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# The Future of INTELSAT in a Competitive Environment

Leland L. Johnson

December 1988





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40 Years 1948-1988

RAND

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## PREFACE

INTELSAT has been an important instrument of U.S. foreign policy because it has spread the benefits of advanced telecommunications technology to nations--especially the developing nations--throughout the world. In earlier years, this role was fairly easy to pursue because there were few alternatives to the use of INTELSAT satellite circuits. More recently, however, other satellite systems have emerged to compete with INTELSAT, with more likely to follow; and fiber optic cables with high capacities are being installed across both the Atlantic and Pacific Oceans as first steps in a global network. Concerns have arisen about INTELSAT's ability to continue its role as global provider of service in the face of growing competition.

In response to these concerns, this study examines the financial situation that INTELSAT may face as a consequence of competition with fiber optic cable and other satellite systems. This is an important area for investigation because it may suggest pricing strategies and other responses by INTELSAT that would strengthen its ability to compete in a rapidly changing market environment.

This study was financed in part by the U.S. Department of State, with supplemental funding from The RAND Corporation. It is intended to provide guidance to State Department and other officials in evaluating INTELSAT traffic and financial projections and in formulating appropriate U.S. policy toward INTELSAT and competing systems.

## SUMMARY

This study projects and assesses possible financial futures faced by the International Telecommunications Satellite Organization (INTELSAT) in an increasingly competitive environment, and suggests appropriate INTELSAT pricing strategies. Of central concern is the potential impact of transoceanic fiber optic cables and of competing satellite systems.

The annual growth rate in the number of "full-time" INTELSAT circuits used for voice and data fell from about 25 percent in 1980 to only 7 percent in 1987. A number of factors may explain this declining growth: (a) the increase over time in the traffic base on which percentage changes are computed, (b) the role of direct distance dialing, (c) increased competition from cable, (d) a slowdown in retail or end-user price reductions, and (e) the increased efficiency of circuit use. These factors together suggest that growth rates will not rise above current relatively low levels.

Obviously, attempts to quantify the future effects of competitive pressures on INTELSAT can only be speculative in light of the many uncertainties. Indeed, even without competitive pressures, attempts at traffic forecasting would be fraught with difficulties.

The estimates made by participants in INTELSAT's annual Global Traffic Meeting are a basic input into INTELSAT traffic forecasting. These estimates have been quite inaccurate, with a striking tendency to overestimate traffic growth. At least in part because of this poor forecasting record, the Director General also makes projections that serve as inputs into INTELSAT planning.

This study takes a different approach to considering alternative traffic projections in light of competitive pressures. It starts with the Comsat-AT&T agreement that will affect AT&T's relative use of cable and satellite circuits during the period 1988-1995. This agreement is very significant because AT&T is directly or indirectly involved in using about 40 percent of INTELSAT full-time voice-grade circuits, which

comprises about 32 percent of INTELSAT's total revenue. In doing so, I allow for specific constraints imposed on AT&T by the agreement. I use the AT&T agreement as the basis for estimating INTELSAT's worldwide traffic levels and revenues.

Under varying assumptions about traffic growth and tariff levels, I project revenues below those in INTELSAT's most recent forecast. One set of estimates, which is roughly in line with the growth rate of INTELSAT's full-time circuits in 1987, tracks fairly closely INTELSAT's future estimates for FM circuits, falls substantially below INTELSAT's forecast for digital circuits, and shows total revenues about 17 percent below INTELSAT's projections for 1995.

The results are particularly sensitive to assumptions about average per-circuit revenues. If cuts in INTELSAT tariffs of 10 to 20 percent below the levels assumed are necessary to maintain projected traffic levels, revenues would be further adversely affected.

In addition to full-time circuit use, including INTELSAT's International Business Services, I examine domestic leases, international video leases, occasional use video, and other services. With alternative assumptions about growth rates, my revenue projections remain below those of INTELSAT.

Of course, the results very much depend upon underlying assumptions. Other factors, not formally taken into account in my framework, could either increase or decrease revenues. For example, fiber optic cable and circuit multiplication equipment may not work as well as many expect for underseas use, at least during the early years. Technical problems might arise that could force AT&T to use a smaller portion of digital circuits, and with a lower circuit multiplication ratio, than is allowed in the Comsat-AT&T agreement. In this case, INTELSAT's revenues could rise substantially above my projected levels, and even above its own projected levels, during the next few years. But in 1992 or so when the TAT-9 cable is finished, technical problems may have been solved and revenues might then fall toward my projections.

In any event, the specific numbers in this Note are only illustrative. The most important contribution of this study is to construct a framework that (a) helps to identify and put into perspective the factors important to INTELSAT's financial future, and (b) permits readers to see the consequences of introducing their own assumptions about growth rates, average per-circuit revenues, and other key considerations.

Although its analysis is subject to many caveats, it suggests that under a wide range of plausible assumptions INTELSAT will face financial stress because of competitive pressures. The situation is likely to intensify after 1992 when (a) multiple fiber cables will cross both the Atlantic and Pacific, (b) whatever technical problems arise in early use of underseas fiber cables may be solved, and (c) large separate satellite systems may be operational.

In response, INTELSAT should abandon its global cost averaging as the basis for setting prices and move to more flexible pricing that takes into account competitive alternatives in particular ocean basins and routes. This restructuring of prices, however, raises three issues:

- INTELSAT's ability to price competitively without requiring modification of Article V(d) in the INTELSAT agreement that forbids price discrimination. While some leeway exists to pricing flexibly under Article V(d), it could pose a barrier to the degree of flexible pricing needed during the 1990s to adequately meet competitive pressures.
- The criteria that should be adopted for judging whether INTELSAT's prices are predatory or anticompetitive. Fully allocated cost criteria, urged by some as the appropriate floor to INTELSAT prices to prevent anticompetitive practices, should be abandoned in favor of incremental cost criteria.
- The effects on INTELSAT's members--largely developing countries--that have limited or no alternatives to INTELSAT service. INTELSAT can reduce the adverse distributional effects of competitive pricing on these countries by examining its other pricing policies and making necessary adjustments where these policies place an undue burden on them. The current pricing of circuit restoration services may be one example.

## ACKNOWLEDGMENTS

I deeply appreciate the help of individuals at INTELSAT, Comsat, and the U.S. Department of State, who gave generously of their time to answer questions and provide detailed information. RAND colleagues Simon Webb, Bridger M. Mitchell, and Jan Paul Acton provided helpful comments on an earlier draft. Dean Olmstead, with the Bureau of International Communications and Information Policy, U.S. Department of State, was the contracting officer's technical representative. His assistance throughout the study is gratefully acknowledged.

The usual disclaimer that the findings are not necessarily shared by sponsors or reviewers, and that the author bears full responsibility for errors of fact and interpretation, applies with particular force in this case, where the subject is so complex and controversial.

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# 1. INTRODUCTION

The International Telecommunications Satellite Organization (INTELSAT) is a nonprofit cooperative of more than 100 member states that invest in the "space segment" (the satellites and associated ground control facilities) in approximate proportion to their use of the system. INTELSAT launched its first satellite, "Early Bird," in 1965. Today, INTELSAT has a global network of 14 far more advanced satellites (covering the Atlantic, Pacific, and Indian Ocean regions) with about 1,750 pathways supplying telephone, data, and television services to about 170 countries and territories. The earth stations in these locations, constituting the "earth segment," are owned and operated by INTELSAT's Signatories or other entities. Except for a number of separate regional and transborder systems and the Soviet INTERSPUTNIK system, INTELSAT holds a monopoly in providing international satellite links.

Comsat is a private for-profit entity that serves as the U.S. Signatory to INTELSAT. It is the sole U.S. investor in the system and the monopoly supplier of INTELSAT circuits to U.S. international service carriers (ISCs) and to other U.S. users. As a private entity, Comsat is unique in that it was expressly established by an act of Congress and three of the 15 members of its board of directors are appointed by the President of the United States.

The purpose of this study is to project and assess possible financial futures faced by INTELSAT in an increasingly competitive environment, and to trace the implications for pricing strategies. Of central concern here is the potential impact to the end of the century of transoceanic fiber optic cables and of separate satellite systems.

Of course, there has always been a degree of competition between INTELSAT and (coaxial) cables--evidenced by endless controversy about whether carriers, especially AT&T, are "biased" toward cable, and by the history of facilities loading constraints that have been imposed by the Federal Communications Commission (FCC) on AT&T and other U.S. carriers.

But it is clear that INTELSAT faces a future very different from the past.

As examples, the transatlantic fiber optic TAT-8, to be completed perhaps in early 1989, will have a maximum theoretical capacity by itself about equal to total U.S.-CEPT voice-grade traffic estimated for 1990.[1] TAT-9, with twice the capacity of TAT-8, will follow in 1991 or 1992 and will be connected to fiber cables in the Mediterranean. The transatlantic "private" PTAT-1, under construction and scheduled for completion in 1989, will have a capacity at least as great as TAT-9. In the Pacific the HAW-4/TPC-3, to be completed in 1989 for service to Japan, is similar in design to TAT-8. The private North Pacific Cable is scheduled for completion in 1991 between the United States and Japan, with a spur to Alaska. There is talk of a second carrier-owned cable across the North Pacific in the early 1990s.[2] The transpacific cables will be connected with other fiber links to serve Korea, Hong Kong, Taiwan, the Philippines, and Guam.

These developments are of great significance, since they cover routes on which INTELSAT has the bulk of its traffic. At year-end 1987, 58 percent of INTELSAT's full-time active circuits for voice and data involved traffic between Canada/U.S. and CEPT countries and between Canada/U.S. and Japan/Hong Kong/Korea.[3]

[1]Traffic projection based on *Contribution of the United States, North Atlantic Consultative Working Group,* Quebec City, Canada, May 28-30, 1986, Table 6-1. CEPT is the Conference Europeenne des Administrations des Postes et des Telecommunications, an association of the PTTs in more than 20 West European nations.

[2]In response to these developments, the point is repeatedly made that cables and satellites are "complementary, not substitutes." This is true for routes where cable circuits are needed on one segment and satellite circuits are needed on another to provide end-to-end service. It is also true in that diversity and balance in routing and use of transmission media are needed to ensure reliable service. But as multiple cables emerge across the Atlantic and Pacific they will afford a range of balance and diversity among themselves, permitting carriers greater flexibility in choosing between cable and satellite circuits in meeting their requirements.

[3]Computed from data supplied by request from INTELSAT.

Competition from other satellite systems also is not new to INTELSAT. Transborder and regional systems carry traffic that, to a degree at least, could otherwise be handled by INTELSAT. But the emergence of large transoceanic satellite systems separate from INTELSAT poses a greater challenge. Although transborder and regional systems are, by and large, owned by the same carriers that participate in INTELSAT, these additional systems will be owned by outsiders. Moreover, they will offer direct transoceanic competition (limited by U.S. regulatory policy to traffic that does not feed into public switched networks), in contrast to the more geographically limited coverage of other systems. Pan American Satellite launched its first spacecraft in June 1988. Use of five of its 24 transponders for service with Latin America has been successfully consulted under Article XIV(d) of the INTELSAT Agreement as posing no "significant" economic harm to INTELSAT. Consultation procedures for six transponders (twelve 36 MHz equivalent) for transatlantic service were completed in the fall of 1988.

