Does Intelsat Face Effective Competition in the Provision of its Services?

by Johannes P. Pfeifenberg and Hendrik S. Houthakker

Columbia Institute for Tele-Information
Graduate School of Business
Columbia University
809 Uris Hall
New York, NY 10027
(212)854-4222

Does Intelsat Face Effective Competition in the Provision of its Services?[1]

Johannes P. Pfeifenberger
The Brattle Group

Hendrik S. Houthakker
Harvard University

FIRST DRAFT
April 25, 1996
Cambridge, Massachusetts

Introduction

Dramatic changes in the telecommunication industry have fundamentally altered the position of Intelsat in the market for international facilities-based telecommunications ("IFBT") services. This paper will present relevant industry data and market developments that lead us to conclude that effective competition has emerged in the IFBT market and that Intelsat is unable to exercise monopoly power. Competition to Intelsat has emerged numerous alternative facility suppliers targeting specific services and geographic markets.

Intelsat's market shares have been declining rapidly world-wide and for all services -- in key market segments, Intelsat market shares already are below 25 percent. Moreover, a market share analysis significantly understates the level of competition because of a number of additional characteristics of the IFBT market. Providers of transmission capacity compete in the presubscription market long before the actual cable or satellite facility goes into service and its existence is reflected in market shares. The rapid entry of new facilities has become a significant competitive force in the IFBT market. The convergence of once distinct types of services and geographic markets creates additional options for IFBT customers. Substantial amounts of excess capacity exist on fiber optic systems and partly presubscribed satellites. Intelsat's geographic rate averaging extends the price pressures from highly competitive routes to routes with lesser competition. IFBT customers are large, sophisticated corporations with significant financial resources and bargaining power. And, because of its organization as a inter-governmental cooperative, Intelsat is burdened with substantial competitive handicaps. The extent of current competition and the great number of facilities

---

[1]The authors like to thank M. Alexis Maniatis for his valuable contributions to this paper.

entering the market make it highly questionable whether Intelsat could even survive in its current structure.

It is critical to distinguish market power in the provision of Intelsat space segment from market power in the provision of the ground segment. Intelsat only provides space-segment services. That is, it makes available to its Signatory owners satellite transmission capacity for resale. Intelsat does not own or operate the earth stations accessing its satellites. In contrast (and despite the fact that some countries such as the U.K., New Zealand, Australia, Chile and Argentina have introduced competition in their domestic telecom markets), the ground segment in most countries other than the U.S. is still dominated by postal and telephone administrations (PTTs) that (1) control all access to the country's end-users as well as any potential competitor's access to international telecommunications facilities;[1] (2) own international fiber optic circuits terminating in their country; (3) may partially or fully own domestic and regional satellite systems that compete with Intelsat; (4) perform the role as Intelsat Signatory; and (5) may be the only parties authorized to provide capacity on independent international satellite systems to end-users of those countries. The addition of new competitors and increased competition in international facilities-based services will not impact PTTs' ability to control telecommunications access to and from their domestic markets. Monopoly PTTs will still be able to extract profits from interconnecting carriers, steer traffic to facilities under their direct control, and use their market power to cross-subsidize domestic services. Therefore, concerns about PTT market power need to be separated clearly from the question of competition in the "international" segment (e.g., the space segment) of the IFBT market addressed in this paper.

Intelsat and its Competitors

In response to the launch in 1960 of the first telecommunications satellite, Echo I, a 1962 United Nations resolution called for a system of "communications by means of satellite" which would be "available to the nations of the world ... on a global and nondiscriminatory basis."[2] However, the task of building a global telecommunications systems was thought to be too ambitious a project to be undertaken by any single country. Thus, in 1964 the U.S. and 18 other members of the United Nations signed an agreement that created Intelsat. In 1973, Intelsat was converted into a international treaty organization, with the prime objective

to provide its members with telecommunications space segment on a non-discriminatory basis to all areas of the world.[3] Under the Intelsat treaty, countries could authorize other satellite systems only if they did not threaten the economic viability of Intelsat.

As telecommunications demand grew rapidly, direct competition to Intelsat first became feasible in the form of domestic and regional satellite systems. Canada, the U.S., and Indonesia ("Palapa") launched their domestic/regional satellite systems in the 1970s. Eutelsat, Arabsat, and the domestic/regional systems of Australia, China, France, India, Japan, and Mexico were launched in the early 1980s. Since then, additional domestic and regional satellite systems have been established by telecommunications companies in countries including Argentina, Brazil, Germany, Israel, Italy, Norway, South Korea, Sweden, Thailand, and Turkey. Few of these systems are only domestic in scope and many provide extensive regional and, in some cases, trans-oceanic coverage. Private regional satellite systems (such as Astra, AsiaSat, and Apstar) also provide extensive coverage in Europe and Asia. Excluding satellite systems with global coverage, we estimate that today, Asia and the Pacific are served by 40 commercial communications satellites;[4] almost 50 domestic and regional satellites currently provide service to the Americas and the Caribbean; and more than 40 commercial satellites are in orbit above Europe and the Middle East.

In the late 1980s, Intelsat also started to face competition from private transoceanic satellite systems. After considerable debates, private transoceanic satellite systems were approved and launched starting with PanAmSat's PAS-1 in 1988. This single satellite now provides service to more than 70 countries and is, by PanAmSat's own account, the leading satellite for services to South America.[5] With three more satellites in orbit today, PanAmSat is able to provide services to 98 percent of the world's population.[6] Columbia Communications, another entrant, uses part of NASA's tracking and data relay satellite system (TDRSS) to provide services stretching from East Asia to North America, and further to all of Europe and North Africa.[7] Orion Network Systems launched its first satellite at the end of 1994 and, by mid 1995, was already providing services to 59 users in 24 European countries and North America.[8]

Frequently overlooked by market analysts, Intersputnik is a global satellite system with almost three decades of operations. Responding to the challenge created by U.S. support of

Intelsat, the Soviet Union created Intersputnik in 1968.[9] Sharing a large number of satellites in at least 11 orbital positions with Russia's PTT, Intersputnik today offers a full range of telecommunication services to users in 70 different countries.[10] As authorized by the FCC, at least five Russian satellites provide services to and from the U.S.[11] Most recently, Intersputnik has registered 15 new orbital positions with the ITU, of which 5 are suitable for transatlantic services.[12]

