the stations, their hours of operation, and the number of competitive stations in the same market area. The close relationship between commercial broadcasting and advertising has stimulated government and public interest in the field of advertising and program production.

Like the other telecommunication components, the broadcast industry plays a vital part to the national security and well-being. It is well recognized that industry has a tremendous capacity to influence the opinions, buying habits, political views, and moral integrity of the public. Its influence extends, via shortwave broadcast, to listeners in distant foreign countries. As such, broadcasting is a potent instrument in the Nation's cold war struggle with the Communist powers for men's minds and allegiance. In an emergency the industry will serve as an instrument of warning, direction, coordination, and reassurance in the furtherance of defense and recovery efforts. As in past mobilizations, the industry can be counted upon in full measure to further and help unify the Nation's effort in the common cause.

COMMERCIAL SATELLITE COMMUNICATIONS

On 2 May 1965, millions of people in North America and Western Europe witnessed the intercontinental relay of live telecasts by a satellite, "Early Bird"—the first attempt at regular space communication. Perched high above the North Atlantic, 22,300 miles above the earth's surface and in synchronous orbit with the Earth, Early Bird signaled a major step toward the design of a satellite system which could provide virtually complete communications coverage of the globe. The ideas about "extraterrestrial relays" and the outlines of such a system had been propounded some two decades earlier. But it was not until early 1958, following the Soviet Union's successful launching of two satellites into orbit, that the U.S. Government in conjunction with several large private organizations turned actively to research and technology in the exploration of the potential of space for global communications.

The ensuing studies and experiments involved a three-sided but interlocking effort—the Department of Defense seeking to serve special military needs; the National Aeronautics and Space Administration (NASA) trying to advance the state of the art and assist nongovernment efforts; and industry exploring commercial possibilities.

Launchings of experimental satellites, such as "Telstar," "Relay," and "Syncom," had provided useful data to the ultimate development of a technically feasible global space communications system. Use of these satellites made it possible to conduct numerous transmissions between ground stations in the United States and abroad. Executed in cooperation with certain foreign governments and communications entities, these experiments laid the groundwork for specific policies and plans for continued joint effort in the establishment of a truly global commercial system of communications by satellites.

Policy guidance in this regard came from President Kennedy in July 1961, more than a year before the enactment of the Communications Satellite Act of 1962. The United States would take the lead to achieve the speedy development of the system. That system would seek global coverage and universal benefit. Foreign countries would be invited to participate through ownership or otherwise. The U.S. portion of the system would be under private ownership and operation, though joined with certain public interest requirements and objectives. The enterprise would be subject to government regulation, but it would also draw certain supporting services from the Federal Government needed for the development and operation of the system. Communication carriers would have equitable and nondiscriminatory access to the system's services. Narrow ownership and monopoly control of the system would be prevented, and effective competition would be sought in the purchase of system equipment. The Federal Government would draw on the system's services for "general governmental purposes," but might establish separate systems when required to meet "unique Government needs which cannot, in the national interest, be met by the commercial system." [7]

Congressional deliberations over the ensuing year brought forth opposing policy positions regarding the instrument for the ownership and operation of the system. Some favored private ownership by established common carriers; others favored a full-fledged Government enterprise. Opponents of a private venture questioned the propriety of continued Government sponsorship of large-scale technical development and provision of launching services in its support. The issue was resolved in favor of a commercial venture with provision, however, for close Government supervision and control. The venture would have the vast resources of the Government for its support, but it would reimburse the

[7] U.S. Congress, House Committee on Government Operations, *Satellite Communications (Military-Civil Roles and Relationships)*. Report prepared by the Military Operations Subcommittee of the Committee on Government Operations, 88th Cong., 2d Sess., October 1964 (hereinafter cited as *Satellite Communications*) (Washington: U.S. Government Printing Office, 1964), pp. 21–22. This report presents a systematic and comprehensive account of the developments and basic policy issues and administrative problems in satellite communications, and ties these in with the broader aspects of Federal telecommunications management.

Government for certain services. It would be a profitmaking organization, but it would also be charged with the noblest objectives of peace and good will and the extension of its service on a universal scale without regard to the relative density and profitability of the traffic. The organization would have government appointees on its board of directors and the backing of the Government's prestige and concern for its ultimate success. The President would promote its aims by providing the proper environment and instruments of cooperation in government and foreign affairs. As an indication of its own continuing interest, Congress would require periodic reports from the President, the FCC, and the enterprise itself.[8]

Though clearly a compromise of opposing views, the Communications Satellite Act of 1962, approved 31 August 1962,[9] substantially mirrored the President's policy guidance of the previous year. The Act directed the President to insure timely arrangements to permit foreign participation in the establishment and use of a communications satellite system. The U.S. instrument of participation in the system is the Communications Satellite Corporation (COMSAT), a privately owned and operated entity organized in accordance with provisions of the Act and subject to Federal regulation. Its board of directors includes Presidential appointees confirmed by the Senate. Communications common carriers authorized by the FCC can purchase, in the aggregate, not more than half of the voting stock of the corporation; the rest is held by the general public. Though operated for profit, the system will be responsive to public needs and national objectives and will extend its services worldwide, including the less developed and hence unprofitable traffic areas of the world. All authorized users shall have nondiscriminatory access to the system, and maximum competition will be maintained in providing equipment and services utilized by the system. NASA provides technical advice and launching and related services. The FCC regulates the corporation at home, assuring fair rates, full carrier access, expansion of facilities as required, broad-based ownership, adequate accounting, authorization for new financing, and effective competition in equipment purchases. In its dealings with foreign countries, COMSAT looks to the State Department for assistance and supervision.

Establishment of the system posed complex policy, technical, organizational, administrative and international problems. Nevertheless, the program has been brought toward practical realization. The corporation was formally incorporated on 1 February 1963. A group of banks arranged interim financing until stock could be issued. The investing public and authorized carriers fully subscribed to COMSAT'S initial stock in the aggregate sum of $200 million. As of 1 July 1964, the

[8] *Ibid.*, pp. 23–24.
[9] Public Law 87–624, 76 *Stat* 419.

FCC had authorized 219 communications common carriers to own such stock. The 50 percent reserved for carriers was oversubscribed, with AT&T, the largest single stockholder, accounting for 57.9 percent of the industry allocation and 28.9 percent of the total allocation. The major purchases by carriers are as follows:

Table VII. Allocation of Communications Satellite Corporation Stock Among Authorized Carriers

American Telephone & Telegraph Co.	$57,915,000
International Telephone & Telegraph Co.	21,000,000
General Telephone & Electronics Corp.	7,000,000
RCA Communications, Inc.	5,000,000
Telephones, Inc.	2,000,000
Time, Inc.	1,500,000
Hawaiian Telephone Co.	1,000,000
Western Union International	1,000,000

Source: FCC, *30th Anniversary Report*, p. 45.

Under procedures established by FCC rules, COMSAT contracted for such matters as multiple-access studies, synchronous satellites for an early capability system, and engineering design studies for the basic global communication satellite system.

The accelerated pace of developments in the United States stimulated other nations to seek participation in the establishment and operation of the system. This move and the progress of negotiations to that end ruled out parallel consideration of a way whereby COMSAT might meet special military needs as well as normal commercial requirements; and the DOD was impelled to resume and intensify work on its own independent system. The international discussions brought agreement in the summer of 1964 to work toward the single global system contemplated in the Satellite Act. There emerged from the negotiations a consortium arrangement, a multinational business-type pool. Under this arrangement, the signatory nations contribute to the capital costs of the satellite system; and COMSAT serves as general manager for the design, development, construction, establishment, operation and maintenance of the space segment of the system.

The 2 May 1965 telecast by the "experimental-operational" synchronous satellite, "Early Bird," was the first of several demonstrations before COMSAT went into commercial operation and started charging for transmission of television programs, telephone calls, messages, and data. COMSAT took in $966,000 from the operation of the Early Bird satellite in the quarter ending 30 September 1965. On that date, its cash and temporary investments, COMSAT reported to its stockholders, totaled $187.7 million. It further advised of its plans to launch two new satellites in 1966, for Atlantic and Pacific commercial service as well as for meeting the communications needs of NASA's Apollo moon-landing program. Other plans for 1966 include the construction of earth stations in Hawaii and the State of Washington.

Although a number of technical and other questions remain to be solved, it is clear that space satellites offer promising means of extending and improving global communications. They will help to supplement the limited capacity and coverage of undersea cable circuits and relieve the crowding of radio channels in the higher frequencies. Continuing advances in space technology promise gains in the ease, economy, dependability, and geographic coverage of all forms of telecommunications.

XI

THE TELECOMMUNICATIONS SYSTEMS OF THE FEDERAL GOVERNMENT

Numerous and widespread telecommunications networks exist to serve the needs of the Federal Government. Within the continental United States the Government has long followed the policy of depending upon privately owned facilities for normal traffic requirements and maintaining its own networks for special needs. The backbone of the majority of the Government's domestic networks, military as well as civil, consists of private line facilities and services that are leased from the commercial carriers. For international service some government agencies own and operate their own networks, though here, too, they often fall back on commercial carriers to round out their overall needs. Efforts to link together, improve and extend governmental telecommunications have brought new instruments of coordination and management: first, within the Department of Defense, with the creation of the Defense Communications System in 1960; second, within the civil sector, with the establishment of the Federal Telecommunications System (FTS) in 1961; and finally in 1963, with the amalgamation of the principal military and civil operating components into a National Communications System (NCS) responsive to a single Executive Agent—the Secretary of Defense, who receives policy direction and guidance from the Director of Telecommunications Management/Special Assistant to the President for Telecommunications.

TELECOMMUNICATIONS FOR THE CIVIL GOVERNMENT

Every department and agency of the Government depends on telecommunications to carry out its mission. Telecommunications networks, in varying degrees, support agency operations—in national defense, radio navigation, air traffic control, intelligence, weather reporting, law enforcement, and agricultural, medical, research, recreational, educational and many other areas. The most important civil long-haul telecommunications networks are those operated by the Department of State, the Federal Aviation Agency (FAA), National Aeronautics and Space Administration (NASA), and the FTS within the General Services Administration (GSA). Together with the Defense networks, these are now the principal operating components of the National Communications System.

DEPARTMENT OF STATE TELECOMMUNICATIONS

The State Department has a twofold interest in telecommunications: it is responsible for international negotiations in telecommunications matters; and it is also a large user of telecommunications for the conduct of its general operations. Millions of telegraphic words annually become a complex problem when the greater portion must be subjected to several different cryptographic processes and the addressees are some 250 embassies, legations, and consulates scattered around the globe. With an ever-changing pattern in the areas of crises in the cold war, telegraphic messages must reach into the most remote corners of the world for ready contact with every diplomatic post. It is the job of the State Department's Diplomatic Telecommunications System (DTS) to insure that they do.

The long-haul, point-to-point circuitry in this system is derived from various sources—some State Department-owned; some leased; and others borrowed from Defense telecommunications channels. To minimize the problem of a multiplicity of separate, costly transmissions to many points within the same area, the State Department has developed a trunk and tributary plan. Based on traffic flow patterns, this plan enables the Department to route a high percentage of its traffic over high-volume leased or military channels to an overseas point from which messages are relayed to their destinations. In areas where the lease of trunk circuits is neither practicable nor possible the State Department depends largely upon Army multichannel trunk circuits to reach its overseas area relay centers. From these centers some of the traffic is refiled by commercial wire to its destination and some is transmitted by radio. The telegraph planning staff in Washington is kept posted on the current lateral rates between the various posts and the relay centers so that advantage may be taken of the lowest prevailing rates for dependable service.

The regular traffic pattern itself fluctuates widely with changes in the focal point of world interest and activities, and it is further distorted by short periods of intense activity during significant international meetings or conferences. These, fortunately, are most likely to materialize in the principal capital cities but occasionally pose an interesting communications problem by convening in such places as Quitandinha, Brazil, and Munsan-Ni, Korea, or other spots equally ill-prepared for large volume, high-precedence international telegraphic communications.

The cooperation of American telegraphic carriers and the military services certainly deserves mention in this connection. The American carriers have voluntarily increased the capacity of facilities or connections in such out-of-the-way locations to accommodate diplomatic traffic during periods of unusual demands. The military services have likewise assisted at many conferences where they had existing facilities. A good example of this was during the Munsan-Ni, Korean Peace talks in 1953; the Army Signal Corps was able to offer rapid service to Washington and other points interested in the talks, including direct teleconference facilities to Washington.

The center of diplomatic communications activity is quite logically just around the corner from the Office of the Secretary of State in Washington. The communications center is a full relay station together with its associated plain language and cryptographic terminals. It provides outlets to all military trunks serving areas in which the State Department utilizes military communications, and it is connected directly with the commercial carriers in Washington through whose facilities many missions are reached.

THE FAA NETWORK

Established early in 1960 by consolidation of activities previously performed by several agencies, mainly the Civil Aeronautics Administration in the Department of Commerce, FAA is a major user of telecommunications. It operates an extensive air traffic control system and weather collection and distribution network within the United States and long-haul telecommunications circuits to and between overseas areas. The growth of FAA communications reflects the increased utilization of aviation in the United States. In order to control the Nation's air traffic movements along the Federal Airways, the FAA leases a multitude of services. Interphone circuits link together FAA Flight Service Stations, Air Route Traffic Control Centers, Airport Towers and Military Air Bases. At many locations extensions are provided to airline offices, a service normally used to file flight plans with the Air Route Traffic Control Centers. Close working relations exist between the FAA facilities and the Air Force's air defense radar network, the Semi-Automatic Ground Environment (SAGE) system. Requirements for improvements in air traffic control facilities are closely related to the use of more and faster aircraft and the use of air space by both military and civil aircraft. The FAA's leased services and its long-haul, point-to-point circuitry have been combined with those of the Defense Communications System, and further consolidations may be anticipated in the future. The present congestion and anticipated saturation of the airways will require the most sophisticated and efficient management of the radio spectrum in terms of both international allocations and the distribution of the U.S.-assigned frequencies among domestic claimants. The FAA conducts extensive research in an attempt to find solutions to these and other problems related to the mass use of air transportation.

THE NASA NETWORK

In its rapidly expanding space explorations, NASA has been developing the most intricate kinds of electronic-communications equipment. These are needed to permit the location and tracking of satellites, probes and rockets, to receive their signals, to reduce the data to intelligible form, and to correlate the information so that it can be analyzed and applied to a multiplicity of purposes. To fulfill these requirements, NASA has installed several networks: (1) *Minitrack Network*, a 10-station network that tracks and gathers data from earth satellites; (2) *Optical Tracking Network*, a worldwide network of 12 stations, under the technical direction of the Smithsonian Astrophysical Observatory; (3) *Deep Space Network*, which maintains contact with space vehicles on lunar and interplanetary missions; (4) Project Gemini Network, the largest automatic communications system, consisting of 125,000 circuit miles of teletypewriter, telephone and high-speed data lines connecting 18 Gemini acquisition sites around the world with the Goddard Space Flight Center at Greenbelt, Maryland, and the Gemini Control Centers at Cape Kennedy, Florida and Houston, Texas; and (5) *Wallops Station*, a unique system with complete tracking and data collection facilities, used for research in aerodynamics and for the development and proof-testing of various components and techniques in launching space vehicles.

NASA leases facilities, uses some military circuitry, and draws on the resources of other organizations to supplement its own networks. All NASA projects make extensive use of non-voice transmissions of instrument data—telemetry. In unmanned space flight, data telemetered back to earth are used as an aid in diagnosing any difficulties encountered. In manned flight, telemetry supplements the voice messages which the astronaut sends back to earth and permits the use of complex computing equipment on the ground which is too heavy to carry in the space vehicle. NASA's space flight control systems are highly efficient and can be used to meet many other requirements should the need arise.

THE FEDERAL TELECOMMUNICATIONS SYSTEM

Until mid-1961 the Government departments and agencies had virtually a free hand in the use of communications. The need for coordination and sound management had been recognized during World War II and in the ensuing years of expanded governmental telecommunications requirements. Responsive to recommendations of the first Hoover Commission, Congress established the General Services Administration (GSA) in 1949, as a single coordinated management entity. A variety of governmental functions, including public utility and communications services, were brought under GSA management. The "public utilities" part of the GSA mission, which includes communications, did not involve operational programs; rather, it was devoted to managing the affairs of the executive agencies to insure more efficient and economical procurement and utilization of these services.[1]

In this role, GSA rendered technical advice and assistance to Government agencies, as requested, in the procurement and utilization of services and in making area-wide or individual agency contracts. It received and analyzed published rates paid by the Government and, where warranted, designed new rates as a basis for negotiations with companies concerned. Also, on behalf of Government agencies as users, GSA was a party to regulatory proceedings involving rates for communications services. Among these proceedings, for example, were those involving rates on the Air Force's Semiautomatic Ground Environment System (SAGE) project. By mid-1960, actions initiated by GSA in these proceedings resulted in annual savings of approximately $8 million in communications costs to the Government; and these were expected to increase to over $15 million upon completion of the SAGE project.[2]

Though helpful, GSA's efforts fell short of the need for improved management of Government telecommunications operations. A report by the Comptroller General of the United States in 1959, pointing up deficiencies in the use of leased private line telephone facilities in the DOD and selected civil agencies, prompted increased emphasis on a governmentwide approach to communications problems. The lack of coordination and the incompatibility of agency equipment and procedures not only meant waste of resources and needless expense, but compromised readiness for national defense. Operation Alert exercises in 1959 and 1960, led by the Office of Civil and Defense Mobilization (predecessor of the present Office of Emergency Planning), highlighted the inadequacies and brought recommendations for a unified communications system to increase the operational capabilities of the civilian agencies of the Government.

These developments set the stage for the establishment in 1961 of the Federal Telecommunications System (FTS) under GSA management, to serve the civil agencies of the Government with telecommunications services. The FTS was soon to become one of the major operating components of the National Communications System (NCS). In addition, by Executive Order 11093, dated 26 February 1963, the Administrator of General Services was directed to plan for and provide, operate and maintain appropriate telecommunications facilities to meet the essential administrative requirements of Federal civilian agencies during an

[1] U.S. General Services Administration, *GSA Services, 1958* (Washington: U.S. General Services Administration, 1958).

[2] U.S. General Services Administration, *Eleventh Annual Report of the Administrator of General Services*, 30 June 1960 (Washington: U.S. Government Printing Office, 1960), p. 40.

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emergency. This would be done in consonance with the standards and procedures prescribed for the NCS and within the framework of that system.[3]

The FTS links together the majority of civil departments and agencies. A complex of communications networks, equipment, centers, installations, and operating personnel within the United States, the system is administered by an Office of Communications in GSA's Transportation and Communications Service. That office establishes policies and procedures and issues directives governing the establishment and operation of the FTS. It leases commercial circuit facilities, equipment and services, designs rates and rate structures to meet Government requirements, and provides technical advice and testimony of expert witnesses in proceedings before Federal and State regulatory bodies. In emergencies the FTS will provide communications between the heads of the civil departments and agencies, their relocation sites, and their regional offices and field activities.

With the support of industry, GSA has proceeded to develop and install two basic FTS networks—a direct distance-dialing Voice Grade Network, and an Advanced Record System. The first, the world's largest private line switched-voice network, was placed in operation in 1963. Linking some 750,000 U.S. Government telephones in 8,000 Federal offices throughout the country, the network has more than 1.6 million circuit-miles and uses 9 major switching centers at strategic locations. The centers are interconnected in such a way as to permit automatic alternative routing in the event of overloading or failure of several centers. The connecting circuits also are diversely routed in order to provide dispersion in the event of attack.[4] Besides serving the Government's relocation requirements, the FTS is bringing substantial savings in communications costs. It is estimated that the Government can now place its long-distance toll business, over facilities leased from industry, at rates at least 25 percent below conventional commercial costs. Economies to the civil agencies are expected to approximate $15 million annually.[5]

The Advanced Record System is being installed to provide modern service in the transmission of teletype, data, facsimile and other record-type communications. The system combines the latest technologies of circuit and message switching and utilizes digital computers for process-

[3] Executive Office of the President, Office of Emergency Planning, ed., *The National Plan for Emergency Preparedness, December 1964* (Washington: U.S. Government Printing Office, 1964), p. 57.

[4] U.S. Congress, *Fourteenth Annual Report of the Activities of the Joint Committee on Defense Production* (House Report No. 1, 89th Cong., 1st Sess.; Washington: U.S. Government Printing Office, 1965), pp. 387–388.

[5] Robert B. Conrad, "Federal Telecommunications for the Civil Government," *Signal* (January, 1964), p. 14.

ing messages. The backbone of the system consists of 3 major switching centers. The system will provide both direct machine-to-machine (circuit switching) and message switching (delivery to processing centers) services. Special processing of messages, such as multiple address delivery, code, speed and format conversion, and necessary storage and queueing, can be accomplished at each of the major switching centers. To insure survivability and emergency service, switching and processing facilities are being located outside probable target areas; and arrangements are made for multiple and diverse circuit routing. Installation of the system began on a phased basis early in 1965. In its full development it will permit the integration of existing teletype and data networks into a truly unified system.

Looking beyond the operation of these two basic networks, GSA is exploring new concepts and techniques in governmental communications. It is experimenting with a mobile radio communications system, interconnected with the FTS voice network, in the many short-haul field activities of government agencies. Compatibility of all FTS and military system components, greater cross-utilization of leased circuitry, flat rate billing, electronic switching, transistorized repeaters, application of Time Assignment Speech Interpolation (TASI) and other time-sharing approaches to both record and voice networks; use of satellite communications in emergency programs; and application of laser techniques—all these are but illustrative of GSA's continuing interests and explorations in the progress of Government communications.

TELECOMMUNICATIONS FOR THE MILITARY ESTABLISHMENT

Telecommunications have been aptly characterized as the "nerve system" of national defense. For the military, communications can never be good enough. They are vital for strategic and tactical purposes; aboard ship, on the ground, and in the air; for interconnecting military headquarters, installations and activities throughout the country; for alerting forces thousands of miles away; for directing the defense of the Nation in case of attack. Whatever the medium—messages, signals, data, pictures, or just ordinary speech—telecommunications are the very lifeblood of the military forces. For them, security and control, operational reliability, and speed of service are of prime importance. Measured against full responsiveness to military requirements, the quest for economy of force or funds in communications, though important, can only be viewed as a secondary consideration.

Responding to the requirements of global operations, new weapons, and revised techniques of warfare, the military services during and since World War II developed worldwide networks of communications. With extensive and dependable commercial networks covering the length and breadth of the United States, the services have seen little need to construct, operate and maintain their own facilities; all rely almost completely on leased lines within the continental United States. Overseas, however, they own and operate more of their own facilities. This is done partly to insure effective support of their widely deployed forces and partly to insure the availability of communications where and when needed in war.

Though they might share or pool facilities in support of joint operations, the services traditionally viewed their telecommunications networks as integral elements of their respective commands, vital to the support of their unique worldwide missions. Following World War II, a Joint Communications-Electronics Committee of the Joint Chiefs of Staff sought to coordinate the telecommunications activities of the several services, but with little to show for its efforts. Repeatedly the question was asked: Would it not be more efficient and more economical to have one military communications system serving all the military services? The answer to this question was always in the negative; and the rationale was always in terms of the distinct missions and separate budgets and organizational structures of the departments and the need for tailoring their communications systems for the most effective command of their forces. About the end of 1953, Mr. Harold Botkin, then DOD consultant on communications problems, and later Assistant Director for Telecommunications in the Office of Defense Mobilization, had this to say about the different communications activities of the services:

> I wanted to point out these differences because a great deal has been said about duplication, and integration had been suggested as a possible economy move. Complete integration of communications, in my opinion, is no more practical for the three Services than integration of the communication facilities of three large industrial companies with separate managements.

Today the three services continue to operate and maintain their own strategic communications networks; but, since May 1960, they have been brought more closely together into a Defense Communications System (DCS) under the operational and management direction of a Defense Communications Agency (DCA). The principal networks in the DCS are: the Strategic Army Communications System (STARCOM); the U.S. Navy Communications System (NTX); and the U.S. Air Force Strategic Communications System (AIRCOM).

ARMY TELECOMMUNICATIONS

During World War I the Army Signal Corps established the first trans-Atlantic radio station. It was not until World War II, however, that the Signal Corps communications developed a truly global look. Out of the expansion and modernization dictated by the unprecedented wartime traffic requirements emerged the Army Command and Administrative Network (ACAN), with its hub, the Department of the Army Communications Center, located in The Pentagon and with many primary, major and minor relay stations and several hundred tributary stations scattered all over the world.[6] The responsibilities of ACAN have since been broadened and it is encompassed by the so-called Strategic Army Communications System (STARCOM).[7]

Currently, 8 primary and 34 major relay stations in the STARCOM System connect the Headquarters of the Department of the Army with major overseas and continental army organizations and other military activities. The relay stations provide central points to which various customers such as depots, transportation commands, supply points and other activities are connected. They also provide a capability to extend the STARCOM main line communications system to such troubled areas as Lebanon, Laos, and Viet-Nam. The long haul point-to-point radio, wire, and cable circuits which interconnect the relay centers consist of modern, high-speed, high traffic capacity facilities. Maximum use is made of the latest transmission techniques including both tropospheric scatter and ionospheric circuits. The majority of the facilities to overseas areas consist of Army-owned and -operated circuits; some are also leased from the commercial carriers.

The high degree of flexibility and reliability of the Army system has resulted in heavy dependence of other agencies on these facilities. In every crisis since World War II, including the Cuban crisis, the Army has been called upon to satisfy unforeseen and critical needs of the Department of Defense, the Department of State and the President. A contributing factor has been the unique quick reaction capability of the Army's Chief Signal Officer to "crash engineer" various types of communications systems for unique problems and to provide trained and equipped units to fulfill these requirements.

Early in 1964, the DOD announced a reorganization of the Army communication-electronics structure.[8] A Chief of Communications-Electronics (formerly the Chief Signal Officer) serves on the Army Special Staff with wide-ranging Army staff responsibilities: radio frequency spectrum and call sign management and utilization; the Army electromagnetic compatibility program; join actions pertaining to communications-electronics; and staff advice and coordination for communications, including pertinent communications security. He advises the Army staff on technical communications-electronics aspects of missile systems, audiovisual communications systems, aviation elec-

[6] Brig. Gen. Walter B. Larew, "World-Wide Communications for the Department of the Army," *Signal* (May–June, 1955), pp. 37–41.

[7] The discussion which follows is based upon a briefing by Lt. General Alfred D. Starbird and Colonel George Adams to an ICAF student committee studying the communications industry, 4 January 1963, and upon information provided by Harold Silverstein, Special Assistant to the Chief Signal Officer, and T. A. Riviere, OCSigO, 17 December 1962.

[8] DOD News Release 107–64, 5 Feb. 1964.

tronics, electronic warfare, fire coordination, combat surveillance and target acquisition, meteorology, and automatic data processing systems.

A U.S. Army Strategic Communications Command, has been established as a major field command of the Department of the Army, with appropriate headquarters staff elements and directorates and various major commands and activities in the continental United States and overseas. The Commanding General functions as principal U.S. Army manager for strategic communications, with the following mission:

1. Function as principal U.S. Army manager for that portion of the Defense Communications System for which responsibility has been assigned to the United States Army (identified by the term "DCS (Army)", including extensions and restorations;
2. Establish, engineer, install, and operate the DCS (Army);
3. Provide engineering, installation and technical support services, as required, for non-DCS communications; and operate non-DCS communications as assigned;
4. Provide central direction and coordination of the leasing of communications for the Army;
5. Provide radio propagation information to the military services as directed; and
6. Except as assigned to the Commanding General, U.S. Army Materiel Command, exercise commodity management of communications security logistics.

In brief, he directs and controls those Army telecommunications elements which operate strategic radio, wire, and cable facilities, and is the principal Army point of contact for coordination of communications operational matters with the Defense Communications Agency.[9]

The Army's broad spectrum of responsibilities has created requirements for massive improvements in telecommunications capabilities. Advances in combat and service support communications, although unheralded, have in many cases been far more dramatic than those in strategic telecommunications functions. The Army in the field has been provided with signal equipment and personnel capable of supporting a timely and varied response to a wide variety of tactical situations, ranging from counterinsurgency operations to the nuclear battlefield. Reliable, rapid and secure communications have been provided to an unprecedented degree. Recent developments include new and improved lightweight field wire and cable, higher powered, lighter weight radios for all elements from the platoon to the field army, and high channel capacity radio relay systems capable of installation in a matter of minutes. The extensive reliance placed upon an area-type communications system in which long-lines support is provided to all users in a given area has added greatly to the flexibility of modern Army forces.