The larger Orion system is being proposed for service in the Atlantic Ocean region. Its total of 88 (36 MHz equivalent) transponders on two satellites planned for launch in 1991-1992 would amount to 42 percent of INTELSAT's current use in the Atlantic Ocean region of some 210 (36 MHz equivalent) transponders.[4]

Obviously, any attempt to quantify the effect of these and other developments on INTELSAT must be speculative and conjectural in light of the many uncertainties. Among them are:

- The prices and services offered by separate satellite systems as affected, for example, by their ability to reach operating agreements with telecommunications entities for end-to-end service, their investment and operating costs, their marketing skills, and their financial backing.

[4]This utilization level is reported by Comsat in its *Application* to the FCC for authority to participate in the INTELSAT VII program, July 12, 1988, p. 11. According to current plans, about 28 of Orion's transponders are to be reserved for domestic services.

- The ability of fiber optic cable to offer high-quality and reliable service in *transoceanic use,* where this technology is new and untried. In the early years, especially, the technology may suffer "teething" problems that could retard cable traffic growth and impose demands on INTELSAT for circuit restoration.
- The preferences of telecommunications customers for either satellite or cable circuits, taking into account the shorter transmission time delay and greater security from eavesdropping afforded by cable, the greater connectivity and opportunities for bypass afforded by satellites, and the differences in cost between cable and satellite circuits.
- The pricing and marketing strategies pursued by INTELSAT and its competitors, as affected in part by U.S. regulatory policies and the positions of INTELSAT Signatories.

Even without competitive pressures, attempts at traffic forecasting would be fraught with uncertainties. Among the key factors are the future "retail" prices set by carriers to their end users, and the response of customers to these prices. By determining overall traffic volume, these factors affect both cable and satellite use.

The estimates made by participants in INTELSAT's annual Global Traffic Meeting (GTM) are a basic input into traffic forecasting. These estimates have been quite inaccurate, with a striking tendency to overestimate traffic growth.[5]

At least in part because of this poor forecasting record, the Director General also makes projections that serve as inputs into INTELSAT's planning. These projections are generally much lower than those of the GTM. For example, the Director General estimates satellite use at year-end 1993 at only about 74 percent of the GTM forecast and at an even lower level--68 percent--at year-end 2000.[6]

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[5] A discussion of past discrepancies between projected and actual traffic levels is contained in Leland L. Johnson, *Excess Capacity in International Telecommunications: Poor Traffic Forecasting or What?* The RAND Corporation, N-2542-MF, November 1986.

[6] Comsat, *Application,* op. cit., Figs. 2 and 3. It would be useful

In neither projection is it clear how mounting competitive pressures are taken into account. Indeed, in Comsat's application to the FCC for authorization to participate in the INTELSAT VII program, there is not a word about how these traffic projections, and hence the use of the INTELSAT VIIs and earlier satellites, have been adjusted to account for competing cable and satellite systems.

This study takes a different approach to considering alternative traffic projections in light of competitive pressures. It starts with the Comsat-AT&T agreement on AT&T's use of cable and satellite circuits during the six-year period 1988-1994. This agreement is very significant for several reasons:

- AT&T is a key player, since it directly uses about 20 percent of INTELSAT's half-circuits. Together with its foreign correspondents (who necessarily use another 20 percent in conjunction with AT&T) AT&T is involved in about 40 percent of INTELSAT's "full-time" circuits, which are used for voice and data. Other major U.S. users include MCI International and US Sprint, which compete with AT&T for telephone traffic; the record carriers, which provide telex and telegraph service; and television networks and other users of video service.
- INTELSAT's revenues for full-time service constitute the bulk of its total revenues. In 1987, they ran to about 82 percent of total revenues, shown in Table 1, compared to 85 percent in both 1981 and 1977.[7] Thus, AT&T is responsible directly or indirectly for about 32 percent of INTELSAT's revenues.
- The agreement clarifies, for AT&T at least, the proportionate future use of analog (FM) and digital services and the maximum allowable circuit multiplication applied to digital channels. The recent introduction of digital bearer channels with circuit

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here to discuss in some detail INTELSAT's forecasting methodologies and data sources, including an analysis of why the Director General's forecasts fall below those of the GTM. However, it seems that no concise description of these techniques exists at INTELSAT.

[7]Figures taken from *INTELSAT Annual Reports*.

Table 1

INTELSAT SERVICES AND REVENUES 1987

| Service | Revenue ($ Millions) | % of Total |
|---|---|---|
| Full-time voice and data | 427.1 | 82.3 |
| Domestic leases | 21.3 | 4.1 |
| International video leases | 17.1 | 3.3 |
| Occasional use video | 24.8 | 4.8 |
| Other revenues | 28.5 | 5.5 |
| Totals | 519.0 | 100.0 |

SOURCE: *INTELSAT Report 1987-1988*, Washington, D.C., p. 38.

multiplication equipment (CME) permits a number of "derived" channels to work on a single bearer channel, depending on the mix of data and voice and other traffic characteristics. INTELSAT's future voice and data revenues depend critically on (a) the speed with which carriers shift from analog to digital service, (b) the speed with which they install and use CME, and (c) the level of the multiplication ratio in practice. By establishing these parameters for AT&T, the Comsat-AT&T agreement provides guidance in estimating future global traffic levels.

The role of the Comsat-AT&T agreement can best be assessed by considering it within the broader context of INTELSAT's full-time service. Section II focuses on this service by (a) describing its components and their vulnerability to competition, (b) discussing major factors that have affected its growth rate, (c) describing the Comsat-AT&T agreement, and (d) making traffic projections based on the agreement.

Section III describes other major INTELSAT services, and makes projections based on assumptions about traffic growth in light of competitive pressures.

Section IV brings the preceding forecasts together into overall INTELSAT revenue projections to the year 2000, with varying assumptions to test the sensitivity of the results. It compares these results with the most recent INTELSAT traffic and revenue projections available at the time of this writing. More important than the specific estimates, however, is the framework that this study provides, within which readers can easily introduce their own assumptions to determine how outcomes vary.

Section V sketches the implications of the above for future INTELSAT pricing in a competitive environment.

Section VI brings together major conclusions.

## II. FULL-TIME VOICE-GRADE CIRCUITS

The major components of this category are (a) analog (FM) and digital channels for switched public and for private line service primarily with use of "Standard A" and other relatively large earth stations, and (b) "International Business Service" (IBS) introduced in 1984 to provide private data, voice, and videoconferencing links into relatively small earth stations located on or near customer premises.

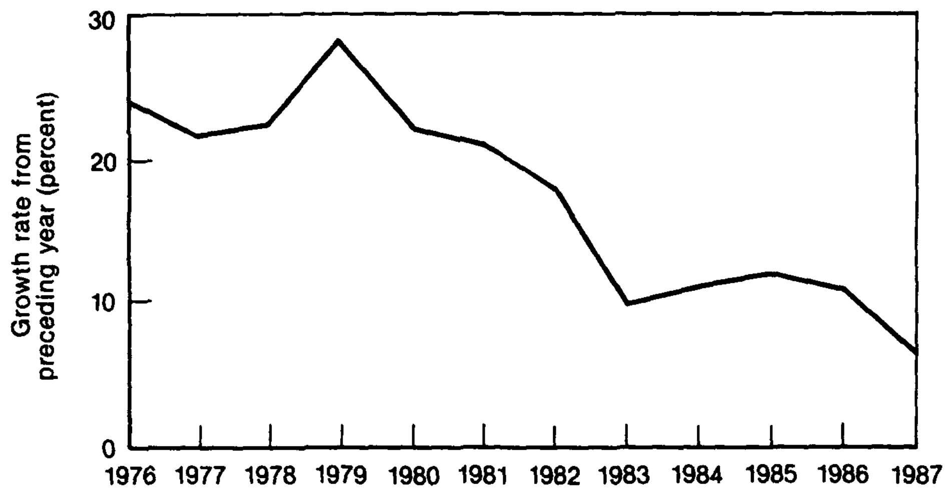
Full-time service generates the bulk of INTELSAT's revenues, accounting for 82 percent of the total in 1987, of which 69 percent was analog (FM) and 13 percent was digital service.[1] Despite the growth of INTELSAT's other services, the percentage attributable to full-time voice and data service in 1987 was even higher than the 81 percent recorded in 1986 and 79 percent in 1985.

### ANNUAL GROWTH RATES

Although this component as a percentage of INTELSAT revenues has risen slightly in recent years, its annual growth rate has declined substantially since the late 1970s, shown in Fig. 1. The rate fell from the mid-20s at the turn of the decade to only 7 percent during 1987, resulting in 96,074 half-circuits in use at year-end 1987. Moreover, the growth rate without IBS was only about 5 percent for 1987.[2] These figures show that a large portion of INTELSAT's total revenue is for service whose rate of growth has been declining, raising questions about the implications for future revenues.

We must immediately note, however, that although growth rates have been declining during the period shown in Fig. 1, more recently they have taken a spurt upward. In just the six months ending June 30, 1988,

[1]*INTELSAT Report 1987-1988*, Washington, D.C., p. 38.
[2]IBS is a rapidly growing new service that accounted for 1,556 and 3,646 half-circuits at year-end 1986 and 1987, respectively. The 3,645 half-circuits amounted to about 4 percent of the total of 96,074 half-circuits at year-end 1987.




SOURCE: Computed from traffic data in *INTELSAT Report*, various issues.

Fig. 1—INTELSAT full-time voice-grade circuits: global annual growth rate, 1976-1987

full-time traffic including IBS grew at an annual rate of 22 percent (from 96,074 to 105,795 half-circuits).[3] This growth is attributable in part to delays in completion of TAT-8. Once the cable is completed and operating satisfactorily, I conjecture that a short-term but abrupt shift from satellite to cable will occur, with carriers terminating whatever month-to-month contracts they have for INTELSAT circuits to load TAT-8.[4] If so, INTELSAT may experience a reduced growth rate for some months after TAT-8 is on line, so that the long-term growth rate will remain in the single digit range.

[3]Data from interviews with INTELSAT staff.

[4]Note that carriers will have strong incentives to load TAT-8 because the marginal cost is near zero for activating channels on cable capacity already purchased, but their marginal cost for satellite channels will remain equal to INTELSAT's utilization charge. Suppose that to ensure service reliability, a carrier follows the rule of not placing more than 30 percent of its traffic on a single cable. If so, it would hasten the shift from INTELSAT to TAT-8 either until it reaches the 30 percent allocation or until it runs out of cable capacity.

Accordingly, it is important to inquire into the possible reasons for the overall decline in the growth rate of full-time circuits. I consider (a) the increase over time in the traffic base on which percentage changes are computed, (b) the role of direct distance dialing, (c) increased competition from cable, (d) retail or end-user price reductions, and (e) the increased efficiency of circuit use.

## The Expansion of Traffic Base

In telecommunications, as elsewhere, it is generally unrealistic to expect continuous high compound rates of growth indefinitely. Early in the life of a new service (IBS, for example) annual growth rates can be quite impressive, since the base on which percentage changes are computed is very small.[5] But as growth continues and the traffic base expands, the volume of *new* traffic must expand at the same rate if a constant overall percentage growth rate is to be maintained. Generally, such expansion of new traffic becomes increasingly difficult to achieve so that the growth rate eventually falls and the market is said to be "mature."

Although this is a simple point, it is surprising how often forecasters, bemused by the impressive results of high compound growth rates, project unrealistic figures into the future. Tendencies to project from past experience, including the possible failure to foresee the decline in growth rates from double digit to single digit levels illustrated in Fig. 1, probably played at least a part in past overestimates of demand for INTELSAT circuits. Because of the "traffic base" effect alone, the question arises as to whether even the relatively low 7 percent growth rate recorded in 1987 will be maintainable to the end of the century.