In addition to satellite systems, Intelsat started to face competition in transoceanic telecommunications from fiber optic cables as well. The first trans-Atlantic fiber optic cable was laid in 1988. By 1993 fiber technology had increased total cable capacity spanning the Atlantic and the Pacific by factors of 10 and 20 respectively. All major telecommunications nations, and close to 100 countries in total, have become accessible from the U.S. through the fiber optic systems.[13] By the end of this year, capacity on these routes will have tripled again from 1993 levels. Total transoceanic fiber optic capacity already exceeds total satellite capacity available for transoceanic service by a significant margin.[14] The largest fiber optic systems already offer capacity equivalent to six times the capacity of the largest telecommunications satellites at equal or lower cost per circuit.[15] Significant further gains in capacity and cost reductions will be realized.[16]

Figure 1 charts geostationary telecommunications satellites and major submarine fiber optic systems as of 1990. **Figure 2** illustrates the deployment of such facilities as of 1997 (i.e., including facilities already under construction) and (in planning stages) beyond. There may be some countries to which Intelsat still is the only international service provider. However, the volume to these countries appears to be only a small fraction of total Intelsat traffic. Furthermore, services to these countries (1) can already be provided by competing systems with global coverage (such as PanAmSat and Intersputnik); (2) may be offered through a combination of other regional and transoceanic facilities; (3) often provides the opportunity for market entry of new satellite and fiber optic systems (e.g., Africa);[17] and (4) benefit from global competition to Intelsat because, by treaty provision, Intelsat does not differentiate rates geographically.

Declining Market Shares

Intelsat's current market position is much smaller than its image as an international satellite organization might suggest. Since the late 1980s, Intelsat's market shares have decreased dramatically for many types of services and for all major geographic areas. The large number of competing facilities already in service and those planned to come on line within the next several years will continue this trend.

Regional Telecommunications Facilities

Figure 3 shows the estimated number of transponders available for regional/domestic services world-wide. The chart is derived by allocating 50% of the capacity on global satellite systems to regional/domestic markets. This allocation is a reasonable working assumption given that transponder configurations are not entirely flexible. Transponders typically operate in pairs which can be connected either for transoceanic (east-west) or regional (north-south) service. For example, only about 50% of Intelsat's POR capacity is currently available for trans-Pacific service. The chart shows that due to the great number of regional/domestic satellite systems (i.e., in the Americas, Europe/Middle East, and Asia-Pacific) Intelsat's share in regional/domestic markets is already well below 30%. Moreover, because of the difficulty in determining and allocating capacity of terrestrial networks, this chart does not even consider competition from domestic/regional fiber optic systems. In addition to more than 10 million miles of domestic fiber optic networks,[18] "regional" fiber optic links already are connecting (1) North America, South America, and the Caribbean; (2) Europe, the Middle East and South Africa; and (3) Japan, Australia, and South-east Asia. The estimates for the year 2000 assume that only about one-third of the recently proposed (Ka-band) satellite systems will be realized.

Transoceanic Telecommunications Facilities

Figure 4 compares estimated capacity available for trans-oceanic telecommunications services for Intelsat, other global/multi-regional satellite systems, and transoceanic fiber optic systems. The figure clearly illustrates the enormous competitive impact that fiber technology has already had in transoceanic telecommunications. Moreover, compared to its satellite competitors, Intelsat generally operates lower-powered, general purpose satellites. Thus, by making no attempt to normalize for differences in technology, this measure of capacity still

overstates Intelsat's market share. The chart also illustrates the significance of planned satellite systems and recently made proposals for Ka-band satellite systems. If only one-third of the proposed systems are realized, competing transoceanic satellite capacity will be twice that of Intelsat (even before restructuring). Transoceanic fiber systems already offer approximately two times Intelsat's capacity for transoceanic service.

Switched Voice and Private Line Markets

The emergence of transoceanic fiber optic systems is significant. Intelsat's main business still is, and historically has been, the provision of switched voice and private line services to its Signatories. As these Signatories have invested in fiber technology, Intelsat's market share has declined rapidly. **Figure 5** shows that Intelsat's share of utilized capacity for switched voice and private line service to and from the U.S. on trans-Atlantic and trans-Pacific routes with fiber competition has dropped from a range of 60% to 85% in 1988 to approximately 25% in 1993.[19] Most significantly, the chart also shows that utilized capacity to countries not accessible through fiber optic systems to and from the U.S. accounts for only 4,000 circuits or only 6% of total utilized switched voice and private line circuits to and from the U.S. Considering that international fiber optic networks continue to grow rapidly and that only 15% of Intelsat's total Atlantic Ocean Region (AOR) traffic does not involve one of the "Big Five" telecommunicating nations (U.S., Canada, Great Britain, France, and Germany),[20] the data for traffic to and from the U.S. will be a good representation of world-wide trends.

Video Markets

The market for international video services has experienced the most dramatic changes in the last few years. Houthakker, et al. (1994), estimated that Intelsat's share of projected growth for video services to and from the U.S. would be in the order of 50%.[21] This would have increased Comsat's revenues from video transponder leases from $28.8 in 1993, to $43.8 million and $50.8 million in 1995 and 1996. In reality, however, Comsat's revenues from video transponder leases have only reached $36.5 million in 1995 and are now expected to be flat for 1996. Intelsat's world-wide "revenues" from video transponder leases were $125 **[check]** million in 1995.