[9] Army Regulation No. 10-18, approved by the Chief of Staff on 27 August 1965, sets forth the mission and principal functions of the U.S. Army Strategic Communications Command and prescribes its relationships with higher and collateral echelons; *see also* U.S. Army Strategic Communications Command Regulations 10-1, 15 July 1965.

Equally spectacular have been the advances in combat area surveillance. Items now found in Army units range from portable radar sets which can detect enemy movements for the rifle company commander to highly sophisticated reconnaissance drone aircraft which can provide *real-time* information of the enemy through the use of telemetry. Tactical elements are also engaged in increasingly important automatic data processing activities which cover the entire gamut of Army operations from operations centers to the processing of requisitions.

Improvements in command and control of communications have been marked by an increased number of communications-electronics personnel at all echelons. For example, the signal company of the infantry division familiar to World War II and Korean War veterans has now been replaced by a signal battalion. Although the signal unit at Corps level is still a Battalion, the Field Army now has not one, but two Signal Groups.

The support of Military Assistance Advisory Groups, military missions and other commands has also required increased numbers of signal personnel. In the current confrontation against forces of the Sino-Soviet bloc, communications elements provide continuous and effective support. For example, the small team of U.S. military advisers on the islands of the Quemoy complex have long been supported by an element of the U.S. Army Communication Detachment of Taiwan. Although only a handful in number, they have continued to provide a high level of communications service even under fire from Chinese Communist artillery.

NAVAL TELECOMMUNICATIONS

Telecommunications is "the voice of naval command." [10] It permits naval commands to communicate with one another over distances ranging from a few yards to thousands of miles. Its primary function is to furnish reliable, secure, and rapid communication service for the use and control of the Naval Operating Forces. The successful conduct of modern warfare is possible only when communications function to carry the orders to operating units and keep the force commanders informed of the progress and effectiveness of operations. The advent of atomic weapons alone involves wide dispersion of forces and greater necessity for rapid dissemination of combat information. These factors place greater emphasis on reliable communications. U.S. Naval Communications is under the direction of an Assistant Chief of Naval Operations who also serves as Director of Naval Communications. It is his responsibility to provide and maintain reliable and secure communications to

[10] Cdr. A. E. Baughman, "Communications—The Voice of Naval Command," *Signal* (May–June 1955), pp. 17–19. The discussion which follows is based upon this article and is supplemented by information supplied by David Meier, U.S. Navy, 31 July 1963.

meet the needs of the Naval Establishment. To carry out this mission the Director maintains and operates the Naval Communications System. The system consists of the essential shore facilities and services required to provide communications support for the Naval Operating Forces, the Navy Department and the Naval Shore Establishment.

The organizational structure of the Naval Communications System provides that primary communication centers be located throughout the world to furnish complete radio coverage of the major portion of the world's strategic ocean areas. These centers maintain broadcast delivery of messages to all naval ships in the ocean area which each station serves; high frequency ship-to-shore circuits; and radio teletypewriter and radio telephone circuits for use by fleet or force commanders or for linking the primary centers.

Relay stations are established at each of the primary communications centers. The various naval districts tie into these relay stations, either by landline or by radio teletypewriter trunk circuits. Each continental naval district has a major relay station and is connected to Washington or San Francisco by direct wire circuits. Relay stations outside the continental limits feed into primary stations by radio teletypewriter. Minor and tributary stations are established within each naval district when the volume of traffic justifies the arrangement.

The Navy utilizes commercial radio, television, cable, telephone, and telegraph communications when naval communications facilities are not available or do not suffice in a particular situation. During a national emergency heavy reliance will be placed on the commercial communication companies to supplement existing naval communication facilities. Such utilization of commercial facilities will be subject to executive order by the President, and will be effected in accordance with prescribed emergency allocation procedures.

Many aspects of communications in the Navy are basically the same as those of any large organization. However, because fleets, shore stations, and aircraft are involved there are certain distinctive features of naval communications. Fleet communications have special problems with regard to equipment. Conditions of gunfire shock, humidity, extremes of temperature, and the effect of salt air, all place severe demands on communications equipment afloat. At the same time absence of units from permanent repair facilities makes the factors of reliability and long life particularly important.

Because of the almost continuous use to which shipboard equipment is subjected, easy maintenance is vital. Furthermore, this maintenance also must be handled by repair men of only moderate skill. Standardization of parts and equipment has aided in the solution of this problem. This has also been beneficial in space and weight considerations, which are always important aboard ship. In addition to ease of maintenance, ease of operation is most desirable. The latter quality reduces the requirements of training of operating personnel and even permits use of equipment by non-communications personnel.

Worldwide naval operations require a worldwide communications network. The Navy has key shore-station components in operation in such widely dispersed locations as Eritrea (bordering Ethiopia in East Africa), the Canal Zone, Guam, the Philippines, Puerto Rico, Japan, Iceland, Northern Ireland, Morocco and Spain, as well as the States of Alaska, Hawaii, California, Washington, Maine, Rhode Island and Virginia, and the Washington, D. C. area. A new $74 million station in Western Australia, scheduled for completion in 1966, will provide improved coverage for Allied surface ships and submarines over a wide area of the Indian Ocean and the Western Pacific. A very low frequency (VLF) transmitting station at Cutler, Maine, is the most powerful radio complex ever built, with a tested power rating of two million watts.

The "broadcast" method is used for communication with fleet units. Radio messages are transmitted simultaneously on several frequencies to provide a high probability of receipt of the message. For communications purposes, the more than 800 commissioned ships in today's Navy may be regarded as steel-encased radio stations, operating in environments seldom conducive to good communications. Shore-based radio must reach these radio stations afloat, wherever they are. This must be accomplished without the aid of the highly efficient directional antennas used on point-to-point circuits, and with a variety of means of transmission.

The Navy has placed increasing emphasis upon speed of communications, and great strides have been made in improving rapid transmission. In 1960, the U.S. SIXTH Fleet had succeeded in relaying a message around the world in 15 minutes, with various ship and shore communications activities participating in the test. That same year the USS NORTHAMPTON, which has been designated as a National Emergency Command Post Afloat for high ranking government officials, sent a radioteletypewriter message around the world in two seconds, with the aid of nine participating shore units. By 1962, the NORTHAMPTON was able to better her own record by sending a message around the world via six Navy relay stations for receipt back on the ship in 0.8 seconds. This record was soon shattered by the USS PROVIDENCE, testing newly installed multi-channel teletypewriters; a message from the PROVIDENCE went around the world in less than 0.5 seconds.

In addition to global strategic networks, special ship-to-shore, shore-to-ship and ship-to-ship networks are in operation for selected units of the fleet. These special networks serve not only U.S. forces, but also special allied (NATO and SEATO) operations.

Operations of the SIXTH Fleet provide a representative example of the magnitude of these facilities. This fleet consists of more than 50 ships, 25,000 men and 200 aircraft. It is divided into three forces—an Attack Carrier Force, an Amphibious Force and a Service Force. Heavy communications traffic is common in commanding and controlling this diverse fleet. More than 1,000 messages are handled each day aboard the flagship. A network of single and multichannel radioteletypewriter circuits, some cryptographically secure, link the fleet commander with his superior headquarters and subordinate task forces. During fleet operations when movements must be concealed, a cryptographically secure broadcast network provides the fleet with tactical and administrative directions. Task force directives are delivered within the force by the use of aircraft equipped with UHF relay equipment. When concealment is not important, long-range single sideband transmitters link the force's units.

The Navy also makes use of more sophisticated Space Age communications techniques. For example, the Communication Moon Relay (CMR) system utilizes the Moon as "the least expensive communications relay satellite known to man." First demonstrated in 1960 after development by the Naval Research Laboratory, the "Moon-bounce" system is used operationally for traffic between Washington, D. C. and Hawaii, when the Moon is visible at both terminals. Since the ultra high frequencies used in the system are not normally affected by solar and ionospheric disturbances, CMR is almost completely reliable. In December 1961, the Navy conducted its first demonstration of shore-to-ship message traffic by Moon relay, and in March 1962, a follow-up experiment showed the feasibility of ship-to-shore Moon relay message transmissions.

The Navy's Microwave Space Relay (MISER) program has the threefold purpose of extending moon relay service to include ship-to-shore and shore-to-ship circuits, adapting the operational concept to other passive reflectors such as balloon-type satellites, and applying similar techniques to active repeater satellites as they become available. The active satellite of principal interest is the one to be developed by the Department of Defense under the medium altitude communications satellite program. The USNS *KINGSPORT* was converted from a cargo ship in 1962, to become the world's first satellite communications ship. A newly established U.S. Naval Research and Development Satellite Communications Group has been assigned to KINGSPORT to operate the complex equipment installed to track, send messages to, and receive data from, communications satellites.

Other developments in naval communications highlight the growing emphasis on the mobility and survivability of seaborne communications as an integral part of modern command control concepts. Whatever the technological complexities, the primary mission of naval communications remains, in substance, simple and constant. The commander must be able to communicate whenever he needs to, in any mode, between and among ships separated by varying distances, and from ships to and from selected shore stations, aircraft and satellites. He must be able to do this in a rapid, secure and utterly reliable manner, despite any kind of disruption. It is this capacity that enables the Navy and the Nation's overall defense structure to realize the fullest potential of seaborne mobile forces under any and all hazards of war, under conditions of impending war, and through the full spectrum of crisis and involvement.

AIR FORCE TELECOMMUNICATIONS

The Air Force has long followed the broad policy objective of integrating all of its communications facilities, except tactical, into one system. Improved, expanded and consolidated systems have been dictated by the rapid advancement and complexities of our global Air Force. The development of high-speed, long-range aircraft with the accompanying increase in personnel, numbers of aircraft, and density of new bases throughout the world creates some of these requirements. In addition, the expansion in scope and mission of the aircraft, crews, associated equipment, and support facilities have further complicated the task of providing fast, accurate, standardized, and flexible communications. The facilities which constitute the system must be flexible, so as to support not only present operations of the Air Force, but also the capabilities required under emergency conditions.[11]

Under this concept, the United States Air Force Strategic Communications System (AIRCOM) has emerged as a worldwide, long-range, point-to-point, and air-to-ground communications system. AIRCOM is designed to provide efficient and effective control of air operations and an overall system of operational, logistical, and essential administrative communications. The system is not so much an operating network as it is an integration and alignment of other, smaller networks, under the Air Force Communications Service and major air commands. AIRCOM support facilities constitute the backbone of the entire system. These consist of transmission systems, relay stations, technical operation facilities, and tributary stations. The AIRCOM stations in which these supporting elements are incorporated are strategically located worldwide, and component networks draw on these elements for communications circuits and facilities. The following are among the major AIRCOM components:

USAF Communications Network (AIRCOMNET)—a worldwide integrated teletype, tape relay network designed to carry Air Force command and

[11] Col. George Higginson, "USAF Strategic Communications System," *Signal* (May–June 1955), pp. 32–35, 125–126.

administrative messages. The AIRCOMNET consists of leased commercial radio and wire circuits; leased commercial teletype reperforator switching equipment which is Air Force operated; Air Force-owned and -operated teletype and radio facilities, and U.S. Army and Navy radio and wire circuits allocated for Air Force use. AIRCOMNET facilities are available to all agencies of the Department of Defense on a common-user basis and to some other Government agencies.

Air Operational Network (AIROPNET)—the primary carrier of air operational teletype traffic. AIROPNET handles flight service and other aircraft movement messages on a global scale. An integration of the old Flight Service Communications System and the MATS Private Line Network, AIROPNET is an integrated network of leased teletype circuits connecting using agencies.

USAF Air-to-Ground Communications Network—an extension of AIRCOM for handling air/ground voice traffic. Primarily a radiotelephone network, it may be used for limited continuous wave operation and is planned for teletype operations. This global system provides the link between ground stations and airborne stations to pass tactical, strategic, and traffic control information and instructions between command posts, operational bases, air traffic control centers, and aircraft.

USAF Weather Communications—include Weather Teletype, Facsimile, and Global Weather Intercept and Broadcast Networks seeking the achievement of an "all-weather" Air Force. All are closely interrelated to provide for interchange of weather data around the world. Weather relay centers are located near weather centrals worldwide, and are also located with AIRCOM stations wherever possible. Tributary terminals are located at each base operations point or at points of special requirements.

EMATS-AF—an automatic system designed to transmit vital standardized messages on the highest priority basis to designated addresses. This functional network has an automatic circuit-seizing capability.

AFDATACOM Phase I (COMLOGNET)—an AIRCOM common-user and functional network. It provides the Defense Communications Agency with a high speed, high capacity communications system for logistical, operational, and statistical data generated through electronic data processing equipment and other sources. Terminals are normally located at local communications centers.

Strategic Air Command Communications—consist of various teletype, telephone, radio, primary alerting, and tactical air/ground networks or subsystems, to provide close-knit command and administrative control of bases in overseas theaters and within the United States. Each is part of the overall Air Force Strategic Communications System and follows the standard operational procedures specified for the system.

Air Defense Command (ADC) Communications Networks—consist of 6 specialized networks: North American Air Defense Command (NORAD)/ADC Surveillance Teletype Network; NORAD/ADC Alert Number 1 Teletype Network; NORAD/ADC Command Telephone Network; NORAD/ADC Space Detection and Tracking System; and NORAD/ADC Ballistic Missile Early Warning System (BMEWS).

Air Force Logistics Command (AFLC) Communications Networks—primarily for handling traffic peculiar to the requirement of the AFLC mission. They consist of 3 separate networks: AFLC Communications Network for command and administrative type traffic; AFLC Site Communications

Network for operational-type traffic; and AFLC Logistics Air Network for traffic in support of LOGAIR transportation service.

USAF Security Service Network—a worldwide network of crypto-secured teletype and data circuits established for the transmission of intelligence to and between intelligence gathering and processing agencies. Relay stations and circuit terminals are located in secured, limited access areas.

Alaskan Air Command Communications—include the Alaskan Communications System, White Alice Communications System, and BMEWS Rearward Long-Lines System.

Military Air Transport Service (MATS) Communications—composed of MATS Command Teletype, Operational Voice, and Facsimile Circuits. These three networks are primarily for meeting the demands of the MATS Transport Control System.

Tactical Air Command (TAC) Communications—teletype and telephone circuits connecting TAC Headquarters and TAC COMBAT Operations Center with subordinate units, NORAD, and Reserve Forces. The system includes an air/ground radio network, and is designed for emergency use and rapid expansion.

Pacific Air Forces (PACAF) Communications—include the following primary networks: PACAF Control Teletype Network; PACAF Defense Teletype Network; PACAF Long-Haul Voice Capabilities Network; and PACAF Commanders' Single Side Band (SSB) Network.

U.S. Air Forces, Europe (USAFE) Communications—include the following primary networks: USAFE Command and Control Network; USAFE Tactical Network; USAFE Air Traffic Control and Flight Service Networks; USAFE Command Administrative Telephone and Radio Telephone Networks; and USAFE Radio Relay System.

The AIRCOM thus presents an imposing array of global communications systems and facilities. Stations are located in 38 different countries. The AIRCOMNET alone includes over 4½ million miles of leased circuits, not to mention the millions of miles of Government-owned circuits. One airman out of eight is directly involved in a primary communication-electronics job; thousands more are involved in the support of telecommunications functions. Financial support of Air Force communications runs into hundreds of millions of dollars annually; in FY 1962 the Air Force budget for leased circuit costs alone amounted to $168 million.

Over the years the Air Force has sought to develop its communications system so that it can be usefully employed in peacetime and have the flexibility and high capacity to meet the impact of increased demands at the onset of an emergency. A continuing AIRCOM objective is to keep pace with ever-changing operational concepts and support requirements. Achievement of this goal requires a concerted effort in research and development. The Air Force Systems Command (AFSC) is responsible for the major portion of this effort. The AFSC performs necessary research and development to improve the functional quality of communications-electronics materiel and recommends adoption of new or improved devices and procedures to meet Air Force requirements.

It also conducts necessary tests to determine the operational suitability of equipment and accomplishes standardization to improve Air Force communications.

Air Force communications further require extensive, efficient, and quick-reacting logistics support. Such support is the responsibility of the Air Force Logistics Command (AFLC). The AFLC effects the necessary procurement, supply and maintenance of Air Force communications. A Ground and Electronics Engineering and Installation Agency under the AFLC is responsible for engineering and installation of ground communications facilities.

THE DCS AND DCA

The expanding and separate telecommunications operations of the services brought persistent White House and congressional concern over mounting costs and possible duplication. Although each system had been established to meet a specific need, all competed for the same radio frequencies, the same channels in overseas cables, and the same dollars to support long-lines and terminal equipment of endless variety. Maintenance of these military communications complexes was becoming extremely expensive, and estimated costs of further improvements which each service desired were prohibitive. It was almost impossible to sort out the numerous proposals, to establish their relative urgency, or to select the projects that would provide the most communications for the fewest dollars. For lack of coordination the military services, like the civil agencies, were leasing commercial circuits unilaterally and without the benefit of lower rate advantages available for volume service under FCC tariffs.[12] A central control would not only bring lower rates from commercial carriers, but would yield economies in the development, construction and operation of new military facilities, would help relieve an overcrowded radio spectrum, and would foster compatibility of equipment and procedures.

Under these pressures, the Secretary of Defense issued a policy statement in 1957, establishing as an objective "to assure an integrated telecommunications system composed of inherently compatible elements that will economically, efficiently and effectively satisfy National Defense requirements." [13] Over the ensuing 3 years many divergent interservice, JCS and OSD views were presented and exchanged on the

[12] Comptroller General of the United States, *Report to the Congress of the United States—Review of Management of Leased Private Lines Telephone Facilities in the Department of Defense and Selected Civil Agencies* (Report No. B-133201; Washington: General Accounting Office, 24 Nov. 1959).

[13] DOD Directive No. 4600.1, 23 March 1957, subject: Telecommunications Policy and Objectives.

achievement of this objective. From this "cauldron of debate" the DCS and DCA emerged.[14]

The DCS and DCA were established by two directives dated 12 May 1960.[15] After a period of trial and error, these directives were cancelled, and a single new directive ensued 14 November 1961, that took advantage of all experience factors up to that time.[16] The latter directive defines the DCS as "the worldwide complex of Department of Defense communications networks, equipments, control centers, operating personnel, installations, and other related activities, facilities, and resources organized into a single, compatible, long-haul, point-to-point, communications system." Specifically, the DCS includes the following:

a. All DOD worldwide, long-haul, Government-owned and leased, point-to-point circuits, trunks, terminals, switching centers, control facilities and tributaries, required to provide communications: (1) From the President to and between the Secretary of Defense, the Joint Chiefs of Staff and other governmental agencies, as directed; (2) From the Secretary of Defense and the Joint Chiefs of Staff to and between the military departments and the unified and specified commands; (3) From the military departments to and between the fixed headquarters of their major commands and to and between the fixed headquarters of their subordinate commands, as directed; (4) From the unified and specified commands to and between the fixed headquarters of their component and other subordinate commands, as directed.

b. In those instances when the President, the Secretary of Defense, the Joint Chiefs of Staff, and/or the unified and specified commanders maintain alternate fixed or mobile communications facilities on land, sea, or in the air, all those communications facilities required to interconnect the alternate facilities to fixed DCS facilities.

c. All point-to-point circuits, trunks, loops, terminals, communications facilities and technical control elements required to: (1) Provide telecommunications to support the Joint War Room, the Alternate Joint Communications Center, and other similar activities as designated; (2) Provide telecommunications to the alternate headquarters and emergency relocation sites of the military services and the fixed headquarters of their major and subordinate commands; (3) Provide telecommunications to allied commands when and as directed; (4) Provide telecommunications to other governmental and non-governmental agencies as directed.

d. Those portions of tactical circuits and weapon systems circuits which are long-haul, point-to-point, and which can be provided by the Defense Communications System.

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[14] Col. David R. Grey, USA, "An Analysis of Strategic Communications Concepts for Modern Warfare" (Thesis M63–64; Washington: U.S. Industrial College of the Armed Forces, March 1963); Col. Blaine O. Vogt, USA, *The Defense Communications Agency: Single Management of the Defense Communications System* (Thesis M63–6; Washington: U.S. Industrial College of the Armed Forces, 1963); *see also* Col. William C. Golladay, USA, "A National Communications System—A Management View" (Thesis M65–55; Washington: U.S. Industrial College of the Armed Forces, 12 March 1965).

[15] DOD Directive No. 4600.2, 12 May 1960, subj: Defense Communications System, and DOD Directive No. 5105.19, 12 May 1960, subj: Defense Communications Agency.

[16] DOD Directive No. 5105.19, 14 November 1961, subj: Defense Communications Agency (DCA).

e. Those communications facilities which are used to extend or restore components of the Defense Communications System, or to provide access facilities for other systems as required.
f. Such other communications circuits, facilities, and activities as may be assigned to the DCS.

Except as stipulated above, the DCS does *not* include: tactical communications which are self-contained within tactical organizations; self-contained information gathering, transmitting and/or processing facilities which are normally local in operation and use; land, ship, and airborne terminal facilities of broadcast, ship-to-ship; ship-to-shore, and ground-air-ground systems; or intra-site communications for command, count-down, range safety, and weapon destruct at missile and air defense launch and firing complexes.

It fell to the DCA, an agency of the DOD under the direction, authority and control of the Secretary of Defense, "to insure that the . . . DCS will be so established, improved, and operated as to meet the long-haul, point-to-point telecommunications requirements of the Department of Defense and other governmental agencies as directed." More specifically, DCA is responsible for: (1) the operational and management direction of the DCS; (2) systems engineering and technical supervision of the implementation of technical support for the recently formalized National Military Command System and of each related system; and (3) the integration between the ground and space borne elements of defense communications satellite systems and between these systems and the existing and expanding global DCS in order to ensure compatibility of satellite equipments and their counterparts on the ground and of such ground equipment with the elements of the DCS. The agency is organized into Headquarters, DCA command elements acting for the Director in their assigned geographical areas of responsibilities, the White House Communications Agency, the Defense Commercial Communications Office, the National Military Command System Support Center, and certain designated field offices.[17]

The initial 12 May 1960 directive establishing the DCA had charged that agency with "operational control and supervision" of the DCS. This proved to be inadequate, and the 14 November 1961 directive introduced two new terms—"operational direction" and "management direction"—each sufficiently definitive to strengthen DCA's role. Operational direction is defined to mean "the authoritative direction necessary to obtain and effectively operate a single long-line, point-to-point communications system for the Department of Defense. It includes, but is not limited to, authority to direct the operating elements of the Defense Communications System, to assign tasks to those elements, to prescribe the manner in which tasks will be performed, and to supervise the execution of

[17] *United States Government Organization Manual 1964–65*, Revised June 1, 1964, p. 201.

those tasks." Management direction is defined to mean "the coordination and review and, within approved programs, the continuing guidance and supervision necessary to accomplish the mission." Such operational and management direction places upon the DCA vast-ranging responsibilities relating to the operation of DCS facilities and resources. These also relate to those research and development planning, engineering, programming and budgetary activities of the military departments, unified commands, and other DOD agencies which directly support the establishment and progressive improvement of the DCS.

Briefly, through its operation of communications control centers, the DCA maintains control over the activities and facilities comprising the DCS. It recommends to the Secretary of Defense the assignment to the military departments of responsibility for providing, operating, and maintaining components of the system. It issues instructions to the departments regarding the operation and maintenance of these components, and prescribes the procedures, principles, standards and practices to be followed. DCA directs the consolidation, expansion, improvement and elimination of facilities, allocates resources to users of the system, and supervises the restoration and reallocation of circuits and channels. It develops plans and programs for the entire system, including provision for emergencies and for the adoption and integration of new modes and techniques of communications.

The responsibility for implementing approved plans rests with the military departments. With them remains the accomplishment of the detailed system engineering, the determination of requirements, the research and development, and the funding, building and operation of their respective component elements of the DCS. To insure effective integration and standardization, however, the DCA supervises the performance of these functions. Contracting for commercial services and equipment is centralized in DCA, thus enabling the departments to take advantage of reduced rates for large volume requirements.

The chain of command runs from the Secretary of Defense through the JCS to the DCA Director, a military chief of general or flag rank. The DCA itself is jointly manned, with uniformed personnel equally balanced as to the military departments. In discharging the agency's responsibilities, the DCA Director and his designees enjoy direct and unrestricted access to all elements of the DOD and the national communications community.

From a practical point of view, the development of the DCS could only be evolutionary. Integration of traditionally unilateral communication systems, involving over 10 million voice and teletypewriter channel-miles and a plant which cost approximately $2 billion to build and over a half-billion dollars annually to operate and maintain, presented a formidable challenge. The task was rendered all the more diffi-

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cult by ongoing system sophistications and equipment and procedural incompatibilities in the service components of the DCS. The system encompassed strategic, not tactical communications, but the line between the two could not always be sharply drawn. For all intents and purposes, the DCS/DCA complex was "a confederacy of organizations and systems." With each department budgeting for, operating and maintaining designated portions of the DCS, some felt, the actuality of single managership might be illusive.

In these circumstances, it was clear that the DCA, particularly at the outset, "had its work cut out just to gain recognition and assume a telling role." [18] The philosophy of individual service networks, bolstered by ownership of the plant and control of the purse strings, could not easily be supplanted. Yet, for all the outstanding problems and unresolved questions, the DCA took shape rapidly and with encouraging results. Accelerated integration of the system within the continental United States alone brought a $12 million reduction in the FY 1963 budgets of the military departments. Consolidation of the Army Switched Circuit Automatic Network (SCAN) and a similar Air Force system, the channelizing of leased voice communications between Hawaii and the mainland, the continuing review of allocated channels, the establishment of a central point for leasing circuits, and the negotiation of reduced tariff rates—these were but a few of the many gains to which the DCA could point early in its career. As put by one student of the agency in the spring of 1963—

> . . . The impact of the DCA to date can be measured in improved service to the DCS users. Complaints may be heard at all levels, but the quality of personnel provided by the services to the DCA activities attests to underlying, if not outspoken, acceptance of the concept. Certainly, no command mission has suffered because of the DCA's control of communications. On the contrary, evidence of rapid response to emergency situations is a matter of record.[19]

While the agency has not had consistently smooth sailing, it has forged ahead toward the attainment of its objectives—the eventual consolidation or interconnection of the major military communications networks all over the world. With the benefit of hindsight, it is now clear that the trend toward integration of defense communications was irrepressible. The same people who had looked askance at the DCS/DCA setup were soon to witness an even more imposing alignment—the pulling together of all major governmental communications, military and civil, into a single National Communications System.

[18] Vogt, *op. cit.*, p. 9.
[19] *Ibid.*, p. 34.

THE NATIONAL COMMUNICATIONS SYSTEM

TELECOMMUNICATIONS UNDER SINGLE MANAGEMENT

The NCS came into being in August 1963, some 10 months after the Cuban missile crisis pointed up the need for still further unification of governmental telecommunications. In a broad sense, the underlying reasons for the NCS are more complex and more longstanding than that crisis; they go back to 1945, when atomic weapons were added to the military arsenal. Increasingly since then, the Nation's security and leadership in the world have come to depend on its ability to react to crises in a timely and responsive manner. Minimal reaction time and, therefore, a high degree of system readiness have become paramount considerations in national security planning. Repeatedly international crises—in Korea, Formosa, Lebanon, the Congo, Berlin, Cuba, Vietnam, the Tonkin Gulf—have demanded of the President a careful consideration of alternative courses of action. Each decision regarding face-to-face confrontation with enemies of the Free World has had to be weighed against possible escalation of a crisis into the holocaust of nuclear war.

In the exercise of this awesome responsibility, the President must have "a capability for crisis management"—a term which the Defense Secretary's Assistant for the NCS defined as—

> . . . the capability which will allow the President to keep even an extensive and long-lasting international crisis from exploding into war, without relinquishing objectives. This requires quick response, continuous and reliable worldwide communications that are survivable, adequate, politically usable and which will function during periods of high tension without serious degradation.