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[5]Similarly, the observation in *INTELSAT Report 1987-1988*, p. 2, that the level of full-time traffic carried at year-end 1987 represents "an almost 700 fold increase over the 150 channels carried at year end 1965" has little meaning because the figure of 150 is so small.

### Direct Distance Dialing

The introduction and growth of direct distance dialing has been an important factor in stimulating the demand for international telephone service. For the United States, Table 2 shows that outbound direct distance dialing grew rapidly from 1980 to 1982 and that direct dialed inbound traffic increased steadily over the period from 1974. The particularly rapid increase in outbound direct dial calls from the United States may have helped keep the growth rate in INTELSAT traffic from falling more rapidly than it did during 1980-1982. By 1983, however, the U.S. direct dial market was mature, as suggested by the small amount of additional growth from 1982 to 1984 in Table 2. Thus, direct dial service had become a less important factor in simulating the growth of overall international traffic--and the growth of INTELSAT service--since about 1982.[6]

Table 2

INTERNATIONAL DIRECT DISTANCE DIALING AS A PERCENTAGE OF U.S. OUTBOUND AND INBOUND CALLS

| | 1974 | 1980 | 1981 | 1982 | 1983 | 1984 |
|---|---|---|---|---|---|---|
| Outbound | 9.8 | 17.4 | 66.9 | 71.9 | 71.9 | 72.8 |
| Inbound | 16.5 | 26.9 | 39.3 | 57.5 | 64.9 | 63.7 |

SOURCE: FCC, Industry Analysis Division, Common Carrier Bureau, unpublished data.

[6] To assess more adequately the impact of direct distance dialing on use of INTELSAT, it would be useful to have traffic figures for country pairs in addition to those involving the United States. Unfortunately, the data are not readily available.

## Increased Competition from Cable

During the period covered in Fig. 1, and previously, successive generations of cables were installed with progressively higher capacity and lower per-circuit cost. Although INTELSAT satellite circuit charges were also decreasing, reflecting technological advance, the satellite utilization charge, which had fallen rapidly during the 1970s, tapered off after 1980. The monthly half-circuit charge of $390 established in 1981 remained constant until it was reduced slightly in 1987 to $370 for service under five-year contracts. Increasing pressure from cable may have contributed to the decline in the percentage growth rate of traffic from 1979 to 1983, and the introduction of TAT-7 in 1983 may have contributed to keeping the growth rate in the relatively low 10 percent region.

Despite the introduction of fiber optic technology, some studies suggest that, on a per-circuit basis, satellites will be cheaper than cable into the foreseeable future.[7] However, differences between the cost of satellite and cable circuits will probably be of declining importance as determinants of demand. Both cable and satellite circuits will be much less expensive during the 1990s than previously, and the per-circuit difference in dollar cost is likely to be low. Of greater importance than relative transoceanic circuit costs will be service quality and related considerations. Thus, users will ask whether cable is superior to satellite for specified applications because of cable's shorter transmission time delay and lower vulnerability to eavesdropping. They will also ask about the superiority of satellites in providing greater access flexibility and network connectivity. Differences in cost will likely play an increasingly minor role in their decisions.

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[7] See, for example, Bruno Miglio, *Satellites and Fiber Optics in the Pacific Region,* Hughes Aircraft Company, Los Angeles, CA, October 1987.

## Retail Price Changes

As noted above, the retail prices charged by carriers to their customers affect the use of both cable and satellite circuits. Because the cost of a satellite circuit is only a small part of this retail price,[8] a given percentage change in the retail price has a greater effect on total traffic than would the same percentage change in the cost of a satellite or a cable circuit to the carrier. Moreover, because the international market appears to exhibit relatively high price elasticities of demand, at least for calls originating in the United States, changes in retail prices have a substantial effect on overall traffic volumes.

Rates in real terms between the United States and the United Kingdom and from the United States to Western Europe fell dramatically in the early 1980s. But smaller reductions have been recorded since that time. Figure 2 shows the rate charged (a) by AT&T to the United Kingdom, (b) by AT&T to most West European countries, and (c) by British Telcom to the United States. The rates between the United States and the United Kingdom are particularly significant because telephone traffic in minutes between these two countries constitutes about 30 percent of the total between the United States and all of Europe, including the Eastern Bloc.[9]

The large price cuts shown in Fig. 2 may have helped to keep the INTELSAT traffic growth rate relatively high through the early part of the decade, and a tapering off of these reductions may have contributed to INTELSAT's lower growth rate after 1983.

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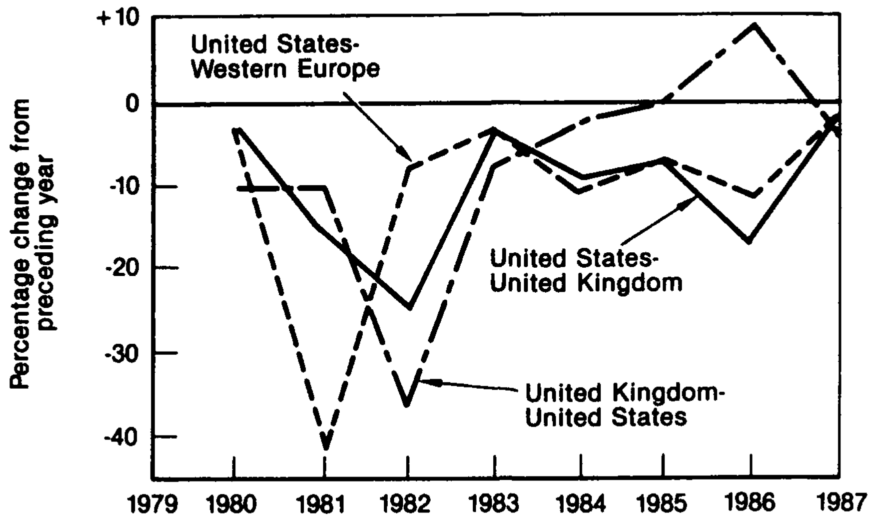
[8]If we assume that a circuit has an average loading of 15 percent, the cost per minute of circuit use (based on an INTELSAT monthly charge of $780) would run to about $0.12. This is about 10 percent of the $1.16 average revenue per minute recorded for U.S. outbound international telephone calls in 1987 (FCC, *Trends in the International Communications Industry,* 1985-1987, Industry Analysis Division, Common Carrier Bureau, Washington, D.C., October 1988, p. 12).

[9]FCC, *International Communications Traffic Data Report for 1987,* Industry Analysis Division, Common Carrier Bureau, Washington, D.C., October 1988, p. 26.




SOURCE: *Eurodata Foundation Yearbook*, National GDP deflators.

NOTE: Figures are for direct dialed, standard rate, each additional minute.

**Fig. 2—Annual percentage changes in real tariffs**

The future trend of retail charges is unclear. Surely they will continue to fall, at least in real terms, and stimulate traffic growth. But we do not know whether that stimulus would be as strong in the future as previously. Suffice it to say that future retail prices constitute one of the most important uncertainties that traffic forecasts face.

## Increased Efficiency of Circuit Use

The limited available evidence suggests that--at least for traffic involving the United States--the growth in number of telephone message minutes has been faster than the growth in the use of INTELSAT circuits or in the capacity available in underseas cable. Telephone traffic between the United States and 10 European countries rose from 194 million minutes in 1975 to 1,536 million minutes in 1986--an increase by a factor of nearly 8.[10] In comparison INTELSAT half-circuit use in the

[10]FCC, *International Message Telephone Service Between the United States and Selected Countries,* Industry Analysis Division, Common Carrier Bureau, Washington, D.C., November 1987. These countries are the United Kingdom, Federal Republic of Germany, France, Italy, Greece, Switzerland, The Netherlands, Belgium, Spain, and Israel.

Atlantic Ocean region rose from 8,862 in 1975 to 56,168 in 1987--an increase by a factor of only about 6.3. Furthermore, as shown in Table 3 the increase in circuit capacity on transatlantic cables grew from 3,259 in 1975 to 11,435 in 1986--a factor of only about 3.5.[11] The figures in Table 3 do not include the use of Time Assigned Speech Interpolation (TASI), which permits about two voice channels to be derived from each basic channel. But even if all the channels shown for 1986 were equipped with TASI, the increase in total channels would fall short of the growth in message minutes.

Table 3

NORTH ATLANTIC CABLE CAPACITY

| | | Voice Grade Circuits | |
|---|---|---|---|
| Cable | Year Completed | 1975 | 1986 |
| TAT-1 | 1956 | 96 | -- |
| TAT-2 | 1959 | 122 | -- |
| TAT-3 | 1963 | 138 | 212 |
| TAT-4 | 1965 | 128 | 138 |
| TAT-5 | 1970 | 845 | 845 |
| TAT-6 | 1976 | -- | 4000 |
| TAT-7 | 1983 | -- | 4200 |
| CANTAT-1 | 1961 | 80 | -- |
| CANTAT-2 | 1974 | 1840 | 1840 |
| Totals | | 3259 | 11435 |

SOURCE: National Telecommunications and Information Administration, 1984 *World's Submarine Telephone Cable Systems,* Washington, D.C., November 1984.

[11]To make the comparison more accurate we should use data on actual cable circuit use which, unfortunately, are not available. But the data on cable capacities can be taken as a rough proxy if we assume that the percentage of cable loading in 1975 did not differ markedly from that in 1986. The analysis would also be more accurate if comparisons were made with the growth of INTELSAT service across the North Atlantic, rather than the overall growth in the Atlantic Ocean region. These data are not available at this time.

This evidence suggests the not surprising possibility that both cable and satellite circuits are being used more intensively nowadays than was true in the mid-1970s. At least three reasons can be adduced for this phenomenon.

**Off-Peak Retail Pricing.** First, some countries--most notably the United States and the United Kingdom--have adopted low nighttime rates, in addition to evening and day rates for telephone service.[12] Such off-peak rates generate traffic during times that capacity would otherwise lie idle, contributing to traffic flows and revenues without requiring use of additional satellite and cable circuits. This factor is especially notable because we can expect other countries to move progressively to off-peak prices to use capacity more efficiently. As this occurs, growth in message minutes will continue to outpace the growth in circuit use.

**Composition of Traffic.** The nature of traffic carried on these circuits may play an important role. For example, the volume of facsimile traffic is growing rapidly because of the worldwide proliferation of low cost, compatible facsimile machines. The ease with which facsimile copy can be sent by simply dialing a telephone number obviously has great appeal. Moreover, modern machines can transmit a page in about 20 seconds, compared to two or more minutes in earlier years--reducing the demand for telephone circuits for a given level of information transfer. Of course, this reduction in demand may be at least partially offset by the increase in circuit use induced by the reduced cost of information transfer.

Much facsimile traffic can be carried during off-peak hours thereby making more efficient use of existing cable and satellite circuits. The development of facsimile machines that can operate unattended, combined with time zone differences that in any event restrict the overlap in business hours, make off-peak use attractive. Introduction of off-peak telephone rates further stimulates off-peak use.

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[12]AT&T adopted nighttime rates to most European countries in 1983 after adopting them to the United Kingdom in 1982.

The situation is similar for much of the communications between computers. A good deal of file transfer, electronic mail, and other data communications can be accommodated during off-peak hours, especially when there is little business-day overlap. The rapid continuing growth expected in data communications will cause further disparities between the growth of overall traffic and the number of circuits used.

