The Space Congress® Proceedings

1976 (13th) Technology For The New Horizon

Apr 1st, 8:00 AM

Commercial Satellite Communications

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ABSTRACT

A need and a tradition existed in international telecommunications when satellites emerged ten years ago. INTELSAT was born in 1964 out of an ideal with the specific aim of establishing a commercial telecommunication satellite system. INTELSAT has responded to a variety of requirements around the world, putting state-of-the-art technology to practical use in an environment of international ownership and management. INTELSAT has brought space activity to public consciousness and benefit. This paper sets out the impact of INTELSAT in the commercial telecommunications field as it moves into its second decade and assesses the opportunity before INTELSAT in its use of Space for an important service.

INTRODUCTION

INTELSAT is the first venture to utilize the satellite medium for providing public telecommunications services on a commercial basis. In this paper, the remarkable success of INTELSAT is explained in terms of the background against which the system developed and the methods and concepts which govern the development and maintenance of the system. The paper summarizes the financial results and spotlights the organizational elements in the operation of the system as a multi-national venture.

WORLD TELECOMMUNICATIONS

Trans-oceanic submarine cable telephony was first established in 1956. Large-scale improvements in the national networks of leading countries commenced in the fifties. The importance of telecommunications as a part of the basic infrastructure of any nation came to be recognized by increasing attention to development assistance in this field. The ITU began the development of the concept of world routing of telephone calls. The feasibility of the satellite medium was established at this juncture and its scope to scan large distances directly commanded immediate attention. The confluence of all these factors can be seen in telecommunication statistics. The world telephone population grew from 143 millions in 1961 to 358.6 millions in 1975 (Figure 1). More telephone networks become automatic (Table 1). An almost insatiable demand for international public telecommunications facilities was created by the developmental environment all around the world.

EMERGENCE OF INTELSAT

INTELSAT was born out of U.S. initiative to achieve the ideal of establishment of a global satellite system of international public telecommunication services with non-discriminatory access to all countries and areas of the world. The U.S. Government set up COMSAT as the U.S. entity to participate in the international effort to establish commercial satellite communications. COMSAT was also entrusted with the task of organizing the global system, interfacing with NASA for launch facilities. U.S.A. sought the cooperation of the governments and telecommunications entities of all countries in the world; a set of interim agreements setting forth the objectives and methodology for the initial phase was drawn up. These interim agreements have since been replaced by the INTELSAT Agreements defining the permanent organizational structure. COMSAT pursued its task with remarkable vigor and the history of INTELSAT in the past ten years has been a chronicle of outstanding achievement.

International telecommunications have always had the attributes of a profitable public utility; it was therefore logical that the use of satellites came to be examined in commercial terms from the outset. Commercial operations require the provision of facilities for an assessed market demand at a cost which the user will regard as fair for the quality and reliability of service he derives. In the field of international satellite telecommunications, these requirements are overlaid with the requirements of national policy of the very many countries constituting the partnership. The concept of public interest varies with place and time but a high degree of reliability, cost effectiveness and quality of service are basic considerations.

INTELSAT GROWTH AND DEVELOPMENT

The experimental stage of INTELSAT launches established the viability of a geostationary system. Even during the developmental stage, INTELSAT served the Atlantic and Pacific regions; the provision of the requisite facilities for the NASCOM (Apollo Project) services was an outstanding achievement. Multi-access capability was introduced in the INTELSAT II series and utilization of the full 500 MHz spectrum was achieved in the INTELSAT III series. INTELSAT achieved global coverage in 1969 with INTELSAT III satellites. The growth of satellite capability is shown in Table 2.

It is interesting to trace the history of user attitudes. The earliest attempt at assembly of agreed forecasts was made in 1966. Users get together annually to agree on their mutual capacity requirements, year by year, for the succeeding five years. There is thus a continuous update of the traffic relations. Figures 2A and 2B show the growth of traffic in the system in two important services. Table 3 shows the progressive forecasts which have formed the basis of INTELSAT planning.