Traditional concepts of command and control could not be followed when information had to flow to and from the bridge of a destroyer and the "Crisis Managers" in the Nation's command posts. In the nuclear age improved, rapid and secure telecommunications hold the key to the effectiveness of the President and his Crisis Managers as "hot spots" appear and present one crisis after another for decision.[20]

As indicated earlier, progressive steps had been taken over the years to attain the requisite communications capability. To meet their heavy global commitments after World War II, the military services developed worldwide strategic networks; and these were brought into the DCS, with the DCA guiding the establishment and modernization of the system and managing its use. On the civil side of the Government, the need for improved and more economical communications support brought a grouping of the majority of the civil agency systems into the FTS under GSA management. At the same time, however, a number of major worldwide networks, notably those of NASA, FAA, and the State De-

[20] Solis Horwitz, "National Communications for the Nuclear Age," *Signal* (July, 1964), p. 34.

partment, and the small but vital networks of many other civil agencies remained under independent management.

The Cuban missile crisis of October–November 1962 brought home the need for further coordination of governmental communications if the urgent requirements of the nuclear age were to be adequately met. In this instance rapid communications were instrumental in averting possible war. But the experience brought out certain weaknesses in Federal communications, and underscored the intimate relationship between military and civil agency systems, especially during emergencies. The deficiencies were highlighted in a report by a special task force headed by William H. Orrick, Jr., then Deputy Under Secretary of State for Administration, whose department experienced particular difficulty with its communications. To achieve the necessary coordination of the Government's telecommunications resources, the Orrick Committee recommended the establishment of a single system that would cut across the agency lines and thus insure greater responsiveness to the requirements of Crisis Managers.[21]

ESTABLISHMENT OF THE NATIONAL COMMUNICATIONS SYSTEM

In a memorandum to the heads of Executive departments and agencies, 21 August 1963, President Kennedy pointed to the need for "a unified governmental communications system" in order to "strengthen the communications support of all major functions of government." Accordingly, he directed the establishment and development of a National Communications System "by linking together, improving, and extending on an evolutionary basis the communications facilities and components of the various Federal agencies." The directive set forth the following objectives for the system: (1) "to provide necessary communications for the Federal Government under all conditions ranging from a normal situation to national emergencies and international crises, including nuclear attack"; (2) "to be responsive to the variety of the national command and user agencies and be capable of meeting priority requirements under emergency or war conditions through use of reserve capacity and additional private facilities"; and (3) to provide "the necessary combinations of hardness, mobility, and circuit redundancy to obtain survivability of essential communications in all circumstances."

In developing the NCS, the President indicated, initial emphasis would be placed on meeting "the most critical needs for communications in national security programs, particularly to overseas areas." As rapidly as was consistent with meeting these needs, other governmental require-

[21] U.S. Congress, House Committee on Government Operations, *Satellite Communications—1964 Hearings before the Military Operations Subcommittee*, Part I, (88th Cong., 2d Sess.; Washington: U.S. Government Printing Office, 1964), pp. 352–358; *see also* the Subcommittee's *Satellite Communications* report of October 1964, pp. 81–82.

ments would be examined and satisfied as circumstances may warrant. The extent and character of the system would be carefully considered in light of the priorities of need, the benefits to be obtained, and the costs involved. A complete definition of the NCS could not be made "in advance of design studies and evolution in practice." It was generally conceived, however, that the system would consist primarily of the long-haul, point-to-point trunk communications which can serve one or more agencies.[22]

Responsibilities for the establishment and operation of the NCS were to be shared by the Executive Office, the Secretary of Defense as "Executive Agent," and by the Administrator of General Services as manager of the FTS. The Director of Telecommunications Management in the Office of Emergency Planning was made responsible for "policy direction" of the development and operation of the NCS. In this capacity, he also serves as Special Assistant to the President for Telecommunications and is to—

> (a) Advise with respect to communications requirements to be supplied through the NCS; the responsibilities of the agencies in implementing and utilizing the NCS; the guidance to be given to the Secretary of Defense as Executive Agent for the NCS with respect to the design and operation of the NCS; and the adequacy of system designs developed by the Executive Agent to provide, on a priority basis and under varying conditions of emergency, communications to the users of the NCS.
>
> (b) Identify those requirements unique to the needs of the Presidency.
>
> (c) Formulate and issue to the Executive Agent guidance as to the relative priorities of requirements.
>
> (d) Exercise review and surveillance of actions to insure compliance with policy determinations and guidance.
>
> (e) Assist the President with respect to his coordination and other functions under the Communications Satellite Act of 1962 as may be specified by executive order or otherwise.

In performing these duties, the Special Assistant to the President for Telecommunications works closely with other Presidential staff elements; arranges for interagency consultations; and carries on the work of the National Security Council's Subcommittee on Communications (which the President has now abolished). In addition to regularly assigned staff, the Special Assistant arranges for the detail or temporary assignment of communications and other specialists from any agency.[23]

To obtain the benefits of unified technical planning and operations, the President saw the need for a single Executive Agent for the NCS,

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[22] White House Memorandum, 21 August 1963, subj: Establishment of the National Communications System, 28 *Federal Register* 9413.

[23] At the time of the President's directive, the position of Director of Telecommunications Management was vacant. Pending the appointment of a new Director, Dr. Jerome B. Wiesner, the President's science adviser, was designated to perform the functions pertaining to the NCS. In April 1964, President Johnson named Lt. Gen. James D. O'Connell, retired Army Chief Signal Officer, to fill this post and that of Special Assistant to the President for Telecommunications.

and he placed this responsibility on the Secretary of Defense. In this capacity, the Secretary of Defense would—

(a) Design, for the approval of the President, the NCS, taking into consideration the communication needs and resources of all Federal agencies.

(b) Develop plans for fulfilling approved requirements and priority determinations, and recommend assignments of implementation responsibilities to user agencies.

(c) Assist the user agencies and the General Services Administration with respect to the Federal Telecommunications System to accomplish their respective undertakings in the development and operation of the system.

(d) Allocate, reallocate, and arrange for restoration of communications facilities to authorized users based on approved requirements and priorities.

(e) Develop operational plans and provide operational guidance with respect to all elements of the NCS, including: (1) the prescription of standards and practices as to operation, maintenance, and installation; (2) the maintenance of necessary records to ensure effective utilization of the NCS; (3) the request of assignments of radio frequencies for the NCS; (4) the monitoring of frequency utilization; and (5) the exercise and test of system effectiveness.

(f) Within general policy guidance, carry on long-range planning to insure the NCS meets future Government needs, especially in the national security area, and conduct and coordinate research and development in support of the NCS to ensure that the NCS reflects advancements in the art of communications.

The Secretary of Defense could delegate these functions within the DOD, "subject at all times to his direction, authority, and control." In executing his responsibilities for design, development and operation of the NCS, the Secretary was to make appropriate arrangements for participation of staff of other agencies.

The FTS, established two years earlier to provide communications services to certain agencies in the 50 States, the Commonwealth of Puerto Rico and the Virgin Islands, was to be part of the NCS. Its development and implementation was to be in accordance with approved plans and policies designed pursuant to this White House memorandum. The Executive Agent and the GSA Administrator would arrange to avoid duplication in requests for cost, traffic, and other information needed from agencies served by the FTS. The President directed all agencies to "cooperate with and assist the Special Assistant to the President for Telecommunications, the Executive Agent, and the Administrator of General Services in the performance of the functions set forth above."

The vehicle for central management and control of the Government's telecommunications resources for national security was thus launched. The task was monumental in scope. Like the DCS, the NCS was to be developed not as a single integrated system, but as a confederation of the major governmental networks, essentially those of the DCS, FTS, NASA, FAA, and the State Department. Included are some 30 million channel-miles of circuitry, about half Government-owned and half leased. Total Government assets are estimated at $2.5 billion, and leasing and operating costs approach $1 billion a year. The major portion of these assets are contained within the DCS and are outside the United States. This vast complex was to be linked and operated by separate organizations, but under central management and in accordance with standardized and unified plans and policies.

Defense Secretary McNamara moved promptly to implement his assignment under the President's directive. He designated an Assistant, Solis Horwitz, to serve as his principal adviser in his role as Executive Agent for the NCS.[24] The job of "Manager, NCS" fell to the DCA Director, Lt. Gen. Alfred D. Starbird. In this two-hat capacity, Gen. Starbird performs the principal unified technical planning for the establishment and development of the NCS and exercises operational direction over the system.[25]

Interim staffing of the office of the Manager, NCS, was accomplished by augmenting DCA space authorizations and by using DCA staff and operational personnel in a dual DCS-NCS role. At the invitation of the Executive Agent, the operators of the major civil networks—State, NASA, FAA, and GSA—assigned fulltime representatives to General Starbird's staff to assist in the management of the NCS. The NCS Manager has also drawn on his DCS control complex to establish the NCS Operations Center (NCSOC). The latter, connected electronically with the primary NCS coordination centers and department and agency networks, is now the focal point for meeting the President's requirements for telecommunications in an emergency. To allow prompt reaction, a National Emergency Action Group consisting of designated DCS and civil department and agency representatives, was formed in June 1964. This group can be convened at the NCSOC on call of the Manager, NCS, to assist in the better use of all NCS facilities in the event of an emergency. The bi-organizational approach to some NCS planning and operational problems, however, has proven somewhat awkward, and General Starbird has proposed the establishment of a separate NCS headquarters. Whatever the outcome, maximum use of DCA operational control machinery and other support services will continue in order to avoid unnecessary duplication of effort.

Much has already been accomplished, and much work still lies ahead, in implementation of the Executive Agent's responsibilities for the NCS. The major national security telecommunications networks (DCS, GSA,

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[24] Horwitz first held the title of Assistant to the Secretary of Defense for the NCS. This job was later incorporated with other top management responsibilities which Mr. Horwitz exercised as Assistant Secretary of Defense (Administration); *see* DOD Directive No. 5100.41, 5 October 1963, subj: Arrangements for the Discharge of Executive Agent Responsibilities for the National Communications System, and DOD Directive No. 5110.1, 11 July 1964, subj: Assistant Secretary of Defense (Administration).

[25] DOD Directive No. 5100.41, 5 October 1963, subj: Arrangements for the Discharge of Executive Agent Responsibilities for the NCS.

FAA, NASA, and State) have been brought into the NCS, and other agency networks are under consideration for inclusion at a later date. A priority system, approved by President Johnson in September 1964, will insure that, in the event of disruption of communications in an emergency, remaining assets are applied first to meeting the most essential needs. A control mechanism has been put into effect to provide current information on the status of NCS assets and permit the application of the priority system under a wide range of circumstances. Procedures have also been developed for exercising the system and evaluating its effectiveness under assumed emergency conditions. Work is going forward on other tasks—design of technical and procedural standards to insure compatibility of equipment; establishment of interconnections needed to integrate the several elements of the system; procedures for the allocation, relocation and restoration of service; management of the radio frequencies used by the NCS; the conduct and coordination of research and development; near-term and long-range planning; and revision of the NCS organizational structure. Some of these tasks are matters of continuing attention; others have proven thorny, have brought forth divergent agency views, and will take time to resolve.[26]

Drawing the leading military and civil telecommunications managers into a consensus of thought and action may not always be an easy matter. The fact is, however, that they are working together on a day-to-day basis toward a common goal. Of necessity, the DCS, which operates three-fourths of the NCS assets, will be the backbone of the system. The linkage of the DCS with the resources of other NCS networks holds out the prospect of greater responsiveness to the requirements of the President and his Crisis Managers.

[26] For a comprehensive account, see Col. William C. Golladay, "A National Communications System—A Management View" (Thesis M65–55; Washington: U.S. Industrial College of the Armed Forces, 12 March 1965).

Domsat

October 30, 1969

Dear Mike:

This will acknowledge and thank you for your telegram to the President concerning a White House report on a domestic communications satellite program.

It is expected that in the not too distant future that the White House will be passing its views on policy questions in the domestic communications satellite area to the Federal Communications Commission and whatever we pass to the FCC will definitely be made public.

With warm regard,

Sincerely,

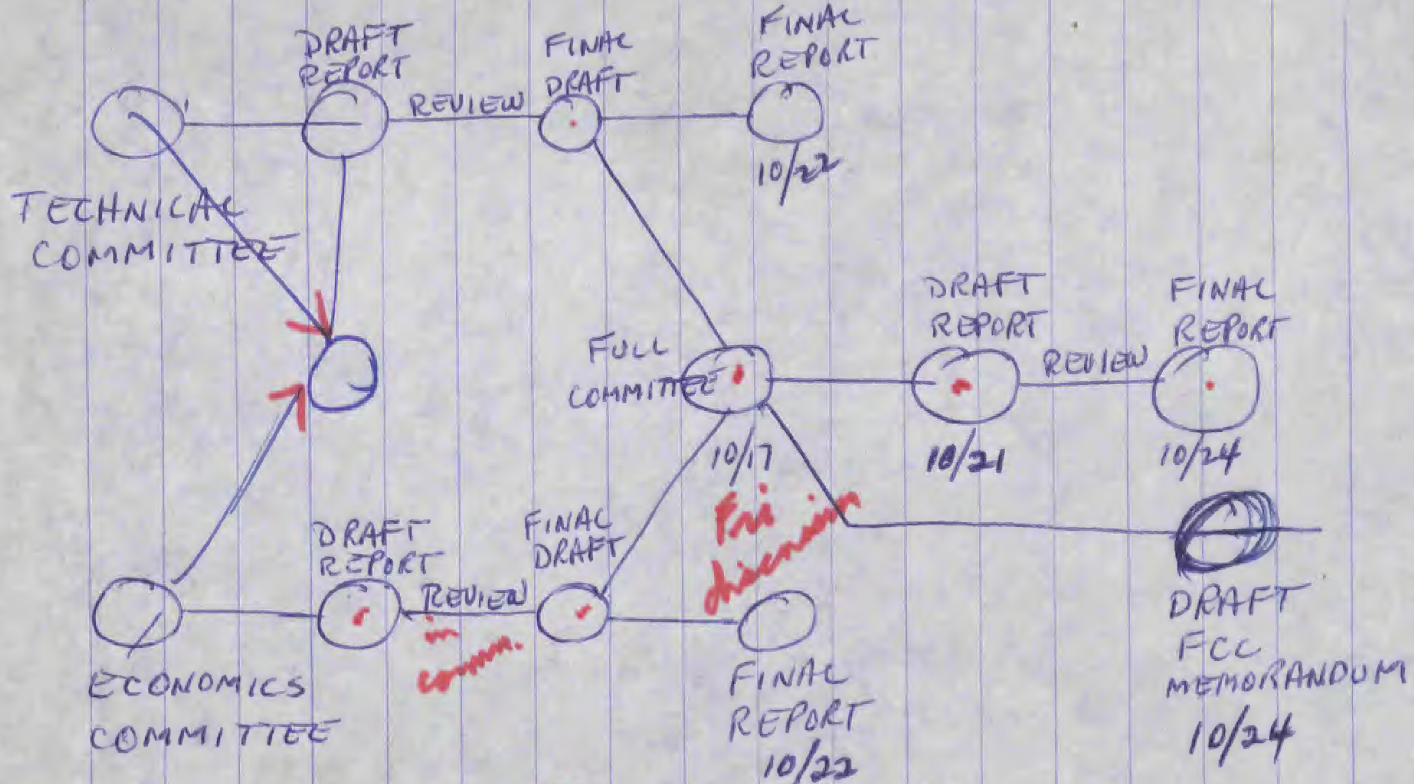
Kenneth E. BeLieu
Deputy Assistant to the President

Honorable Mike Gravel
United States Senate
Washington, D.C.

bcc: Mr. Whitehead - FYI

KEB:EF:VO:vo

Paragraph #2 dictated over phone by Mr. Whitehead's Secretary



10/9

COB Monday 10/13 Committee chm

draft dist Thurs 10/16 → Conv's writis

Domsat

Thursday 10/30/69

3:05 Virginia Olson in Harlow's office had called about a telegram they have received from Sen. Gravel asking when the W.H. report on alternativ e policy for domestic satellites would be released.

Checked with TW and he said to tell her that we expect that at some time in the not too distant future the W. H. will be passing its .views on policy questions in the dome stic satellite area to the FCC. Whatever they pass to the FCC will definitely be made public.

Domsat

Wednesday 10/29/69

3:10 I had a call from Gloria Klein, Assistant to Irving B. Kahn, President and Chairman of the Board of Teleprompter Corporation, indicating they had sent a telegram to you this morning at 11 a.m. (she had called Comsat, who checked with us and found out we had not received it). The telegram read as follows: Judson 2-3800

October 29, 1969

Honorable C. T. Whitehead
Office of the President
The White House
Washington, D. C.

Yesterday I requested and was denied attendance on behalf of Teleprompter Corporation at a meeting arranged by James McCormack, Chairman of Comsat, to be held at 2:30 p.m. Wednesday, October 29, with the networks, CBS, NBC, ABC, and the Corporation for Public Broadcasting. In a telegram sent to James McCormack yesterday, I said

> "Per telephone conferences today, this confirms repeated demands for full Teleprompter CATV representation and participation at conference scheduled tomorrow, October 29, 1969, by your office with TV broadcast networks re domestic satellite distribution plans for video programs.
>
> Exclusion of CATV from this meeting prejudices and impairs right of our company and industry to full participation in network distribution by satellite in clear violation of antitrust laws. Must respectfully demand that you reconsider decision to bar Teleprompter CATV participation in all facets of this critical meeting."

I believe it to be absolutely imperative that whatever domesstic satellite system is proposed that we have open access, including ownership participation, on the part of all possible domestic users.

/s/ Irving B. Kahn
President and Chairman of the Board
Teleprompter Corporation

50 West 44th Street
New York, New York 10036

DRAFT

MEMORANDUM TO THE FCC

Communications via satellite represents one of the most striking technological by-products of this nation's space program. Already we have seen this technology applied to international communications needs, with dramatic success. At the same time, the service and economic potential of satellites for domestic uses have become increasingly apparent.

The policies and rules governing establishment and operation of domestic communication satellite (domsat) facilities will have a profound and lasting impact on potential manufacturers, suppliers and users of communication services, independent operators, and the public interest. The Administration considers it imperative that these policies permit the freest possible interplay of ideas, technology, and economics within the private sector. Regulatory and policy concern should be limited to those non-economic considerations which significantly affect the public interest.

One non-economic issue which engendered considerable debate during the FCC's domestic satellite inquiry (Docket 16495) had to do with the technical feasibility and electromagnetic compatibility of Domsat facilities. Our studies show, however, that such technical considerations are not of controlling importance in this proceeding. Specifically, we have found that:

-- existing spectrum allocations at 4 and 6GHz can be used extensively by both Domsat and terrestrial radio relay facilities without harmful interference, provided normal coordination and sharing criteria are observed.

-- these allocations are adequate to accommodate all foreseeable proposals for initial Domsat systems plus Canadian and/or Intelsat requirements, with ample margin for short-term growth in systems and/or services.

-- additional frequency allocations now being cleared through the International Telecommunications Union will accommodate any long-term growth in Domsat requirements.

Based on these findings, we believe policies governing ownership and operating arrangements for Domsat facilities can be established without concern for the technical issues.

Since the technical question of resource allocation is not controlling, our principal public policy concern is that three basic public interest objectives be effectively pursued. The first objective is to ensure that entities providing communication services of major public benefit directly to the public (e.g., public message telephone and telegraph exchange services) have both the freedom and the incentives to exploit communications satellite technology wherever it is operationally and economically attractive. The second objective is to encourage innovation and efficiency in the provision of new or improved communication services to meet the special needs of business, industry, and Government, as well as unique public communications requirements. The third objective is to minimize the need for continuing economic regulatory controls of Domsat operations, maximize the opportunities for the private sector to resolve economic matters directly, while at the same time preventing anti-completive practices.

To some extent, these objectives contain built-in conflicts, due largely to past policies and regulatory practices and the resultant structure of the domestic telecommunications industry. For example, the right to own and operate Domsat facilities without restriction might provide common-carrier suppliers of public message services the greatest freedom and incentives to use satellite technology; but the admixture of such public message services with specialized, potentially competitive services can lead to anti-competitive conditions (e.g., cross-subsidization, interconnnection barriers, procurement barriers, R & D subsidization, etc.) which would prevent effective completion and innovation to evolve. On the other hand, while competition is considered more conducive to innovation and efficiency than is monopoly, any suggestion of competition in the provision of public message exchange services -- long protected as a "natural" monopoly by public policy -- must now be dismissed due to the sheer magnitude of investments involved.

We have evaluated a number of potential guidelines for the establishment and operation of initial Domsat facilities. These ranged from completely open entry to selection of a chosen instrument for all Domsat operations. The most practical and effective guidelines for meeting the objectives cited, we are convinced, would be the following:

(1) Permit only those entities providing public message exchange services (switched telephone and/or telegraph) to establish and operate Domsat facilities (satellite and earth stations) to be used in the carriage of this class of traffic.

(2) Permit only those entities who do not provide public message exchange services -- e.g., specialized carriers, independent operators, common-user cooperatives, public institutions, etc. -- to establish and operate Domsat facilities to be used in the carriage of other than public message exchange traffic.

(3) Authorize those carriers providing both public message exchange and specialized services to lease Domsat transmission services from specialized carriers for their specialized service offerings, and require such specialized carriers to provide such

services as available at reasonable rates and on a non-discriminating basis.

(4) Authorize both specialized carriers and private Domsat system operators to lease local interconnection service to Domsat earth stations and among local users of their service, from local telecommunications utilities; and require such utilities to provide these services at reasonable rates and on a non-discriminating basis.

(5) Limit the Commission's review of applications for Domsat facilities to ensuring that:

(a) the above guidelines are observed;

(b) the proposed facilities met the Commission's technical standards, rules and regulations;

(c) the operator was financially responsible and able to carry through the proposed development;

(d) rates and service offerings of carriers were just, reasonable, and non-discriminating; and

(e) spectrum and orbital resources were, in fact, available to accommodate the facilities, and the amount of such resources required did not exceed 25% of the total spectrum/orbital capacity potentially available to the United States.

* Dr. Drew, Dr. Moore and Mr. Kriegsman have been invited to join Mr. Whitehead in the initial 45-minute meeting with industry people -- prior to their meeting with Domsat Working Group

DOMESTIC SATELLITE MEETINGS
(with industry)

Friday, October 24, 1969

*	10:00 a.m.	AT&T	Rm. 730 1800 G St., N.W.
		Ed Crosland, Vice President, Federal Relations Dean Gillete Ken McKay, Vice President for Engineering William Stump Charles McWhorter, Executive Assistant	
	10:30 a.m.	All will be joined by Domsat Working Group	

Tuesday, November 4, 1969

*	10:00 a.m.	COMSAT	Rm. 110
		Joseph Charyk, President Gen. James McCormack, Chairman	
	10:45 a.m.	All will be joined by Domsat Working Group and others from Comsat	Rm. 208
*	2:00 p.m.	COLUMBIA BROADCASTING SYSTEM	Rm. 110
		William Lodge, Vice President for Affiliate Relations and Networking Dr. David Blank, Vice President for Economics and Research	
	2:45 p.m.	All will be joined by Domsat Working Group	Rm. 272
*	4:00 p.m.	MAXIMUM SERVICE TELECASTERS	Rm. 110
		Roy Easley, Assistant Executive Director Lester Lindow, Executive Director Howard Head, Engineering Counsel Henry Goldberg, one of their legal counsel (Covington & Burling)	
		No meeting with Domsat Working Group	

Wednesday, November 5, 1969

* 10:00 a.m. COMMUNICATIONS WORKERS OF AMERICA Rm. 110

Joseph Beirne, President
John Morgan, Administrative Assistant
George Miller

10:45 a.m. All will be joined by Domsat Working Group Rm. 272

Thursday, November 6, 1969

UNIVERSITY COMPUTING COMPANY

* 2:00 p.m. Martin Hoffman, Assistant General Counsel Rm. 110
Seymour Joffee
David Foster
Ed Berg

2:45 p.m. All will be joined by Domsat Working Group Rm. 272

Friday, November 7, 1969

2:00 p.m. Windup meeting of the Domsat Working Group Rm. 272

David Acheson
Dr. James Armstrong
Dora ld Baker
Lucius Battle
Richard Beam
Dean Burch
Robert Button
Asher Ende
Jerome Freibaum
George Haydon
Dr. Richard Marsten
Dr. Boyd Nelson
Robert Powers
Dr. Walter Radius
Siegfried Reiger
John Richardson
Abbott Roseman
Gen. George Sampson
Robert Scherr
Wilbur Serwat
Willis Shapley
Bernard Strassburg
Dr. Myron Tribus
William Watkins

10/24
10 a.m.

FORM WH-25

EXECUTIVE OFFICE BUILDING
WHITE HOUSE
Washington, D. C.

To: Security Officer, White House Police
Main Lobby, EOB

Please admit the following appointments on 10/24/ 1969 for (Mr.) (Mrs.) (Miss) Tom Whitehead, Agency White House.

Name ____ Time ____ Name ____ Time ____

10:00 a.m. Crosland, Edward
Gillette, Dean
McKay, Ken
McWhorter, Charles
Stump, William

Meeting Room: 110 Secretary: Eva Daughtrey

Telephone Ext. 2786

Date: 10/23/69

mtg
10/24
10 am

Thursday 10/23/69

2:15 Tom Moore, Russ Drew and Will Kriegsman are available to meet with you and the people from AT&T tomorrow at 10 a.m.

McWhorter will bring --

Ed Crosland
William Stump
Ken McKay
Dean Gillette

At 10:30 you are all scheduled to go to Rm. 730 at 1800 G Street, N. W., and meet with the Domsat working group people.

cc: Mr. Kriegsman

vit. Y.
10/24
10am

Monday 10/20/69

4:30 We have Room 730 -- at 1800 G Street, N. W. -- assigned to us for both Thursday and Friday of this week.

We will have McWhorter's group there -- if that's O.K. -- as well as the Domsat group at 2 o'clock Thursday.

Monday 10/20/69

10:10 Meeting with Charlie McWhorter, et al., is scheduled for 10 a.m. Friday. Mr Kriegsman has been invited.

We're trying to get a conference room but they're pretty well tied up.

FORM WH-25

EXECUTIVE OFFICE BUILDING
WHITE HOUSE
Washington, D. C.

To: Security Officer, White House Police
Main Lobby, EOB

Please admit the following appointments on Nov. 4 19 69, for (Mr.) ~~(Mrs.)~~ ~~(Miss)~~ Clay T. Whitehead, Agency White House.

Name	Time	Name	Time
10:00 a.m.	Charyk, Joseph	Rm. 110 EOB	
	McCormack, James	Rm. 110 EOB	
10:45 a.m.	Acheson, David C.	Rm. 208 EOB	
	Armstrong, Dr. James		
	Baker, Donald		
	Battle, Lucius		
	Button, Robert		
	Ende, Asher		
	Haydon, George		
	Marsten, Dr. Richard		
	Powers, Robert		
	Radius, Dr. Walter A.		
	Reiger, Siegfried		
	Richardson, John		
	[illegible]		
	Sampson, Gen. George		
	Scherr, Robert		
	Serwat, Wilbur		
	Shapley, Willis		
	Strassburg, Bernard		
	Tribus, Dr. Myron		
	~~Dr. Boyd Nelson~~		
	~~Wm. Watkins~~		
	Freibaum, Jerome		

Meeting Room: Secretary: Eva Daughtrey

Telephone Ext. 2786

Date: 11/3/69

FORM WH-25

EXECUTIVE OFFICE BUILDING
WHITE HOUSE
Washington, D. C.

To: Security Officer, White House Police
Main Lobby, EOB

Please admit the following appointments on Nov. 4 1969 for (Mr.) (Mrs.) (Miss) Clay T. Whitehead, Agency White House.

Name	Time	Name	Time
2:00 p.m.	Lodge, William Blank, David	Rm. 110 EOB	
2:45 p.m.	Armstrong, Dr. James Baker, Donald Beam, Richard L. Ende, Asher Haydon, George Marsten, Dr. Richard Powers, Robert Radius, Dr. Walter A. Richardson, John Scherr, Robert Serwat, Wilbur Shapley, Willis Strassburg, Bernard Tribus, Dr. Myron - Watkins, William Wiesbaum, Jerome	Rm. 272 EOB	
4:00 p.m.	Easley, Roy Goldberg, Henry Head, Howard Lindow, Lester	Rm. 110 EOB Rm. 110 EOB Rm. 110 EOB Rm. 110 EOB	

Meeting Room: _____ Secretary: Eva Daughtrey

Telephone Ext. 2786

Date: 11/3/69

Other appointments may be called in during the day.