**Circuit Multiplication.** For satellites, another factor just now emerging is the use of bearer circuits to provide several derived circuits, thereby multiplying the traffic-handling capacity of a bearer circuit. Digital bearer circuits used for circuit multiplication--Intermediate Data Rate (IDR) and Time Division Multiple Access (TDMA)--accounted for only about 7 percent of the 96,074 half-circuits in use at year-end 1987. But their use is expected to grow (especially IDR) so that INTELSAT estimates that these two categories will constitute about 50 percent of total circuits in use by year-end 1997.[13]

The last few years shown in Fig. 1 may reflect the early effects of circuit multiplication on digital bearer channels.[14] As AT&T and other carriers derive an increasing number of channels from their bearer channels, their demand for bearer channels will fall. The growth in derived circuit traffic may partially explain the reduction in growth to 5 percent (excluding IBS) shown in Fig. 1. This factor, of course, will be far more important in the future as carriers convert from analog to digital circuits.

The shift toward digital circuits and CME parallels the development of digital fiber optic cable where circuit multiplication will also be used. By encouraging the shift to digital and circuit multiplication for satellites, INTELSAT hopes to remain competitive with cable.

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[13]*Supporting Information for Revenues for 1988 Budget, 1988-1992 Five-Year Financial Plan and Longer-Term Financial Projections*, BG/BC-WD-32-1E, 23 November 1987 (INTELSAT Restricted).

[14]Data on the number of channels now being derived from bearer circuits are unavailable, because INTELSAT cannot easily determine how customers are using their bearer channels. IDR offers the digital equivalent of analog FDM/FM service. IDR circuits provide integrated, digital communications with ISDN-quality performance standards.

This shift toward digital circuits and CME has pressing financial implications for INTELSAT. Today an FM half-circuit on a Standard A earth station is priced at $370 monthly under a five-year contract, in comparison with $450 for an IDR half-circuit. If CME permits a multiplication factor of four, for example, a single $450 IDR half-circuit can be substituted for four FM circuits that otherwise would have generated $1,480 in INTELSAT revenues. Thus, INTELSAT would suffer a monthly revenue loss of over $1,000. Of course, if these price reductions stimulate traffic growth the net loss would be reduced.

Thus, two factors are working above, both of which would tend to reduce INTELSAT revenues: (a) the use of derived circuits or bearer circuits, reducing the number of (bearer) circuits on which INTELSAT earns revenues, and (b) the greater loading on *all* circuits, including derived circuits, because of off-peak pricing and changes in traffic composition, further reducing circuit demand.

### Worldwide Business Conditions

It is reasonable to believe that the level of global economic growth affects the demand for INTELSAT service. The years of reduced growth for full-time service--after 1983 as shown in Fig. 1--have covered a period of relative economic prosperity for the United States and many other countries. A fall in economic growth would be another factor that would tend to drive down the growth in full-time service below the relatively low levels of recent years. Because it is very difficult, if not impossible, to predict the course of future economic growth, no attempt is made in this study to take this factor into account.

## THE COMSAT-AT&T AGREEMENT

As noted above, this agreement is of great significance for INTELSAT because it delineates AT&T use of digital bearer circuits with CME, in relation to analog circuits. The agreement marks the culmination of years of controversy between AT&T and Comsat about the FCC regulatory constraints, if any, that should be imposed to require

AT&T to place specified minimum percentages of its traffic on satellites. Dating from Comsat's earliest years, the FCC had required AT&T (because of its alleged "bias" toward cable) to place specified portions of its traffic on INTELSAT in accordance with particular facilities loading formulas. Over the North Atlantic these formulas resulted in roughly a 50:50 split between satellite and cable. In response to an FCC proposal in 1987 to phase out these loading guidelines, as part of its overall push toward deregulation, AT&T and Comsat came to agreement. In return for assurances to Comsat that AT&T will assign specified minimum portions of its traffic to satellites, and will place its IDR bearer circuits under 10-year contracts, Comsat has committed itself to relatively low 10-year IDR tariffs--$875 in 1988, falling to $825 in 1993 and to $800 in 1994. These tariffs are fixed regardless of inflation or the prices charged by INTELSAT to Comsat (and other INTELSAT members) for these channels.[15] The agreement was originally intended to become effective at the beginning of 1988 and to run through 1994, with its 10-year effects reaching out to the year 2004. But because AT&T's use of satellite circuits had not yet reached the specified level required to trigger the agreement, its effective date was moved to July 1, 1988, and its end date to June 30, 1995. Limited to international message telephone service, the agreement does not cover IBS, which is discussed separately below.

The nature of the agreement, and my projections based on it, are fairly straightforward. In Table 4, line 5 shows 20,099 AT&T circuits on INTELSAT in (mid) 1988--the number stipulated that would trigger the effective date of the agreement. The parties assumed that AT&T's total use of both satellite and cable circuits would amount to about 32,915 at the time the agreement was to become effective, shown on line 1.

Let us assume as "Case 1" that AT&T's circuit use grows by 10.5 percent annually during the entire period shown in Table 4 so that in the year 2000 the total figure would be 109,080. (Other cases are considered in Sec. IV.) This projection is roughly consistent with that included by Comsat in its analysis of circuit-use projections in a 1987

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[15]These prices are higher than INTELSAT's $450 IDR rate noted above, reflecting Comsat's markup to its customers such as AT&T.

[16]Comments of Communications Satellite Corporation, CC docket No. 87-67, June 1, 1987.

Table 4

PROJECTIONS FROM AT&T-COMSAT AGREEMENT: CASE 1

| | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Assumed total AT&T voice-grade circuits | 32915 | 36371 | 40190 | 44410 | 49073 | 54226 | 59920 | 66212 | 73164 | 80846 | 89335 | 98715 | 109080 |
| 2. Increase in number of voice-grade circuits | | 3456 | 3819 | 4220 | 4663 | 5153 | 5694 | 6292 | 6952 | 7682 | 8489 | 9380 | 10365 |
| 3. Percent of additional circuits on INTELSAT (Article V-A) | | 55 | 20 | 45 | 35 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| 4. Number of additional circuits on INTELSAT (line 3 times 2) | | 1901 | 764 | 1899 | 1632 | 1546 | 1708 | 1888 | 2086 | 2305 | 2547 | 2814 | 3110 |
| 5. Total circuits on INTELSAT (line 4 plus line 5 for preceding year) | 20099 | 22000 | 22764 | 24663 | 26295 | 27841 | 29549 | 31437 | 33523 | 35828 | 38375 | 41189 | 44299 |
| 6. Percent of INTELSAT circuits on digital circuits (Article VI-A) | | 36.42 | 61.23 | 68.15 | 70.18 | 76.04 | 82.66 | 83.33 | 83.33 | 83.33 | 83.33 | 83.33 | 83.33 |
| 7. Percent of INTELSAT circuits on FM circuits (100%-line 6) | | 63.58 | 38.77 | 31.85 | 29.82 | 23.96 | 17.34 | 16.67 | 16.67 | 16.67 | 16.67 | 16.67 | 16.67 |
| 8. Number of FM circuits (line 5 times line 7) | | 13988 | 8826 | 7855 | 7841 | 6671 | 5124 | 5241 | 5588 | 5973 | 6397 | 6866 | 7385 |
| 9. Number of digital circuits (line 5 times line 6) | | 8012 | 13938 | 16808 | 18454 | 21170 | 24425 | 26196 | 27935 | 29855 | 31978 | 34323 | 36914 |
| 10. Digital efficiency factor (Article VI-C) | | 3.96 | 4.12 | 4.29 | 4.26 | 4.27 | 4.28 | 4.29 | 4.29 | 4.29 | 4.29 | 4.29 | 4.29 |
| 11. Number of digital circuits (line 9 divided by line 10) | | 2023 | 3383 | 3918 | 4332 | 4958 | 5707 | 6106 | 6512 | 6959 | 7454 | 8001 | 8605 |

SOURCE: Agreement between Comsat and AT&T, October 8, 1987, revised May 16, 1988 (mimeo).
Item 1--10.5 percent annual growth rate assumed throughout.

NOTE: All figures are shown at mid-year. Circuits shown are half-circuits.

FCC filing.[16] The projection is also consistent with the growth rate estimated by AT&T during the period 1986-1991 for U.S.-CEPT traffic.[17] The percentage of circuit growth to be allocated to satellites, shown in line 3, is given by Article V-A of the agreement. The minimum allocation to satellite is specified at 55 percent between mid-1988 and mid-1989, falling to 30 percent by mid-1995 at the time the agreement is to expire.[18] Critical to my analysis is the assumption that the agreement will be extended to the year 2000 under the same constraints (shown on lines 3, 6, 7, and 10) that were in force in mid-1995. Thus, for example, I project the 30 percent figure in line 3 out to the year 2000. The consequences of relaxing this assumption are discussed in Sec. IV.

The number of "growth" or additional circuits, and the total number of circuits, on satellites are shown respectively on lines 4 and 5. A critical factor is the percentage of satellite circuits to be carried on digital circuits--a factor that affects the speed with which AT&T may convert from FM to digital circuits. The agreement stipulates a maximum of 36.42 percent level by the end of the first year, rising to 83.33 percent in 1995, shown on line 6. Given the split between FM and digital circuits shown on lines 6 and 7, the numbers of FM circuits and circuits derived from digital circuits are shown on lines 8 and 9.

Another critical consideration is the multiplication factor from bearer to derived circuits, depending on the installation and use of CME. This multiplication is stipulated in the agreement at a maximum of 3.96 in the first year and rising to 4.29 in the last, shown on line 10. Finally, the number of digital circuits rises from 2,023 at mid-1989 to 8,605 at mid-2000 shown on line 11.

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[17]Information filed by AT&T in FCC CC docket No. 87-67, May 11, 1987.

[18]The reduction in growth traffic allocated to INTELSAT in 1990--amounting only to 20 percent--reflects the flexibility that AT&T has to load TAT-8 and TPC-3 in their early operation.