INTELSAT stepped into long term planning concepts in 1972 and, with estimates secured from user entities as to their long term aspirations, established a set of weighted long term growth rates for pre-assigned telephone channel requirements as follows:

Region	1979-1983	1984-1988
Atlantic	18%	16%
Indian	18%	16%
Pacific	17%	17%

Telephony has been the pacing element in the demand for space segment capacity. All around the world there has been a growth in investments in gateway exchanges using, generally, the CCITT No 5 system of signaling for international services. There has also been a corresponding growth in telex exchange plant, and a recent trend is the setting up of stored program controlled exchanges for telex and message relay operations. All these developments have assumed the continued satisfactory and cost-effective performance of the INTELSAT system. Similarly, the interest expressed in the use of the SPADE system is also a demonstration of the need for telephone services even on thin traffic routes.

The main types of services now provided by INTELSAT are:

Fulltime

Pre-assigned telephony 4 KHz channels	FM/FDM packaged carrier groups for point-point services.
SPADE telephony	PCM/PSK demand assigned mode operating with CCITT No 5 signaling system.
SCPC voice and data services	PCM/PSK 50 kbs operation; package data service with combinations of data speeds up to 9600 bits available.
Bulk leases	Full or fractional transponders with suitable terms and conditions to regulate system discipline and to cater to relative priorities of allotment.

Occasional Use

Television	Full or half transponder used with associated audio programs carried on separate FM carriers.
Cable restoration services	To restore circuit groups lost due to interruptions of submarine cable systems: FM/FDM carrier operation.
Broadcast press service	Unidirectional multi-destination services (FM/FDM or PCM/PSK)

INTELSAT: A COMMERCIAL VENTURE

The commercial character of INTELSAT is shown in the following aspects of its conduct of business:

a. Maintaining a competitive posture. INTELSAT has no means of influencing the placement of traffic on its satellites by entities having access to satellites as well as other media. Telecommunication entities regard satellites and cables as complementary media.

b. Responsiveness to demand. INTELSAT draws up its operational plans in response to stated user requirements. But, INTELSAT has to live with unpredictability in the location of new earth stations as well as in the actual development of traffic volume and of interconnectivity.

c. INTELSAT has to maintain non-discriminatory availability of capacity on a global basis. This meets a wide definition of public interest.

d. Need for high reliability in an environment of cost effectiveness. Emphasis is laid on use of proven technology in design and on cost consciousness at all stages of decision-making.

IMPACT OF INTELSAT

Satellite Utilization

The most direct demonstration of the impact of INTELSAT is in the number of countries joining the partnership and in the growth of operational antennas in the system (Figures 3 and 4). The global impact is seen in the distribution of antennas operating in the system, summarized here for 1968 and 1975:

	1968	1975
Africa	1	19
Europe	6	25
North America	4	12
Caribbean	-	6
Central/South America	2	13
Asia/Oceania	7	30
Mideast	-	10

In numerical terms, more countries are dependent solely on the satellite system than on cable systems. Another facet of INTELSAT service record brought out by the following examples is that the need and interest of several users are not confined to one region of INTELSAT:

International Circuits Used by	As of 31 Dec. 1975 Region		
	Atlantic	Indian	Pacific
U.S.A. (Mainland)	2953	56	426
U.K.	800	445	6
France	541	83	-
Germany	351	73	-
Canada	258	4	70
Italy	-	97	-
Japan	-	208	406
Australia	-	179	199

Furthermore, as many as 24 countries already operate, or have firm plans for operating, with the INTELSAT satellites in two regions. These facts emphasize the global character of the system.

INTELSAT Operations

With the introduction of international subcriber dialing and of semi-automatic services, loss of the circuit medium would cause very heavy congestion and operational disarray. INTELSAT operational practice is to provide redundant capability by placement of an in-orbit spare satellite of each of the satellite types in each region; this enables full service to be restored within a very short while in cast of satellite failure or malfunction. INTELSAT has thus been able to achieve reliability in continuity of service in excess of 99.9%. In 1974 and 1975 the annual average number of outages per operating satellite was 0.875 and the mean circuit outage duration was 46 minutes. On two occasions, previously agreed contingency plans were implemented to restore services on the spare satellite in orbit.

Operational concepts have evolved as the traffic volume, the connectivity pattern and the number of earth stations grew. In order to meet the requirements of all users in the Atlantic Region, a two-satellite configuration has been implemented since 1971. One satellite provides access between almost all the earth stations in the region and other shares the traffic with the first satellite on relations between earth stations having two antennas in service. This split of traffic reduces congestion on the first satellite, and also provides diversity routing for traffic in the same relation; the enhanced system protection achieved through diversity routing is the prime benefit for users operating two antennas in the same region. The multi-access capability of the system also facilitates quick accommodation of unanticipated demands for increased capacity.