Meeting -- Tuesday, November 4, 1969

Roy Easley, Asst. Exec. Director
Lester Lindow, Exec. Director
Howard Head, Engineering Counsel
Henry Goldberg, one of their legal counsel (Covington & Burling)

FORM WH-25

EXECUTIVE OFFICE BUILDING
WHITE HOUSE
Washington, D. C.

To: Security Officer, White House Police
Main Lobby, EOB

Please admit the following appointments on Nov. 5 1969 for (Mr.) (Mrs.) / (Miss) Clay T. Whitehead, Agency White House.

Name ______ Time ______ Name ______ Time ______

10:00 a.m.	Beirne, Joseph	Rm. 110 EOB
	Miller, George	Rm. 110 EOB
	Morgan, John	Rm. 110 EOB
10:45 a.m.	Acheson, David C.	Rm. 272 EOB
	Armstrong, Dr. James	
	Baker, Donald	
	Battle, Lucius	
	Button, Robert	
	Ende, Asher	
	Freibaum, Jerome	
	Haydon, George	
	Marsten, Dr. Richard	
	Nelson, Dr. Boyd	
	Powers, Robert	
	Radius, Dr. Walter A.	
	Reiger, Siegfried	
	Richardson, John	
	Roseman, Abbott	
	Sampson, Gen. George	
	Scherr, Robert	
	Serwat, Wilbur	
	Shapley, Willis	
	Strassburg, Bernard	
	Tribus, Dr. Myron	
	Watkins, William	

Meeting Room: ______ Secretary: Eva Daughtrey

Telephone Ext. 2786

Date: 11/3/69

Other appointments may be called in during the day.

FORM WH-25

EXECUTIVE OFFICE BUILDING
WHITE HOUSE
Washington, D. C.

To: Security Officer, White House Police
Main Lobby, EOB

Please admit the following appointments on November 6 19 69 for (Mr.) (~~Mrs.~~)/(~~Miss~~) Clay T. Whitehead, Agency White House.

Name ______ Time ______ Name ______ Time ______

2:00 p.m.
Berg, Al
Foster, David
Hoffmann, Martin
Jaffe, Seymour

Rm. 110 EOB

2:45 p.m.

Rm. 272 EOB

Acheson, David C.
Armstrong, Dr. James
Baker, Donald
Battle, Lucius
Beam, Richard
Button, Robert
Criswell, Ray
Ende, Asher
Freibaum, Jerome
Haydon, George
Marsten, Dr. Richard
Nelson, Dr. Boyd
Powers, Robert
Radius, Dr. Walter A.
Reiger, Siegfried
Richardson, John
Roseman, Abbott
Sampson, Gen. George
Scherr, Robert
Serwat, Wilbur
Shapley, Willis
Strassburg, Bernard
Tribus, Dr. Myron
Watkins, William

Meeting Room: ______ Secretary: Eva Daughtrey

Telephone Ext. 2786

Date: 11/3/69

... may be called in during the day.

FORM WH-25

EXECUTIVE OFFICE BUILDING
WHITE HOUSE
Washington, D. C.

To: Security Officer, White House Police
Main Lobby, EOB

Please admit the following appointments on Nov. 7 1969 for (Mr.) ~~(Mrs.)~~ ~~(Miss)~~ Clay T. Whitehead, Agency White House.

Name ______ Time ______ Name ______ Time ______

2:00 p.m. Acheson, David C. Rm. 272 EOB
Armstrong, Dr. James
Baker, Donald
Battle, Lucius
~~Button, Robert~~ Bean, Richard
Ende, Asher
Freibaum, Jerome
Haydon, George
Marsten, Dr. Richard
Nelson, Dr. Boyd
Powers, Robert
Radius, Dr. Walter A.
Reiger, Siegfried
Richardson, John
Roseman, Abbott
Sampson, Gen. George
Scherr, Robert
Serwat, Wilbur
Shapley, Willis
Strassburg, Bernard
Tribus, Dr. Myron
Watkins, William

Burd Bean

Meeting Room: 272 EOB Secretary: Eva Daughtrey

Telephone Ext. 2786

Date: 11/3/69

Other appointments may be called in during the day.

Meetings with Industry on Domestic Satellite Communications

	Date of Meeting	Representatives	Telephone Number
AT&T	10/24/69 10:00 a.m.	Ed Crosland, V.P., Federal Relations, N.Y. 195 Broadway, NYC 10007 Dean Gillete Ken McKay, V.P. for Engineering, N.Y. 195 Broadway, NYC 10007 William Stump Charles McWhorter, Executive Assistant, N.Y. Working Group representatives	(212) 393-1000 (212) 393-4459
COMSAT	11/4/69 10:00 a.m.	General James McCormack, Chairman Joseph Charyk, President 950 L'Enfant Plaza, Wash., D. C. 20024 Working Group representatives	(202) 554-6020
Columbia Broadcasting System	11/4/69 2:00 p.m.	Dr. David Blank, V.P. for Economics and Research William Lodge, V.P. for Affiliate Relations and Networking 51 West 52nd Street, NYC 10019 Working Group representatives	(212) 765-4321, x 3561 (212) 765-4321, x 3541
Maximum Service Telecasters	11/4/69 4:00 p.m.	Roy Easley, Asst. Exec. Director Lester Lindow, Exec, Director Howard Head, Engineering Counsel Henry Goldberg, one of their legal counsel (Covington and Burling) 1735 DeSales Street, N.W., Wash., D.C.	(202) DI7-5412

Meetings with Industry on Domestic Satellite Communications

	Date of Meeting	Representatives	Telephone Number
Communication Workers of America	11/5/69 10:00 a.m.	Joseph Beirne, President John Morgan, Administrative Assistant George Miller 1925 K Street, N. W., Wash., D. C. Working Group representatives	(202) FE7-7711
University Computing Co.	11/6/69 2:00 p.m.	Martin Hoffman, Asst. General Counsel 1300 Frito-Lay Tower, Dallas, Tex. 75235 Seymour Joffee Ed Berg David Foster Working Group representatives	(214) 350-1211
Windup meeting	11/7/69 2:00 p.m.	Domsat Satellite Working Group	

Mr. David Acheson		
Mr. William Anders National Aeronautics and Space Council New Executive Office Building Washington, D. C. 20502	3300	
Dr. James Armstrong Post Office Department Room 7119 New Post Office Bldg. Washington, D. C.	(177) 7442	961-7442
Mr. Donald Baker Chief of Evaluation Section Antitrust Division Room 3115 Justice Department 10th and Constitution Avenue, N. W. Washington, D. C.	(187) 2411	
Mr. Richard Beam Director, Office of Telecommunications Department of Transportation Room 834 West 800 Independence Avenue, S. W. Washington, D. C. 20590	(13) 34313	963-4313
Dr. Russell Drew Office of Science and Technology Room 285 - EOB Washington, D. C.	(103) 3570	395-3570
Mr. Asher Ende		
Mr. Peter Flanigan Assistant to the President White House Washington, D. C.	2361	
Mr. Richard Gabel		
Mr. Larry Gatterer Department of Commerce		
Mr. Walter Hinchman Room 493 - EOB Washington, D. C.		
Chairman Rosel Hyde Federal Communications Commission Room 814 1919 M Street, N. W. Washington, D. C. 20554		632-6336

Mr. Will Kriegsman		
Dr. Richard Marsten National Aeronautics and Space Administration Room 5081 - FOB 6 400 Maryland Avenue, S. W. Washington, D. C.	(13) 20888	962-0888
Dr. Thomas Moore Council of Economic Advisers Room 327 EOB Washington, D. C.	(103) 5080	395-5080
Mr. William Morrill Bureau of the Budget Room 10009 New EOB Washington, D. C.	(103) 4684	395-4684
Col. Ward Olsson Office of Telecommunications Management Room 750 1800 G Street, N. W. Washington, D. C.	5190	395-5190
Mr. Robert Powers		
Dr. Walter A. Radius National Aeronautics and Space Administration Room 7101 - FOB 6 400 Maryland Avenue, S. W. Washington, D. C.	(13) 24583	962-4583
Mr. John Richardson		
Mr. Jonathan Rose Administrative Assistant White House Washington, D. C.	2514	
Mr. Robert Scherr Room 4226 New Post Office Building 12th and Pennsylvania Avenue, N. W. Washington, D. C.	(177) 7472	961-7472
Mr. Wilbur Serwat Post Office Department Room 306 Safeway Building Washington, D. C.	(177) 8687	961-8687

Mr. Willis Shapley Associate Deputy Administrator National Aeronautics and Space Administration Room 7137 - FOB 6 400 Maryland Avenue, S. W. Washington, D. C.	(13) 24715	962-4715
Mr. Bernard Strassburg Federal Communications Commission Room 514 1919 M Street, N.W. Washington, D. C.		632-6910
Dr. Myron Tribus Asst. Secy. of Commerce for Science and Technology Room 5884 Commerce Dept. 14th and Constitution Ave., N.W. Washington, D. C.	(189) 3111	
Mr. William Watkins Federal Communications Commission Room 714 1919 M Street, N. W. Washington, D. C.		632-7060

THE WHITE HOUSE

WASHINGTON

October 31, 1969

Memorandum for the Domestic Satellite Working Group Members

The following meetings have been scheduled in Room 272, Executive Office Building. Would you please let my office know who will be attending.

Tuesday, November 4

10:45 a.m.	COMSAT
2:45 p.m.	Columbia Broadcasting System

Wednesday, November 5

10:45 a.m.	Communication Workers of America
~~2:45 p.m.~~	~~University Computing Company~~

Thursday, November 6

2:45 pm	University Computing Company
~~2:00 p.m.~~	~~Working group meeting to wind up the report~~

Friday, Nov. 7

2:00 pm. Working Group meeting to wind up report.

Clay T. Whitehead
Staff Assistant

Attached is the list
of those who
responded to your
August 19 letter.

(International Brotherhood
(of Electrical Workers
(and
(National Assoc. of
(Broadcasters did not
(send in a reply.

Those unmarked sent in
statements without your
request.

X Leonard H. Goldenson
President
American Broadcasting Companies, Inc.
1330 Avenue of the Americas
New York, N. Y. 10019

X Julian Goodman
President
National Broadcasting Company, Inc.
Thirty Rockefeller Plaza
New York, N. Y. 10020

ITT World Communications, Inc.
J. R. McNitt (James)
X President
67 Broad Street
New York, N. y. 10004

Charles J. Wyly, Jr.
President
X University Computing Company
1300 Frito-Lay Tower
Dallas, Texas 75235

Joseph A. Beirne
President
X Communications Workers of America
1925 K Street, N. W.
Washington, D. C. 20006

George D. Butler
President
X Electronic Industries Association
2001 Eye Street, N. W.
Washington, D. C. 20006

Richard D. DeLauer
Vice President & General Manager
X TRW Systems Group, TRW Inc.
One Space Park
Redondo Beach, California 90278

X Edward B. Crosland
Vice President
American Telephone and Telegraph Company
195 Broadway
New York, New York 10007

X S. G. Lutz
Chief Scientist
Hughes Research Laboratories
3011 Malibu Canyon Road
Malibu, California

T. Vincent Learson (President - ?)
International Business Machines
X Corporation
Armonk, New York 10504

L. B. Davis
Vice President
X General Electric Company
777 Fourteenth Street, N. W.
Washington, D. C. 20005

James J. Clerkin, Jr.
Executive Vice President-Telephone
X Operations
General Telephone & Electronics
Corporation
730 Third Avenue
New York N. Y. 10017

Earl D. Hilburn
Executive Vice President
X Western Union
60 Hudson Street
New York, N. Y. 10013

Communications Satellite Corporat
Joseph V. Charyk
X President
950 L'Enfant Plaza South, S. W.
Washington, D. C. 20024

Frank W. Norwood
Executive Secretary
Joint Council on Educational
Telecommunications
1126 Sixteenth Street, N. W.
Washington, D. C. 20036

X John W. Macy, Jr.
President
Corporation for Public Broadcasting
Suite 630
1250 Connectivut Avenue, N. W.
Washington, D. C. 20036

J. D. O'Connell
Director
Office of Telecommunications Management
Executive Office of the President
Washington, D. C. 20504

X Howard R. Hawkins
President
RCA Global Communications, Inc.
60 Broad Street
New York. N.Y. 10004

X Indicates organizations to whom the 19 Sep letter frm Mr. Whitehead were forwarded for submission.

Note: Submissions were not received from International Brotherhood of Electrical Workers or National Association of Broadcasters.

X E. A. Gallagher
President
Western Union International, Inc.
26 Broadway
New York, N.Y. 10004

X Frank Stanton
President
Columbia Broadcasting System, Inc.
51 West 52 Street
New York, N.Y. 10019

X The Ford Foundation
McGeorge Bundy
President
320 East 43rd Street
New York, N. Y. 10017

Richard S. Mann
President
The RME Group of Communocations Companies
100 East Broad Street (Suite 1302)
Columbus, Ohio 43215

M. G. Robertson
President
Christian Broadcasting Network, Inc.
P. O. Box 111
1318 Spratley Street
Portsmouth, Va. 23705

X National Cable Television Association Inc.
Frederick W. Ford
President
1634 Eye Street, N. W.
Washington, D.C. 20006

Domestic Communications Satellite Facilities
Policy Guidelines
Option A

The basic policy governing the establishment and operation of domestic communications satellite facilities should be the same as that for terrestrial facilities; any financially qualified entity should be free to choose between installing a private communications satellite system to meet its own requirements, joining with related entities in a common-user cooperative satellite system, or obtaining communications services from a common-carrier or specialized carrier supplier. Furthermore, where the choice is a private system or a common-user system, the public interest does not require that the venture be economically viable, thus no such showing should be required.

There are two areas of public interest concern which may require additional policy guidelines. First, where communications services are provided at a profit to others (including but not limited to the general public), it is in the public interest to protect users from discriminatory or excessive monopoly rates and to prevent anti-competitive practices by the suppliers. Second, since use of the radio frequency spectrum--a limited and valuable natural resource--is required, it is in the public interest to prevent unfair monopolization and encourage the most efficient use of this resource.

Regarding the first issue, we favor reliance on competition to produce the greatest innovation and lowest rates wherever such competition is possible. We are thus concerned lest switched public message exchange services--long considered a natural monopoly subject to regulation in lieu of competition--be used intentionally or inadvertently to subsidize specialized, potentially competitive services when provided by the same entity through common facilities. This could result in excessive monopoly rates to users of the switched public message exchange service as well as being an anti-competitive barrier to other potential suppliers of specialized services.

The following guidelines are believed to be the minimum acceptable conditions to be placed on communications carriers, to meet the foregoing objectives and issues:

(1) The establishment and operation of domestic communications satellite facilities for the transmission of traffic in the switched public message exchange service should be limited to those entities responsible for originating and delivering such traffic (i.e., common carriers).

(2) The establishment and operation of domestic communications satellite facilities for the transmission of specialized communications traffic (e.g., video interconnection and/or distribution, high-speed data exchange, private line services, etc.) should be limited to those entities having no public message exchange monopoly--i.e., specialized carriers, common-user cooperatives, and independent operators.

(3) Any entity should be authorized to lease transmission services from operators of specialized domestic communications satellite facilities on a competitive basis; specialized carriers should be required to supply such services as available to common-carriers for use in carrying either switched public message exchange traffic or specialized traffic, or both.

(4) Any operator or user of domestic communications satellite facilities should be authorized to lease interconnection to earth stations (and among local users of satellite services) from local communications utilities, who should be required to provide such services at reasonable rates and on a nondiscriminatory basis.

(5) The Commission's economic review and oversight of specialized (competitive) carriers should be limited to determining that:

(a) guidelines 1 through 4 are observed;

(b) the entity is financially responsible and capable of carrying out the proposed operation;

(c) rates are non-discriminatory among users;

(6) The Commission's regulation of common-carrier rates, investments and performance should be continued, with the addition of guidelines 1 through 4 above.

(7) The Commission's regulation of private systems and common-user systems should be limited to the minimum required by law, and should not include consideration of the economic impact of such systems on common-carriers or specialized carriers.

With regard to the radio frequency spectrum resource (which includes satellite orbital space as one parameter), we believe the issue of scarcity has been overstated. Stated otherwise, any limitation on the capacity of this resource which may exist seems continuously extendable through technological and/or operational innovation, at a price. We have difficulty envisioning this as a classic resource allocation problem where discrete quantities of a finite resource must be rationed among prospective users according to some economic or public interest criteria. Particularly during the early establishment and use of domestic satellite facilities, it will more likely be a question of establishing and enforcing appropriate technical standards representing the best judgment of the Commission as to optimum trade-offs between economic viability and technical efficiency in the light of projected demand for communications channels. For example, the Commission may wish to establish a minimum acceptable earth station antenna diameter (e.g., 30 ft.), in order to accommodate a particular number of U. S. domestic satellites. Should the Commission receive applications in excess of this number during a specified initial filing period, it has the option of:

(a) establishing higher standards (e.g., 40 ft. minimum antenna diameter) to accommodate more satellites if this were considered economically justified;

(b) processing applications on a first-come, first-served basis using the existing standards; or

(c) ruling on the relative public benefits of alternative proposals and setting priorities accordingly.

To the extent that applicants are few--as we expect--presently allocated spectrum resources should accommodate all applicants without conflict under reasonable technical standards, thus the above procedures would not be required. Should additional applicants come forward subsequent to the initial filing period, the Commission has recourse to several additional options;

(d) authorize later systems to use additional spectrum resources now being cleared with appropriate international agencies for satellite use, based on new technical standards plus any of options (a) through (c) above.

(e) authorize later applicants to either "buy out" some existing system's spectrum claim, or compensate an existing user for modifications (e.g., larger antennas, relocation of satellites and/or earth stations, etc.) to his system to accommodate the new entrant.

In no event, therefore, can we envision the need for a prior ruling by the Commission on the relative priority of potential applicants; only when applications are in hand can the extent of scarcity and the relative merit of alternative uses be weighed. However, the Commission may wish to consider a policy which would limit the amount of spectrum resource (i.e., frequency bandwidth and orbital range) which any single user may control, to avoid monopolization of the resource. To the extent that particular orbital sectors have special attributes (e.g., coverage of all 50 states rather than just the contiguous 48 states), such a restriction should apply within this sector as well as overall.

Domestic Communications Satellite Facilities
Policy Guidelines
Option B

The basic policy governing the establishment and operation of domestic communications satellite facilities should be the same as that for terrestrial facilities; any financially qualified entity should be free to choose between installing a private communications satellite system to meet its own requirements, joining with related entities in a common-user cooperative satellite system, or obtaining communications services from a common-carrier or specialized carrier supplier. Furthermore, where the choice is a private system or a common-user system, the public interest does not require that the venture be economically viable, thus no such showing should be required.

There are two areas of public interest concern which may require additional policy guidelines. First, where communications services are provided at a profit to others (including but not limited to the general public), it is in the public interest to protect users from discriminatory or excessive monopoly rates and to prevent anti-competitive practices by the suppliers. Second, since use of the radio frequency spectrum--a limited and valuable natural resource--is required, it is in the public interest to prevent unfair monopolization and encourage the most efficient use of this resource.

Regarding the first issue, we favor reliance on competition to produce the greatest innovation and lowest rates wherever such competition is possible. We are thus concerned lest switched public message exchange services--long considered a natural monopoly subject to regulation in lieu of competition--be used intentionally or inadvertently to subsidize specialized, potentially competitive services when provided by the same entity through common facilities. This could result in excessive monopoly rates to users of the switched public message exchange service as well as being an anti-competitive barrier to other potential suppliers of specialized services. To avoid this possibility, the Commission may wish to segregate these service classes, both organizationally and operationally, at least in the initial use of communications satellite facilities. Alternatively, the Commission may find some other practical means for avoiding the cross-subsidization problem, though this seems difficult given the complex relationships between R&D, manufacturing, procurement, and operations and maintenance in a multi-purpose telecommunications network.

Other potential anti-competitive practices with which the Commission should be concerned include constraints on interconnection and access to satellite system earth stations. Since the facilities required to provide local interconnection and earth station access will in many instances be under the control of local communications utilities--whose parent organizations may be one of the long-haul competitors--it will be necessary to ensure that all long-haul suppliers are granted equal interconnection and access rights.

A different yet similar issue of access could arise in the case of common-user cooperative systems, wherein one group of users might join in a cartel arrangement and exclude existing or prospective competitors from the benefits of a common-user system. We would expect that both the FCC and the Attorney General would take appropriate steps to ensure that, where competing services are involved, no such practices are permitted. On the other hand, we find no justification for requiring a common-user system to provide services to non-competing entities, though they should be free to do so at their option.

We wish to emphasize that none of the above suggestions are intended to "promote" competition where it is indeed untenable, nor to restrict the realization and exploitation of genuine economies of scale and of common operations. Rather, the emphasis is on being able to more accurately identify those areas where competition and/or complementarity is a viable means to innovation, efficiency and lower-cost service, and to ensure that competition and/or complementarity has a fair trial in these situations.

With regard to the radio frequency spectrum resource (which includes satellite orbital space as one parameter), we believe the issue of scarcity has been overstated. Stated otherwise, any limitation on the capacity of this resource which may exist seems continuously extendable through technological and/or operational innovation, at a price. We have difficulty envisioning this as a classic resource allocation problem where discrete quantities of a finite resource must be rationed among prospective users according to some economic or public interest criteria. Particularly during the early establishment and use of domestic satellite facilities, it will more likely be a question of establishing and enforcing appropriate technical standards representing the best judgment of the

Commission as to optimum trade-offs between economic viability and technical efficiency in the light of projected demand for communications channels. For example, the Commission may wish to establish a minimum acceptable earth station antenna diameter (e.g., 30 ft.), in order to accommodate a particular number of U. S. domestic satellites. Should the Commission receive applications in excess of this number during a specified initial filing period, it has the option of:

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(c) ruling on the relative public benefits of alternative proposals and setting priorities accordingly.

To the extent that applicants are few--as we expect--presently allocated spectrum resources should accommodate all applicants without conflict under reasonable technical standards, thus the above procedures would not be required. Should additional applicants come forward subsequent to the initial filing period, the Commission has recourse to several additional options:

(d) authorize later systems to use additional spectrum resources now being cleared with appropriate international agencies for satellite use, based on new technical standards plus any of options (a) through (c) above.

(e) authorize later applicants to either "buy out" some existing system's spectrum claim, or compensate an existing user for modifications (e.g., larger antennas, relocation of satellites and/or earth stations, etc.) to his system to accommodate the new entrant.

In no event, therefore, can we envision the need for a prior ruling by the Commission on the relative priority of potential applicants; only when applications are in hand can the extent of scarcity and the relative merit of alternative uses be weighed. However, the Commission may wish to consider a policy which would limit the amount of spectrum resource (i. e., frequency bandwidth and orbital range) which any single user may control, to avoid monopolization of the resource. To the extent that particular orbital sectors have special attributes (e.g., coverage of all 50 states rather than just the contiguous 48 states), such a restriction should apply within this sector as well as overall.

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF TELECOMMUNICATIONS MANAGEMENT
WASHINGTON, D.C. 20504

Date: October 29, 1969

Subject: Comments on Draft Report of the Economic Committee on Domestic Satellites, October 24, 1969

To: Dr. Tom Moore
Council of Economic Advisors

The Office of Telecommunications Management does not concur with the findings, conclusions and implied recommendations of the subject Draft Report. Overall, we cannot agree with the general thrust of the Economic Report and caution its use in the formulation of national policy.

The highly theoretical conceptual approach reflected in the Report is aimed fundamentally at achieving the objectives of promoting competition and innovation rather than structuring an approach based upon meeting service oriented goals. The basic questions are:

> How should this new technology be organized to make the maximum contribution to the total communications resources available to the American people? This technology -- the product of great expenditures by the American taxpayer -- could be utilized as an integral part, an extension of, or independently of the existing enormous telecommunications infrastructure (systems, networks and institutions). Are there any logical roles for satellite communications which can and should be established on a fully independent basis? On the other hand, is there an economically viable role for domestic communications satellite services independent of the existing common carrier structure?

In developing answers to these questions, we feel a full appreciation of the institutional and system/network facilities of the existing domestic telecommunications complex is necessary in the development of realistic and meaningful roles for satellite communications. To aid in such understanding, a summary description of domestic telecommunications in the United States which highlights the magnitude, interactions between components and value to users of this vital resource has been prepared by this office and is attached as Tab A.

Since the United States has the most comprehensive, economical and flexible system of telecommunications in the world, we believe it is important that the Administration adopt a policy framework which will promote the timely introduction of this new technology and the concomitant orderly evolution of the domestic telecommunications environment for the benefit of our people. Such national policy should be based on "real world" considerations rather than untested theoretical patterns of institutional arrangements and methods of Regulatory control.

Examples of some of our reservations on the national policy implications and other aspects contained in the draft Economic Report are as follows:

a. Role of Satellite Communications -- The Report does not contain an explicit appreciation of the magnitude and importance of the existing domestic telecommunications environment in the development of possible roles of satellite communications. The potential market for the Government as a substantial user is not treated specifically.

b. Institutional Approach -- In the view of this office, the report develops a theoretical approach to fostering competition and innovation in the absence of valid data to prove that the provision of satellite communications services is not a natural monopoly enterprise.

c. Multiple-Purpose vs. Single Purpose Systems -- We note that the Report does not examine the cost/benefit tradeoffs between a multiple-purpose system (furnishing a spectrum of services) and an approach utilizing a multiplicity of separate systems (common carrier and dedicated). There seems to be merit in further examination of the ideas presented by NBC and COMSAT (response to Dr. Whitehead) with respect to the use of a multiple-purpose space segment and separate families of common carrier and dedicated user earth station networks.

d. Spectrum Allocation and Orbital Space -- Since it seems reasonable that initially the U. S. domestic satellite facilities will be limited to about a maximum of ten 4 and 6 GHz satellites, we believe the national interest dictates the formulation of national policy which would assign a priority to assure the establishment of a common carrier multiple-purpose system available to all users private and Government. We think a pre-assigned precentage division of the "available orbital space" is not the best way to structure the institutional arrangements for domestic satellite communications.

e. Cost Estimates -- We note that the costs used in the Report are in some cases old, obsolete and incomplete with respect to including launch vehicle failure costs, overhead (Manager) costs, profit and cost of money, and terrestrial inter-connection charges.

f. Regulation -- We note the Report seems to lack an appreciation or recognition of AT&T's key role in domestic telecommunications, and suggests an arbitrary restriction of AT&T's satellite role. We also note the Report generally derogates the quality of FCC Regulation.

This office feels it is noteworthy to observe that the responses to Dr. Whitehead's letter of August 14, 1969 (addressed to numerous potential entities and users) presented no new facts which would change the basic technical and economic conclusions on the capability, costs, risks, and uncertainty of satellite communications reached by the FCC in its draft of the First Report and Order for Docket 16495 (May 23, 1969).

The above views of this office are based, in part, on its intimate familiarity with domestic telecommunications, its activities in performing the delegated function of the President in satellite communications, and its close surveillance of the actions leading to and during FCC's Docket 16495 inquiry since 1965.

In light of the above, this office recommends the Economic Report be revised to reflect the "real world" situation which exists today and to formulate logical and meaningful alternatives for the future utilization of satellite communications technology in the domestic telecommunications environment.

The international implications of domestic satellite communications in the areas of: (a) negotiations of Definitive Arrangements for the INTELSAT Consortium; and (b) U. S. preparations for the 1971 Space World Administrative Radio Conference are treated separately in the DTM memorandum to Dr. Whitehead of September 18, 1969.

Tom Olsson
W. T. Olsson

Encl. Tab A

cc: Dr. Whitehead
Dr. Drew

DOMESTIC TELECOMMUNICATIONS

IN THE

UNITED STATES

The Magnitude of Domestic Telecommunications

The United States presently has the most comprehensive, economical and flexible system of domestic communications in the world. These include extensive common carrier networks, broadcast stations and networks, private commercial systems, and millions of private, personal facilities. These systems, worth an aggregate of over $50 billion, include 48% of the world's telephones (1 for each 2 U.S. residents); and provide multi-channel TV service, including some 118 educational TV stations, to some 55 million residences (including 10 million color TV sets) in virtually every region of the country, no matter how sparsely settled.