Table 5

TOTAL INTELSAT HALF-CIRCUITS MID-YEAR 1989-2000: CASE 1

| | | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | AT&T Total | 22000 | 22764 | 24663 | 26295 | 27841 | 29549 | 31437 | 33523 | 35828 | 38375 | 41189 | 44299 |
| 2. | FM | 13988 | 8826 | 7855 | 7841 | 6671 | 5124 | 5241 | 5588 | 5973 | 6397 | 6866 | 7385 |
| 3. | Digital | 2023 | 3383 | 3918 | 4332 | 4958 | 5707 | 6106 | 6512 | 6959 | 7454 | 8001 | 8605 |
| 4. | AT&T-Foreign | 44000 | 45528 | 49326 | 52590 | 55682 | 59098 | 62874 | 67046 | 71656 | 76750 | 82378 | 88598 |
| 5. | FM | 27976 | 17652 | 15710 | 15682 | 13342 | 10248 | 10482 | 11176 | 11946 | 12794 | 13732 | 14770 |
| 6. | Digital | 4046 | 6766 | 7836 | 8664 | 9916 | 11414 | 12212 | 13024 | 13918 | 14908 | 16002 | 17210 |
| 7. | Total World (AT&T = 40%) | 110000 | 113820 | 123315 | 131475 | 139205 | 147745 | 157185 | 167615 | 179140 | 191875 | 205945 | 221495 |
| 8. | FM | 69940 | 44130 | 39275 | 39205 | 33355 | 25620 | 26205 | 27940 | 29865 | 31985 | 34330 | 36925 |
| 9. | Digital | 10115 | 16915 | 19590 | 21660 | 24790 | 28535 | 30505 | 32560 | 34795 | 37270 | 40005 | 43025 |
| 10. | Totals | 80055 | 61045 | 58865 | 60865 | 55675 | 54155 | 56710 | 60500 | 64660 | 69255 | 74335 | 79950 |

Table 5 recapitulates from Table 4 the AT&T satellite circuit totals (including derived circuits), divided into FM and digital circuits, on lines 1-3. Since AT&T's half-circuits must be connected to the half-circuits of its foreign correspondents for end-to-end service, these totals are doubled, shown on lines 4-6. Now let us assume that AT&Ts share of INTELSAT circuits, along with its correspondents' share, remains constant at 40 percent throughout the period. This assumption, along with an AT&T growth rate of 10.5 percent, is consistent with any of three scenarios:

1. Traffic in the rest of the world grows at the same rate, with other carriers shifting to digital on cable and satellite and using CME at the same rate as AT&T so that AT&T's share of INTELSAT use remains constant.
2. Traffic in the rest of the world grows at a faster rate, so that AT&T loses world market share (perhaps because of competition), for cable and satellite circuits combined; but other carriers shift even faster to digital and CME because they are not constrained by the Comsat-AT&T agreement, so that AT&T's share of INTELSAT use remains constant.
3. Traffic in the rest of the world grows at a slower rate, so that AT&T gains world market share, but a slower shift of other carriers to digital and CME keeps AT&T's share of INTELSAT use constant.[19]

[19]One might argue that AT&T's share of INTELSAT use would fall in these scenarios because many non-AT&T routes are thin and therefore less suitable for CME than are AT&T's high-density routes. If so, the use of digital circuits and circuit multiplication factors would be less for these other carriers than otherwise, so that their share of INTELSAT circuits to support a given level of traffic might rise relative to AT&T's. With a fall in AT&T's share, the figures on lines 7, 8, and 10 would rise, with a consequent *increase* in projected INTELSAT revenues. However, multiple destination CME has been developed such that up to four destinations can be connected from a major communications point. Thus, for example, CME might be installed in Buenos Aires for thin routes to four destinations in Africa.

With this assumption of constant INTELSAT share, total world use of INTELSAT circuits--including circuits derived from bearer circuits--is shown on line 7. The split between FM and digital circuits is shown on lines 8 and 9, with totals on line 10. Lines 8 and 9 are critical, for these are the circuits that generate revenues for INTELSAT. By multiplying these numbers by average per-circuit revenues, I project INTELSAT revenues to the year 2000 for FM and digital services, as discussed in Sec. IV.

Three characteristics of lines 7 through 10 are notable. First, total world use of INTELSAT circuits, including derived circuits, shows an annual growth of about 7 percent. This is roughly the same growth rate as for 1987, show in Fig. 1. Because of the considerations previously mentioned that may tend to force the growth rate of circuit use downward--especially increased efficiency of circuit use with more widespread adoption of off-peak retail prices--a projected growth rate of 7 percent may be, if anything, on the optimistic side.

Second, the results depend critically on my assumption about AT&T's constant share of INTELSAT full-time circuit use. Were AT&T's and its correspondents' share to fall, say, to 35 percent by 1995, total world use of circuits shown on line 7 would rise to 179,640--an increase of 14 percent over the figure of 157,185 shown.[20]

Third, it is instructive to compare the figures on lines 8 (FM-Case 1) and 9 (FM-Case 2) with those projected by INTELSAT, shown in Fig. 3. The FM estimates track fairly closely, but INTELSAT's estimates for digital are substantially higher than those in this study for all years. The reason for the discrepancy is not clear, although such a discrepancy is perhaps not surprising. My estimates flow from the Comsat-AT&T agreement and, as mentioned above, INTELSAT's are based on the GTM as adjusted by the Director General.

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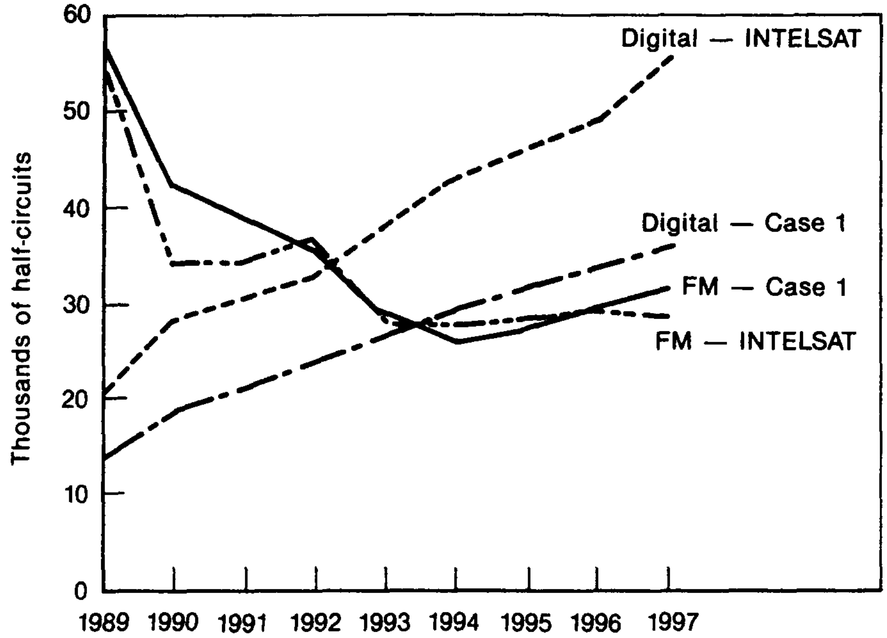
[20]AT&T's share has remained nearly constant in recent years, running to 18 percent in 1984, 19 percent in 1985 and 1986, and 20 percent in 1987. Data from AT&T year-end circuit-use figures are on file with the FCC.




SOURCES: Text and *INTELSAT Supporting Information*, op. cit.

Fig. 3—Year-end estimated use of INTELSAT circuits

Especially notable, however, is that the INTELSAT forecasts in Fig. 3, current in November 1987, differ markedly from its forecasts that were current in August 1987--only a few months earlier. The forecasts in Fig. 3 are shown as the "later" forecasts in Table 6, along with the "early" forecasts. The differences shown for the last years in Table 6 are understandable in light of the highly conjectural nature of any long-term forecast. But the greatest discrepancy is for 1989, where the later forecast shows more than twice as many FM circuits. The large revision for 1989 apparently reflects a disagreement between the Board of Governors and the Director General about how much the 1987 GTM forecasts should be discounted. Specifically, the Board of Governors noted that "...the Director General's generally optimistic expectations in relation to the introduction of IDR and the penetration of CME were

Table 6

CHANGES IN INTELSAT CIRCUIT FORECASTS

(Thousands of Half-Circuits, Year-End)

| | 1989 | 1991 | 1993 | 1995 | 1997 |
|---|---|---|---|---|---|
| FM-early forecast | 27.2 | 28.8 | 29.1 | 31.4 | 34.9 |
| FM-later forecast | 55.7 | 34.4 | 27.4 | 28.1 | 28.4 |
| Digital-early forecast | 29.2 | 40.0 | 34.8 | 40.1 | 46.4 |
| Digital-later forecast | 20.9 | 30.0 | 37.9 | 46.6 | 55.7 |

SOURCES: *Traffic Forecast Analysis,* BG-73-63E W/9/87, BG/PC-37-13E W/9/87, 21 August 1987, Attachment 1 (INTELSAT Restricted); and *Supporting Information,* 23 Novembei 1987, op. cit.

unlikely to materialize in the 1988-1990 timeframe."[21] Interestingly, however, even the more "pessimistic" expectations of the Board of Governors leads to a *higher* number of digital channels (including IDR), shown in Fig. 3, than do my projections. All this reinforces the dictum that all such forecasts--mine included--must be treated with great caution.

## INTERNATIONAL BUSINESS SERVICE

IBS must be treated separately, since it is not included in the Comsat-AT&T agreement. As noted above, this service, introduced in 1984, has been growing rapidly. From 14 half-circuits at year-end 1984, the service grew to 3,646 half-circuits by year-end 1987. Despite the rapid growth it still comprises only about 4 percent of INTELSAT's revenue from full-time voice-grade service.

Projecting the growth of IBS is especially difficult for two reasons. First, the embryonic nature of the service, with high initial growth rates, provides little basis for long-term projections. Second, IBS is particularly vulnerable to competition from separate satellite systems. Although these systems are (currently) prohibited from offering switched services as a matter of U.S. government policy, they are free to offer services comparable to IBS. Indeed, a basic rationale

[21] *Supporting Information,* op. cit., p. 1.

for the FCC's approving the entry of separate systems was to stimulate the development of "specialized," "innovative" new services--like IBS.

INTELSAT's five-year financial plan includes substantial revenue growth for IBS. Revenues are projected to grow from $13 million earned in 1987 to over $43 million in 1992--an annual growth rate of 27 percent.[22] How INTELSAT makes these projections, and especially how it takes into account competitive pressures, is unclear. Lacking any potentially better approach to the problem, I use these same figures through 1992 in the projections in Sec. IV. But I use a lower "Case 1" growth rate arbitrarily set at 5 percent for 1993-1995 and 3 percent for 1996-2000, on grounds that competitive pressures from separate satellite systems will require some years to develop into a viable and broad competitive threat, so that pressures from new entrants may become particularly severe after 1992. Moreover, because of its lower transmission time delay, cable may be more suitable than satellite for some kinds of data transmission (a point of current controversy in the industry). If so, cable will also pose a threat, with effects on INTELSAT felt even earlier than 1992.

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[22] *INTELSAT Revised Five-Year Financial Plan (1988-1992)*, BG-75-19E W/3/87, 29 January 1988 (INTELSAT Restricted).

## III. OTHER SERVICES

Three other services merit separate treatment: domestic leases, international video leases, and occasional use video. Together, they constitute about 17 percent of INTELSAT's revenues. INTELSAT expects overall revenues from these services to grow rapidly to 1992, at least, by an average annual growth rate of 15 percent, so that their share of total revenues may rise to 24 percent by that year.[1]

These services are significant in that they are used heavily for point-to-multipoint service where satellites are generally regarded as more cost effective than cable. Thus, competition for these services can be expected to come primarily from other satellite systems, rather than from fiber optic cables or other terrestrial links.

### DOMESTIC LEASES

For many years INTELSAT has provided satellite capacity to satisfy domestic data, voice, and video needs. This offering is especially attractive to developing countries whose remote areas are not well served by terrestrial means. As of year-end 1987 INTELSAT provided preemptible service to 19 countries. In addition, nonpreemptible service is offered in INTELSAT's Planned Domestic Service (PDS) under which transponders are available for either sale or lease.

Stiff competition can be expected in this market from domestic, transborder, and regional satellite systems, as well as from transoceanic satellite systems. Notably, Pan American Satellite already has 13 transponders in orbit that have been reserved for domestic service, in addition to 11 transponders for international use as noted above.

In its financial plan, INTELSAT projects a revenue of $28.3 million in 1988, rising to $51.3 million in 1992, for an annual growth rate of 17 percent. I use these same figures in the projections in Sec. IV, but

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[1]These and other INTELSAT estimates in this section are taken from *Five-Year Financial Plan*, 29 January 1988, op. cit., Attachment No. 7.

there, Case 1 is assumed to have a lower (5 percent) growth rate for 1993-1995 and a 3 percent rate for 1996-2000 to reflect increased competitive pressure and the maturation of some markets.