Operational discipline is achieved by the setting up of performance standards for earth stations some of which are held to be mandatory, and by setting up a monitoring and testing schedule which provides the means of ensuring freedom from degradation of service quality. All earth stations are required to measure, periodically, the out-of-band noise on the carriers they receive and report results to the central operations center in Washington. INTELSAT monitoring centers monitor the transmissions and bring out-of-tolerance performance quickly to notice. Each earth station is carefully tested for adherence to performance standards whenever a new station enters the system, and whenever a new satellite series is deployed.

Financial Arrangements

INTELSAT has proved the commercial viability of a satellite system operating in an international environment. Its principles of financial management are designed to suit its basic character as an international cooperative venture. INTELSAT draws its capital requirements from its member entities; the prospect for the coming five years may be an average annual rate of capital requirements close to $110 million. The costs of the system are computed including a target compensation for the use of capital, presently fixed at 14%. The revenue requirements consisting of cash working expenses, depreciation and compensation for the use of capital are divided into a realistic estimate of anticipated usage to fix the tariff for each year. INTELSAT derives revenue from the telecommunication entities using the system, meets the cash working expenses of the system and returns the balance to the owner-investors. The Signatories contributing capital thus receive, on a continuous basis, the element of revenue corresponding to depreciation and compensation for the use of capital.

The financial history of INTELSAT is illustrated by these figures:

	1969	1972	1975
Revenues ($ m)	44.7	89.6	117.7
Depreciation ($ m)	23.5	38.9	42.2
Expenses ($ m)	12.0	15.7	22.8
Cumulative comensation for use of capital %	3.7	14.3	15.3
Net capital in the system (owners' equi ty) ($ m)	120.6	235.7	354.2

These results have been accompanied by a progressive reduction in the annual rental from $32,000 in 1965 to $8280 in 1976 for pre-assigned telephone channels which constitute the bulk of revenue (Figure 5).

An indirect indicator of the cost-effectiveness of INTELSAT operations is the fact that investment in earth stations has been included in projects appraised by international lending institutions and a good number of earth stations have been financed in this manner.

Technology

INTELSAT has had an impact on international telecommunications through its use of advanced technology in the space and earth segments. The utilization of the full 500 MHz spectrum in the space segment was accompanied by the use of cooled paramps with full 500 MHz capability in earth stations. These developments contributed to system growth, and consequently, to the dramatic decrease in system costs to the telecommunication entities using the system. Further increase in traffic demand was met by increased satellite e.i.r.p. Shaped beams facilitated interconnection. The use of TWT highpower amplifiers with the full 500 MHz bandwidth capability at least in some major earth stations helped greatly in the orderly and continuous development in the connectivity of the system through their ability to put up additional carriers. INTELSAT's adherence to the principle of establishing performance standards rather than prescribe equipment specifications has contributed to diversified development of earth station equipment. INTELSAT was also successful in establishing test procedures and agreement on the use of different types of test equipment for common purpose, an essential requisite for commercial operation of far-flung earth stations in the system.

Multi-access capability also led to unique INTELSAT experience in the understanding of intermodulation effects in multicarrier operation. INTELSAT work in this area has now reached a stage where the satellite hardware is well optimised operationally to derive the best results in terms of configured capacity in the system.

The experience of INTELSAT Signatories has contributed to the activities of CCIR, such as in defining recommendations on energy dispersal, and flux density control. INTELSAT has developed its own operating limits for off-beam radiation and for out-of-band distortion. In recent times, INTELSAT experience is also reducing ITU procedures on intersystem coordination to effective practice; pragmatic concepts in operational adjustments in accordance with agreed interference allocation to the noise budget of different satellite systems are emerging. Since, in general, the performance of the INTELSAT system exceeds the recommended standards based on radio relay operation, it leaves flexibility in the system for adjustments in the process of intersystem coordination.