By far the largest part of the investment is included in what is usually spoken of as the Telephone Network, provided by the Bell System and the 2244 Independent Telephone Companies jointly. Of the Telephone Network, about 85% is used for the provision of Public Message Telephone Service, i.e., ordinary telephone calls. The term "telephone", used in this connection, is becoming more and more of a misnomer since it includes a variety of other services such as Dataphone and, in the future can be expected to furnish a very large variety of services.

Today there are over 110 million telephones in the United States and telegraph service to 5700 cities. There are approximately 200 million miles of voice equivalent circuits, better than twice the distance to the sun, interconnecting virtually every city, town and hamlet. This has grown from a scant 2000 miles in 1920--7.7 million miles at the end of World War II-- and is expanding today at a rate of about 25 million miles per year. In this same 20 year period since the end of World War II, annual conversations have soared to 130 billion from 40 billion. It is significant that more than half (63%) of the longer circuits are provided by microwave facilities of which the overwhelming preponderance operate in the 4-6 GHz frequency bands, the same bands presently employed in satellite communications.

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Within this vast system there is a network of television grade facilities interconnecting 370 stations in 220 cities. To coordinate national television broadcasting, and to permit the splitting of each TV network into as many as 23 segments for local commercial advertising and reconstituting it into a national network within the 60 seconds allowed for commercials, there are 150 TV operating centers scattered throughout the U.S. There are approximately 600 more TV stations in the U.S. not connected into the network.

In addition to the Telephone Network, Western Union provides a variety of telegraph and data services including the familiar yellow Message Telegram, private line telegraph and data services, Telex, some facsimile service and a number of miscellaneous classifications.

Intercom service within plants or office buildings are, for the most part, furnished by PBX switching systems furnished by the telephone companies both for that purpose and for telephone service from the general network. However, there are a significant number, figures not available, of firms which purchase the equivalent of PBX switching systems, known as PAX systems, specifically for the purpose of intercommunications within their own organization in confined locations and not interconnected with the Telephone Network.

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A number of entities, particularly those known as "right-of-way" companies, such as railroads, gas and oil pipe lines, electric utilities, have constructed private microwave transmission facilities for their own inter-location telecommunications and control purposes.

The Common Carriers and privately owned microwave networks provide extensive coverage nationwide. As of October 1967, there were 419 privately owned microwave networks, covering over 110,000 route miles versus approximately 72,000 route miles of microwave for the carriers. However, in channel miles the Common Carriers' capacity is far in excess of the privately owned system, 150 million versus 2-1/2 million.

A point for consideration is that very few of the privately owned microwave systems carry over 24 voice channels, whereas the Common Carrier systems carry up to 12,000 voice channels on a single frequency.

Interactions between Components

Because of the tremendous growth in telecommunications and the effect it has on our political, economic and social life, management and control of such an industry is extremely important.

The management of such a complex system consists of many operating details. The system must provide for different types of services; it must provide for variations in bandwidth. Voice, teletype, data facsimile, television, telemetry, all require different bandwidths to operate. Operating and maintenance personnel require specialized skills. Operating costs must be low enough that the services may be available to all. Systems engineering is required to provide for reliability, good quality, and interface of equipment and systems. The systems, equipment, and personnel must have the ability to react quickly and competently to system failures. No system remains static, therefore continuing research and development programs are necessary

The control of such a vast system of networks requires regulation. The need for technical coordination and management was recognized in the United States in 1922, when the Secretary of Commerce convened the first of the National Radio Conferences, which led to the establishment of a Federal Radio Commission. Later, the Communications Act of 1934 created the Federal Communications Commission (FCC) to regulate interstate and foreign commerce in communication by wire and radio.

Rigid standardization of terminal and switching equipment was necessary before the Independent Telephone Companies and the Bell System could effect calls originating in one company's franchise area, traverse the Bell System Long Lines, and be terminated in another company's franchise area. Since the advent of the first commercial microwave system by the carriers in 1946, standardization, therefore, has been a major factor influencing telecommunications systems technology. This standardization among the Common Carriers is one factor missing among the many privately owned microwave equipment and system networks.

The Common Carrier systems provide for a variety of services and customers throughout the nation. The management and engineering of such a nationwide system is a monumental task. To provide and maintain such a system requires a coordinated effort if economics and efficient operating performance are to be maintained. There are definite relationships between the capabilities of instruments, the sizes of wire, the types of circuits employed, and the distances covered. The engineering requires the provision of alternate routing facilities and efficient network management centers. These network management centers monitor and control the network so as to get the most efficient and effective use of the networks. It does this by:

- Exercising control during periods of disaster, major facility failures, and high traffic volumes, so that more calls can be completed.

- Rerouting traffic that encounters busy circuits to idle circuits when available.

- Making sure that switching systems and equipment function properly at all times.

- Making regular checks of circuit and machine facilities and arranging for special action when necessary.

The service must be rapid, reliable, and economical. The equipment to provide Common Carrier service is extremely complex, consisting of many millions of different kinds of parts, switches, relays, transistors, vacuum tubes, cables, etc. The reliability of each part of this communications system depends upon the quality and the compatibility of every other part. The resulting service is no better than the weakest link in the combination of plant and equipment which is used to complete the connection. As new requirements arise, there may be some cases where new developments are necessary as well as the addition of plant and equipment. These new developments must be designed so that they may be incorporated within existing equipments without undue modification or degradation to the operation of the system.

It is this unitary concept that distinguishes Common Carrier service from privately owned systems. In addition to quality of service the advantages of a unitary concept extends to logistics--procurement of equipment, spare parts, personnel, personnel training, maintenance, etc.

Private microwave route mileage has been growing at an average rate of 14% a year. There are many reasons for the growth and expansion of privately owned microwave systems. Since World War II, great strides have been made in the development and use of microwave equipment and the equipment manufacturers became very active in promoting their product. As more quipment and personnel became available, here was an alternate to leasing from a Common Carrier. The microwave equipment industry is now a 10 million dollar a year industry.

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The decision by industry to install and use private communication systems, while basically economic in orgin, is not always based on cost factors. It is usually justified on the premise that they have better control over their facilities; it is more dependable; and above all, the system may be used in the manner and way that will be of greater benefit to them at the time. As additional requirements develop for communications, the rationale is that with little added cost the existing microwave system can be extended to provide for this need and the same operating and maintenance personnel can handle the larger system.

Usually it is only when a communication system reaches a certain size that a company begins to realize that here is a capability that should be used to its greatest advantage to protect its investment. It is at this time that system outages and costs caused by equipment failures and maintenance upkeep begin to be noticed. It is at this time also that, for the first time, the cost factor is raised; in many cases it is found that the same service can be provided by the Common Carriers at a lower cost over the long run. Bulk Common Carrier communication rates such as TELPAK and WATS have been very effective in this respect.

Today the Switched Network is the heart of the U.S. National Telephone System, yet many of its more modern switches are capable of handling digital communication traffic as well as telephone voice traffic.

The role of any switch in a telecommunication network is to allow for the interconnection of user terminals without the necessity of costly interconnection directly to each user in the network from every other user in the network. Within the U.S. the DDD switched network allows the interconnection of over 110,000,000 users via more than 300,000 long distance lines which crisscross the continent. This network of voiceways uses a switching plan, automatic switching equipment, and alternate routing.

The switching plan provides a flexible arrangement of telephone circuits so that calls can go through quickly. It divides the continent geographically into 12 regions, each with its own switching center. Each region in turn is divided into sections with sectional centers, then primary centers and finally, toll centers. Like a computer, the network is programmed to handle any call in a systematic, economical manner with alternate routes provided when the normal one is not available.

Alternate routing helps prevent delays. If the most direct route is busy when you dial the number, the quipment will try another, then another. If these should happen to be busy, your call is routed automatically to a "final route." This final route has been planned so that under normal conditions practically all calls offered to it--even during the busiest hour of the day--will find a circuit available.

Because of the interconnectibility offered by the switched network continuity of service, or survivability of a communication capability is available on a scale far greater than would be possible with a multitude of direct connections. Survivability planning then deals with emergency situations and disasters, such as hurricanes, floods, fires, earthquakes, snow, ice and even war. Some examples are provided: Since 1955 all cable or radio relay routes built have been laid out according to the Bell System "Express Route" principle. This also applies to the Western Union microwave beam system. Instead of running from city to city and interconnecting in downtown areas of major cities, such attractive targets as military installations and industrial complexes are avoided entirely. Connections to cities, military installations, or industrial complexes are made by side-leg connections. Bell is also "hardening" toll facilities, making them as resistant to weapons effects as practicable. The transcontinental coaxial cable provides a hardened backbone route clear across the country, with legs into such places as Offutt Air Force Base, Blue Ridge Summit, and NORAD. At San Luis Obispo, it connects with the new Trans-Pacific cable. All of the main and auxiliary repeater stations along the route are underground. The main stations are in heavy, reinforced concrete buildings under two feet of earth. They are equipped with emergency power, air conditioning, food, fuel, and safe water supplies to permit them to operate "buttoned up" and safe from fallout for a period of about three weeks. Similar hardened cables are planned from Massachusetts to the vicinity of San Francisco and one from Boston southward along the Atlantic coast to Miami is nearing completion. By combining these measures with growth construction, the cost of survivability is held comparatively low. Fallout protection is also being provided for personnel at selected switching centers and junction points on other cable and radio relay routes. A program is underway to provide such protection at some 170 points across the nation at a cost of about 10 million dollars. Considerable effort has been expended to ensure uninterrupted service. On both coaxial and radio routes, protection channels are provided that are automatically switched into service in the event of unforeseen equipment troubles. Some 25 million dollars will be spent through 1970 to improve the effectiveness of presently installed automatic equipment to accomplish this operation. Should the regular primary control offices be knocked out in a nuclear attack, communications would be supervised from emergency control centers which are being established at strategic points across the country. The Long Lines Department has 17 of these centers spread out around the country. Each of the operating companies has at least one similar installation.

Value of Domestic Telecommunications To Its Users

Value measurements are usually subjective. Value of telecommunications in the U.S. is indicated by the demand for it. The preceding paragraphs attest to the great demand for telecommunication services in this country.

The value to the President and to the Government in general is evident in that the Federal Government is the largest single user of telecommunication services.

Other users place value on telecommunication in that needs in many areas are being met, for example: The Nation's airways could not function without radio for communication, navigation and control. The New York State library system uses facsimile interconnections in place of books shipped on loan between libraries. State and local governments are highly dependent upon communications for their operations involving education, crime fighting, transportation, fire control, and life support activities. The telephone serves as a vital tool in medicine; it is a boon to the handicapped. New electronic systems for analyzing electrocardiograms (EKGs) are linked by telephone to computers, leading to improved diagnosis of disease. An attending physician can obtain an immediate consultation with a cardiologist. As the electrocardiogram is traced out in graph form, it is sent over telephone lines to the cardiologist who can read it along with the doctor at the bedside. Specifically-designed telephones enable the deaf to hear, and an "artificial larynx" gives voice to those who otherwise could not talk.

New communication uses are being developed every day, such as electronic monitors attached to telephones to warn of intrusions of fire, flood, or other dangerous conditions. Experimental video telephones already enable people hundreds of miles apart to see each other on an eight-inch screen.

For better or for worse, telecommunication does bring people and their interdependent needs closer together. The value of any telecommunication capability is to its users and in its use and not in the telecommunication organizations which are perpetuated by that use.

Dr Whitehead

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF TELECOMMUNICATIONS MANAGEMENT
WASHINGTON, D.C. 20504

DRAFT/OLSSON

WORKING PAPER

Date: October 28, 1969

Subject: Comments on Draft Report of the Economic Committee on Domestic Satellites, October 24, 1969

To: Dr. Tom Moore
Council of Economic Advisors

The Office of Telecommunications Management does not concur with the findings, conclusions and implied recommendations of the subject Draft Report. Overall, we cannot agree with the general thrust of the Economic Report and caution its use in the formulation of national policy.

The highly theoretical conceptual approach reflected in the Report is aimed fundamentally at achieving the objectives of promoting competition and innovation rather than structuring an approach based upon meeting service oriented goals. The basic questions are:

> How should this new technology be organized to make the maximum contribution to the total communications resources available to the American people? This technology -- the product of great expenditures by the American taxpayer -- could be utilized as an integral part, an extension of, or independently of the existing enormous telecommunications infrastructure (systems, networks and institutions). Are they any logical roles for satellite communications which can and should be established on a fully independent basis? On the other hand, is there an economically viable role for domestic communications satellite services independent of the existing common carrier structure?

In developing answers to these questions, we feel a full appreciation of the institutional and system/network facilities of the existing domestic telecommunications complex is necessary in the development of realistic and meaningful roles for satellite communications. To aid in such understanding, a summary description of domestic telecommunications in the United States which highlights the magnitude, interattions between components and value to users of this vital resource has been prepared by this office and is attached as Tab A.

Since the United States has the most comprehensive, economical and flexible system of telecommunications in the world, we believe it is important that the Administration adopt a policy framework which will promote the timely introduction of this new technology and the orderly concomitant evolution of the domestic telecommunications environment for the benefit of our people. Such national policy should be based on "real world" considerations rather than untested theoretical patterns of institutional arrangements and methods of Regulatory control.

Examples of some of our reservations on the national policy implications and other aspects contained in the draft Economic Report are as follows:

a. Role of Satellite Communications -- The Report does not contain an explicit appreciation of the magnitude and importance of the existing domestic telecommunications environment in the development of possible roles of satellite communications. The potential market for the Government as a substantial user is not treated specifically.

b. Institutional Approach -- The report develops a theoretical approach to fostering competition and innovation in the absence of valid data to prove that the provision of satellite communications services is not a natural monopoly enterprise.

c. Multiple-Purpose vs. Single Purpose Systems -- We note that the Report does not examine the cost/benefit trade-offs between a multiple-purpose system (furnishing a spectrum of services) and an approach utilizing a multiplicity of separate systems (common carrier and dedicated). There seems to be merit in further examination of the ideas presented by NBC and COMSAT (response to Dr. Whitehead) with respect to the use of a multiple-purpose space segment and separate families of common carrier and dedicated user earth station networks.

d. Spectrum Allocation and Orbital Space -- Since it seems reasonable that initially the U. S. domestic satellite facilities will be limited to about a maximum of ten 4 and 6 GHz satellites, we believe the national interest dictates the formulation of national policy which would assign a priority to assure the establishment of a common carrier multiple-purpose system available to all users private and Government.

e. Cost Estimates - We note that the costs used in the Report are in some cases old, obsolete and incomplete with respect to including launch vehicle failure costs, overhead (Manager) costs, profit and cost of money, and terrestrial interconnection charges.

f. Regulation - We note the Report seems to lack an appreciation or recognition of AT&T's key role in domestic telecommunications and to generally derrogate the quality of FCC Regulation.

This office feels it is noteworthy to observe that the responses to Dr. Whitehead's letter of August 14, 1969 (addressed to numerous potential entities and users) presented no new facts which would change the basic technical and economic conclusions on the capability, costs, risks, and uncertainty of satellite communications reached by the FCC in its draft of the First Report and Order for Docket 16495 (May 23, 1969).

The above views of this Office are based, in part, on its intimate familiarity with domestic telecommunications, its activities in performing the delegated function of the President in satellite communications, and its close surveillance of the actions leading to and during FCC's Docket 16495 inquiry since 1965.

In light of the above, this Office recommends the Economic Report be revised to reflect the "real world" situation which exists today and to formulate logical and meaningful alternatives for the future utilization of satellite communications technology in the domestic telecommunications environment.

W. T. Olsson

cc: Dr. Whitehead
Dr Drew

Encl. Tab A

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The switching plan provides a flexible arrangement of telephone circuits so that calls can go through quickly. It divides the continent geographically into 12 regions, each with its own switching center. Each region in turn is divided into sections with sectional centers, then primary centers and finally, toll centers. Like a computer, the network is programmed to handle any call in a systematic, economical manner with alternate routes provided when the normal one is not available.

Alternate routing helps prevent delays. If the most direct route is busy when you dial the number, the quipment will try another, then another. If these should happen to be busy, your call is routed automatically to a "final route." This final route has been planned so that under normal conditions practically all calls offered to it--even during the busiest hour of the day--will find a circuit available.

Because of the interconnectibility offered by the switched network continuity of service, or survivability of a communication capability is available on a scale far greater than would be possible with a multitude of direct connections. Survivability planning then deals with emergency situations and disasters, such as hurricanes, floods, fires, earthquakes, snow, ice and even war. Some examples are provided: Since 1955 all cable or radio relay routes built have been laid out according to the Bell System "Express Route" principle. This also applies to the Western Union microwave beam system. Instead of running from city to city and interconnecting in downtown areas of major cities, such attractive targets as military installations and industrial complexes are avoided entirely. Connections to cities, military installations, or industrial complexes are made by side-leg connections. Bell is also "hardening" toll facilities, making them as resistant to weapons effects as practicable. The transcontinental coaxial cable provides a hardened backbone route clear across the country, with legs into such places as Offutt Air Force Base, Blue Ridge Summit, and NORAD. At San Luis Obispo, it connects with the new Trans-Pacific cable. All of the main and auxiliary repeater stations along the route are underground. The main stations are in heavy, reinforced concrete buildings under two feet of earth. They are equipped with emergency power, air conditioning, food, fuel, and safe water supplies to permit them to operate "buttoned up" and safe from fallout for a period of about three weeks. Similar hardened cables are planned from Massachusetts to the vicinity of San Francisco and one from Boston southward along the Atlantic coast to Miami is nearing completion. By combining these measures with growth construction, the cost of survivability is held comparatively low. Fallout protection is also being provided for personnel at selected switching centers and junction points on other cable and radio relay routes. A program is underway to provide such protection at some 170 points across the nation at a cost of about 10 million dollars. Considerable effort has been expended to ensure uninterrupted service. On both coaxial and radio routes, protection channels are provided that are automatically switched into service in the event of unforeseen equipment troubles. Some 25 million dollars will be spent through 1970 to improve the effectiveness of presently installed automatic equipment to accomplish this operation. Should the regular primary control offices be knocked out in a nuclear attack, communications would be supervised from emergency control centers which are being established at strategic points across the country. The Long Lines Department has 17 of these centers spread out around the country. Each of the operating companies has at least one similar installation.

Value of Domestic Telecommunications To Its Users

Value measurements are usually subjective. Value of telecommunications in the U.S. is indicated by the demand for it. The preceding paragraphs attest to the great demand for telecommunication services in this country.

The value to the President and to the Government in general is evident in that the Federal Government is the largest single user of telecommunication services.

Other users place value on telecommunication in that needs in many areas are being met, for example: The Nation's airways could not function without radio for communication, navigation and control. The New York State library system uses facsimile interconnections in place of books shipped on loan between libraries. State and local governments are highly dependent upon communications for their operations involving education, crime fighting, transportation, fire control, and life support activities. The telephone serves as a vital tool in medicine; it is a boon to the handicapped. New electronic systems for analyzing electrocardiograms (EKGs) are linked by telephone to computers, leading to improved diagnosis of disease. An attending physician can obtain an immediate consultation with a cardiologist. As the electrocardiogram is traced out in graph form, it is sent over telephone lines to the cardiologist who can read it along with the doctor at the bedside. Specifically-designed telephones enable the deaf to hear, and an "artificial larynx" gives voice to those who otherwise could not talk.

New communication uses are being developed every day, such as electronic monitors attached to telephones to warn of intrusions of fire, flood, or other dangerous conditions. Experimental video telephones already enable people hundreds of miles apart to see each other on an eight-inch screen.

For better or for worse, telecommunication does bring people and their interdependent needs closer together. The value of any telecommunication capability is to its users and in its use and not in the telecommunication organizations which are perpetuated by that use.

October 29, 1969

MEMORANDUM FOR MR. TOM WHITEHEAD

I have reviewed the OTM comments dated 10/24/69 on the Economic Committee draft report, and find them completely devoid of substance, relevance or consistency. To be precise, these "comments" are nothing more than a series of rhetorical questions and empty cliches. At best, these indicate a complete lack of understanding of the technology, operations, economics -- or even history -- of telecommunications service; at worst, they might be considered a prostitution of the "public interest" they claim to represent. In either case, they provide adequate basis for disqualifying the author from participation in this proceeding; to formulate public policies on the basis of such inputs would be a national disgrace.

The following are some specific comments on the paper:

Page 1

(a) It is true that a major (though not "fundamental") objective of the approach suggested is to permit (not "promote") competition and innovation. I fail to understand why this is objectionable in a free economy, or why the government should be involved in "structuring an approach based upon meeting service-oriented goals"--whatever that may mean.

(b) How does one organize a new technology to make the maximum contribution to the total communications resources -- ?

(c) Since when is it the government's business to decide if there are any "logical roles for satellite communications which can and should be established on a fully independent basis" or to determine if there is an "economically viable role for domestic communications satellite services independent of the existing common carrier structure"?

Page 2

(a) I would agree that "an appreciation of the institutional and system/network facilities of the existing domestic telecommunications complex is necessary for the development of realistic and meaningful roles for satellite communications." It is most unfortunate that the OTM paper does not reflect such an appreciation, but merely a compendium of meaningless statistics on such vital(?) factors as route-miles of microwave, numbers of mobile radios(?) and radio amateurs(?), numbers of telephones and telephone calls, and "value" of telecommunications service (e.g., "--users place value on telecommunication in that needs in many areas are being met--"???). The data on electronic systems for analyzing electrocardiograms was another jewel of relevant(?) policy-making information.

(b) The repeated reference to "real world" considerations rather than "untested theoretical patterns" is an obvious attempt to discredit the committee as a group of fuzzy-headed intellectuals. It is interesting to note in this regard that virtually none of the "communicators" who make up the OTM staff have a professional degree in any relevant field -- engineering, economics, law, business administration, public administration, etc. For the most part, these founts of wisdom and protectors of the faith are active and retired military whose communications qualifications consist of having operated or worked on a radio during some phase of their careers.

Page 3

Institutional Approach -- What warped sense of devotion to monolithic structures could prompt one to ask that the government "prove that the provision of satellite communication service is not a natural monopoly enterprise"? In all my experience, the burden of proof of any such point falls on the prospective monopolist. As a point of fact, the economics paper fairly conclusively shows that this is not a natural monopoly--even if such a concept were valid, in any situation, which I very much doubt.

Multi-Purpose vs. Single Purpose -- The report indeed does not examine the cost/benefit trade-offs between multi-purpose and single-purpose systems, for the very good reason that there are no firm systems, cost studies, benefit studies, or demand studies on which such an examination could be made. The ideas presented by NBC and Comsat on the benefits of multi-purpose operations are entirely subjective and speculative--as are OTM's--and thus impossible to evaluate. However, it is important to note that the freedom to establish multi-purpose systems is both implicitly and explicity recognized in the paper.

Spectrum Allocation and Orbital Space -- The rationale for proposing a priority on spectrum and orbital space for common-carrier systems is unclear. First, the technical committee indicates that more satellites can be accommodated than are likely to be proposed for initial systems, and that additional allocations will be made available to meet future demands. Second, the principal common carrier--AT&T-- indicates their economic analysis does not show that satellites will be attractive to them, in the near future, particularly in the 4 and 6GHz bonds. Finally, the paper contains explicit statements to the effect that, should there indeed be an excessive demand for satellites, the FCC would set some sort of priority system based on their evaluation of the relative benefits (it might well be, for example, that the greatest public benefits from the use of spectrum and orbital resources might not result from common-carrier operations, but from some special public-service operation such as educational programs, health information dissemination, disaster warnings, etc.)

Page 4

(a) Regulations -- The report does not lack an appreciation or recognition of AT&T's key role in domestic telecommunications; to the contrary, it reflects some serious concern for this role--although it does not "stand in awe" of AT&T as perhaps the DTM was suggesting.

(b) It is noteworthy to observe that the findings of neither the Technical nor Economic Committees were based on the responses to Dr. Whitehead's letter, which explicitly requested that entities refrain from specific proposals or detailed technical and economic data. On the other hand, the Committees did have available to them considerably more recent and substantial data, particularly on technical factors, than did the FCC when its proposed First Report and Order were prepared.

(c) The Office of Telecommunications Management, contrary to its claims, does not possess an intimate familiarity with domestic telecommunications, only with certain suppliers of such telecommunications.

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In light of the above, I recommend that the Office of Telecommunications Management be requested to cease and desist its advocacy of special private interests and to participate constructively in the formulation of national policies which are in the public interest.

WRH

Walter Hinchman

Domestic Satellite Pot Boils

Past FCC Indecision on Domestic Satellite System Provides Take-Off Point for Renewed Action

By Robert J. Samuelson
Washington Post Staff Writer

The idea of establishing a system of domestic communications satellites is not new. As early as 1967, the Federal Communications Commission prepared to authorize an initial network. Had the FCC given its approval, the satellites might have become operational next year.

But the FCC remained silent, and now the earliest potential starting date is probably 1972. The satellite issue has since emerged as a classic case of governmental indecision—the result of divided federal responsibilities, complicated technical and legal issues, and powerful, competing industrial interests.

In 1967, the FCC deferred to the White House. Satellite communications appeared to be one of those grey areas of federal regulatory law, a confusing combination of "regulation" (the awarding of radio and television licenses, for example) and longrange national communications "policy." Though the FCC retained final jurisdiction, it felt it must await recommendations from the executive. In August 1967, President Johnson appointed a special Communications Task Force to study a long list of communications issues, including satellites.

Study Undertaken Again

By last December, when the task force had finished its report, the vicissitudes of politics had rendered most of the exercise meaningless. The Nixon specialists read the massive document, put it aside and began their own separate investigation. Nearly a year has passed.

That a system can be built is not disputed. For five years, the United States has provided the main support for an international satellite network, which has lowered transoceanic phone rates and expanded international television transmissions (including those of the Apollo missions). Now supporters of a domestic system, frustrated by repeated delay, are pushing the White House and the FCC for a quick decision.

The Communications Satellite Corp. (Comsat), a Congressionally created corporation whose only business—and, therefore, whose very existence—is satellites, has always been an ardent advocate. More important is the renewed interest of the television networks. In 1965 and 1966, ABC and NBC enthusiastically embraced satellites as a means of transmitting television signals. The third network, CBS, was lukewarm. But this month, Frank Stanton, CBS's president, officially became a convert:

"Painstaking technical work and great ingenuity went into the many proposals of 1965 and 1966. But to what avail? Now we are in the fifth year of discussion, analysis—and bureaucratic inaction. What a national waste!" he said in a well-publicized speech.

Higher Rates

What apparently provoked Stanton's calculated outburst was American Telephone and Telegraph's new, higher rates for television signals. The new charges will cost the three major networks $20 million more a year, raising their total bill to $65 million.

"We were bitten very badly on this go-round," says one TV executive of the rate changes. In the future, the networks see nothing but more increases from AT&T. This prospect apparently moved CBS to seek its independence from AT&T's land communications system.

"Before the new rates, CBS was reluctant to change," guesses another TV man. "AT&T's service is first-rate, and you don't like to shift from a known to an unknown."

(The increase must also be kept in perspective, as AT&T is the first to point out. According to the phone company, the change is the first major upward rate revision since 1948. And under the old rates, transmission charges declined from 8.8 per cent of the networks total cost in 1954 to about 4 per cent in 1969, AT&T says).

Within the next month, the White House, which has been studying the satellite problem intensively since summer, may give the networks satisfaction by proposing that a domestic system be approved. The question has never been whether, but how and when. And even a positive recommendations would still leave the difficult task of approving a specific system in the hands of the FCC.

Predicting Complicated

No one knows when the FCC will act, though most of the preliminary staff work has apparently been completed. The arrival of two new commissioners, including a new chairman, complicates predicting. Having recently been appointed by the President, the new members might accept the outlines of a White House recommendation; on the other hand, they might want to reevaluate the entire matter.

Such a reassessment could consume a great deal of time, for the questions which originally puzzled the Johnson task force and the subsequent Nixon study group are indeed complicated.

See SATELLITE, F2, Col. 1

INTELSTAT III—Orbiting the earth 24,000 miles above the equator, communications satellites keep a fixed position in relation to the earth, and can relay signals to a large portion of the globe. Here is an artist's con- tion of an Intelstat III satellite, already in service for the internatio- satellite communication system.