## INTERNATIONAL VIDEO LEASES

INTELSAT's international leased television services are offered on a preemptible and nonpreemptible basis and are available from full-time (24 hour/day, two-year minimum) to part-time (one hour/day, one-year minimum) basis. This service, too, can be expected to face strong competition from separate satellite systems. The Orion System--as one example--plans 88 transponders, many of which could be used for transatlantic television service.

INTELSAT projects a somewhat lower rate of growth for international leases--10 percent--than for domestic leases. I use these numbers in the projections in Sec. IV, but with the same reduced growth rates after 1992 as for domestic leases.

## OCCASIONAL USE VIDEO

These services are typically offered on short notice with minimum transmission durations of 10 minutes. Although the service has grown substantially over the years, it is subject to wide annual fluctuations, depending on such events as sports and political and economic happenings. This service is expected to grow from $28.9 million in 1988, with some fluctuations, to nearly $35.8 million by 1992--a growth rate of 6 percent. I will use INTELSAT's figures in the Case 1 projections, with the same lower growth rates after 1992 as for the services above.

## OTHER SERVICES

INTELSAT provides other services such as maritime leases to INMARSAT, circuit restoration, and Vista (for voice and low-speed data communications for remote communities with low traffic requirements). Some of these services are expected to grow (but not especially rapidly) and others are expected to decline.[2] INTELSAT expects these services to

[2]For example, maritime leases will decline as INMARSAT's second-generation satellites become operational during the period 1989 to 1995.

contribute about 3 percent to total revenues in 1992--down from the more than 5 percent in 1987 shown in Table 1. I use INTELSAT's figures in the Case 1 projection. Because some may fall while others rise, I assume a constant overall level after 1992.

One component deserves special attention, however. Cable circuit restoration is frequently mentioned as a critically important function for INTELSAT. To ensure overall reliability of service, satellite backup is frequently used when a cable breaks or malfunctions.

The use of INTELSAT for circuit restoration has risen steadily and rapidly from 44,924 half-circuit days in 1980 t› 430,852 half-circuit days in 1987--about 1.3 percent of INTELSAT's full-time circuit use. It accounted for $8.2 million in revenues in 1987, less than 2 percent of INTELSAT's total.[3] However, INTELSAT's financial plan projects circuit restoration to remain constant at only $1.57 million for the years 1988-1992. This situation raises questions of appropriate pricing of circuit restoration services, discussed in Sec. V.

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[3]*INTELSAT Financial Status of 31 December 1987,* Addendum, No. 1 to BG-75-6E, W/3/87, 29 January 1988 (Privileged), Attachment No. 1.

## IV. FINANCIAL PROJECTIONS

Table 7 brings together revenue projections for Case 1. Total revenues of \$528.3 million in 1989 are slightly higher than the total of \$519 million for 1987 shown in Table 1, but they fall for a number of years because of the switch to digital transmission and use of CME. They subsequently rise because of the effects of continued compound traffic growth in nearly all service categories, reaching \$673.2 million in the year 2000.

For these financial projections, I assume a constant average monthly per-circuit revenue of \$380 for FM compared to today's FM rates for use with standard A earth stations of \$390 and \$370, respectively, for month-to-month service and for five-year contracts. I assume a figure of \$500 monthly based on today's rates for IDR of \$585 and \$450, respectively, for month-to-month and five-year contracts. Future average circuit revenues are affected by factors that pull in opposite directions. On the one hand, INTELSAT charges higher rates for service to smaller earth stations, and over time an increasing portion of traffic may be served by smaller stations -tending to increase average per-circuit revenue. On the other hand, tariffs are likely to fall in response to technological advance and competitive pressures. In choosing the above numbers, I have tried to strike a balance between these two forces.

It is instructive to compare these results with INTELSAT's own revenue projections and estimated revenue "requirements." Figure 4 shows these comparisons based on the latest INTELSAT data available at this writing, covering the period through 1997. Revenue requirements encompass the sum of operations and maintenance expense, depreciation, and a return on owners' investment based on a target rate of return of 14 percent. Unfortunately, these requirements are based on preliminary plans for the purchase of the INTELSAT VII spacecraft available at this writing. They do not reflect the more definitive plans now being made for launch services and other system needs, based on the decision in

Table 7

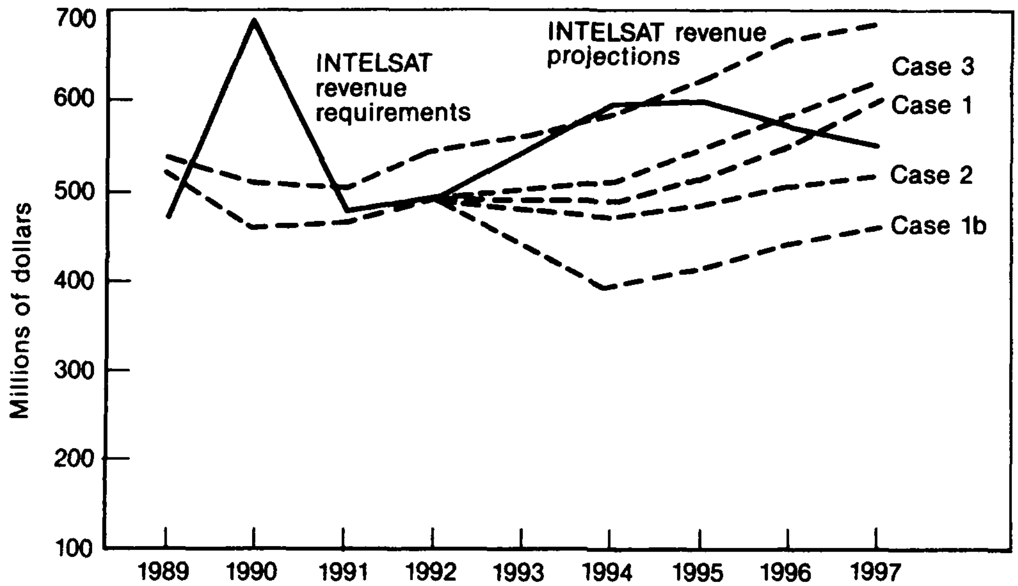
REVENUE PROJECTIONS 1989-2000: CASE 1
(Millions of dollars)

| | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. FM services | 318.9 | 201.2 | 179.1 | 178.8 | 152.1 | 116.8 | 119.5 | 127.4 | 136.2 | 145.9 | 156.5 | 168.4 |
| 2. Digital services | 60.7 | 101.5 | 117.5 | 130.0 | 148.7 | 171.2 | 183.0 | 195.4 | 208.8 | 223.6 | 240.0 | 258.2 |
| 3. IBS | 31.9 | 36.7 | 40.4 | 43.3 | 45.5 | 47.8 | 50.2 | 51.7 | 53.3 | 54.9 | 56.6 | 58.3 |
| 4. Domestic leases | 32.9 | 38.3 | 44.6 | 51.3 | 53.9 | 56.6 | 59.4 | 61.2 | 63.0 | 64.9 | 66.9 | 68.9 |
| 5. International video leases | 33.0 | 35.0 | 37.2 | 40.5 | 42.5 | 44.6 | 46.8 | 48.2 | 49.7 | 51.2 | 52.7 | 54.3 |
| 6. Occasional use video | 27.1 | 32.4 | 30.3 | 35.8 | 37.6 | 39.5 | 41.5 | 42.8 | 44.1 | 45.4 | 46.8 | 48.2 |
| 7. Other services | 23.8 | 19.3 | 17.6 | 16.9 | 16.9 | 16.9 | 16.9 | 16.9 | 16.9 | 16.9 | 16.9 | 16.9 |
| Totals | 528.3 | 464.4 | 466.7 | 496.6 | 497.2 | 493.4 | 517.3 | 543.6 | 572.0 | 602.8 | 636.4 | 673.2 |

SOURCES AND METHODOLOGY:

Items 1 and 2 from Table 5, assumed average monthly circuit revenue--$380 for FM; $500 for digital.
Items 3-7 for 1989-1992, INTELSAT Revised Five Year Financial Plan (1988-1992) (INTELSAT Restricted).
BG-75-19 W/3/87, 29 January 1988, Attachment 7.
Items 3-6, 5 percent growth rate 1993-1995, 3 percent growth rate thereafter.
Item 7 for 1993-2000 held constant from 1992 level.

NOTE: Item 7 includes maritime, circuit restoration, vista, spade, other occasional services, investment income, and other revenues.




SOURCES: Tables 6-8 and INTELSAT, *Excess Compensation*, March 11, 1988, Table 6.

Fig. 4—Comparisons of projections

September 1988 by INTELSAT's Board of Governors to procure five spacecraft from a specific contractor at agreed upon prices.

Case 1 shows revenue projections consistently below INTELSAT's estimates and also below INTELSAT's revenue "requirements" for most years. If the revenue requirements are not met, and if the opportunity cost of capital to INTELSAT's owners is equal to the target rate of 14 percent, the owners would have an incentive to reduce or eliminate their investment in INTELSAT. But, of course, not all members can reduce their investment share at the same time. Although users who are not members (such as the Soviet Union) would be unaffected, INTELSAT's investors would suffer losses. For example, Comsat has historically held a greater ownership share than use share. The reduced return on its INTELSAT investment would result in a loss to be borne by its shareholders.[1]

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[1]These revenue requirements should be interpreted differently from those considered by regulatory agencies, such as the FCC, in deciding

A primary factor driving both my results and those of INTELSAT is the assumption of continued growth of most services. With the effects of compounding over a long enough time period, projected revenue will inevitably rise despite the effects of digital use and CME.

Of course, Case 1 is only one of many possible outcomes. Because of the increasingly competitive international market, let us consider, as "Case 2," a modified assumption for AT&T's growth. Instead of an AT&T traffic growth of 10.5 percent throughout, assume that its growth is 10.5 percent until 1992, but then drops to 5 percent to the end of the century. Let us further suppose that its share of INTELSAT traffic (with its correspondents) remains at 40 percent as before.

The results of Case 2 are shown in Table 8 and in Fig. 4. As expected, the results show lower revenues than before. This comparison with Case 1 suggests that over a substantial range of AT&T growth rates (and with the assumption of a constant AT&T share of INTELSAT circuits intact), revenues will be lower than INTELSAT's projections.

Another potentially important area involves INTELSAT's other services for which it projects rather high rates of revenue growth, at least through 1992. Instead of the lower projections in Case 1, let us assume in "Case 3" that IBS, domestic leases, and international video leases grow after 1992 at the same rate that INTELSAT estimates for them from 1991 to 1992. These revenue growth rates are 7 percent for IBS, 15 percent for domestic leases, and 9 percent for international video leases. The results, in Table 9 and in Fig. 4, show revenue increases that still fall short of INTELSAT's projections. Because these services

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whether the regulated firm should be permitted to change its tariffs to just cover its costs and to reap a "fair" return on its investment. If revenues fall short of requirements, the firm is generally permitted to increase its rates. Since the regulated firm is a monopolist (which is the reason why it is regulated), it can pass these rate increases to its customers with relatively little loss of sales, so that its total revenues increase to cover the shortfall. However, since INTELSAT's markets are becoming increasingly competitive, it cannot be assured that simply raising its utilization charges will compensate for a revenue deficiency. Such rate increases, by encouraging users to shift to competing systems, might lead to a reduction rather than an increase in total revenues.