BENEFITS TO THE PUBLIC

As the eventual test of the commercial success of any system, direct benefits to the public at large have to be noted. INTELSAT satellites have provided an increasing proportion of international wideband facilities:

	Countries (areas) Connected to Wideband Systems		
	Cables	Satellite	Cable & Satellite
1960	13	-	-
1970	49	34	23
1975	54	77	35

INTELSAT earth stations now link over 95% of the world's telephone population, and with improvements in the domestic networks of various countries now under way, even the existing connectivity pattern should be expected to provide continuing growth. The bulk of INTELSAT earth stations is in developing areas of the world and the INTELSAT system provides them with high quality dependable service for the first time. One of the most interesting facts of INTELSAT statistics is that over 60% of all television transmissions in the system involve developing countries. Table 4 summarizes the results for September and October 1975. The SPADE system has facilitated direct links on thin traffic routes. Even fully automatic operation has been recently established on the SPADE system between Switzerland and Venezuela.

International telecommunications are a regulated industry in all countries. The policy may be to pass on benefits of system economies partly or wholly to the customer, as in U.S.A., or to use the surplus-generating potential of these services for other social benefits. It is also known that telecommunications entities may maintain charges at levels which contribute to internal resources of capital for future improvements. In the U.S.A., for example, telephone charges and leased circuit rentals have progressively declined with implementation of advanced technology. Some reductions in telephone charges have taken place in other countries such as Japan. It is usual to associate telephone charge reduction with the introduction of subscriber dialing. There is also evidence that the average levels of investment of a telecommunications entity is now considerably higher than it was ten years ago. This is a reflection of the demand for high quality services and the generation of surpluses; the contribution of INTELSAT as a commercially operated system to these facts cannot be assessed in precise terms but its financial results are indicative of a significant correlation. One view could be that the economic viability of the system has contributed to the maintenance of charges at least at the same level, which is an effective reduction in cost at a time of inflation.

Television is a unique capability not yet provided by any other medium on an international scale. The impact of the INTELSAT system in promoting international television service has been dramatic; it has brought satellite communications into the home.

It was inevitable that the use of satellites for domestic services in highly developed networks such as that in U.S.A. and Canada should attract early attention. But it is to INTELSAT's credit that this important application is being extended to a number of developing countries, who see in it a means of leap-frogging into modern network facilities for their domestic systems. The commercial approach adopted by INTELSAT in offering spare capacity at special rates, subject to relevant operational priorities, has greatly accelerated this process. The international basis of INTELSAT operations also makes it attractive for various countries to rely upon INTELSAT for the carriage of their domestic traffic. Table 5 is a list of bulk leases so far authorized on the INTELSAT system.

RESPONSIVENESS TO USER NEEDS

Responsiveness to market demands is an essential characteristic of a commercial system. The operational concepts earlier described are themselves a demonstration of such responsiveness. INTELSAT operational plans are also continuously updated and revised by mutual agreement among users in response to changes in user forecasts. Important system decisions early in 1966 and 1967 had been made in response to stated needs of the Apollo Project for telecommunications, after a study of the costs and benefits associated with meeting those requirements. From the beginning, television has been provided with very favorable charges. The SPADE service, introduced in 1973, has a charge on a pre-access-minute basis to align with switching techniques. Table 6 summarizes the INTELSAT approach.

The provision of diversity routing through two operating satellites to user entities having multiple antennas has been already mentioned. This diversity routing divides circuits in major relations and thereby increases the service protection. Some user entities have also made arrangements for mutual aid between their earth station facilities as a further element in improvement of service reliability. INTELSAT planning takes into account these user needs.

The organizational structure and methods of INTELSAT are a reflection of the response required of an international telecommunications organization. A distinction is made between the aspects of concern to governments relating to public interest and the commercial orientation of telecommunication entities. Commercial decisions are taken by representatives of investing entities who are also the prime users of the system. Expert assistance on an international scale is provided by a succession of meetings of advisory committees for finance, technical matters and planning. User needs are assessed at annual meetings. Operational plans are agreed in minute detail at regional meetings of earth station operators; such meetings are also used for dissemination of information on impending changes in the system. The extensive consultation between the several elements of the INTELSAT system is shown by the fact that during 1975 international meetings organized by INTELSAT covered 112 working days.

CURRENT AND FUTURE TRENDS

Demand for INTELSAT capacity will, in the foreseeable future of the next decade, center around telephony and telephony-based services. The expansion and upgrading of domestic networks are bound to increase the demand for international circuits; the extension of international subscriber dialing will increase the numbers of circuits required for the better grade of service inherent in the service, and the need for operational adjustments such as diversity routing and mutual aid arrangements will increase. Figure 7A and 7B show the growth of connectivity among earth stations, and demonstrate the scope that exists for growth even in the conventional field of telephony. AVD and data services will also increase, though not necessarily in step with the rate of growth of telephony. All these developments feed upon themselves by contributing to further economies of scale.