Significantly, PanAmSat's 1995 video revenues have reached $83.9 million world wide.[22] With the launch of PAS-1, PanAmSat instantaneously captured at least a 50% share of video services between the U.S. and Latin America in 1989 and has increased its presence since.[23] PanAmSat, having reached global coverage in 1994, derives two-thirds of its revenues from video services. Since 1989, PanAmSat's growth in video revenues has averaged 64% per year.[24] After commencing operations of its Atlantic-ocean satellite in January 1995, Orion also has been successful in attracting a number of video customers to fill a significant fraction of its available transoceanic capacity. For 1995, Orion derived $12.3 million from video services. Columbia Communications is explicitly focusing its business on trans-Atlantic and trans-Pacific video transmissions and lists CBS, Reuters, HBO and the BBC (among others) as video customers. U.S. telecommunications providers have also been authorized by the FCC to provide video (and other) services to and from the U.S. on five Russian satellites.[25] A number of regional/domestic systems now also provide transoceanic video transmission service. For example, both Hispasat and JSAT have provided video services to and from the U.S. Also, major U.S. domestic satellites operators (like Hughes and GE Americom) have now been authorized by the FCC to expand their satellite video services internationally. Hughes is already aggresively expanding its Latin American coverage.[26]

Revenues from occasional-use video service in 1995 amounted to only $25 **[check]** million for Intelsat. PanAmSat, Intersputnik, Orion, Columbia, and various regional satellite systems provide and actively market occasional-use video services in direct competition with Intelsat.[27] Occasional-use video service on fiber optics cables is now also available between the U.S., Canada, and the U.K.[28] and is planned to become available to Japan, Singapore, and continental Europe in the immediate future.[29]

What Market Shares Don't Tell Us

Presubscription Practices

In this industry, today's market shares of existing facilities are mostly yesterday's news. The fact that significant capacity on planned new facilities usually is presubscribed will not be reflected in actual market share data until these facilities become operational. As a result,

observed market shares will significantly understate the actual level of competition. Capacity usually is leased or acquired on a long-term basis -- often years before a facility becomes available. For example, Apstar I sold *all* its capacity almost a full year before launch,[30] and PanAmSat has already negotiated $1.9 billion in future global telecommunications services.[31] In fact, given the lead times and financial commitments required for the construction of new satellite or cable systems, proposed facilities may not be built until a significant fraction of their planned capacity is presubscribed under long-term contracts.[32] As a result, new or existing providers of international telecommunications facilities attempting to presubscribe capacity exert considerable competitive pressure long before the facilities become operational and their existence can be reflected in market shares.[33]

Competitive Entry

Entry is a significant competitive force in the IFBT market. The rapid construction and launch of new satellite systems has already been referred to with terms such as "Star Wars," "Space Race,"[34] and "Oklahoma Land Rush."[35] Today, telecommunications satellite technology and launch services are widely available, and given the rate of new launches, effective entry barriers do not appear to exist. As high presubscription rates suggest, individual satellite capacity has become relatively small compared to telecommunications traffic growth expectations. Operators of satellite systems have been able to find financing for their projects and, increasingly, ambitious new satellite projects are backed by large, financially sound companies. Although the coordination of orbital slots has become more difficult, all new entrants seem to have managed to find geostationary orbits from which to provide the service they desire. New technologies (digital compression, higher capacity/power satellites, increased frequency reuse), co-location of several satellites, leasing orbital slots from other countries or territories, and the reduction of the minimum spacing of orbital slots, seem to effectively mitigate scarcity concerns.[36] Industry analysts also appear to concur that the problem is not a scarcity of slots as much as outdated international coordination procedures. It has been suggested that better coordination would create enough room to more than double the number of all transponders now in orbit.[37]

In 1994 and 1995, a world-wide total of approximately 50 telecommunications satellites were launched. Moreover, the pace of launches is increasing. To serve the Asia-Pacific region, for example, 17 new satellites are forecast for 1996,[38] and a total of 62 new satellites are planned for the region through the year 2000.[39] Based on launch manifests for the five largest launch providers, more than 60 telecommunications satellites are already scheduled for launch in 1996 and 1997 world-wide.[40] Arianespace, which deployed 13 satellites in 1995 and has scheduled 17 launches for 1996, plans to order extra rockets so it can launch 65 to 70 satellites during 1997 and 1998.[41]

Entry is not been limited to domestic/regional systems. Global satellite systems also continue to expand rapidly. For example, at least seven high-powered Express satellites are scheduled for launch in 1996 and 1997 for Intersputnik and the Russian PTT. PanAmSat has scheduled for launch four more satellites for 1996 and 1997,[42] has final authority to launch PAS-9, and has already filed for authorization to build and launch PAS 10 and 11,[43] as well as seven additional satellites.[44] **[cross-check]** Orion Network Systems intends to launch two more satellites in 1997 and 1998 and has announced plans for Orion 4, 7, 8 and 9.[45] Competition from these satellite systems goes well beyond the threat of entry because many of these facilities already compete in the presubscription market.

Several new players have announced plans to enter the IFBT market. Major U.S. companies have proposed to build and launch within the next several years a combined $23 billion or more of satellites.[46] AT&T has applied for authorization to launch twelve geo-stationary satellites providing services "ranging from basic telephone connectivity to advanced multimedia offerings, to consumers and business users both domestically and globally."[47] Lockheed Martin has applied for authorization to launch its nine-satellite Astrolink system to deliver international voice, video, and data telecommunications services.[48] GE applied for its global nine-satellite GE-Star system.[49] And Hughes unveiled its twenty-satellite, Galaxy/Spaceway system that, with launches starting in 1998, will provide a full range of world-wide switched voice, private line, and video services.[50]

In addition to entry in the satellite market, there is a significant threat that fiber optic systems will enter the market for international video transmissions on a much larger scale. Domestically, fiber optic cables already carry a significant fraction of video transmission

services.[51] For some U.S. broadcasting networks, fiber has already become the medium of choice for point-to-point video transmission.[52] Given the significant excess capacity on transoceanic fiber optic systems, offering video services seems the logical next step. Entry of fiber video is facilitated by demand for international point-to-point video service. Obvious examples for point-to-point service are applications such as "backhaul" of news and sports events. However, international distribution of video programing is also likely to be point-to-point for its transoceanic leg because overseas programming typically involves local editing (e.g., commercials) at regional "hubs," and further distribution to cable TV networks and end users via regional satellites (such as the European Astra, Eutelsat, or the Asian Palapa, Apstar, and Asiasat systems). Global news gathering networks utilizing similar "hub and spoke" systems may also be able to utilize fiber video services to connect hubs fed by regional satellites. Vyvx, a pioneer in fiber video transmission and with an extensive U.S. network, is already providing occasional-use video transmission between North America and the U.K. through its "AtlanticVision" fiber optic service.[53] The company is about to introduce fiber video service between North America, Japan, and continental Europe, and is also exploring full-time fiber video service with detailed fiber-to-fiber restoration plans.[54] Recently, AT&T has also started to offer international 45-Mbps private line service that provides sufficient transmission capacity to carry one or two broadcast-quality video transmissions.[55] AT&T will also utilize transoceanic fiber as part of its video network distributing the 1996 Olympic Games to worldwide audiences.[56]

PanAmSat's experience also shows that entry can be very profitable. Based on strong historic growth and similar projections, PanAmSat's market capitalization has already climbed to $3.5 billion -- or almost two times the capitalization of Comsat ($1.85 billion).[57] Similarly, the cost of fiber transoceanic optic cables having decreased below the costs of point-to-point satellite service,[58] and new cable systems continue to be built despite low overall utilization.