Table 8

REVENUE PROJECTIONS 1989-2000: CASE 2
(Millions of dollars)

| | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. FM services | 318.9 | 201.2 | 179.1 | 178.8 | 147.7 | 109.9 | 108.8 | 112.0 | 115.4 | 119.0 | 122.7 | 126.7 |
| 2. Digital services | 60.7 | 101.5 | 117.5 | 130.0 | 144.4 | 161.1 | 166.8 | 171.8 | 176.9 | 182.4 | 188.2 | 194.2 |
| 3. IBS | 31.9 | 36.7 | 40.4 | 43.3 | 45.5 | 47.8 | 50.2 | 51.7 | 53.3 | 54.9 | 56.6 | 58.3 |
| 4. Domestic leases | 32.9 | 38.3 | 44.6 | 51.3 | 53.9 | 56.6 | 59.4 | 61.2 | 63.0 | 64.9 | 66.9 | 68.9 |
| 5. International video leases | 33.0 | 35.0 | 37.2 | 40.5 | 42.5 | 44.6 | 46.8 | 48.2 | 49.7 | 51.2 | 52.7 | 54.3 |
| 6. Occasional use video | 27.1 | 32.4 | 30.3 | 35.8 | 37.6 | 39.5 | 41.5 | 42.8 | 44.1 | 45.4 | 46.8 | 48.2 |
| 7. Other services | 23.8 | 19.3 | 17.6 | 16.9 | 16.9 | 16.9 | 16.9 | 16.9 | 16.9 | 16.9 | 16.9 | 16.9 |
| Totals | 528.3 | 464.4 | 466.7 | 496.6 | 488.5 | 476.4 | 490.4 | 504.6 | 519.3 | 534.7 | 550.8 | 567.5 |

SOURCES AND METHODOLOGY:

Items 1 and 2 from Tables 4 and 5 with AT&T voice-grade circuit annual growth rate of 10.5 percent 1989-1992; 5 percent thereafter. Assumed average monthly circuit revenue--$380 for FM; $500 for digital. Items 3-7 from Table 6.

NOTE: Item 7 includes maritime, circuit restoration, vista, spade, other occasional services, investment income, and other revenues.

Table 9

REVENUE PROJECTIONS 1989-2000: CASE 3
(Millions of dollars)

| | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. FM services | 318.9 | 201.2 | 179.1 | 178.8 | 152.1 | 116.8 | 119.5 | 127.4 | 136.2 | 145.9 | 156.5 | 168.4 |
| 2. Digital services | 60.7 | 101.5 | 117.5 | 130.0 | 148.7 | 171.2 | 183.0 | 195.4 | 208.8 | 223.6 | 240.0 | 258.2 |
| 3. IBS | 31.9 | 36.7 | 40.4 | 43.3 | 46.3 | 49.6 | 53.0 | 56.8 | 60.8 | 65.1 | 69.6 | 74.5 |
| 4. Domestic leases | 32.9 | 38.3 | 44.6 | 51.3 | 59.0 | 67.8 | 78.0 | 89.7 | 103.2 | 118.7 | 136.5 | 157.0 |
| 5. International video leases | 33.0 | 35.0 | 37.2 | 40.5 | 44.2 | 48.1 | 52.5 | 57.2 | 62.3 | 67.9 | 74.0 | 80.7 |
| 6. Occasional use video | 27.1 | 32.4 | 30.3 | 35.8 | 37.6 | 39.5 | 41.5 | 42.8 | 44.1 | 45.4 | 46.8 | 48.2 |
| 7. Other services | 23.8 | 19.3 | 17.6 | 16.9 | 16.9 | 16.9 | 16.9 | 16.9 | 16.9 | 16.9 | 16.9 | 16.9 |
| Totals | 528.3 | 464.4 | 466.7 | 496.6 | 504.8 | 509.9 | 544.4 | 586.2 | 632.3 | 683.5 | 740.3 | 803.9 |

SOURCES AND METHODOLOGY: Items 1,2 from Table 6. Items 3-5 for 1989-1992 from Table 6. Item 3, 7 percent growth rate 1992-2000. Item 4, 15 percent growth rate 1992-2000. Item 5, 9 percent growth rate 1992-2000. Items 6 and 7 from Table 6.

NOTE: Item 7 includes maritime, circuit restoration, vista, spade, other occasional services, investment income, and other revenues.

are overshadowed by full-time circuit revenues, the results seem fairly insensitive to assumptions about growth rates to 1997, but these services would have a progressively greater impact in later years.

Another, potentially more important, factor is the level of tariff rates INTELSAT charges for its various services. Recall that all the preceding cases hold constant the average per-circuit revenue of $500 for digital and $380 for FM, with any reductions in tariffs offset by higher per-circuit revenues earned from the progressively greater relative use of smaller earth stations. But reductions in tariff rates that reduce overall per-circuit revenues may be required to meet competition. Indeed, the reduction in the 10-year IDR contract price embodied in the Comsat-AT&T agreement is predicated on the notion that INTELSAT will reduce its IDR tariffs as more advanced satellite technology is introduced. Suppose, in "Case 1b," that all tariffs are reduced by 10 percent at year-end 1992 and by another 10 percent at year-end 1993, to maintain the level of circuit use that underlies Case 1 in Table 7. Case 1B in Fig. 4 shows a striking drop in revenues.

At least two other factors could further reduce revenues. First, after the Comsat AT&T agreement expires in mid-1995, the situation could be less favorable for Comsat and INTELSAT than depicted above. In case 1, I assume that a new agreement is reached that maintains the stipulations that were current at the time the previous agreement expires. I do this because it is difficult to imagine a new agreement that would be more constraining on AT&T than the old. It is easier to imagine an agreement that further loosens the constraints on AT&T. For example, it might agree to place only 20 or 25 percent of its growth traffic on INTELSAT, instead of 30 percent shown in Table 4.

Of course, the parties may fail to reach a new agreement, in which case the issue of facilities loading would be thrown back to the FCC. It is difficult to imagine that the FCC would impose stronger facilities loading constraints on AT&T than those in the expired agreement. It is easier to imagine that the FCC would decline to adopt any loading constraints in 1995, since it was contemplating abolishing or phasing out the constraints at the time Comsat and AT&T came to agreement in 1987.

Second, the U.S. government's restrictions on the use of separate satellite systems for switched traffic might be lifted. This would expose the largest portion of INTELSAT's revenues--full-time switched traffic--to competitive pressure from other satellite systems, in addition to the pressure that INTELSAT already faces from cable. At the same time, the success of these systems would depend on many considerations--including the need to get operating agreements with countries to be served, which may not be easy.

Against the above considerations that would tend to reduce INTELSAT's revenues, one can reasonably ask whether other factors working in the opposite direction might arise. There are at least two: First, and especially important, fiber optic cable and CME may not work as well as many expect for underseas use, at least during the early years. Technical problems might arise that could force AT&T to use a smaller proportion of digital circuits and with a lower circuit multiplication ratio than is allowed in the Comsat-AT&T agreement. In this case, INTELSAT's revenues could rise substantially above my projected levels. A plausible scenario is that (a) difficulties arise in the early use of TAT-8 and HAW3/TPC-3, forcing a slower conversion to digital circuits and CME than now planned, and (b) INTELSAT revenues will be higher than my projections in Fig. 4--and perhaps even higher than INTELSAT's own estimates--until 1991 or 1992 when TAT-9 is finished. By that time the problems may have been worked out of the technology so that revenues fall toward my projections in subsequent years.

Second, neither my projections nor INTELSAT's five-year plan specifically accounts for *sales* of transponders (as opposed to leases) in its PDS program. The profitable sale of transponders would, of course, strengthen INTELSAT's position. The ability of INTELSAT to do this--in competition with other satellite systems--will depend in part on how pricing issues are resolved, discussed in Sec. V, along with many other considerations beyond the scope of this study.

In any event, the specific numbers computed in the above tables and figures are only illustrative. The more important contribution of this study has been to construct a framework that (a) helps to identify and put into perspective factors important to INTELSAT's financial future, and (b) permits readers to see the consequences of introducing their own assumptions about growth rates, average per circuit revenues, and other key considerations. An instructive exercise for the interested reader might be to construct combinations of assumptions that, within my framework, generate revenues close to INTELSAT's figures and then to ask whether these combinations seem plausible.

## V. IMPLICATIONS FOR PRICING INTELSAT SERVICES

Although the preceding analysis is subject to many caveats, it suggests that under a wide range of plausible assumptions INTELSAT will face financial stress because of competitive pressures. This situation is likely to intensify after 1992 because by that time (a) multiple fiber cables will cross both the Atlantic and Pacific, permitting carriers greater flexibility to use cable while maintaining balance and diversity among facilities required for service reliability, (b) whatever technical problems arise in early use of underseas fiber cable may be solved, and (c) large separate satellite systems--Orion as one possibility--may be operational.

One can ask whether this situation poses a threat to INTELSAT's obligation to provide "universal" global service--including service on low-density routes involving many dozens of less developed countries. The question cannot be directly answered here because it depends on a host of complex factors, including the amounts that less developed countries are willing to pay for service. But I will address one policy that might improve INTELSAT's ability to compete and to continue providing global service--greater flexibility in pricing in response to competitive pressures in particular markets.

All the tariffs quoted above are based on global cost averaging. Costs are simply taken together and divided by the expected number of active circuits to establish tariffs that, more or less, cover the total. Although tariffs vary by particular kinds of service (e.g., FM compared with IDR) and by earth station characteristics that put differential demands on satellites, each tariff is globally uniform. But INTELSAT will face increasing pressure to abandon global cost averaging and to reduce prices on routes where good alternatives exist, relative to prices among points heavily dependent on INTELSAT.

To be sure, even if no competition existed, it would be desirable on economic efficiency grounds for INTELSAT to abandon global cost averaging, in favor of prices that cover at least the incremental or marginal cost of the service in question. Were INTELSAT a monopoly with economies of scale in offering worldwide service, it should set prices in an inverse relationship to the price elasticity of demand for each service. That is, price would be fairly high relative to the incremental cost of a service that has a low elasticity of demand, and fairly low for a service with a high elasticity of demand, so that total revenue just covers total cost. These relationships, in a more rigorously defined framework commonly called "Ramsey pricing," are addressed in detail in an ongoing major study of "resource-based" pricing being supported by INTELSAT.

This restructuring of prices raises three issues: (a) INTELSAT's leeway to price competitively without requiring modification of Article V(d) in the INTELSAT agreement that forbids price discrimination, (b) the criteria that should be adopted for judging whether INTELSAT's prices are predatory or anticompetitive, and (c) the effects on INTELSAT members who have limited or no alternatives to INTELSAT service.

## CONSTRAINTS ON PRICE DISCRIMINATION

Article V(d) of the INTELSAT agreement stipulates that "the rates of space segment utilization charge for each type of utilization charge shall be the same for all applicants for space segment capacity for that type of utilization."

In the words of the U.S. Department of State:

> this provision...means, essentially, that once a particular utilization (service) has been defined, prices charged for that service cannot discriminate amongst individual users or geographical regions.[1]

Thus, global cost averaging, with its nondiscriminating tariffs, is fully consistent with Article V(d).