Even in 1975, a year of recession, INTELSAT traffic grew by 16.2%. It seems possible that global channel capacities of the order of 60,000-70,000 will be required in the eighties. INTELSAT V, expected to enter service in 1979, introduces new technology in the form of frequency reuse by dual polarization and the use of the 14/11 GHz band. Operational field trials of TDMA/DSI system are due to commence soon. One of the several options for future development could, for reasons of system advantage, be that satellite capacities are retained at around 25,000 channels, and dual or triple operational satellite configurations (with additional in-orbit spares) may become normal operating practice.

The nature of services provided may also change in this period. INTELSAT has had a standard for earth stations with a G/T of 40.7 dB/K and has accepted stations of less size on an exceptional case-by-case basis. While the growth in the number of standard earth stations has been impressive, there are indications that INTELSAT has yet to cater to a large number of countries or areas with relatively small traffic potential who find the 40.7 dB/K station too expensive. Earth stations have come into being in the bulk of countries with telephone populations in excess of about 100,000 (Figure 6). It is a fact that several areas with small telephone populations have completely automatic systems and consequently these compact service areas present a ready market for international traffic if high quality service can be provided. In the past two years, these factors are reflected in a request for approval of 33 domestic and 8 international service stations of G/T less than 40.7 dB/K for access to the INTELSAT system. INTELSAT is therefore in the process of developing a second standard for earth stations with G/T of 31.7 dB/K typically with a 10 for 12 meter dish; in combination with improved modulation and access methods, these stations may be expected to form a self-contained community of stations providing service between a number of small areas and the major centers of traffic with which they have community interest. One estimate places the potential in the immediate future in this area at about 57 antennas.

The development of small diameter antennas for public service is becoming widespread. Even recently, a wholly new system for digital transmission with direct access to the customer premises has been announced. The introduction of such services in the INTELSAT or other systems will have to be governed by considerations related to orbit utilization. However, it is conceivable that remote area communications using antennas of diameter around 5 meters could also become part of the system; the nature of the service may permit operational constraints such as denial of television capability to be imposed.

In the further future, satellite system developments could be dependent upon the introduction of digital transmissions in terrestrial networks; digital telephone networks may be the pacing element in this report.

INTELSAT is organizationally and technically well-poised to respond to all these developments. INTELSAT has an adequate long term focus through a mix of INTELSAT-funded R&D and of demand studies to be able to adapt its system to such developments, retaining its basic commercial character.

ILLUSTRATIONS

Notes:
* Data unavailable for 4 countries
# Data unavailable for 3 countries
Data unavailable for 1 country
** Data unavailable for 19 countries

WORLD TELEPHONES: DISTRIBUTION

		NORTH AMERICA	CENTRAL AMERICA	SOUTH AMERICA	EUROPE	AFRICA	ASIA	OCEANIA
Number of Countries	1965	3	32	14	36	58	47*	8
	1975	3	33*	14#	36##	56	48**	28
Number of Telephones (millions)	1965	95.5	1.5	4.1	57.4	2.4	17.6	4.0
	1975	155.9	4.2	8.1	124.1	4.3	54.7	7.3
Number of Countries with over 80% automatic telephones	1965	2	19	12	22	28	25	5
	1975	2	29	11	33	28	26	21

TABLE NO. 1

INTELSAT SATELLITE CAPABILITIES

SERIES	I	II	III	IV	IVA
Year	1965	1967	1969	1971	1975
Weight in orbit (lbs)	85	190	334	1,610	1,818
Number of transponders	1	1	2	12	20
Bandwidth (MHz)	40	40	480	480	480
Technology introduced	Synchronous orbit	Multiple access, radome eliminated	Cooled paramps, 500 MHz HPA	Spot beams, SPADE, SCPC	Frequency Reuse, Shaped spot beams, Dual polarization experiment
Typical capacity (channels)	240	240	1,200	4,000	12,000

TABLE NO. 2

TRAFFIC DEMAND FOR PRE-ASSIGNED TELEPHONY
(Half-circuits)

Year of assembly of forecast	Forecast for year						
	1968	1970	1972	1974	1976	1978	1979
1966	1670						
1967	1792	5258					
1970		4330	10108	15046			
1972			8108	14460	21062		
1974				13234	20894	29940	
1975					19914	29308	34776

TABLE NO. 3

TELEVISION TRANSMISSIONS

Total for September and October 1975

USERS	OCEAN REGION			TOTAL
	ATLANTIC	INDIAN	PACIFIC	
Developing countries (hours)	459	56	14	531*
Total (hours)	618	88	179	887*
Proportion used by, or emerging from developing countries	74%	64%	8%	60%

Note: * Includes 2 hours double-hop transmissions in the Atlantic and Indian Ocean Regions.