Convergence of Market Segments

New technologies and the elimination of regulatory barriers between markets have resulted in increasing degrees of overlap in what were once distinct markets. We have labeled this phenomenon "convergence," and it is becoming an important aspect of competition in the

IFBT market that makes many traditional market definitions obsolete. For Intelsat, the result of convergence has been the erosion of the advantage it once had as a global system. In many cases, Intelsat is at a competitive disadvantage as more flexible competitors with more specialized high-powered satellites target particular services and geographic markets.

Geographic convergence in the satellite market includes global systems offering domestic and regional services, domestic satellite services expanding regionally, and regional systems expanding coverage areas while also providing domestic services. For example, Eutelsat has gained a number of new members and is expanding its Iceland-to-Moscow coverage into the Far East.[59] A number of regional systems already provide trans-oceanic service. Convergence in many cases is the result of the relaxation of regulations that had created market distinctions where there were no technological constraints. For example, a domestic satellite may have been capable of providing regional (or even trans-oceanic) service but may not have been authorized to do so. Furthering the trend toward convergence, the FCC recently eliminated regulations that distinguished between U.S. licensed domestic and international fixed satellite systems.[60]

The flexibility of many satellites provides ample opportunity for geographic convergence to continue. For example, Hughes Communications applied for authorization to lease transponders on a domestic Brazilian satellite to provide U.S.-domestic service.[61] [62] A domestic Canadian Anik satellite recently has been transferred to an orbital position to provide service to Arab league countries in the Middle East and North Africa;[63] and two Canadian Anik satellites have been moved to provide domestic services in Argentina.[64] As regional and trans-oceanic fiber optic systems become increasingly interconnected, geographic distinctions will blur further.

Just as geographic markets are converging, so too are service markets. Switched voice, private line and video service were once differentiated for both technical and regulatory reasons. But again, technological progress (like digitalization) and liberalization of regulatory constraints are eliminating critical differences. The line between switched voice and private line services is fading as resellers offer telephone service to end users with private line capacity leased from providers of facilities-based services. Similarly, private branch exchanges (PBXs) of company-internal telecommunications networks increasingly

compete with the public switched networks.[65] In the U.S., the FCC has greatly relaxed (and will abolish about six months from now) limits on the number of telephony circuits that separate systems could interconnect with the public switched network.[66] As a result, separate satellite systems are also entering the transoceanic telephone markets that, in the past, were served mostly through cable systems and Intelsat.

As pointed out above, fiber optic technology recently is becoming an increasingly attractive medium for the transmission of video services—particularly for point-to-point applications such as gathering of news and sports events. The distinction between data transmission and video service will continue to become obsolete as the use of digital video technology expands. Digital video in combination with hub and spoke systems for video distribution eliminate the advantage of global satellite systems over fiber optic transmission (into a hub) and regional satellite transmission (to the spokes). For large users of video service with global satellite networks, such as major news gathering organizations, the ability to create a global distribution with a collection of regional/domestic systems (by transmitting from region-to-region, where the signals must be distributed in any case) offers a realistic substitute for single-source global service providers.

Excess Capacity

Currently, competing satellite systems are planned and launched at a rapid pace. Also, vast amounts of idle capacity are available on existing and planned fiber optic systems. The ITU has estimated that only about 20 percent of total submarine fiber optic capacity currently is in use.[67] **Figure 6** shows that, in 1993, the total available capacity on facilities to and from the U.S. had amounted to almost three times total utilized capacity. Houthakker, et al. (1994) show that as of 1993, excess cable capacity could have easily absorbed *all* of Intelsat's services to and from the U.S.[68] Considering the rate at which cable capacity has grown since 1993, excess capacity is most likely to have increased relative to the demand for IFBT services. The sheer size of excess fiber capacity and capacity on partly pre-subscribed competing satellites puts significant competitive pressures on all market participants.

Geographic Rate Averaging

The absence of geographic rate differentiation for Intelsat services extends the intense competitive pressure in some geographic markets (e.g., from trans-oceanic fiber optic cables and from regional satellites in Asia, Europe and the Americas) to the regions in which there may still be fewer competitive alternatives. Since a particular rate for a particular service applies to all Intelsat routes, the price pressures on highly competitive telecommunications routes will automatically benefit routes with lesser competition.