A common way to price competitively without giving the appearance of price discrimination is to set a uniform price for a service made available to everyone, but to design the service to suit only a limited

[1]U.S. Department of State, *Flexibility to Compete: INTELSAT in an Era of Separate Systems,* Washington, D.C., May 1985, p. 8.

class of users. A good example is INTELSAT's adoption of bearer circuit pricing. Installation of CME economically is most strongly justified on high-density routes--the same ones for which cable is most competitive. For routes on which alternatives to INTELSAT are less attractive, users will continue to pay fairly high utilization charges.[2] Nevertheless, bearer circuit pricing is consistent with Article V(d) because it offers these circuits at a uniform price.

A major issue, however, is whether this strategy will be enough as competitive pressures mount. One could imagine a situation where INTELSAT would be strengthened, while contributing to greater efficiency in use of global telecommunications resources, by setting lower bearer circuit prices in one ocean basin where alternatives to INTELSAT are good, and higher prices in other ocean basins where the alternatives are weaker, and where in all cases each service covers its incremental costs. Or (similar to the behavior of U.S. airlines) it might go even further by pricing on a route-by-route basis, depending on competitive alternatives. But such practices would clearly violate Article V(d).

Modification of Article V(d) would be difficult and time consuming because of controversies among INTELSAT members, some of which would stand to gain (or lose) more than others. It remains to be seen how much flexibility INTELSAT will be able to exercise without violating Article V(d). Suffice it to say here that Article V(d) could eventually pose a serious barrier to moving to more competitive prices.

## ANTICOMPETITIVE PRICING

Past attempts by INTELSAT to reduce prices as a competitive response have led to loudly voiced concerns that it is pricing in a predatory or anticompetitive fashion. That is, it deliberately sets prices below cost to discourage entry by competitors whose costs may be as low or lower than its own.

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[2]However, the use of multiple-destination CME, noted above, may make economically attractive the use of digital bearer circuits on many low-density routes as well.

A leading example is the "Caribnet" service for which INTELSAT proposed discounts for service in the Caribbean Basin. In the words of one U.S. senator:

> INTELSAT also has proposed drastic price reductions in those regions where [Pan American Satellite] plans to do business. Many believe these new prices are not cost-based....INTELSAT may be exploiting its ample pricing flexibility to preempt competition and market entry, while purporting merely to encourage greater use of its system. The recent across-the-board "Caribnet" 50% discount of otherwise applicable rates for Caribbean Basin digital services suggests the approach that INTELSAT can employ to prevent separate systems and U.S. transborder ventures from competing in the marketplace.[3]

Under pressure from U.S. government agencies, and after much controversy, Comsat withdrew its tariff application for this service.

To guard against predatory pricing, many insist that prices cover their "full costs" or "fully distributed costs." Under this cost criterion the price must cover not only directly identified or out-of-pocket cost of the service in question, but also a "fair" share of common costs incurred in the joint provision of this and other services. One example is the objection raised to prices that INTELSAT proposed for transponders in its PDS initiative. As described in one INTELSAT report:

> The U.S. was not convinced the prices adopted were sufficient to cover the relevant costs incurred to supply the INTELSAT V/VA transponders. It stated further that the prices should be based on the full costs incurred to supply the transponders, including an appropriate allocation of the Executive Organ and common overhead costs, and that the prices proposed by the Director General did not appear to include an appropriate allocation of such common costs. Furthermore, it was difficult to understand the Director General's rationale in not including in the proposed prices an allocation of a

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[3]Letter from Senate Commerce, Science, and Transportation Committee Chairman John C. Danforth to FCC Chairman Mark S. Fowler, as reported in *Telecommunications Reports*, October 27, 1986, p. 30. The proposed Caribnet discounts may have been in violation of Article V(d), but they were put forth anyway simply because no INTELSAT members objected.

share of the cost to be recovered for transponders not used in either international or domestic services.[4]

The fully distributed cost approach has been widely criticized by economists and others because costs of facilities shared by multiple services can be allocated among the services in accordance with a variety of economically meaningless formulas, giving widely varying outcomes.[5]

The danger of insisting that the incumbent firm set prices to cover a fair portion of common costs is that competitors may undercut these prices even if their costs are higher than those of the incumbent. Use of fully allocated cost criteria is appealing to those who would like to protect new firms in their "infancy" by placing a high floor on the incumbent's prices.

The appropriate pricing criterion is one where the service in question covers at least the additional cost that it imposes on the system. In that way customers of the other services are no worse off, and would be even better off if the service in question covers any of the common cost that the other services otherwise must bear.

To be sure, estimation of incremental costs is difficult, and economists debate about whether short-run or long-run costs are the appropriate measure. INTELSAT's ongoing study of resource-based pricing may shed light on its incremental costs.

In any case, issues of cost of service will remain highly controversial, in part because of concerns that INTELSAT might engage in below cost "predatory" pricing in markets where it is vulnerable to competition, while compensating for these losses by raising rates in its monopoly markets. This controversy will disappear only after all markets are competitive enough to preclude anticompetitive cross-subsidization.[6]

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[4] INTELSAT, *Cost Methodology for Planned Domestic Service*, BG-67-63E, 17 June 1987, p. 1.

[5] See, for example, W. J. Baumol, M. F. Koehn, and R. D. Willig, "How Arbitrary Is 'Arbitrary'?--or, Toward the Deserved Demise of Full Cost Allocation," *Public Utilities Fortnightly*, September 3, 1987, pp. 16-21.

[6] For an elaboration see Leland L. Johnson, "International

## EFFECTS ON DEVELOPING COUNTRIES

The pricing strategies described above would generally mean higher prices to developing countries than otherwise since, as a group, they have fewer good alternatives to satellites than do the industrialized nations. It is beyond the scope of this study to estimate the differential effects of repricing on these two groups. But two points about these effects are worth noting. First, the acceptability of competitive pricing to developing countries would depend in part on whether they face price increases over current levels or only prices that are equal to or lower than those today but higher than those offered on high-density routes. The second situation would be more palatable than the first. Conceivably, the costs and capabilities of the INTELSAT VI and VII series on top of satellites already in orbit will permit price reductions to everyone (or at least will forestall increases) while permitting INTELSAT to price appropriately in response to competitive pressures. In any event, since INTELSAT charges are a small part of retail prices, an increase would have a relatively small impact on the profits of PTTs in developing countries.

Second, although it is generally assumed that subsidies flow from high-density to low-density routes, situations may arise where the opposite is true. It would be useful for INTELSAT to identify these situations and to take corrective action. Doing so would help to counteract the distributional effects of competitive pricing and perhaps make this approach more acceptable to nations on low-density routes.

Cable circuit restoration is an example of where a reverse subsidy may exist. As noted in Sec IV, although INTELSAT has an important role in serving as a backup to cable, its revenues in 1987 from this service amounted to less than 2 percent of the total, because its charge for this service is low. In 1987 the average monthly revenue per half-circuit was about $572,[7] which for emergency and short-notice demand

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Telecommunications: Issues and Possible Solutions," *New Directions in Telecommunications Policy*, The Markle Foundation, New York (also to be published by Duke University Press, Durham, NC, 1989).

[7]Computed from 1987 data by dividing the $8.225 million earned by this service by 430,852 half-circuit days of service.

seems low in comparison with the standard month-to-month rate of $390 for FM service and $585 for IDR service. The opportunity cost of the transponders used for circuit restoration is an important consideration. Transponders must be shifted from other services that use the transponders on a preemptible basis; while other transponders, although idle, are included in original investment plans and costs as a cushion to meet circuit restoration demands and other contingencies. Indeed, some carriers tend to inflate their traffic forecasts at the GTM probably to help insure that in response to these estimates INTELSAT will install plenty of capacity to meet whatever circuit restoration needs might arise.

At issue is the level of circuit restoration charges required to cover the opportunity costs--including the cost savings that would have occurred from not investing in extra transponders for contingency purposes. Because circuit restoration generally involves transponder use for only days rather than months while cable outages are corrected, they are idle for extended periods until used for other contingencies.

Investigation of whether circuit restoration is underpriced is important because of the differences in benefits from circuit restoration among INTELSAT's members. To illustrate, Nairobi, Kenya, is a city essentially wholly dependent on satellites for international communications, in contrast to New York and London. Although New York and London greatly benefit from cable circuit restoration service, Nairobi may benefit little because its intercontinental traffic is by satellite.*

Thus, circuit restoration may be a case where subsidies flow in the other direction. If this service is underpriced, i.e., does not cover its incremental costs, costs are imposed on Kenya and other such INTELSAT members for the benefit of the industrialized countries. Again, INTELSAT's ongoing study of resource-based pricing may shed light on this issue.

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*To be sure, Nairobi would benefit from cable circuit restoration if any of its traffic with North America is routed by transatlantic cable to transit points in Europe.

## VI. CONCLUSIONS

The major conclusions from the preceding can be tabulated as follows:

- Several factors can be identified that help explain the decline in the rate of growth of full-time voice-grade service from the double-digit levels in the late 1970s. These factors suggest that growth will continue at a relatively low level of below 10 percent, with possibilities of further declines.
- Using the Comsat-AT&T agreement as a point of departure, and under a range of plausible assumptions, I project INTELSAT's revenue levels to be somewhat below those of INTELSAT's current estimates at least through 1997.
- Of course, results very much depend on the assumed rate of compound growth of various services. But under a range of assumptions about growth rates of INTELSAT's services, my projections remain below INTELSAT's.
- Although my estimates track fairly closely those of INTELSAT for FM service, they are substantially below INTELSAT's estimate for digital service.
- The results are particularly sensitive to assumptions about average per-circuit revenues. An across-the-board cut in INTELSAT's tariffs of 10 to 20 percent, in response to competition during the 1990s, would have a substantial effect on revenues.
- INTELSAT will face progressively greater financial stress under competitive pressures, with these pressures being especially severe after 1992 when multiple cables will cross both the Atlantic and Pacific Oceans and large separate satellite systems may be operational.

- These financial pressures will be affected by the course of retail prices. Reductions in these prices may substantially stimulate overall traffic growth, to the benefit of INTELSAT and other suppliers.
- Other factors, not taken formally into account in the projections, could adversely affect revenues. Two possibilities are (a) renewal of the Comsat-AT&T agreement in 1995 under terms less favorable to Comsat than the existing one, and (b) abolition by the U.S. government of its prohibition on the carriage of switched traffic by separate satellite systems.
- Other factors would favorably effect revenues. Two possibilities are (a) technical problems in the use of fiber optic cable and CME that would raise INTELSAT's revenues, perhaps even above its own projections in the early years of fiber optic cable use, and (b) profitable sale of transponders under INTELSAT's PDS program.
- Adoption of more flexible, competitive pricing would help INTELSAT meet these challenges and would also lead to a more efficient allocation of telecommunications resources.
- Article V(d) of the INTELSAT agreement could, however, pose a serious barrier to the degree of pricing flexibility that may eventually be needed to meet competition.
- Fully allocated cost criteria for judging whether INTELSAT's prices are predatory or anticompetitive should be abandoned in favor of incremental cost tests. This would encourage more flexible pricing that would help INTELSAT meet competition and would contribute to greater efficiency in use of resources. Issues of predatory pricing will be resolved only when all of INTELSAT's markets are competitive enough to preclude anticompetitive cross subsidization.
- INTELSAT can reduce the adverse distributional effects of competitive pricing on less developed countries by examining its other pricing policies, and making necessary adjustments,

where these policies place an undue burden on developing countries. The current pricing of circuit restoration services may be one example.