TABLE NO. 4

BULK SERVICE LEASES FOR DOMESTIC SERVICES

IN SERVICE	DATE OF SERVICE	OCEAN REGION(S)	TRANSPONDER CAPACITY
U.S. (Mainland) to U.S. (Hawaii)	15 Feb. 1974	Pacific	Full
Algeria	17 Feb. 1975	Indian/Atlantic	Full
Brazil	1 July 1975	Atlantic	Full
Malaysia	1 Aug. 1975	Indian/Pacific	Full
Nigeria	31 Dec. 1975	Atlantic/Indian	Full
Norway	31 Dec. 1975	Atlantic/Indian	Half
Spain	Mar. 1976	Atlantic	Half
APPROVED			
France/Reunion	1 June 1976	Atlantic/Indian	Half
Nigeria	1 June 1976	Indian/Atlantic	Full
Colombia	mid-1976	Atlantic	Quarter
Zaire (Provisional)		Atlantic/Indian	Full

TABLE NO. 5

TARIFFS IN THE INTELSAT SYSTEM

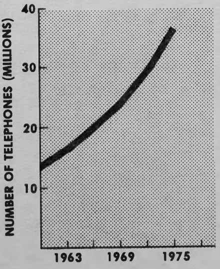
CATEGORIES

SERVICE	BASIS OF CHARGE	METHOD OF CHARGE
Full-time		
Pre-assigned telephony	Half circuit 4KHz	Unit of utilization
SPADE telephony	Access time in minutes	Chargeable minute
Broadcast press service	Unidirectional multidestination 4KHz circuit	Half unit at transmitting station. Quarter unit for each receiving station.
Bulk Leases	On spare capacity (with relevant priority)	Annual charge, usually with five year minimum period.
	On an operating satellite along with regular international traffic	360 units for full transponder
Occasional		
Television	Chargeable for duration of transmission. Minimum booking time of 10 minutes.	Chargeable minute for duration of transmission for video and associated audio transmissions.

TABLE NO. 6

World's Telephones

(AS OF 1 JANUARY)

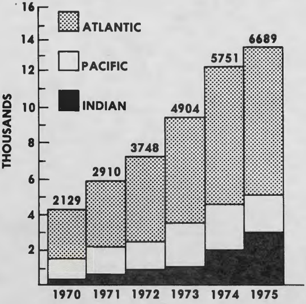


YEARS	TELEPHONES
1960	134,600,000
1963	161,100,000
1966	195,100,000
1969	237,780,000
1972	291,299,000
1975	358,590,000

INTERNATIONAL TELECOMMUNICATIONS SATELLITE ORGANIZATION
ORGANISATION INTERNATIONALE DE TELECOMMUNICATIONS PAR SATELLITES
ORGANIZACION INTERNACIONAL DE TELECOMUNICACIONES POR SATELITE

FIGURE 1

Full-Time Satellite Circuits In Use At Year End By Region *



	ATLANTIC	PACIFIC	INDIAN	TOTAL
1970	1316	157	656	2129
1971	1756	327	827	2910
1972	2373	450	925	3748
1973	3144	635	1125	4904
1974	3846	976	929	5751
1975	4438	1288	963	6689

* EXCLUDES LONG TERM TRANSPONDER ALLOTMENTS.