Sophistication and Bargaining Power of Customers

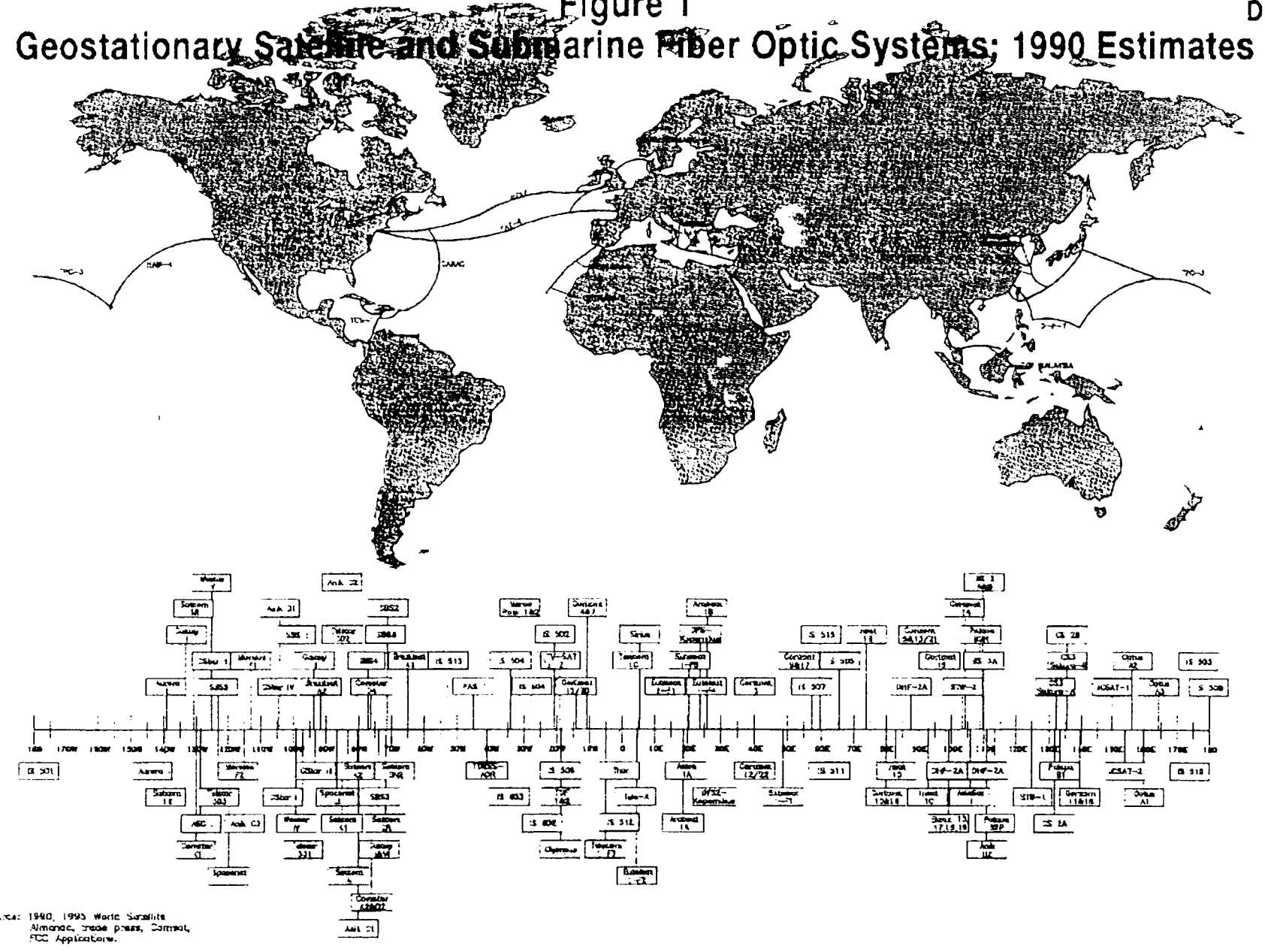
The customers in the market for IFBT are large international telecommunications carriers (such as AT&T), large multinational corporations (such as IBM), and major TV networks and broadcasters (such as CBS). There should be little doubt that these customers are highly sophisticated, are aware of their competitive options, and have significant negotiating leverage. Each of the major customers in this market dwarfs Intelsat (and, of course, Comsat) in size and financial resources. Many customers of international satellite services (such as AT&T) also own and operate competing facilities (such as fiber optic cables or domestic/regional satellite systems).

Competitive Handicaps

Despite its privileges and immunities as an international organization, Intelsat is burdened with at least three competitive handicaps that are directly related to its structure. First, Intelsat's multilateral governing structure makes it very difficult to reach decisions efficiently. With signatories' often conflicting interests (in part because of ownership interests in competing cable and satellite facilities), Intelsat's decision making process is increasingly stymied by conflicts of interests and is is too cumbersome for today's fast-moving marketplace. Second (as PanAmSat points out),[69] Intelsat's general purpose satellites, originally designed for PTT-to-PTT switched voice service, are not well-suited to serve the fastest-growing IFBT market segments (i.e., video and business applications). And finally (as both PanAmSat and Orion point out),[70] Intelsat's marketing flexibility is very limited by its inability to provide "one-stop shopping." In contrast to customers of competing satellite systems, Intelsat customers have to arrange with separate entities for ground- and space-segment on both ends of the transmission.

4/25/96
DRAFT

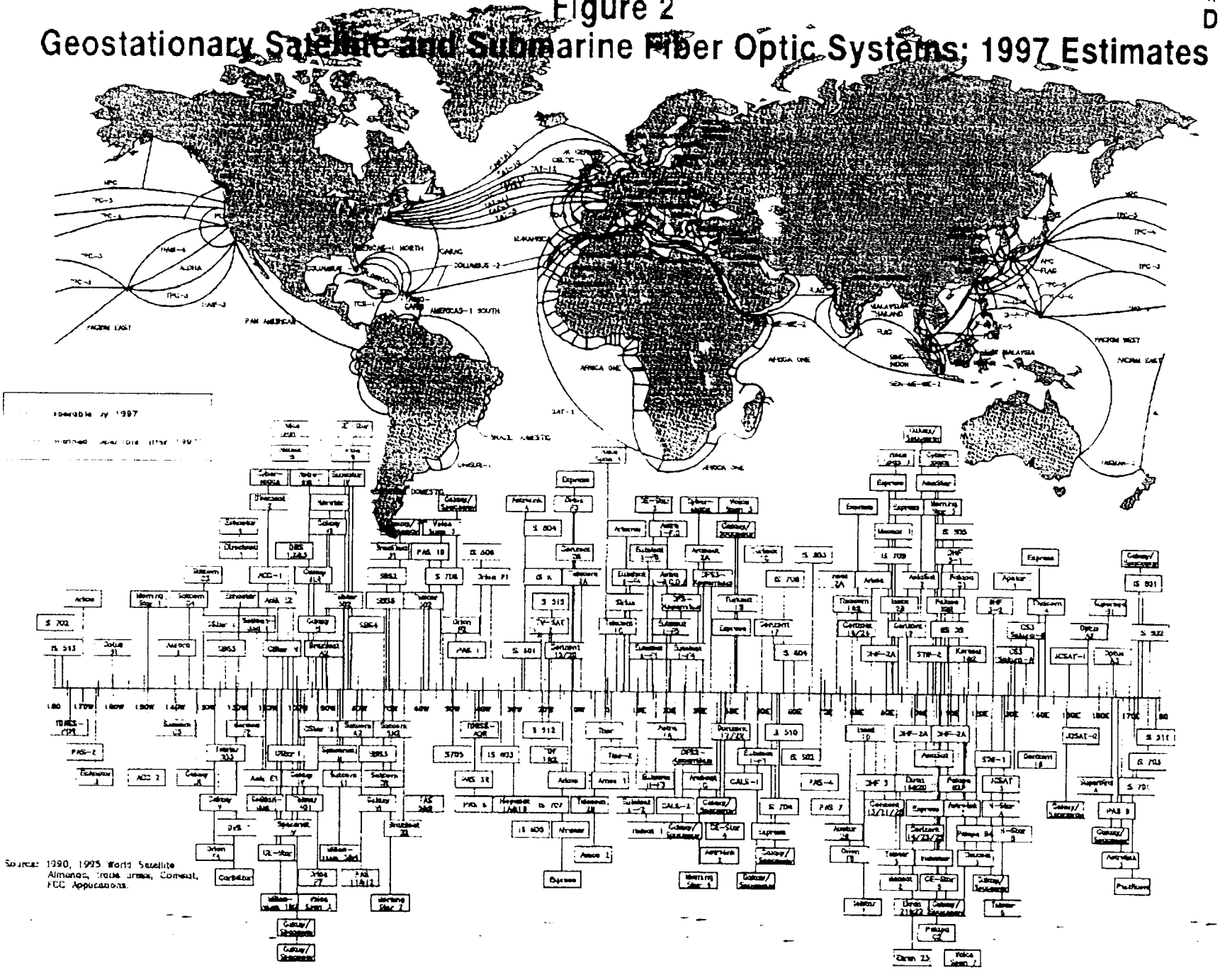
Figure 1
Geostationary Satellite and Submarine Fiber Optic Systems; 1990 Estimates