Washington Post - Business Section, Oct 26, 1969

Action Asked on Satellite

SATELLITE, From F1

First, it is agreed that the government cannot allow anyone to launch his own communications satellite. The satellites would be placed in space 24,000 miles above the equator and orbit the earth at the same rate as the globe spins—therefore, they would remain stationary above one spot. Even if the government were to allow more than one satellite system, experts agree that there are a limited number of satellites which could be "parked" without having one satellite's transmissions interfere with the others.

Second, no one knows how important a communications medium satellites will become. Television is regarded as the biggest early user, but some analysts have suggested that the satellites should be able to perform a variety of other tasks efficiently: transmit data between computers; transmit business letters and legal documents at rates which would eventually attract most important commercial mail from the Post Office; provide private television lines for businesses which feel the need for face-to-face, coast-to-coast conferences.

Finally, there are powerful interests vying for the right to own part, or all, of any prospective satellite system. If satellites assume a major role in filling future communications needs, any decision allocating ownership rights of the satellites and the ground stations (which send and receive signals) could eventually involve many millions in revenue annually. Some of the contestants include AT&T, television networks and Comsat.

At first, the networks asked that they be allowed to create a system to provide for their own needs. Other systems could satisfy other needs. Comsat and AT&T, in a fragile alliance, said that there should be one system and one system only.

Though they disagreed on the details of ownership, Comsat and AT&T argued that the costs of the satellite system could be spread most economically among many different users, including television. The limited "parking space" for orbits also favored the single system.

The networks feared (and still fear) that a single system would result in higher television rates. They believe that a general system—transmitting television, data, and telephone signals —would require a larger investment in complicated ground stations than a simple system which would serve only television. T.V. doesn't want to pay for that added investment.

The issue remains unresolved, and along with the companion question of who should be allowed to get into the satellite business, helps explain the extended years of study. Events of the past month, however, may make compromise a more likely possibility.

The most important change has been AT&T's abandonment of its one-system approach. "The wisest public policy at this time," the company said a few weeks ago, "would be to permit any organization or group interested in establishing a domestic satellite system —including the networks—to apply for a license to establish and operate such a system."

Why AT&T changed its mind is something of a mystery. The company cited recent studies on the economies of its land facilities. The capacity of microwave networks and coaxial cables for voice and "record" (data, telegrams, facsimile) transmissions have expanded rapidly, reducing unit costs in the process. Consequently, AT&T said, "satellite costs currently may be less favorable . . . than appeared to be the case some years ago."

If AT&T is right, the network may reap smaller savings than they expect. When economies improve, AT&T said it might want to adopt satellites for some of its own services. Meanwhile, most satellite partisans suggest that the phone company, which has more than $40 billion invested in its ground system, has a vested interest in delaying a satellite system.

In any case, AT&T's new position changed the balance of power. Comsat, having lost its strongest ally, is now scrambling to convince the television networks that it should be allowed to place a satellite system in orbit for them.

There are advantages for television. Comsat, with years of experience operating the international system (Intelsat), has the requisite know-how and a cash reserve raised by the sale of stock years ago. This would spare the networks the unpleasant experience of raising more than $100 million during an era of high interest rates.

The television companies still don't want to bear the extra cost of a general system. At least one of them NBC, has apparently proposed a pla to please both Comsat and the ne works.

Under NBC's proposal, televisio rates would reflect the investment only the satellites and the major ear stations (probably two or three) send T.V. signals. The networks them selves would build the hundreds of small earth stations necessary to receive the satellite beams.

Then, if Comsat (or whoever owned the satellite system) wanted to make added investment for other communications services, it could. Rates for new users would simply be adjusted to account for this extra capital. And if enough additional users were attracted, the whole system, including the networks, would benefit from lower costs.

Domestic Satelite

Friday 10/24/69

10:15 Dr. Lyons called--make sure Tom sees Comsat News Digest, October 21, Vol. 8, No. 3. Has whole press play on Domestic Satelite as well as speculation about Telecommunications Management in Government.

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6
UNITED STATES GOVERNMENT

Memorandum

T. Whitehead

TO : Economic Committee Members

DATE: 24 October 1969

FROM : Tom Moore, CEA

SUBJECT: Comments on Draft

Please let me know either by phone or in writing Monday if you hav e any problems with any part.

Attachment

TGM:eam

REPORT OF THE
ECONOMIC COMMITTEE ON DOMESTIC SATELLITES

I. The Role of Satellites in Domestic Communications

The two basic functions performed by telecommunications are interconnection and mass communications. The objective of interconnection is to permit individuals or machines to communicate with each other by telephone, telegraph, teletype, facsimile dataphone or other similar equipment. This function is performed by both common carriers and private systems, and typically involves switching facilities and trunk routes. Interconnection is not necessarily restricted to bi-directional communications; it also includes the function of transmission of information to one or more receive-only terminals.

Mass communications or the one-way transmission of information is performed by the broadcasting stations and CATV systems which also use interconnection facilities to convey their program material from points of origin to transmitting stations.

While satellites may some day perform mass communications by transmitting directly to modified or unmodified home receivers, it is unlikely that this function will be performed under an initial domestic satellite program. Such satellites are beyond the proven state-of-the art and no frequencies are available for such services. Consequently, domestic communications satellites will be used principally in an interconnection role.

Initially satellites for domestic services generally will not directly interconnect user terminals but will interconnect gateway earth stations which in turn will serve one or more user terminals in the adjoining area through land-line connections. In some instances, notably local broadcasters, educational institutions, or large industrial complexes, direct user access may be provided. Although this same interconnecting function can be performed by terrestrial communications facilities through a combination of transmission and switching facilities, the satellite can directly connect any two gateway earth stations, or can relay a signal from any transmitting earth station to all receiving earth stations simultaneously. The exploitation of these capabilities can provide, for some services, greater economy and flexibility of operations.

Any user having a requirement for interconnection is a potential user of domestic satellites so long as he can deliver his signal to the earth station. If he has sufficient traffic to warrant the cost of earth stations at each of the points with which he wishes to communicate or provides terrestrial links to such stations and the requisite number of satellites to assure reliability of service, he could theoretically have a system dedicated to his sole use. On the other hand, it would also be possible for him to combine with other users having similar requirements to jointly finance such a system. A third alternative would be for a separate satellite entity to provide the required services to all users as a common carrier. Under this last alternative, the common carrier could either be the same as that providing common carrier services between the users' terminals and the earth station (as AT&T, for example), or one limited to transmission of the signal between earth terminals, (as COMSAT, for example) in which case the user would be responsible for obtaining the link to the earth station. The communications functions that could be performed would be identical in each of these cases.

Potential Applications

Some of the potential applications of domestic satellite communications are:

Nationwide and/or Regional Distribution of Television and Radio: The distribution of television and radio programs from one (or a few) originating points to many local broadcast stations is basically a wide-area, wide-bandwidth broadcast function. This is currently performed by long chains of microwave and coaxial cable links, in which the program travels from A to B, where it is both used and forwarded to C, and so on through the country. At each junction, there is both terminating equipment (to pick off the desired signal); retransmission equipment (to forward the signal along); local distribution lines to each individual broadcast station being served; and, of course, additional terminating equipment at the local station. Additionally, there is a complex network of control circuits and associated switching/routing facilities to provide the sub-network interconnections, or alternate routing in case of a break in the transmission chain, and intermediate testing, monitoring and maintenance equipment with the personnel needed to maintain adequate signal quality through this maze of switching and transmission facilities (which are prone to introduce different distortions to the signal, depending on weather conditions, differing routes, etc.).

To accomplish this same task via satellite requires a single transmission from the originating point to the satellite, and a single broadcast transmission from the satellite direct to the local stations. To the extent that different local stations desire different program material, it is only necessary that the satellite broadcast multiple program channels, the local station then selecting the particular one it wished to use -- as in the case of the home broadcast receiver.

This is clearly the most attractive domestic application of communication satellite technology at the present time. Despite the occasional requirement of present-day commercial TV networks for simultaneous nationwide distribution of programs, the normal operation of these networks is that of a series of regional or time-zone sub-networks, each using delayed broadcast of programs taped earlier and each inserting a variety of both local and regional advertising, news programs, etc., at varying times. This type of operation, being somewhat closer to interconnection rather than purely distribution, requires additional satellite channels and hence provides less opportunity to exploit the satellite distributional advantage.

Several comparisons have been made between satellite and terrestrial systems for TV program distribution and interconnection. These differ appreciably in their assumptions, in the factors compared (some compare satellite system costs with terrestrial system rates, some compare only transmission costs, some include the cost of local loops while others do not, etc.) and, obviously, in their findings. However, without exception, they all found savings from the use of satellites for this purpose.

National/Regional Data Exchange and Video Conferencing Networks: For the foreseeable future, the market for wide-band data exchange, telemail, and video-conferencing (including Picturephone) appears to be thinly dispersed and limited primarily to business uses, since the terminal equipment is costly and the benefits limited. In addition to demand being thin and widely dispersed, these markets also require very specialized communication interconnections, such as wide-bandwidths (possibly variable) and limited phase shift and distortion. Moreover, such digital services can not easily utilize the existing long-lines transmission and switching network since it is built around the requirements of analog voice signals. In any event to take care of digital services new facilities will have to be built or existing equipment extensively modified.

By its very nature, a thinly dispersed communications market is prone to much wider fluctuations in traffic loading than a dense market in which customer use is statistically smoothed out. Using fixed capacity, fixed route terrestrial transmission and switching facilities, a high degree of excess system capacity is often required to handle such a market. On the other hand, satellite systems employing demand-assigned circuit capacity are much more adaptable in fluctuating demand. In effect, the satellite system smooths out the demand by averaging over many routes throughout the country, which terrestrial systems cannot do. Therefore, it would seem that satellites might be most economical for serving any long-haul, thinly dispersed communications market which is too specialized for the basic telephone plant.

Point-to-Point Trunking: As the preceding discussion should indicate, point-to-point trunking appears the least economic utilization of satellites in the domestic environment, in relation to terrestrial alternatives. There are several reasons for this. First, this mode of operation derives no benefit from the routing capability of satellites; hence, they must compete on a straight-transmission basis. Furthermore, terrestrial facilities are themselves most economical in point-to-point trunking, with a sharp downward cost trend with increasing route density. Satellites show much less difference in costs between thin and dense routes, yet dense rather than thin routes are presently most in demand for long-haul point-to-point trunking in the domestic switched network.

Satellites may consequently be useful for point-to-point trunking, but potential cost savings appear slight and may be of fleeting duration, unless future developments in satellite technology bring about very significant cost reductions -- which is certainly possible.

In addition to the relay functions described above, there are specialized services which satellites can perform which are uniquely suited to their characteristics. Some of the specialized services could be provided within existing state-of-the-art technology, although they might raise problems of frequency allocation and compatibility with existing ITU and CCIR regulations. Among such services would be communications with mobile terminals such as aircraft and ships for navigation and air traffic control functions, collection and relay of data from remote terminals and clock coordination for many ground or mobile applications. Whether these services could be incorporated in satellites configured primarily to provide the interconnection function discussed earlier, or would require separate systems, would require an anlysis of the requirements for such services and their technical and operational compatibility with other services that might be provided by the satellite.

Costs

Lacking stated requirements for a system and the technical specifications for its design, the only generalized approach that can be made to costs is to look at the cost of various components of a system and to indicate the additional cost items that would have to be taken into account in an operational system.

Satellite costs are difficult to forecast at this stage of technological development. To date, each satellite procurement has represented a new development, with large associated R&D costs. However, based on INTELSAT procurements the following range of costs emerge for typical satellites and associated launch vehicles:

Satellite	Incremental Unit Cost	Launch Vehicle	Incremental Unit Cost
Intelsat II	$ 2.7 M	Thor/Delta	$ 4.3M
Intelsat III	5.3M	Thor/Delta	4.3M
Intelsat IV	6.5M	Atlas/Centaur	16M

Depending on the specific application, a domestic satellite could be configured along the lines of any of the above satellites. Assuming up to $9M added R&D costs to convert these to a domestic model, spread over a procurement of at least 3 satellites, the in-orbit cost range for each domestic satellite would be from $10M to $25.5M.

If we assume an initial operational system capable of handling an adequate number of channels for TV distribution, the satellite will probably be similar to the INTELSAT IV in capability and weight.

With two satellites in operation, there might be one spare in orbit, and allowing for risk of launch failure, the initial order might call for one spare satellite. Therefore, the rough costing of the space segment would come to $40 million for the four satellites, and $48 million for three successful launches, or a total of $88 million. Additional costs will be incurred for command and control facilities.

Aside from the above hardware or engineering costs, an operating organization will have to take into account the risk factors with respect to both launches and satellites. The fewer satellites in a system, the greater the impact of a single failure. Depreciation, replacement and similar charges must also be included in order to determine the revenue requirements for the lifetime of the space segment of the system.

While it may be pōssible to determine with greater accuracy the cost of individual ground stations, as the risk factors here are negligible, the question of location becomes of paramount importance to the operator. The land-line connections between stations and the users and the possibility that special equipment might be necessary to handle local switching or processing are unknown elements. COMSAT's standard earth stations have run $5 to $7 million each, are located far from urban centers, and are not necessarily the type that would be used for domestic services of the TV distribution type. However, some cost figures that appear reasonable, assuming a basic transmit/receive capability, are:

90 foot antenna - Intelsat standard: $4 to $5 million

42 foot antenna - Simple T/R: $250 to $350 thousand

30 foot antenna - Simple T/R: $200 to $300 thousand

15 foot antenna - Simple T/R: $175 to $225 thousand

Important economic and technical trade-offs are involved between the power and cost of the space segment and the number and size of ground stations, and these can only be determined on the basis of a system designed to meet stated requirements. However, it appears that a domestic satellite system will range in initial cost from $10 million to $75 million or more for the space segment with the ground segment costs dependent upon the size and number of ground stations selected.

An additional factor that needs to be taken into account, particularly in connection with any comparison between satellite and terrestrial systems, is the large initial satellite and ground station investment required and the commitment of this investment over at least two years before any revenue can be recovered.

Although we have made no study, the filings with the FCC show some savings may be possible in special purpose systems such as one devoted to television. The table below indicates the amount of savings claimed in filings and by the Rostow Task Force:

Savings Indicated

Source	Year Filed	Savings (in millions)
AT&T	1966	$19 in first year
Ford Foundation	1966	$31-36 annual savings
ABC	1965	$33 annual savings
Rostow Task Force	1968	$154-246 over 12 yrs. system life.

Economies of Scale

Provided there is a demand for the circuits, high capacity transmission facilities are the most economical per unit of traffic. When applied to satellites, the larger the capacity of the satellite, the lower the cost per circuit. But helping offset the lower circuit cost of higher capacity satellites is the trade-off between launch cost and satellite weight, which in turn is a rough measure of its capacity.

Other important variables that could further affect the relative costs of large and small satellites are the manner by which launch and satellite failure risks are accounted for, the lifetime of the satellites and whether in-orbit or on-ground spares are included. Additionally, a major impediment to further scale economies beyond the INTELSAT IV is the limitation imposed by existing frequency bandwidths allocation.

If communications satellites should continue to grow in size beyond the capability of the Atlas-Centaur, launch costs would make the large incremental step to the Titan-Centaur vehicles and hence introduce problems of risk and redundancy that might well outweigh the advantages of added communications capability. One can only conclude that "economies of scale" are probably exhausted by large systems, but that the minimum cost would depend on a specific system configuration.

II. An Evaluation of the Basic Alternatives

While there are an infinite number of institutional arrangements for a future domestic satellite communications industry, the committee focused on two polar categories. Clearly some position between the extremes of competitive entry or a chosen instrument could be chosen but the arguments are best/ clarified by discussing these categories.

The first category, called competitive entry, is defined to mean that no economic criteria other than minimum financial capability would be used to screen potential entrants, but that antitrust considerations could be used to restrict the manner in which some firms would be allowed to participate. With the exception of that caveat, authorization would be automatically granted to a system. In other words, the FCC would issue a license to any applicant to use the allocated spectrum provided that the proposed satellite would not create undue interference problems with other systems. The location of each transmitting earth station would, of course, have to be considered and licensed. The criteria for licensing would be whether such an earth station might cause interference with either terrestrial users or other earth stations. If interference were expected to result from the use of such an earth station or developed after installation, the applicant could be required to pay the cost of relocating the terrestrial equipment to provide equipment to eliminate interference, or to relocate his earth station.

Even under the competitive entry approach, the Commission could not totally ignore economic considerations. Under existing law, it would have to be able to make a finding that competition - the basic feature of the competitive entry policy - would produce some economic benefit to the public. We would anticipate that the Commission would have no difficulty in making such a finding in an industry such as this one, where rate and technical competition is possible. In other words, while the FCC has certain statutory responsibilities, we would expect the FCC to minimize its activity in this field to give competitive forces the maximum free play consistent with the law. We note that the FCC has no statutory requirement to protect the earnings of any common carrier but it must assure that desirable services are not unduly restricted.

Underlying the open entry option is the assumption that the orbital space exceeds for the foreseeable future the needs of potential entrants. In fact, the technical committee has found that with existing technology, the orbital space could accommodate at least 16 satellites covering all of the contiguous 48 States - a number in excess of the total proposed in filings with the FCC. If, however, more systems are proposed than there exists space for, arrangements would be required for allocating space among entrants.* Since this appears to be unlikely at this point in time, that problem will not be considered further.

*Several solutions to that problem exist: first-come, first-served (with the option of selling a system), or having the FCC allocate the space to those with the most desirable attributes.

While no test of profitability of future entrants would be involved in competitive entry, certain classes of companies, e.g., terrestrial common carriers, could be barred for antitrust or regulatory reasons. This point is elaborated below in Section III, Policy on Potential Entrants.

Competitive entry does involve an implicit change in U.S. policy. In the past we have strongly supported the monopoly of Intelsat by opposing regional systems. Allowing domestic competition would appear to be inconsistent with that position.

The other category, called a chosen instrument, would involve management of all satellites by one entity. Such a single system could either involve the system being a common carrier, or alternatively, the satellite system could in fact be a combination of users organized under one agent, thus a common user system. Any chosen instrument would clearly have a common carrier network and might in addition have some specialized satellites or earth stations. It is, of course, quite possible that under competitive entry a single system might result. It could be that only a single firm would apply for a license to run a satellite system or it could be that after an initial trial of several rivals, economies of scale might be so pronounced as to result in the combination of all the systems.

Evaluation

The Committee has attempted to evaluate each of these categories according to some desirable criteria. Much of the evaluation must perforce depend on theoretical considerations which may not be borne out in all situations. Some of the evaluation is based on evidence from other industries or studies of a wide variety of industries. Nevertheless we cannot be dogmatic about our conclusions. They are the probable results as forecasted by theory and evidence but they might not result for the future satellite industry.

While we have identified some of the potential services that satellites can perform, there are undoubtedly others. Consequently, a major goal is for the policy adopted to offer flexibility in providing the public with a wide variety of services. Clearly the more separate entrants, the more flexibility; the more flexibility, the more freedom to innovate. Therefore, the competitive entry policy should maximize the opportunity for flexibility.

A second major goal is to insure that satellites and satellite communication are used efficiently. It may be argued that a chosen instrument would be somewhat more efficient than competitive entry. Overcapacity and redundancy might be avoided and, especially under a single system, it could be easier to avoid interference. However, provided no minimum rate regulation is imposed, competition among entrants should eliminate, at least in the long run, excess capacity even under competitive entry. Thus, in the long run, competitive entry could be expected to be about as economically efficient as the other alternative.

A third major goal is to set up a system that will keep rates low and in line with costs. In general, we would expect competitive entry, which would lead to the most competition, to produce the lowest rates. On the other hand, if economies of scale were substantial for a specific service , and economies of specialization negligible, a chosen instrument would be lower cost and could offer lower rates.

Even under competitive entry we would not expect a large number of systems. Thus, any competition in satellite service offering would at best tend to be among a few oligopolists (as well as with the terrestrial common carriers). Such competition is unlikely to lead to vigorous rate competition. Yet, experience in other sectors of the economy shows that even a few competitors tend to produce better service and lower rates than one.

Experience in the commercial aviation industry indicates that a three-firm oligopoly leads to some price competition. In routes with 3 or 4 carriers, price competition is considerably more vigorous and prices considerably lower than in markets with fewer carriers. The natural gas pipeline industry is another example where even under regulation, competition among two or three lines has benefited consumers.

Even prior to the antitrust laws, a three-firm oligopoly could not control prices. In the early 1870's only two railroads competed between New York and Chicago. With the entry of a third line, prices declined substantially. Even with periodic attempts to stabilize price with formal cartel meetings and even though there was no legal barrier to collusion, price competition continued to break out and prices could not be maintained for long. While examples from other industries can never be completely persuasive, the railroad case may be quite similar to the satellite case. Both offer homogeneous services, have large fixed investment, and have small incremental costs.

There are almost unlimited ways that satellite services can be "packaged" and sold. Different rates probably would develop for interruptible service, continuous service, on demand service, when space is available service, peak service, and so forth. Such differentials will promote active competition in offering the various services at various rates. Thus even under oligopoly conditions considerable competition can be expected among the various entrants.

It should also be noted that for almost all uses of satellites, terresttrial carriers compete. Thus, a maximum rate is imposed by the terrestrial service. Nevertheless, there may be a few uses for satellites which are unique. In these areas rates could conceivably be high relative to costs. Yet, since these services are now unavailable, the public would still gain even if rates were high. It is possible that maximum rate regulation could be imposed in these areas, but such a step could deter entry by many firms.

A fourth major goal of any system is to encourage innovation in communications. Clearly the more different systems, the more different decision-making bodies putting up systems, the greater innovations would likely be. Thus, innovations in communications are likely to be greatest under open entry.

A number of statistical studies have shown that the very highly concentrated industries tend to be less innovative and inventive than the somewhat less concentrated. A major study of the aluminum industry concluded that the introduction of two competitors led to more inventions in the postwar period than would have occurred if Alcoa had maintained its monopoly. Thus, competition in the provision of satellite communication services should stimulate innovations.

The final objective of a domestic satellite system is to increase the learning about possible uses, costs and services. Again it is clear that the more competitive and the more open the market, the greater the possibilities are of learning about new uses, about the true costs, and about potential service. Thus, open entry would provide the greatest possibility of learning. While it is possible that a single system or a limited entry system could have imposed on it some requirements for experimentation, it is unlikely that these requirements could or would cover all the possibilities and might overlook some important uses. Moreover, it would not be possible under a single system to derive very good estimates of costs of particular services.

III. Policy on Potential Entrants

While COMSAT would prefer to be the chosen instrument, it is a likely entrant regardless of conditions of entry or service terms. COMSAT with large cash reserves needs investment outlets. Moreover, its business and its expertise lie in satellites and consequently it would be very unlikely to pass up an opportunity to enter the market even if it expected to face competition. Obviously, it would prefer to be the sole operating entity.

Among the terrestrial carriers, the magnitude of the project would restrict the possibilities to three firms: General Telephone & Electronics, Western Union, and AT&T. General Telephone has expressed little interest in establishing a satellite system and can probably be discarded at the outset, as an independent entrant, as can be Western Union, whose small size and all-consuming interest in developing its data processing and switching capacity probably precludes consideration of such a massive new undertaking. Both companies, of course, might consider participation in any joint venture along the lines of COMSAT. Basically though the only likely potential independent entrant in this class is AT&T whose expertise in communications systems management and sophisticated technology is well known. It has ample resources available to finance such a project, and as a large potential user, sufficient motivation. Furthermore, traditionally the company has shown strong interest in new communications techniques, and prior to the establishment of COMSAT was the prime contender in the international sector. Moreover, AT&T has advocated in a letter to the White House that any one be permitted to apply for a satellite system.

ABC has already requested authorization from the FCC to operate a dedicated broadcast system. The president of CBS very recently advocated a joint network dedicated system. As broadcast distribution presently offers the greatest cost-savings through satellite services, all three networks might be viewed as potential independent entrants, but their participation in a dedicated satellite joint venture seems even more likely.

General Electric has proposed a satellite system to provide high speed record and video interconnection services. There presently exists a large potential domestic demand for a high speed record service, principally in business, that existing terrestrial carriers cannot satisfy without a major investment in new communications facilities. GE's longstanding position as a leading innovator, and its ample resources, make it a definite potential entrant. Yet in its filing, GE refrained from requesting operating rights for reasons which are not clear.

It is possible that GE was reluctant to enter high risk industry in which their rate of return might be limited by regulation.

Conditions of Entry

In principle, a policy of competitive entry provided it results in a number of entrants appears the most effective in promoting innovation, economy, and learning in the use of domestic satellites. One entity, AT&T, so dominates the domestic communications industry that without appropriate guidelines "competitive entry" might well mean the entry of only AT&T.

The gross assets of AT&T and the associated operating companies of the Bell System are worth about $43 billion, making it the largest corporation in the world; by comparison, the largest potential other entrant (the parent compaines of three TV broadcast networks) have combined assets of only $3.6 billion. Furthermore, AT&T provides through its terrestrial long-lines network over 90% of all long-distance communication services (public and private); through the local operating companies, it also controls over 95% of the local distribution facilities, the use of which are essential to many long-distance services. Finally, this position of AT&T is largely the result of a longstanding public policy at both the state and national level that the public message telephone service represents a "natural monopoly" subject to public regulation rather than private competition. Given this monopoly control of the public message service, representing most of the nation's communications, AT&T 's ability to control the private line service as well is virtually assured.

Unrestricted entry by Bell into satellite operations could discourage entry of other firms and thus reduce the possibility of increasing competition in communications. Most satellite systems will have to use AT&T ground facilities to reach the ultimate users. Therefore, if AT&T also offers satellite services, other satellite entities would face the very real possibility that Bell might reduce its rates on private line offerings to a point that competitors could not afford to match.

To ensure that AT&T -- or for that matter any other entity -- not enjoy an unfair advantage as a result of prior policies or entrenched position several potential conditions on entry might be imposed:

Bar AT&T From Entry: AT&T would not be permitted to own or operate domestic satellite systems, on the grounds their entry would automatically discourage other potentially innovative entrants and thereby further extend their monopoly control of both public and private communication systems. AT&T would, however, be authorized to lease satellite transmission services from other entrants; and those entrants providing for-hire services in competition with AT&T (but not dedicated user systems) would be required to lease to AT&T.

A major drawback in excluding AT&T is that the Bell System would not be likely to patronize satellite systems extensively. Thus it might be more economically efficient to lease some trunk capacity through a satellite but since such leased lines would not go into the rate base, terrestrial lines would be unduly favored.

Limit AT&T's satellite to serving only public message telephone: AT&T would be permitted to put up and operate a satellite system dedicated to the public message telephone. No private line, date transmission, or video could be sent through Bell's satellite. However, Bell would be permitted to lease capacity from other satellite entities for its other offerings.

This would clearly prevent Bell from using its public message telephone to subsidize its other offerings that go by satellite. It would permit AT&T to participate in satellite operations and thus give them motivation to innovate.

The primary drawback to this alternative is that it would restrict a technically advanced company from exploring many potential uses with its own satellites and it would reduce the incentive to innovate in areas outside of public message telephone transmission.

The Committee believed that this restriction on AT&T would lead to the greatest number of entrants and would in the long run most promote competition. Even under this restriction, the Committee believed that AT&T might still apply for authorization to operate a satellite, although this would clearly reduce the profits to Bell from satellite operations.

Require AT&T to Establish Separate Domestic Satellite Operations: AT&T would be permitted to own and operate a domestic satellite system, but must keep the operations separate from its terrestrial network. This separation could be accomplished by establishing a separate satellite affiliate, charged with competitive procurement practices, and whose operations were not included in the rate-base regulation of the terrestrial system. Or it could be accomplished by careful segregation of costs and bookkeeping.

One major problem is that AT&T might attempt to underprice terrestrial competitive services to maintain its monopoly. This seems both unlikely and impossible to completely prevent without a complete restructuring of the terrestrial system. It is unlikely because two primary satellite services -- TV transmission and data transmission -- have advantages over the terrestrial system. AT&T has filed for higher television transmission rates and FCC studies indicate that even at this new level they will not be completely compensatory. Yet even at the existing rates the economics of satellite transmission looked good. For data transmission, AT&T cannot handle the expected growth without the construction of additional facilities. A satellite system might easily be a cheaper alternative.

Nevertheless the problem of terrestrial cross subsidization will remain. Without a major restructuring of the industry, the only way cross subsidization can be minimized is by depending on the diligency of the FCC in regulating AT&T.