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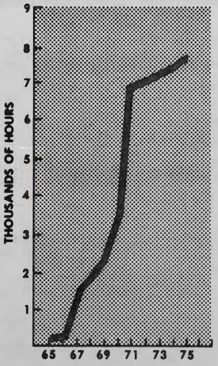
FIGURE 2A

Television Half Channel Hours



Year	Television Half Channel Hours
1965	80
1966	152
1967	450
1968	1,372
1969	1,826
1970	2,428
1971	3,562
1972	6,792
1973	6,817
1974	7,361
1975	7,887

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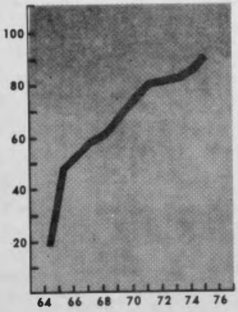
FIGURE 2B

Growth in Number of INTELSAT Members



	Added	Total
1964	19	19
1965	30	49
1966	6	55
1967	5	60
1968	3	63
1969	7	70
1970	7	77
1971	5	82
1972	1	83
1973	1	84
1974	4	88
1975	3	91

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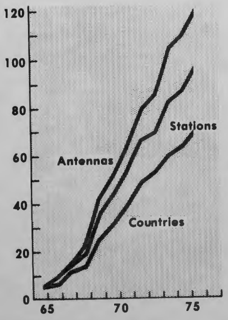
FIGURE 3

Earth Stations In The INTELSAT System



	Antennas	Stations	Countries
1965	5	5	5
1966	8	8	6
1967	15	14	11
1968	20	19	13
1969	41	36	24
1970	51	43	30
1971	63	52	39
1972	79	65	49
1973	85	68	52
1974	104	82	60
1975	123	97	71

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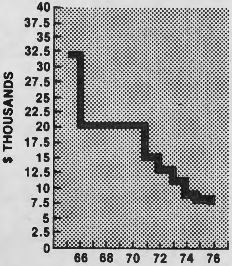
FIGURE 4

INTELSAT Satellite Utilization Charge



Year	Annual Charge Per Half Circuit
6/28/65	$32,000
1/1/66	20,000
1/1/71	15,000
1/1/72	12,960
1/1/73	11,160
1/1/74	9,000
1/1/75	8,460
1/1/76	8,280

INTERNATIONAL TELECOMMUNICATIONS SATELLITE ORGANIZATION
ORGANISATION INTERNATIONALE DE TELECOMMUNICATIONS PAR SATELLITES
ORGANIZACION INTERNACIONAL DE TELECOMUNICACIONES POR SATELITE

FIGURE 5

PERCENTAGE OF COUNTRIES HAVING STANDARD INTELSAT EARTH STATIONS VS. SIZE OF THE NATIONAL TELEPHONE NETWORK

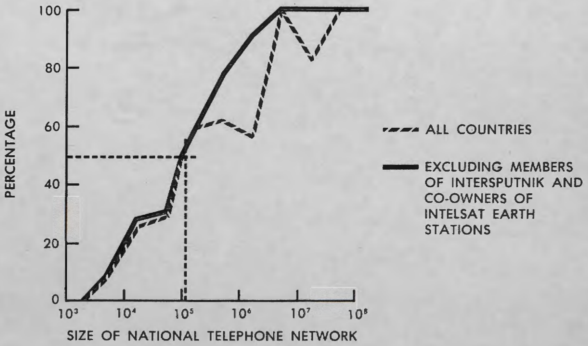


FIGURE 6

INTELSAT System: Connection Ratios
1967-1975

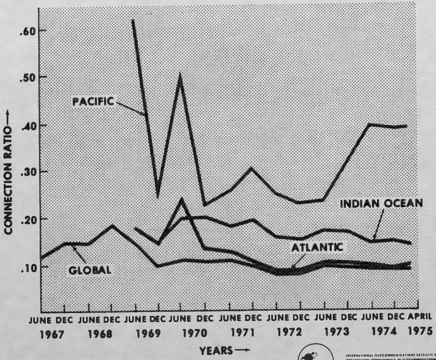


FIGURE 7A

Traffic Relations And Earth Stations In The INTELSAT System

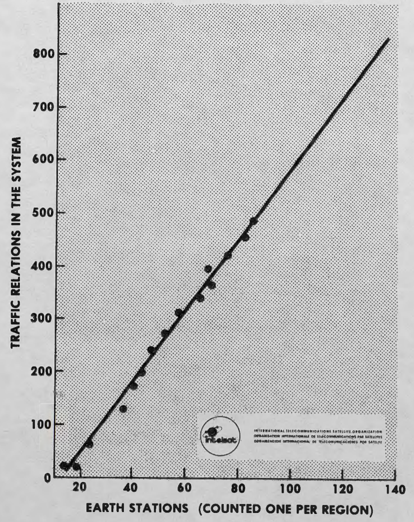


FIGURE 7B