Source: 1990, 1995 World Satellite Almanac, trade press, Comsat, FCC Applications.

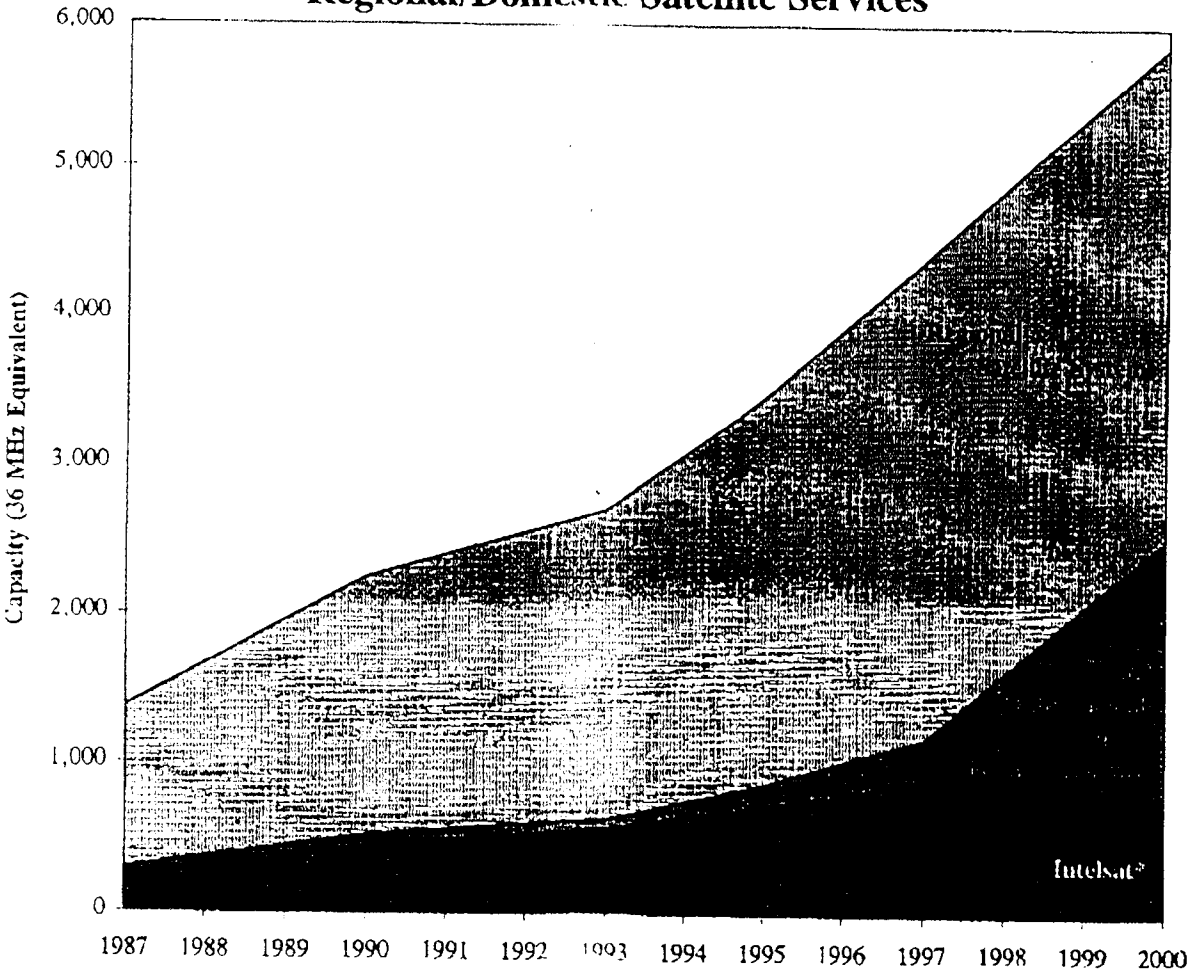
4/25/96
DRAFT

Figure 2
Geostationary Satellite and Submarine Fiber Optic Systems; 1997 Estimates



Source: 1990, 1995 World Satellite Almanac, Trade Press, Comsat, FCC Applications.