Some of the Committee believe that a separate affiliate by having publicly identified rates would aid regulators in preventing cross subsidization. Other members believed that the FCC can be equally effective in policing AT&T through separate bookkeeping. All members of the Committee recognize that neither solution is a panacea or could completely prevent cross subsidization.

Therefore, we concluded that Bell should not be allowed in unconditionally and while any of the alternatives might help reduce the problem of cross subsidization, we believe that limiting any AT&T satellite to public message telephone service would most satisfy the conflict between increasing the number of entrants and the potential for AT&T to dominate the system.

Conditions of Entry for Other Classes of Users

Another problem involves the potential entry of one or more of the major networks which would lead to vertical integration.

The principal reason for limiting vertial integration is that it may involve foreclosure of independent entities not enjoying the same advantages.

Since both television networking and satellite communications are businesses involving high costs to enter (quite apart from any regulatory barriers), major network control of satellites might lead to the exclusion of additional commercial networks, or competing sources of information and entertainment (including educational television networks and CATV networks.)

On the other hand, excluding networks would exclude one of a few possible entrants. Moreover, broadcasting unlike common carrier communications, is not a "cost-plus" proposition, and hence broadcasters may have the maximum incentive to encourage innovation with resulting cost reduction.

Given these circumstances, the networks should be permitted entry either individually or in a joint venture. Any foreclosure problem that arose out of a joint venture should be dealt with by requiring that access be granted to all in the trade - including other networks, broadcast stations, CATV systems, etc., - on equal and nondiscriminatory terms.

The Problem of Few Entrants

It appears that entry requires a capital expenditure of at least $30 million for small specialized systems and much more for any large scale operation. Such a figure would necessarily limit the number of individual potential entrants. It seems likely, however, that if competitive entry were permitted, there would be at least two potential entrants for large scale systems: these would include some broadcaster joint venture and a common carrier system owned by either AT&T, COMSAT, or both.

Whilethe market would appear to exist now for two systems, it is unclear whether it will support three or more. Therefore we would conclude that a competitive entry policy should result in at least two entrants, and may well result in three or four entrants.

We would stress, however, that entry confined to one or two entities as a result of marketplace forces would be quite different in effect from the same result achieved by regulatory action. Such a marketplace resultwould suggest that those with capital, resources, and experience now see relatively modest opportunities in satellite communications for domestic purposes; but the door would remain open to them (assuming available spectrum space) if and when market conditions or technology justified it. Thus, such a competitive entry policy - even combined with very limited actual entry - would continue to act as a spur to innovation of low-cost technology. Limited entry achieved by regulation would, on the other hand, probably tend to inhibit technical innovation by those not having some financial stake in the system chosen and reduce the need for innovation by those operating the system. While there might be an opportunity for later entry (especially if the original program were regarded as some sort of pilot project), the non-included interests might well conclude that they would not have a substantially better chance the next time around; and this would in turn lead them to devote their capital and technical resources to other areas of innovation and growth.

Assuming that only one or two bidders came forward under a competitive entry policy, the economic results would depend to a considerable extent on who those entrants were. If the only entrants were television networks, this would probably be sufficient to produce distribution cost lower than now applied on the terrestrial network. On the other hand, it would probably do little to develop new uses of satellites.

If the only entry were by AT&T, satellite development might have a relatively modest impact on long-haul communications and on rates (except possibly for television distribution rates). AT&T would have the least incentive to push the satellite technology far and fast or to encourage new satellite uses.

There is obviously a Government interest that domestic satellite communications be developed commensurate with their economic usefulness. This suggests that the Government shouldtake affirmative steps to encourage sensible economic entry - but that it should not support uneconomic entry with public funds. It is particularly important that the Government should, if potential entry is in fact narrowly limited by high capital requirements and other economic factors, take steps to assure that no other noneconomic factors act as unreasonable barriers to entry. The possible steps the Government could take to encourage additional entry in accordance with this principle would include the following:

a. The Commission could lengthen the period for the initial program, in order to give potential entrants a greater opportunity to recover the cost of their investment.

b. The Government, as a user, could guarantee traffic at economic rates (e.g. terrestrial rates) for a limited period to give additional entrants reasonable assurance as to revenues.

c. The Government could also encourage common carriers to enter domestic satellite business by including satellite investment in their overall rate base. This would simply, in the case of a profirable carrier make the investment a riskless investment with the ultimate cost being borne by the rate payers. Such cross subsidy seem highly undesirable and therefore we would not recommend it as a way of achieving additional new entry.

IV. Policy on Operation of System

Regulation of Satellites

Some minimum amount of regulation is required by law; other regulation is permissible and may be desirable. Initial specification of regulatory actions required by statute does not settle the question of how much and what kind of regulation is desirable, only what is necessary without statutory change. Examination of the Communications Act of 1934 and the Communication Satellite Act of 1962 indicates four basic requirements:

(1) an FCC license for use of the spectrum would be required for both satellite operations and for any terrestrial radio facilities.

(2) if land lines are used to connect earth terminals with common carrier facilities or connect other points by common carrier facilities, the common carriers would require a certificate of public convenience and necessity from the FCC.

(3) if the satellite system were to provide common carrier services, the FCC would need to insure that rates are just, reasonable, and avoid undue discrimination among users. While the FCC must concern itself with rates of the common carriers, the statutes do not require a particular means of regulation.

(4) if the Communication Satellite Act were deemed to apply and the system provided common carrier services, the FCC would also be required to authorize earth terminals and insure effective competition in procurement, equitable and non-discriminatory access, and technical compatibility and interconnection of the system. There is, however, a question concerning the applicability of these provisions to the domestic system.

Given these requirements, what should public policy be on ownership, rates, spectrum use and access for each of the major alternative systems under consideration?

Ownership: By definition ownership of satellites would be up to the market under competitive entry. Alternatively under the chosen instrument approach ownership must be carefully considered. This report does not attempt to identify whether the chosen instrument should be a combination of users, a combination of terrestrial common carriers, or a single entity. If a decision were made to choose a chosen instrument for the operation of a domestic satellite system, a careful study should be made on the ownership of the system.

Rates. In a competitive entry approach, there does not appear to be a strong theoretical case for either maximum or minimum rate regulation since the market would over the longer run force an efficient provision of service. There are, however, two practical problems. First, the FCC is required to provide some oversight over the tariffs of all common carrier services. This responsibility, however, could be met without utilizing rate of return regulation. For example, regulatory intervention might be limited to insuring separation of costs and revenues for the initial operating period and non-discriminatory pricing. Second, permitting rate competition by a satellite entity could cause problems for terrestrial comm on carriers which normally practice average pricing in the terrestrial network. Equity and efficiency therefore require that terrestrial common carriers be permitted to compete with common carrier satellite systems on an equal footing (non-predatory pricing and true marginal costs for the specific service).

In the chosen instrument approach, more comprehensive rate regulation would be required, though it would not necessarily need to follow the same form as terrestrial common carrier regulation so long as tariffs bear some reasonable relationship to costs and provided comparable alternative terrestrial services were available. Maximum rate regulation would appear to be in order, and possibly minimum as well depending on the stance taken with respect to competitive pricing in terrestrial common carrier systems.

Spectrum use: From the previous discussion, it is clear that FCC will be required to issue a license for use of the spectrum. The Technical Committee has indicated that several domestic satellites can be accommodated. Since a number of systems are technically possible within the ground rules, the license for spectrum use appears relatively straight forward except for the problem of interference with terrestrial microwave systems. In this problem area, there are some technical uncertainties which may make guarantees of non-interference difficult. A means of handling this problem is discussed in the next section.

Access and interconnection. Except for private systems, a general rule would require non-discriminatory access or use of the system by the class of users for which the system was designed. With respect to multi-purpose or common carrier type systems, it is assumed (as all seem to have agreed) that the authorized user ruling would not apply to the domestic system.

In the competitive entry concept, few rules beyond these two basic ones appear justified. Users would essentially have satisfactory options in that they could either obtain services if available or undertake individually or collectively to provide services through their own system whether such services were otherwise available or not.

In the chosen instrument concept, the rules concerning access become more complicated as governmental intervention substitutes for the market place.

While the basic rules of access to encourage economical uses may not be radically different, the government may need to become much more involved in the technical design of the system to insure that the technical characteristics of the system do not defeat the objective of open access and exploitation of new or different technology.

The subject of interconnection is a highly complex problem full of convictions of ancient and often unexamined variety. Much time was devoted to this subject by the Rostow task force. For the sake of brevity here, only a basic guiding principle is asserted. In neither of the concepts under consideration shall terrestrial common carriers be permitted to deny interconnection on a non-discriminatory basis nor should unnecessarily expensive buffer systems be permitted.

Moreover, it is essential that local communications utilities be required to provide private line and common carrier interconnection (if desired) with earth stations. Such interconnection must of course be provided at reasonable and non-discriminatory rates. Absent this requirement AT&T could strangle any satellite company.

Earth station ownership

It is necessary to coordinate the design and operation of space and earth stations employed in a specific system, but users might participate in ownership of ground terminals. No strong reasons exist for specification of ownership for receive-only terminals or for small mobile two-way terminals.

Trial Period

The committee has found unanimously that a competitive entry system would provide the greatest flexibility, the most innovation, the maximum learning, and the lowest prices in the absence of regulation and would insure an efficient use of scarce resources. While we believe that such a system could and probably would be best in the long run, there is some doubt about the number of entrants, the amount of competition that would develop, the problems of interference, and the effects on terrestrial carriers. Therefore we would recommend that the competitive entry option be instituted for a trial period in which any firm is free to occupy up to 25% of the available orbital space. At the end of the trial period, the policy would be re-examined and if changed, existing satellite companies would be assured that they either would be given a fair price for their system or allowed to continue operating it for some period.

The orbital space limitation would prevent any satellite company from dominating the system. If a company could show a compelling reason for additional space <u>and</u> the extra space would not limit the entry of other firms, the FCC could authorize the addition.

Clearly the FCC must allocate the frequencies which in practice means approving the orbital positions and the location of the earth stations.

While the FCC is required to insure that any common carrier's rates are reasonable and not unduly discriminatory, we would recommend that under the competitive entry system that maximum reliance be placed on the forces of competition. In particular, no matter how low the rates are they should be considered reasonable and provided they are less than or equal to terrestrial rates for similar services, they be authorized. Primarily the FCC would insure that whatever rates were charged would be open to all users of the appropriate class.

V. Effects of Alternatives on the Terrestrial Common Carriers

Most economic discussion of a domestic satellite system tends to focus on setting a "break-even point" -- the distance above which satellite service would supposedly be cheaper than equivalent terrestrial links. The rule of thumb has been that long distances favor the use of satellites, short distance cable and microwave relay. However, the break-even point is also a function of the total traffic load and the number of routes served.

Generally, the space segment cost of a satellite system is independent of whether total traffic is used to connect two points along a high traffic-density route or many points with relatively lower traffic-density. For instance, a 2000-circuit satellite can equally well provide 2000 circuits between 200 points or 200 circuits over each of ten different routes representing all possible interconnections among five points. In the latter system, with many low-traffic-density stations, the break-even distance can be lower than is the case for the high density point-to-point systems, although there is a point beyond which a further increase in the number of terminals because of this high cost reverses the diminishing-costs curve. The important concept, though, appears that the special advantage of a satellite system lies typically in providing many routes between many points through a single space relay.

The impact of a domestic satellite system would be felt primarily by the two major communications systems -- AT&T and Western Union.

Presently, Bell estimates the break-even point for message traffic is 1300 miles. This distance may be affected by different trends. Greatly improved cable technology implies a trend towards more cable use. Projected systems - millimeter - wave guide and laser guided-beam - are extensions of the land cable concept, both being fully enclosed systems, and presage even greater cost savings. Thus, while switching cost trends might make satellite transmission more feasible eventually, an increasingly local nature of telephone traffic and the improvement of cable techniques mitigate against utilizing such transmission.

Insofar as message telephone service, which accounts for roughly 85 percent of Bell revenues, satellite displacement or for that matter, competition seem highly unlikely.

Bell's broadcast distribution service, however, seems likely to feel the impact of domestic satellite competition, for a number of reasons. Bell has implied that the 1300 mile break-even point applies also to television distribution. The Ford Foundation has concluded that in light of present tariffs, the break-even point for television distribution is only 50 miles. The truth may lie somewhere in between these two proposals.

Nevertheless, it appears that television distribution via satellite is very likely to displace a large proportion of Bell's present program transmission system. However, Bell seems surprisingly relaxed about the matter, stating that "television distribution represents only a very small percentage of total revenues."

Western Union, however, does not stand in early so secure a position as Bell. Potentially, satellite services could compete directly with Western Union's most profitable market - private line service. Much of their extensive investment in microwave facilities might therefore be made redundant.

Within the past ten years, Western Union has been diversifying into various types of record message services. The largest of these new services is Telex, a teletypewriter exchange network, though there are several others, such as Sicom and the private leased systems that involve the collection of information relayed from many low traffic - density stations at a central point, and the reverse process. Switching costs represent a generally lower proportion of total cost in many of these systems. This factor, and the nation-wide coverage of some systems plus their basic nature implies that they are highly susceptible to competing services using satellites. Furthermore, the General Electric proposal seems to indicate that even the public message (telegram) service - 42% of Western Union's 1968 revenues - is susceptible.

This latter proposal could seriously affect Western Union insofar as it currently relied on PMS revenues to support its $700 million diversification program, and its new services until they become more profitable.

The FCC is required by law to insure that desirable public services are maintained. Even if the profitable private line services of Western Union were diverted to satellites, it is unlikely that this would affect the basic public message service. Western Union might, however, suffer a loss. Presumably though the telegraph service is a profitable enterprise. If not or if not alone, it should not be supported by the users of other services. If it should be maintained and it cannot pay for itself then subsidies should come from the public treasury. In other words, the potential impact of any future satellite system on Western Union should not be used to either prevent that satellite offering or to require the satellite entity to provide non-profitable services unless subsidized by the public treasury.

Cream Skimming

Potential new entrants in terrestrial communication markets are frequently accused of cream skimming by the common carriers, and in the past these changes have often played a part in FCC denials for establishment or extension of non-common carrier systems. The question of cream skimming will undoubtedly arise in a similar context with domestic satellite operations.

In theory, cream skimming represents unfair competition between a common carrier and a potential new entrant in the communication field. The common carrier, serving perhaps a nation-wide market under a uniform rate policy, presumably cannot compete with a new entrant who provides similar services for only the most lucrative portions of that market. It is argued that the common carrier, through a policy of cross subsidization, is performing a public service by providing, at reasonable rates, communication services to less populated areas and lean markets.

In practice, the question of cream skimming is not so clear cut. Historically, the expansion of communication services to less profitable areas and thin markets has not been made under the "public-spirited" auspices of the common carriers. Both the Federal Government and independent operators (perhaps later acquired by the common carrier) have been at least as responsible as common carriers for past expansion and much of today's growth of common carrier services (e.g. private line-service) to remote customers is normally undertaken either at the customers' expense or with a guaranteed minimum revenue requirement over the installation amortization period. Hence, the basic assertion underlying the cream skimming argument, that public benefits actually result from cross subsidization, is questionable.

Moreover, carriers are usually unable to show that the low-volume routes are otherwise uneconomical. Too often the reality of the situation is that the carrier earns some profit on some service routes and a better profit on others. Furthermore, the charge of "cream skimming" often arises in the context of communications services, such as private microwave systems which are not necessarily an integral part of, for instance, the telephone company's primary business - telephone service. Absent some better rationale, there seems little justification for a regulatory policy facilitating and protecting super-normal profits on some services because supposedly these profits are subsidizing service to parties for some reason unable to pay the fully allocated cost of the service.

Even if cross subsidization were being practiced, the public would actually be losing from this practice. Those who would be benefitting receive a service at less than it costs. Since the public values the marginal unit of service at its price, the value to consumers of the marginal unit must be less than the cost of providing the incremental unit. Thus there would be a net loss if we add the value to the user and subtract the cost of the service. For those who would pay a price higher than the cost of the service, their loss is clear. Moreover some of them would have been willing to buy even more of the service if they had had to pay only the true cost of servicing them. In general then a policy of cross subsidizing is undesirable in principle since it misallocates resources and makes us all poorer.

In sum, cream skimming would not seem objectionable, but rather desirable. Carrier revenues from the private line, specialty systems, clearly do not support other services such as the general message systems. Nor is the spectre of the small specialty system subscriber being deprived of service very tenable. Rather, because satellite costs are substantially independent of terrestrial distance-cost factors, it is arguable that a satellite system would increase the likelihood of such a small user being served. Similarly, it is difficult to visualize a satellite system displacing, for example, the Bell System on certain high traffic-density trunk routes. The fixed switching costs, cable improvements and demographic trends would seem to mitigate against such displacement.

Regulation and Rates

If the "cream skimming" argument given above is correct, the introduction of satellite service should not lead to higher charges on any existing service. However, it is possible that some existing terrestrial investment may become obsolete. If such equipment is left in the rate base by the regulatory commission, it could be used to justify higher rates on an already profitable service. Part of the dictates of the market system is that from time to time certain investment becomes worthless due to new developments. Regulatory bodies should not try to "bail out" past decisions through higher rates on non-competitive services.

A more likely problem is that satellites will offer lower cost service for some uses. Terrestrial common carriers will either have to meet the lower prices or give up the service. Regulators and particularly the FCC should permit fair competition between these technologies and not try to protect one from another. This means that the new satellite systems should be free to offer their services on as low rates as they wish in competition with terrestrial systems. But the terrestrial carriers should be free to retaliate by lowering their rates provided such rates cover at least their incremental costs. Once these rules are spelled out, competition should be allowed to decide who receives the business.

Interference and Compensation

Interference with, and from, existing terrestrial microwave installations represents a significant potential problem area for any prospective domestic satellite operator. In addition, future satellite systems might cause interference with and between other satellite systems. Existing licensees will expect protection from harmful interference and will look to the FCC for assurance of that protection.

From a technical point of view, the problem of interference can be handled in one of several ways. Newcomes can be required to accommodate to the existing system: existing facilities can be moved or modified to eliminate the problem. Through two-party negotiation, interference problems between established terrestrial carriers are sometimes handled in this way. Another method of eliminating interference is for one, or both of the parties involved to shift operating frequencies or lower output power. Such a procedure is, of course, under the full regulatory authority of the FCC. A frequency shift is not always technically feasible and in any case usually works to the economic disadvantage of one, or both, of the parties involved. For an established carrier, any shift from his assigned time, area, and spectrum can be argued to represent a loss. For a new user, a spectrum assignment different from his request usually means a higher frequency, and larger investment, than anticipated.

Another means of handling the interference problem is to force one, or both, of the parties to operate with inferior, lower-grace signal channels. It should be noted that operating on totally interference-free basis does not represent the most efficient use of the available spectrum.

Maximum utilization of the spectrum would occur when spectrum assignments overlapped to a degree which, in some sense, resulted in the "maximum tolerable" interference. Frequency assignment on this basis would require a much larger, more complicated, and more technically-oriented process than that currently employed by FCC in the granting of licenses.

Because there is a cost associated with avoiding, or eliminating, harmful interference, the question of financial compensation to the disadvantaged party arises. No single guideline or overriding precedent exists for determining when compensation is warranted or how much compensation is called for, although there is little doubt that in terrestrial telecommunications the burden of compensation normally falls to the newcomer. When, because a change in operations, an interference problem arises between two established carriers, resolution is usually affected through negotiation. If this procedure fails, recourse is available through an appeal either to the FCC or, in some locations, to a consortium of interested parties.

The magnitude of interference-compensation problem to be encountered by the operator of a domestic satellite system cannot be determined without full knowledge of the technical specifications of the satellite system. That interference problems will arise and that initially terrestrial common carriers will be the principal second-party participants in such encounters is beyond doubt. Minimum government involvement in these matters is possible simply by adopting existing terrestrial procedures and treating the satellite system operator in the manner of a new microwave competitor. By so doing, any interference-compensation conflict becomes a matter for two-party resolution between existing terrestrial carrier and proposed satellite carrier. Such a policy would be consistent with establishing the position of satellite systems as competitors on an equal, non-favored basis with terrestrial systems. No new problems arise as a result of this policy, but likewise several old problems (e.g. compensation guidelines) are left unsolved.

The opposite of such a policy, a more-or-less maximum government involvement might include the establishment of a national communication service priority ranking. Interference-compensation problems could be resolved in a manner most favorable to the operator providing the more desirable (higher priority) services. While there may be some advantages to such an arrangement, its effective administration would be difficult and, more important, it could stifle the innovative development of new telecommunication services.

We would recommend the adoption of the existing terrestrial procedures that the burden of adjustment lies with the new entity and that the two parties settle the problem through negotiations. However, if negotiations fail and the satellite company believes it has made an offer that would fully compensate the existing system appeal to the FCC or to the Courts should be possible.

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10/24/69

TECHNICAL ASPECTS OF DOMESTIC SATELLITE COMMUNICATIONS

A Report by the

Technical Committee

of the

Domestic Satellite Working Group

CONTENTS

SUMMARY

PURPOSE OF REPORT

An Ad Hoc Working Group on Domestic Satellite Communications was established on August 5, 1969, to assist the White House Staff in developing Administration views on the use of satellites for domestic communications. The Working Group formed two committees (economic and technical) to examine the issues involved. This report, prepared by the Technical Committee, treats some of the more important technical aspects of implementing satellite communications technology in the domestic telecommunications environment.

The Technical Committee membership included: Chairman, Dr. Russell C. Drew, Office of Science and Technology; Colonel Ward Olsson, (USAF) Office of Telecommunications Management; Dr. Richard Marsten, NASA; Mr. Richard Beam, Department of Transportation; Mr. Wilbur Serwat, Post Office Department; and Mr. Walter Hinchman, White House Staff. Mr. William Watkins, Federal Communications Commission participated in an ex officio capacity.

SUMMARY CONCLUSIONS

The Technical Committee has concluded that it is technically feasible to establish U.S. domestic communications satellite facilities at this time. Such satellite facilities can be made compatible with, and where appropriate, can be interconnected with terrestrial communications facilities. There will be technical problems associated with the establishment and operation of such facilities, but these problems should not preclude prompt initial deployment. Regulatory control should be exercised over establishment and operation of domestic communications satellite facilities, including promulgation of procedures, standards and regulations concerning frequency sharing and appropriate spacecraft and ground station characteristics.

A principal conclusion reached by the Committee is that technical considerations, though of great importance in the detailed engineering, operations and economics of particular systems, are not controlling with respect to basic policies governing the ownership or mode of operation (single or multi-purpose) of such systems. Specifically, the committee concluded that;

Multi-purpose vs. Single-purpose Systems

-- technically, there is little difference between multi-purpose and single-purpose operation of present day communication satellites; these are merely relay stations containing transponders designed for specific frequency bands, inherently capable of handling voice, data, or video signals with equal facility;

-- there are, however, technical differences in the design and operation of earth stations for multi-purpose and single-purpose operations; e.g., use of receive-only stations for program distribution vis-a-vis transmit/receive stations and greater time-sharing opportunities in multi-purpose systems;

-- these technical and operational differences lead to both economies of scale and offsetting economies of specialization; the committee has no adequate basis for determining which of these -- if either -- will dominate.

Within the presently allocated 4 and 6 GHz bands

-- available spectrum and orbital resources are adequate to accommodate several U. S. domestic satellites, which could, in turn, be part of one or several domestic satellite systems;

-- it should be technically feasible to site from one to several transmit/receive earth stations capable of working with these satellites in or near most urban centers; the exact number and location would be a subject for detailed engineering studies on a case-by-case basis;

-- it should be technically feasible to site a larger number of receive-only stations in the same areas particularly if users of satellite distribution services were willing to accept a lower quality of service than that identified as CCIR/CCITT relay quality.

Future Trends and Opportunities

-- future growth in the demand for communication services via satellite (fixed, mobile or broadcast) are expected to create the need to accommodate additional satellites and associated earth station facilities in the U.S.

-- future technological developments should make possible more intensive use of existing spectrum allocations as well as the effective use of other frequency bands, to accommodate the growth in demand. For example, multiple antenna beams and greater effective radiated power from satellites, improved modulation techniques, more versatile earth stations, development of improved multiple-access techniques, etc. are foreseen.

-- it is technically feasible for future satellite systems to use certain other frequency bands not now available to such systems, on either a shared or exclusive basis. Plans for expansion of spectrum resources for satellite services are presently well advanced, and will be the subject of the Space World Administrative Radio Conference to be convened in mid-1971 under the auspices of the International Telecommunications Union.

-- the opportunity for continued exploitation of satellite communications technological innovations appears to be promising in light of the healthy programs pursued by Government and a wide spectrum of competing private industrial organizations.

II

INTRODUCTION

The United States possesses a highly developed and valuable telecommunications infrastructure which provides a wide diversity of telephone, telegraph, telex, television, radio, facsimile and data exchange services for the Nations' private, public and Government uses.[1/] These services are provided through an intricate complex of private and government-owned facilities and systems including; (a) radio and television broadcast stations and receiving sets; (b) an integrated public switched telephone network, including common carrier transmission systems (wire, cable and radio); (c) fixed radio networks; and (d) mobile radio networks (vehicular, aeronautical and maritime). For example, the United States has more than 110,000 telephones, 6,700 radio broadcast stations, several million mobile radio transmitters, 200,000,000 miles of voice equivalent circuits interconnecting virtually every town and city, and 3,893 local and toll switching centers in the public telephone network.

Satellite communication technology benefits from substantial research and development accomplished by the communications and electronics industry, by educational establishments, and by Government laboratories.

1/ See memorandum from Director of Telecommunications Management to President Nixon, September 11, 1969, and memorandum from Director of Telecommunications Management to Dr. Clay T. Whitehead, September 18, 1969.

Fundamental elements of satellite communications technology flow from United States space research and development programs accomplished by the Government (principally NASA and DOD) and a broad sector of U.S. industry.

With the development of geostationary orbital capability and the demonstration of communications relay techniques utilizing satellites in this orbit, a new era opened for long-distance communications. This capability was soon utilized on an operational basis internationally through INTELSAT and its potential for providing domestic telecommunications services has been the subject of wide interest. But use of domestic satellite systems in the US poses a number of challenges because of the comprehensive nature of the existing domestic telecommunications network, international interactions, uncertain economics, and lack of policy guidelines. Nevertheless, a number of entities have indicated an interest in the establishment of various types of domestic satellite systems.

Technical considerations which affect the ability to accommodate one or more of these proposals are important as a basis for informed policy decisions to enable timely introduction of domestic satellite services. Policy decisions on the introduction of satellites must also take into account potential future requirements and must not unduly restrict or foreclose expansion of these services if this expansion were in the public interest. For these reasons, a Technical Committee of the Domestic Satellite Working Group was established.

This Committee was asked to identify and evaluate the importance of those technical factors which affect (1) the uses, numbers and types of domestic satellite systems, (2) operation of these systems, and (3) their related economics.

While the committee did not limit its deliberations to particular communication services or to short-term issues, it recognized the urgent need to provide guidance for immediate policy decisions dealing with the introduction of satellites for primarily fixed (i. e., point-to-point and multi-point) long distance services. Accordingly, important questions relating to the use of satellites for mobile and direct broadcast services were not treated in detail. The Committee urges that these potential uses be kept in mind, and that further study be given to the technical, economic, and policy issues involved.

Because of the limited time available, the Committee has based its conclusions on work already completed and reported elsewhere and on the technical judgment of its members. Where uncertainties exist, the Committee has attempted to identify additional work that needs to be done. The Committee considered a number of specific questions which were intended to span the range of technical points of interest in this study, and used the answers to these questions as background for the conclusions and recommendations of the report. The questions and the detailed answers are included as Section V.

III

TERMINOLOGY

This report is only concerned with use of "satellite communication systems" for domestic purposes, including fixed and mobile communications services. The distribution of signals destined for redistribution to the public either by broadcasting stations or by microwave relay, wire or cable networks is included. Domestic communication satellite systems may have one or more interfaces with international systems.

"Single-purpose satellites" are those satellites which are used for a single type of communications. For example, single-purpose satellites could provide services like television and radio distribution, data exchange or direct TV and voice broadcast.