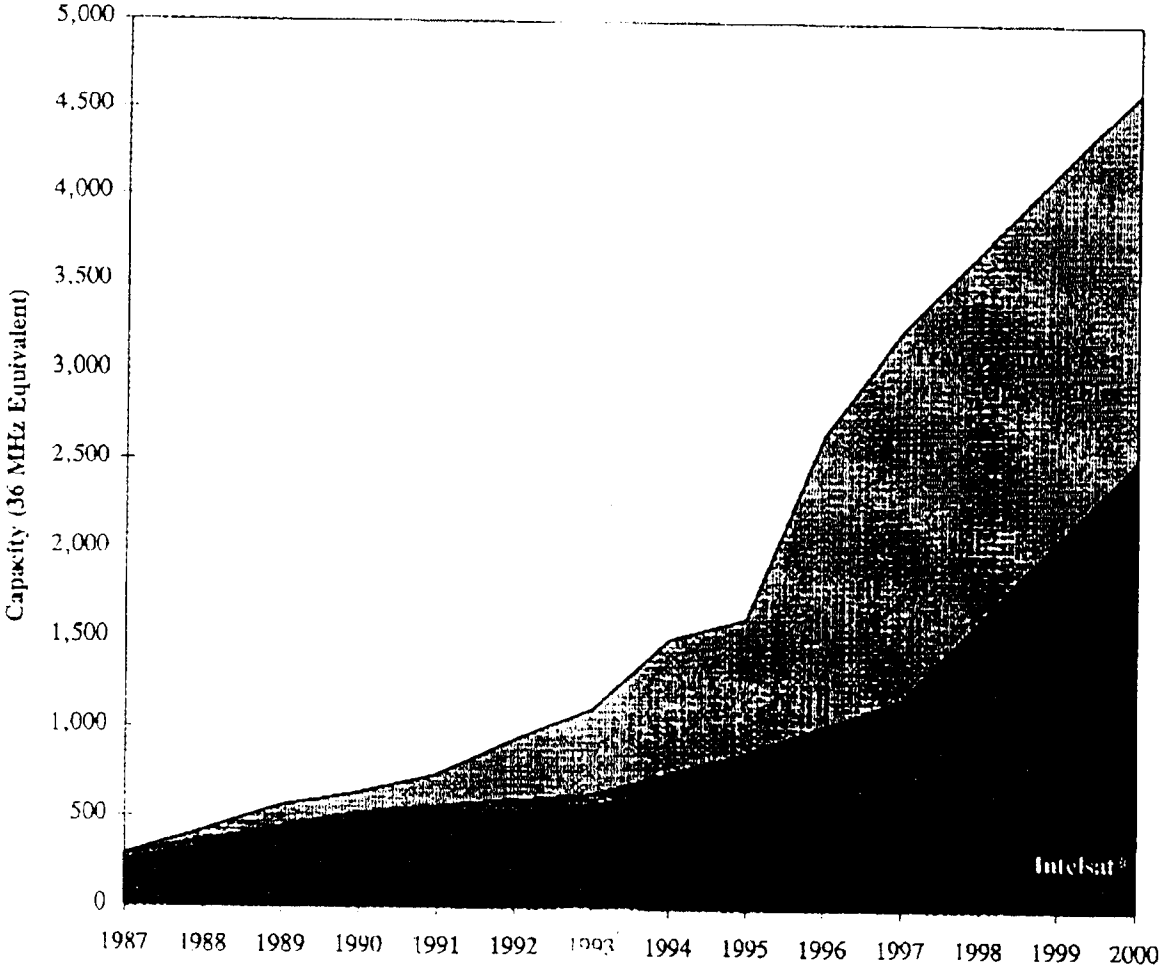
Figure 3
Estimated Capacity Available for Regional/Domestic Satellite Services



NOTES

* Assumes 50% of satellite systems' total capacity is available for regional/domestic services.
Transponder estimates for 1987, '90, '93, '95, 2000.
Estimates for 2000 include approximately 30% of capacity of announced Ka-band satellite systems.
Due to the network architecture of regional/domestic fiber optic systems, capacity on such systems is not included in this chart.
Source: 1990, 1995 World Satellite Almanac, trade press, Comsat, FCC Applications.

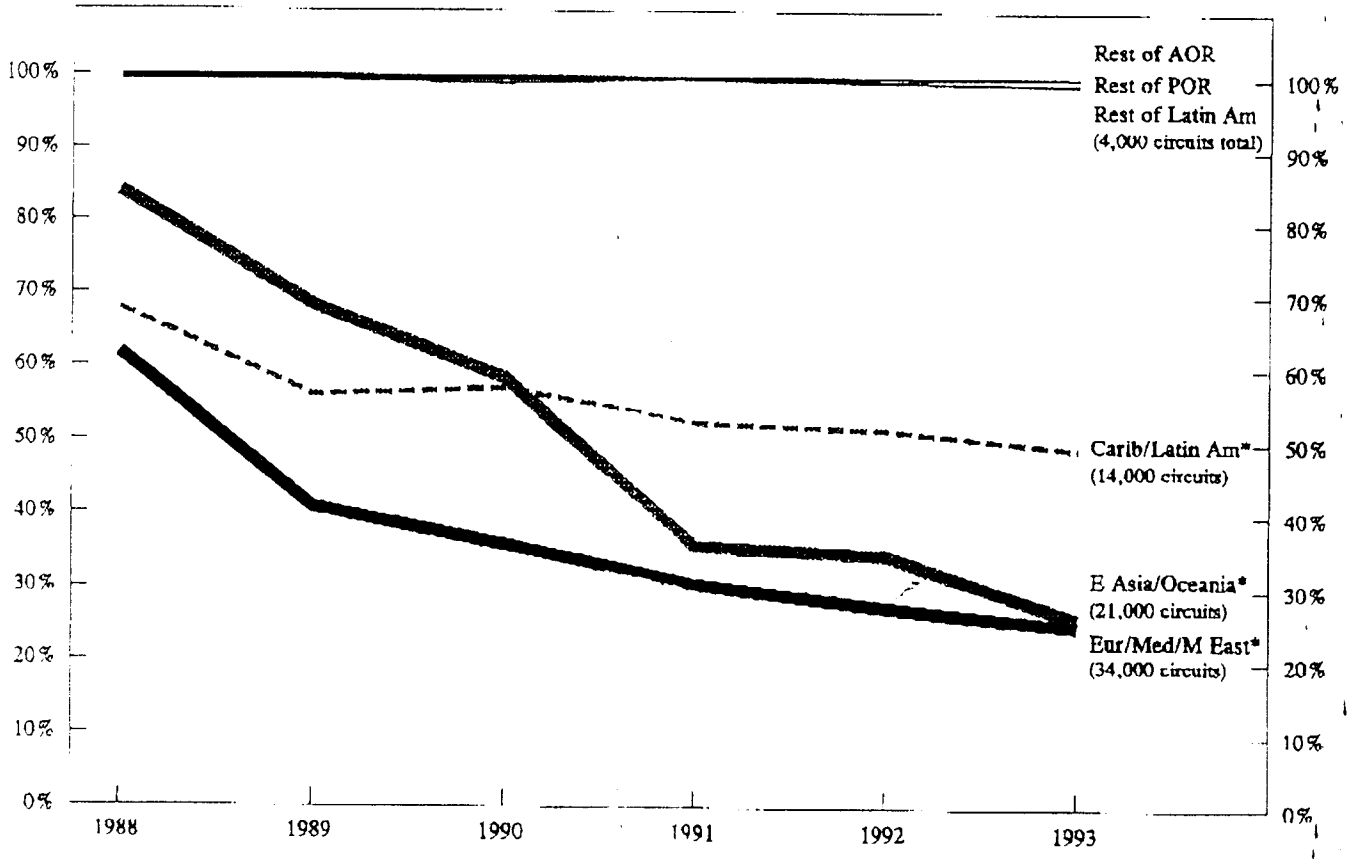
Figure 4
Estimated Capacity Available for Transoceanic Telecommunications Services



NOTES

* Assumes 50% of satellite systems' total capacity is available for transoceanic services.
Transponder estimates for 1987, '90, '93, '95, 2000.
Estimates for 2000 include approximately 30% of capacity of announced Ka-band satellite systems.
Source: 1990, 1995 World Satellite Almanac, trade press, Comsat, FCC Applications.

Figure 5
COMSAT Market Shares in Utilized Capacity for Trans-Oceanic Switched Voice and Private Line Services
(Based on utilized 64 kbps-equivalent circuits to and from the U.S.)



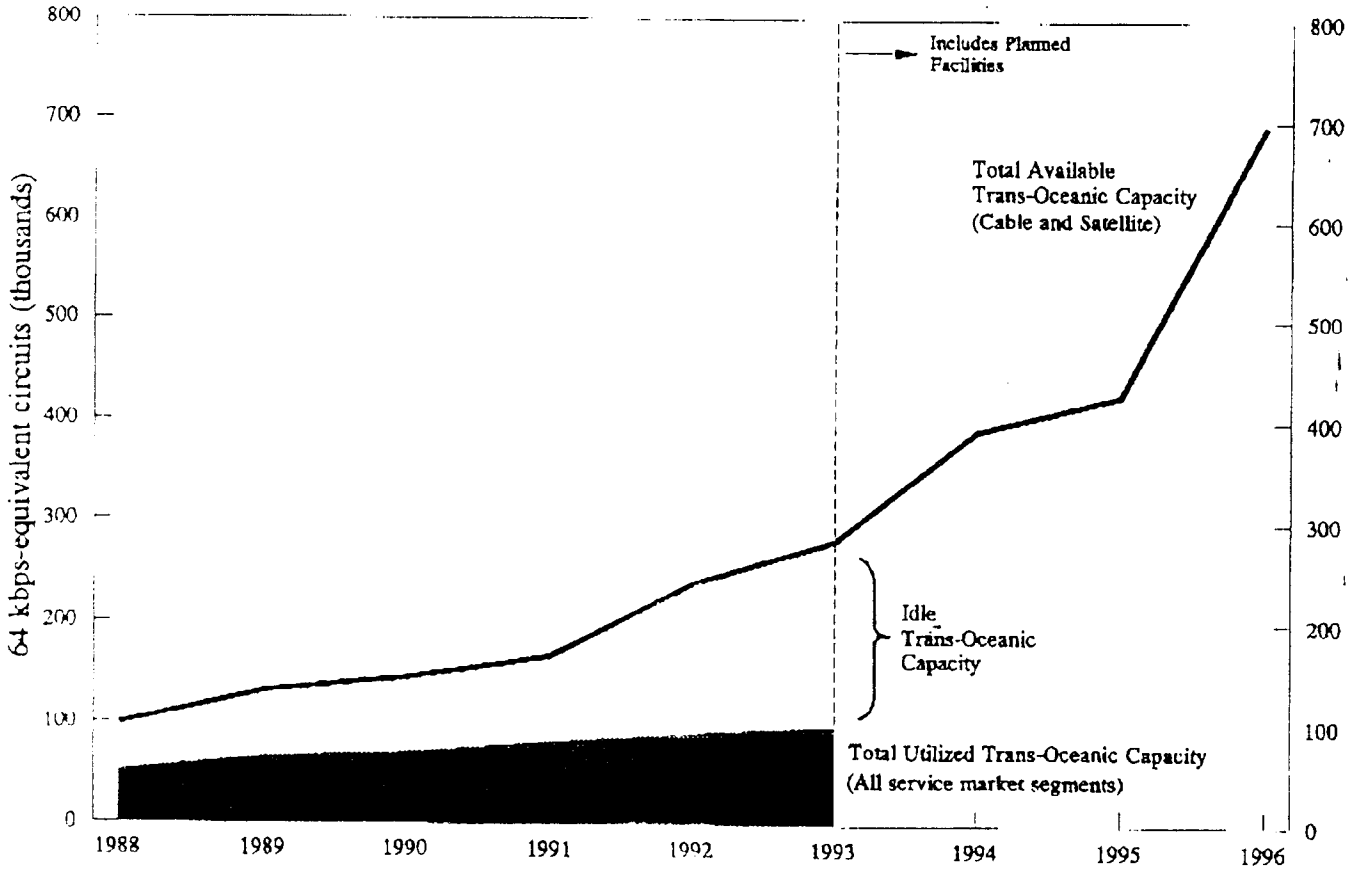
NOTES:

Does not take into consideration utilized capacity for switched voice and private line services on separate satellite systems.

Source: Houthakker et al., 1994.

* Geographic market segments with competition from existing and planned satellite and fiber optic systems.

Figure 6
Available vs. Utilized Trans-Oceanic Capacity
(64 kbps-equivalent circuits to and from the U.S.)



NOTES:

One 36/27 Mhz-equivalent transponder lease is assumed to be equal to 275 64 kbps-equivalent duplex circuits.

Source: Houthakker et al., 1994.