"Multi-purpose satellites" are those satellites which are used for providing more than one type of communications. For example, a given mutli-purpose satellite might be used simultaneously for transmission of any mix of data, telephony, telegraphy, television distribution or broadcasting, radionavigation, aeronautical mobile radio service, etc. Although a multiplicity of services may be provided by multi-purpose satellites in domestic satellite systems, some services may be precluded from certain frequency bands as a matter of International Regulations or U. S. policy. For example, multi-purpose satellites operating in the 4 and 6 GHz bands may provide only fixed (i. e., pt-to-pt or multi-pt) services included in the internationally defined "communication-satellite service."

IV

CONCLUSIONS

A. Technical Feasibility

1. General

The Committee concluded that demonstrated capability exists for the establishment of domestic satellite systems compatible with terrestrial radio relay systems, and compatible with other projected requirements on the geostationary orbit. With proper system design - modulation technique, frequency, satellite orbital location, operating rules, ground station siting and antenna capability - a small number of domestic satellite systems may be accommodated. The number of systems which can be accommodated will depend upon parameters of the systems in question, e.g., number and location and characteristics of satellites and earth stations, antenna directivity, bandwidth needs, etc. The Committee found no technical problems associated with interconnecting satellite and terrestrial facilities, if required.

The Committee concluded that technical constraints are not the controlling factor in policy decisions governing authorization of initial domestic satellite systems.

2. Specific

Assuming the use of 30 foot antennas at earth stations, it appears that at least 16 common frequency satellites operating in the

4 and 6 GHz bands could be accommodated within that portion of the geostationary orbit simultaneously visible from the contiguous 48 States with angles of arrival of 5° or greater. Under these conditions, several U.S. domestic satellites can be accommodated in addition to planned Canadian and/or other Western Hemisphere domestic and international satellites. Only five of the possible 16 satellites would be properly located in the orbital arc to provide simultaneous coverage to Alaska and Hawaii in addition to the 48 contiguous states. Service to Puerto Rico can be provided by any satellite capable of serving the 48 contiguous states.

It should be technically feasible for radio relay networks and communications satellite systems, each potentially involving large numbers of stations, to share the same 4 and 6 GHz frequency bands. In order to share these frequency bands, careful siting of earth stations and terrestrial stations will be required.

Although it is technically feasible to site earth stations at major urban areas in the U.S., certain communication hubs will require special attention and may involve significant additional costs.

B. Frequency Allocations

The amount of electromagnetic spectrum presently available within the 4 and 6 GHz bands (500 MHz in each band) should be adequate for initial domestic use.

It is technically feasible to share the two 500 MHz space communication bands at 7 and 8 GHz which are not now available to commercial communication-satellite systems. Whether or not sharing should be permitted in these bands is a policy matter not treated in this report.

It also is technically feasible to share other bands both above and below 10 GHz which are not now available for use by satellite communication systems. Significant growth in the demand for domestic satellite communication services will create requirements for additional frequency spectrum allocations. In anticipation of such a development, the allocation of additional spectrum space should be and presently is being discussed within the U. S. organizations concerned. Plans for expansion are presently well advanced. There will be a world radio conference dealing with this matter in mid-1971, under auspices of the International Telecommunication Union.

C. Regulation

The Committee has concluded that regulatory control is needed in the establishment and operation of domestic satellite facilities, to promulgate procedures, standards, and regulations concerning frequency sharing. For the earth station, regulation is needed for antenna locations, antenna directivity, effective radiated power, maximum permissible interfering signals, frequencies employed, etc. For the space segment, regulations are needed to govern satellite spacing and station keeping, antenna directivity, effective radiated power, frequencies employed, etc.

The coordination and interference computational techniques and criteria to protect both terrestrial radio relay systems and satellite communication systems, existing and planned, are contained in International Radio Consultative Committee (CCIR) documentation. FCC regulations contain most of the CCIR criteria for sharing between communication-satellite and radio relay systems and these regulations can be readily implemented to cover sharing among satellite communication systems. The FCC regulations should be appropriately responsive to engineering portions of the latest CCIR Recommendations approved by International Telecommunications Union (ITU) administrative radio conferences.

Sharing criteria at present may be conservative, but further work on interference mechanisms at the various relevant frequencies and under a diversity of weather conditions will be required before more precise criteria can be established.

It will be desirable to set the minimum performance capability of earth station antennas to ensure accommodation of an adequate number of satellites for western hemisphere use, but exceptions may be necessary to accommodate special requirements, e. g., in the 4 GHz band, receive-only earth stations smaller than approximately 30 feet can be used with no penalty in terms of number of satellites accommodated, if a slightly lower grade of service can be accepted by the stations concerned. Use of less than 30 foot antennas for transmitting in the 6 GHz band should be considered only in exceptional circumstances.

D. Implications of New Technology

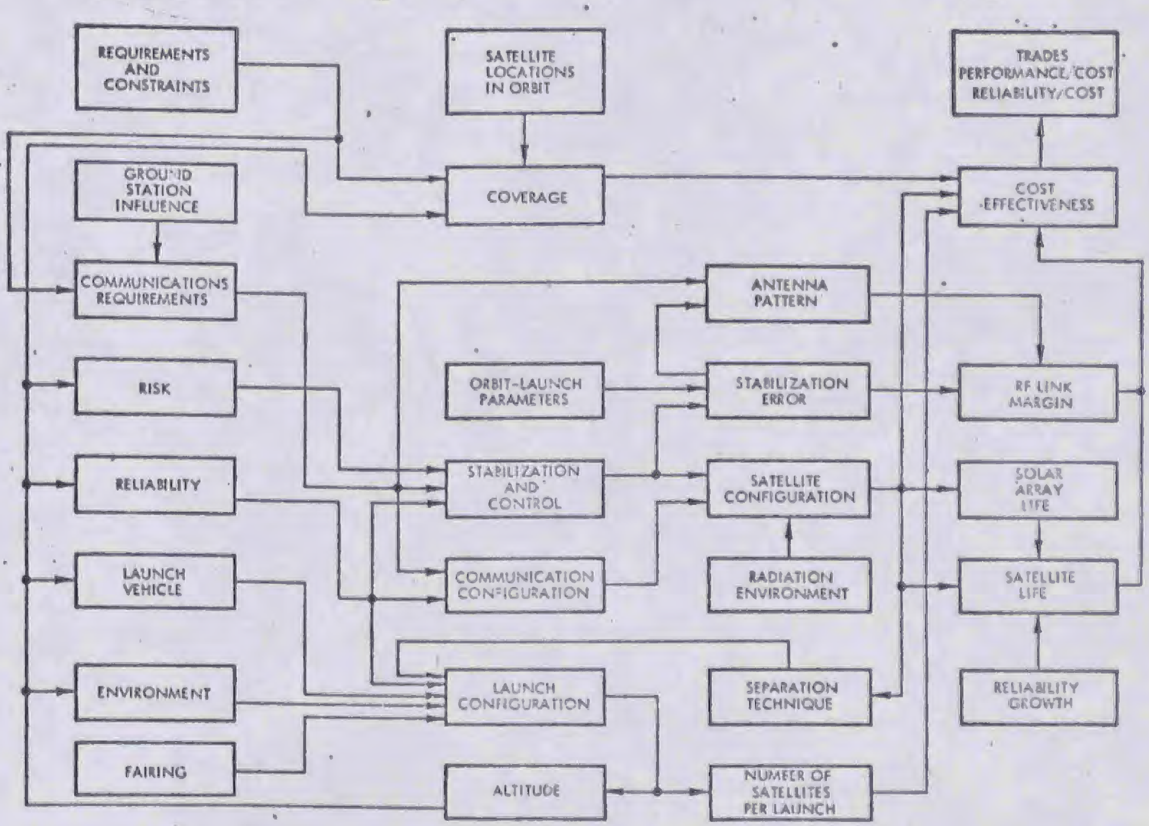
New technology is becoming available in design and operation of both satellites and earth stations that will improve reliability, quality and cost of service. New techniques are being developed (narrow-beam and multiple-beam satellite antennas, greater effective radiated power, and improved earth station antennas) that will permit better utilization of limited orbital arc and allocated spectrum now available.

The eventual use of frequency bands higher than the 4 and 6 GHz bands will allow progressively smaller earth station antennas to be used without penalty, both for reception and transmission, since antenna directivity improves directly with increasing frequency.

New technology is also becoming available in terrestrial systems and this technology will be influencing the relative attractiveness of satellite systems for many uses, particularly within the contiguous 48 states. At the present time it is not possible to predict with confidence what the mix of satellite and terrestrial services will be in the future, although it is obvious that terrestrial distribution systems are needed which will interface with the earth stations.

E. Technical Considerations

1. System Design and Deployment -- There are many important technical factors which serve as constraints in the formulation of a specific design for a domestic communications satellite system. A complex set of technical considerations is applicable to various sub-system elements and therefore serves to influence the trade-offs in establishing an optimum system configuration. An example of the complex trade-offs required is shown in the following figure:[2/]



Typical satellite system tradeoffs. [2]

2/ George E. Mueller and Eugene R. Spangler, Communication Satellites, (New York: John Wiley & Sons, Inc., 1964), pp. 192-193.

The important elements related to system design and deployment include the following:

(a) Space Segment -- The placing of satellites in geostationary orbit is a very sophisticated operation which requires a suitable launch vehicle and launch facilities, and a sophisticated Tracking, Telemetry and Control complex.

Launch Vehicle -- A limited range of launch vehicle types is available for launching communications satellites into geostationary orbit.

Some of the more suitable launch vehicles are identified below:

Class	Range of Satellite in-orbit weight in lbs. (geostationary position)	Time Period
Delta	420 - 470	Current
Delta	480 - 650	1972
Atlas Centaur	1000 - 1600	Current
Atlas Centaur	1100 - 1900	1974
Titan III C	2000 - 2200	Current
Titan III D/Centaur	7000 - 8000	1973
Saturn V	50, 000 - 55, 000	Current

The launch vehicles available provide geostationary orbit capability which increases in discrete steps. Exceeding the capability of a smaller vehicle may result in significantly increased launch costs.

Spacecraft - Detailed design of communication satellite spacecraft requires an integration of the airframe, stabilization devices, telemetry and communications electronics, antennas, propulsion, apogee kick motor (if required), prime power and other components needed to create modern, high capacity, long life communication satellites. One of the important tradeoffs in the design of the initial domestic system is that between life in-orbit versus obsolescence brought about by the rapidly advancing technology.

Tracking, Telemetry and Control (TT&C). Development of satellite systems requires the availability of a network of earch stations equipped with a TT&C sub-system. The TT&C sub-system is used to control the injection of satellites into geostationary orbit, to maintain station and inclination, to reposition the satellite, and to maintain technical control of the operational elements of the satellite. Early consideration should be given to requirements for adequate TT&C support for domestic satellite systems.

(b) Earth Stations. There are important technical tradeoffs which involve relative performance characteristics of the space segment and the earth station complex, e.g., costs of increased satellite capability can be balanced by potential cost reductions resulting from the ability to utilize smaller and less costly earth stations. Earth station planning must also include costs for interconnection between remote locations and terrestrial facilities supplying the users. Domestic earth stations may range from very large, high capacity and costly transmit/receive types to small low-capacity receive-only types.

2. System Integration. There are no known technical limitations which would prevent the integration of satellite systems with domestic terrestrial telecommunications facilities, although further evaluation of the significance of added "time delay" and "echos" introduced by use of satellites will be required. Care will be required to avoid unintentional two hop satellite links for two-way voice telephony.

3. Compatibility with other Satellite Systems. It is essential that a U.S. domestic satellite system and a co-regional system, such as a Canadian or South American system or the INTELSAT system, be compatible, that is, be non-interfering. It is desirable that such systems also be interoperable, that is, capable of providing backup coverage for each other, insofar as practical.

4. Reliability. Reliability of specific elements of the system must be viewed as it contributes to the important objective of maintaining continuity of service. Current planning of systems assumes a mean satellite life of about 7 years. Studies and the performance of satellites systems support the view that a life expectancy of up to ten years can be achieved by careful design and utilization of techniques such as component redundancy and use of in-orbit and ground spares. Solar panels must be large enough to allow for the progressive deterioration that takes place in space. Fuel requirements for station-keeping and attitude stabilization may well be large, possibly of the order of twenty to twenty-five percent of the mass of the satellite if existing techniques are employed, but future developments could reduce this proportion. It is important to note that life expectancies of ten years or more may not be desirable because of obsolescence and potentially high costs associated with achieving such extended lifetimes.

V

ANSWERS TO SPECIFIC QUESTIONS

QUESTION 1: Is it technically feasible to accommodate planned INTELSAT and Canadian domestic satellites plus one or more satellites for U. S. domestic services, using the 4 and 6 GHz spectrum bands presently allocated for commercial communication satellite services? If so, approximately how many U. S. satellites could be accommodated, assuming present and near-future technology and design possibilities?

STATEMENT: Existing technology will permit the accommodation of a small number of communication satellites in geostationary orbit capable of serving the 50 States and Puerto Rico, using the existing frequency allocations at 4 and 6 GHz. A larger number of communication satellites can be accommodated when the coverage required is limited to the contiguous 48 States. The specific number of 4 and 6 GHz geostationary satellites that could serve domestic communication requirements depends on factors such as earth station antenna size, modulation techniques, required quality of service, bandwidth needs, etc.

Assuming the use of 30 foot earth station antennas at 4 and 6 GHz and present frequency modulation techniques, it is estimated that 16 common-frequency communication satellites can be accommodated in the 60° - 135° W orbital arc which provides full visibility of the contiguous 48 States with a 5° minimum angle of elevation at the earth stations. When coverage of the 50 States is required the orbital arc is between 115° W and 135° W (5° minimum angle of elevation at earth stations), and it is estimated that 5 communication satellites can be accommodated in this range The above satellite spacing of 5° should permit voice, data and video services of CCIR/CCITT quality. The use of larger antennas or more interference-resistant modulation techniques -- or the adoption of lower quality of service -- would decrease required inter-satellite spacing; hence, increase the possible number of satellites. Conversely, smaller antennas or less interference-resistant modulation techniques e.g., single side-band would increase required inter-satellite spacing and reduce the possible number of satellites. An important observation is that the effectiveness with which various techniques for spectrum/orbit conservation can be exploited depends to a considerable extent on the "homogeneity" among adjacent satellites. This cautions against too great an intermingling of satellites having significantly different characteristics in the geostationary orbit, and emphasizes the need for coordination among systems with respect to system characteristics and orbital locations.

Not all the satellites which the 60° - 135° W orbital arc can accommodate can be counted on for U. S. domestic services. Canada has indicated a desire to deploy several domestic satellites and INTELSAT may desire one or more for North/South America traffic. On the other hand, regions outside this orbital sector will be useful for some U. S. domestic services where full coverage of the contiguous 48 States is not essential.

This analysis should not be misconstrued as indicating that all domestic communication satellite services and requirements for the future can be accommodated using the present 4 and 6 GHz bands. Assuming the economic viability of domestic satellites, as well as the feasibility of large-scale earth station deployment compatible with terrestrial radio relay facilities, additional frequency allocations will probably be required. The U. S. is presently seeking the international allocation of several additional frequency bands for communication satellite services at the 1971 World Administrative Radio Conference. Meanwhile, the 4 and 6 GHz bands can accommodate initial systems development under known radio propagation conditions and using proven, state-of-the-art technology.

QUESTION 2: Is it technically feasible to accommodate one or more domestic earth stations within or near typical major metropolitan areas, again assuming use of 4 and 6 GHz spectrum allocations, under various combinations of the following alternative deployments ?

(a) all stations operate in send/receive mode

(b) most stations are receive only

(c) each station uses entire spectrum allocation

(d) most stations use only small fraction of spectrum allocations

(e) minimum earth station antenna size is 15, 30, 60, or 90 feet

(f) only highest grades of telephone and video service are acceptable

(g) lower grades of service are acceptable

STATEMENT: The Committee recognizes the risks involved in the accommodation of a number of earth stations in or near any metropolitan area; but believes that at least one transmit/receive station operating at 4 and 6 GHz can be located near most metropolitan areas and within a number of the smaller metropolitan areas.

The degree of coordination required to accommodate the number of stations indicated will, of course, depend on the local environment, including topography, meteorology, earth station design, and deployment and characteristics of radio relay systems and any nearby high power radiating sources. This will clearly affect the cost of satellite system operations, though to what degree one cannot determine at this time. Studies and experiments now being designed are expected to provide further information about the feasibility of more extensive sharing.

In addition to transmit/receive stations, it should be possible to accommodate a number of receive-only stations in any metropolitan area, especially if a somewhat lower grade of service than CCIR/CCITT quality is acceptable. The above is based on the assumption that relatively few stations in the initial systems will use the full 500 MHz bandwidth and that satellites will be maintained on station with $\pm$ 0.5 degree of arc.

QUESTION 3: To what extent is it technically feasible to use other spectrum bands not now available to commercial communications satellite services (e. g., 7 and 8 GHz communication satellite allocations now reserved for government use) on a shared basis, or to achieve greater use of any of these spectrum bands through multiple antenna beam technology, reversal of up-and-down link frequency assignments, etc? What multiplication of the basic communications capacity indicated in (1) above appears likely through such techniques, assuming there were no policy or other impediments to their exploitation?

STATEMENT: The amount of electromagnetic spectrum presently available within the bands at 4 and 6 GHz is adequate for the initial use of domestic satellites (500 MHz in each band).

It is technically feasible to share bands both above and below 10 GHz which are not now available for use by commercial communication satellite systems. Significant growth in the demand for domestic communication satellite services will create requirements for additional frequency spectrum allocations. In anticipation of such a development, the allocation of additional spectrum space should be and presently is being discussed within the U. S. organizations concerned. Plans for expansion are presently well advanced. There will be a world radio conference dealing with this matter in mid-1971, under auspices of the International Telecommunication Union.

Reversed Frequency Bands -- The use of reversed direction on the up-and-down link frequency assignments can, in principle, nearly double the number of satellites and communications capacity which a given orbital sector can accommodate. In exclusive frequency bands this technique may be used to advantage. In the shared bands, the use of this technique would depend on coordinating terrestrial systems and other earth stations sharing the same frequency band.

The present International (ITU) and United States policy is that the reversed frequency technique will not be used in bands shared between terrestrial and space systems.

Multiple Antenna Beam Satellites -- Multiple antenna beam satellite technology advances should enable a single satellite to "reuse" the allocated frequency band. This added capability should help to overcome the inherent bandwidth-limited case of high powered satellites. However, there is need for more research and development to be carried out to determine the capabilities and limitations of this technique.

QUESTION 4: Is it technically feasible to provide communications service to Alaska and/or Hawaii and/or Puerto Rico through separate antenna beams on a satellite designed for service to the contiguous 48 States? Would this materially alter the reliability and total cost (combined earth and space segment) of (a) service to the contiguous states and (b) service to and within Alaska, Hawaii, or Puerto Rico (as compared with provision of the same service through INTELSAT or Canadian satellites, for example)?

STATEMENT: Using existing and projected technology, it should be technically feasible in the future to provide communications service through a single geostationary satellite -- configured with multiple antenna beams -- simultaneously to Alaska, Hawaii, Puerto Rico, and the contiguous 48 States. This would provide certain operational advantages and potential cost savings for service to outlying areas when compared with separate systems or the use of INTELSAT facilities:

-- The higher effective radiated power obtainable from separate, highly directive antennas would permit the use of lower-cost earth stations than are required when present INTELSAT satellites are used. In certain areas, this will require coordination with other countries.

-- The use of multiple highly directive antenna beams at the satellite could provide, through spectrum reuse, a substantially greater number of simultaneous channels per satellite at a low incremental cost.

-- Direct satellite links to locations throughout the contiguous 48 would be possible, which INTELSAT satellites cannot provide from their present mid-ocean location.

-- Cost sharing of R&D, launch, operating, spare, and maintenance services could provide significant economies.

Quantitative estimates of potential savings cannot be made in the absence of specific systems design models. Both costs and performance vary considerably with system configuration and size, percent of fill, service quality objectives, satellite spare and replenishment doctrine, R&D base, procurement source, etc.

QUESTION 5: Which design and/or operating characteristics of domestic satellite systems require standardization and/or coordination to insure compatibility among systems and adequate growth potential? To what extent are these standards and coordination likely to be worked out among the parties concerned, under present FCC rules and regulations, and to what extent will it be essential that the Government exercise regulatory control of such proceedings? What alternative steps could be taken to encourage resolution of these issues directly by the parties concerned? Specifically, would it be technically feasible for one party or another to either operate with reduced quality of service or adopt appropriate design changes to accommodate a potentially interfering service, if there were effective rules for and means of compensation?

STATEMENT: It appears essential that regulatory control be exercised regarding any domestic satellite system(s) to the extent of establishing procedures, standards, and regulations concerning frequency sharing and efficiency of spectrum utilization. To achieve these objectives it will be necessary to regulate earth station antenna locations, antenna directivity and station operating characteristics, etc. With respect to the space segment, regulatory control should be maintained over satellite spacing and associated station keeping, antenna directivity and polarization and effective radiated power.

The present FCC rules can and should be modified and updated to cover the communication-satellite service to insure compatibility between terrestrial systems and space systems, and among space systems sharing the same frequency bands. The FCC regulations should be appropriately responsive to the engineering portions of the latest CCIR Recommendations as approved by ITU administrative radio conferences. In some instances it may be technically feasible and acceptable for a system to operate with reduced quality of service or to adopt appropriate design changes to accommodate a potential interfering service but such deviations should be approached with caution. A decision which affects the quality of service should not normally be left to the discretion of the parties concerned when the public interest is involved.

To permit an optimum number of common frequency satellites to occupy the geostationary orbit, it is desirable that earth station antennas have as much horizontal discrimination as is economically feasible. Lacking any existing framework within which the economically optimum size can be resolved, it may be necessary as an interim measure to establish minimum antenna discrimination standards. Inasmuch as the potential demand for satellite space is not uniform along the geostationary orbit, these standards for antenna discrimination should vary with satellite location, as well as with geographic area served.

Receive only stations may operate with less than minimum standard antenna discrimination providing the operators are willing to accept a quality of service somewhat inferior to the CCIR/CCITT radio relay standard. Permitting the use of less than standard antenna discrimination for transmit antennas should be approached very cautiously and permitted only after a thorough consideration of the desirable and undesirable effects.

QUESTION 6: (a) What significant developments in either technology or technical information are foreseen during the next ten years which might result in major improvements in the cost and capacity of satellite communications, greater and more efficient utilization of the radio spectrum resource, or the operational scope and effectiveness of satellite communications?

(b) What are the significant developments foreseen in terrestrial communications?

(c) How will the cost effectiveness of terrestrial communications compare with satellite communications in the next decade?

STATEMENT ON QUESTION 6(a): There are numerous technological advances forecast for the next decade which will provide significant enhancement of satellite communications capabilities and economy of service. These include (a) larger, longer life, higher capacity and more powerful 3-axis stabilized geostationary, multiple-purpose satellites; (b) more efficient modulation subsystems; and (c) more efficient, reliable and higher capacity earth stations, in fixed, transportable and mobile configurations.

The developments that offer the greatest potential improvements for satellite communications are:

(a) The use of multiple, narrow, and steerable beams from satellites. This could significantly increase the circuit capacity of each satellite for a given bandwidth, and could greatly reduce the cost per circuit.

(b) Subject to treaty limitations, the use of much larger effective radiated power from satellites. This could be used to decrease the cost of earth stations for a given level of service.

(c) The use of more versatile and better discriminating earth station antennas. When earth stations need to be in simultaneous contact with a number of satellites the development of earth station antennas with multiple independent beams will become important in the total system cost. Also, the design of the antennas can be made to provide greater system discrimination between wanted and unwanted signals for a given size or cost of antenna.

(d) Development of techniques and hardware including solid state devices which will permit: (1) increased spectrum sharing between satellite and terrestrial systems; and (2) useful exploitation of the higher frequency domains, including optical frequencies.

(e) Better understanding of radio propagation and interference factors. For example, with more information on radio propagation and interference it will be possible to design systems with smaller margins for such contingencies and hence with greater capabilities or less cost.

(f) Further development of multiple-access techniques will improve system effectiveness. For example, the ability to assign satellite circuits "on-demand" will improve circuit utilization and provide the ability to allocate circuits flexibly among many routes to meet variations in demand. This multiple-access feature is economically attractive for servicing thin (low-traffic) routes.

(g) Development of enhanced satellite performance. For example, developments are proceeding which should lead to improved in-orbit life-time, more accurate spacecraft stabilization and orbit repositioning capability, and more efficient prime power supply.

(h) Development of other advanced techniques. For example, the introduction of improved digital modulation techniques would facilitate data transmission as well as increase the immunity to interference from other systems.

STATEMENT ON QUESTION 6 (b)

Some examples of private research and development programs applicable to terrestrial telecommunications systems follow: (Bell Telephone Laboratory programs used as an example)

Coaxial Cable

The L-5 Coaxial Cable now in the final stages of development will permit the transmission of both analog and digital information. It will provide 90,000 two-way voice conversations on 20 coaxial tubes in a single cable. Each coaxial tube has a bandwidth of 60 MHz. Additionally, it will contain one service protection channel in each direction which will permit the restoral of 9,000 channels in each direction in the event of service failure.

Wave Guides

Millimeter Wave Guide Transmission Systems are being developed and an experimental link is being established. The 2 1/2 inch diameter precision waveguide is buried at least 4 feet deep. The operating frequency band of the waveguide is 30 - 300 GHz. This system should provide more than 240,000 voice channels per wave guide.

Microwave Systems

Since 1952 TD microwave systems have expanded from 2400 to 12,000 channels using the same 500 MHz bandwidth. A new development known as the TD-3 is presently undergoing field trials in Arkansas and Oklahoma. The TD-3, as are the other

TDs, operates on the 4 GHz part of the spectrum. The TD-3 has the same 12, 000 channel capability as the TD-2; however, there are lower investment costs, higher reliability and reduced maintenance.

The TH-3 is the equivalent of the TD-3 but utilizes the 6 GHz part of the frequency spectrum. It has a 10, 800 voice channel capability. Its field trial is underway in a few places in the United States.

A new system called the "Pole Line System" is presently in test bed operation in New Jersey. This concept includes mounting small suitcase size packages atop 60-90 foot aluminum poles to be located three miles apart. This system operates in the 18-20 GHz part of the spectrum and has a capacity of 32, 000 voice channels.

<u>Digital Transmission</u>

Digital transmission provides one answer to the problem of economically handling the growing volume of communications. Systems now in use can carry 24 simultaneous one-way conversations on two pairs of wire in a cable. The Digital T-5 Transmission System is in final stage of development and will provide 80-90, 000 voice channels. Now under development are systems operating at nearly300 million bits per second which one day may carry thousands of voice channels, several TV channels and high speed computer data on the same channel.

STATEMENT ON QUESTION 6 (c): The relative cost effectiveness between satellite communications and terrestrial communications in the future will depend on the specific application under consideration and the rate of technological advance of each transmission medium. The Committee believes that satellite communications should offer advantages: (a) in applications requiring simultaneous relay to a large number of geographically dispersed points or areas; (b) in applications employing multiple-access to widely dispersed low-traffic areas; (c) in applications involving mobile terminals, and (d) in applications where a quick reaction capability is needed, particularly in remote areas. Projected development of terrestrial micro-wave, coaxial cable and guided wave technologies indicate a continued advantage for these techniques on high density trunk routes of short and intermediate lengths. Since there are technical and economic advantages in both satellite communications and terrestrial facilities depending on the specific application, it is reasonable to expect a complementary mix of facilities in the domestic telecommunications environment.

QUESTION 7:

(a) If a domestic communications satellite system is implemented what will be the long-term impact on the quality and economy of telecommunications services made available to users, both private and Government? (b) Is the quality and reliability of service from satellite communications now or likely to be obtainable adequate to satisfy user needs?

STATEMENT ON QUESTION 7(a)

(a) Enhanced versatility, diversity and redundancy of domestic telecommunications should be realized by the introduction of another means of transmission and distribution capability.

(b) The pace of satellite communications technology has demonstrated a steady growth in the quality and reliability of service and continued advance is forecast. Techniques such as component and subsystem redundancy both on the ground and in space, and use of in-orbit spares are available which should make it possible to provide continuity of service comparable to that available to users of the terrestrial network.

Adequate quality service should be obtainable through advances in electronic circuitry, antenna performance, etc. Actual operating experience will be needed to determine the importance of "time delay" and "echo phenomena" in domestic telephone and certain kinds of data service.